Regional Unemployment Disparities: Can Fiscal Policy Help?

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Abstract
Regional unemployment disparities are widely observed, appear to persist through time and are often a reason for concern on the part of both regional and national governments. This paper constructs a small two-region general-equilibrium model and uses it to assess the effectiveness of traditional fiscal policy in combating regional unemployment disparities. The model is based on optimising behaviour of households and firms and incorporates inter-regional migration. It is calibrated using data for the Australian states and then simulated to evaluate the effects of expenditure changes by both regional and federal governments. In particular, we consider (i) a rise in federal government spending in one region, (ii) a rise in regional government spending, (iii) a policy of ‘unlocking the forests’ in which a regional government increases the availability of regional natural resources, and (iv) a general increase in federal government spending. The results are often surprising – only the fourth policy reduces unemployment in the high-unemployment region and all policies exacerbate the disparity.

1. Introduction
Regional unemployment-rate disparities have been widely investigated since the late 1960s and are still the subject of active research. Recent work includes Groenewold and Hagger (1995), Debelle and Vickery (1999), McGuire (2001), Dixon and Shepherd (2001), Dixon et al. (2001) for Australia, Baddeley et al. (1998) and Cameron and Muellbauer (2001) for the UK, Jimeno and Bentolila (1998) for Spain, Weiler (2001) for the US, Brunello et al. (2001) for Italy and Pehkonen and Tervo (1998) for Finland.

Of the many policy questions which are associated with the regional-unemployment-rate-disparities phenomenon the one which arises at the outset is the following: is policy intervention required to remove regional unemployment-rate disparities or are there inter-regional mechanisms at work which make them self-correcting? A strong candidate for an inter-regional mechanism which makes disparities self-correcting is inter-regional migration. However, recent studies by Groenewold (1997), Tervo (2000) and Cameron and Muellbauer (2001) cast doubt on this possibility; all show that migration is slow to work and cannot be relied upon to eliminate differences in unemployment rates between regions.
If the existence of self-correcting mechanisms is ruled out the question which then arises is whether the regional unemployment disparities can be reduced by policy actions. It was this question which motivated the seminal work by Thirlwall (1966). He approached it through a prior question: how do unemployment rate disparities arise? His view was that if we can answer this question we are better placed for deriving policies for getting rid of disparities.

Thirlwall tackled the task of explaining regional unemployment-rate disparities by advancing a plausible explanatory hypothesis and testing it against UK data by means of a straightforward regression technique. The hypothesis to be tested was that the immediate cause of observed regional unemployment-rate disparities are differences between regions in sensitivity to the national cycle, these differences being due, in turn, to a combination of different industry sensitivities and different industry composition between regions.

Thirlwall found some support for his hypothesis but was not able to proceed beyond his ‘prior’ question to the question which lay behind it – whether regional unemployment-rate disparities can be reduced by policy action. Rather, he concluded with a plea for more research into the causes of sensitivities which he saw as a prerequisite for policy-formulation.

The additional research which Thirlwall considered necessary has been undertaken with considerable vigour in the last thirty years. Numerous studies which follow the basic Thirwall analytical strategy with some extensions or elaborations have appeared in the literature and these include Brechling (1967), Harris and Thirlwall (1968), Elias (1978, 1979, 1980), Gordon (1979, 1980, 1985), Bell (1981), Byers (1990), Chapman (1991), Forrest and Naisbitt (1988), Groenewold (1991) and Debelle and Vickery (1998) together with those cited at the beginning of this section.

Despite all this work, however, the question which set it in motion – what policy measures, if any, can be employed to remove unemployment-rate disparities – is still to be tackled. This suggests that the Thirlwall approach has little more to offer to the policy-effectiveness debate and that something new is called for. Besides, a recent paper by Dixon and Shepherd (2001) points to a number of serious statistical problems connected with the Thirlwall approach and confirms the view that it may have reached a dead end.

The present paper pursues the question of whether regional unemployment-rate disparities can be reduced by policy action but approaches the question in a new way. We use the framework of a two-region general equilibrium model taken from a class which has played an important part in the fiscal-federalism literature generally, viz., models of multi-regional federations with a given freely-mobile supply of labour such as used in, e.g. Boadway and Flatters (1982), Myers (1990), Petchey (1993, 1995), Petchey and Shapiro (2000) and Groenewold, Hagger and Madden (2000, 2003). In these models labour is allowed to migrate costlessly between regions in search of maximum welfare and they typically impose, as an equilibrium condition, that the utility of the representative household be the same in all regions.
The model which we build has two regions, each with households, firms and a (regional) government. In addition to regional governments, there is also a federal government. The households and firms are optimizers but the governments are not; the fiscal decisions of the governments are treated as exogenous.¹

The firms produce a single good which, for simplicity, we assume to be the same in both regions. It is supplied to households for consumption or, after costless transformation, to regional governments. The regional government supplies the transformed good to households in its region free of charge and finances the purchase of the good by a payroll tax levied on firms located in its region. The federal government provides output to households in both regions (possibly different amounts per capita) and finances this by a tax on household incomes.

Output is produced using a single factor, labour, which is supplied by households. We assume that households supply labour only to firms in the region in which they live, thus excluding the possibility that they live in one region and commute to work in the other. Regional population and labour force are therefore effectively the same. We do allow inter-regional migration, however, and this is the main source of inter-connectedness between the two regions. We follow the literature cited above and assume migration to occur in response to inter-regional utility differentials.

We model the labour market in each region by assuming bargaining between firms and a union which represents households. Unions are assumed to bargain with firms over wages and firms then decide on employment to maximise profits. There is no reason why employment should equal the labour force in equilibrium so that, despite its Walrasian nature, the model allows for equilibrium unemployment. Since migration equalises utility and not unemployment across regions, there is no reason why unemployment rates should be equalised by the forces of migration. In this sense the model generates endogenous unemployment disparities as the outcome of any differences in exogenous variables and parameters across regions and the disparities can be thought of in terms of compensating differentials.

There are therefore two sources of interconnectedness between the regions – the main one is inter-regional migration and the other is the redistribution carried out by the federal government. We abstract from other inter-regional effects. In particular, it is assumed that firms supply output only to the households and the government in the region in which they are located so that we exclude inter-regional trade in goods. Further, we assume that each regional government supplies the government good only to households living in its own region, thus abstracting from inter-regional spillover effects in the provision of government goods. Finally, we assume that each firm is owned by households in the region in which it is located.

¹Recent work has extended models of this type by making the regional governments behave in an optimizing way, commonly by assuming that regional governments are beneficent in that they choose their tax and expenditure levels so as to maximise the utility of their citizens subject to the constraints imposed by the structure of the economy. Such an approach has been used in, e.g. Petchey (1993), Petchey and Shapiro (2000, 2002) and Groenewold, Hagger and Madden (2000, 2003). However, in the fiscal-policy literature, it is still conventional to assume government is exogenous so that policy is treated as an exogenous shock and we follow this convention.
The resulting model we call our general equilibrium (GE) model. It is highly non-linear. For this reason it cannot be solved analytically and so cannot be used, as it stands, to address the question with which the paper is concerned – whether there are policies through which regional unemployment disparities can be removed. We get round this difficulty by using a process of log-differentiation to linearise the model which is then calibrated from Australia data and used to simulate the effects of a variety of shocks designed to capture policies which might be used to combat unemployment disparities.

We carry out a number of simulations:

1. A federal government regional fiscal policy in which the federal government increases expenditure in one region while keeping expenditure in the other region constant, with its budget being balanced by a general increase in income tax;
2. A regional government regional fiscal policy in which a regional government increases its expenditure in an attempt to reduce unemployment in its region;
3. An increase in a region’s stock of non-labour productive resources. We think of this as a policy of ‘unlocking the forests’ in which a regional government would increase substantially the extent of forest which may be used for logging;
4. A federal government general fiscal policy in which the federal government increases expenditure in both regions equally.

Clearly, more interesting simulations could be carried out in this model or in straightforward extensions of it – one is the transfer of purchasing power from the federal to the regional governments as effected, for example, by a federal-fiscal transfer – but they will have to await a future paper.

The rest of the paper consists of five main sections. In section 2 we begin by building the small two-region GE model. This model is linearised and calibrated in section 3. In section 4 we simulate the numerical form of the GE model and use the results of our simulations to answer the questions of interest. In the final section of the paper the major conclusions are dealt with in detail.

2. The Two-region GE Model

The Representative Household

The representative household of region $i$ operates with a utility function of the form:

$$V_i = \beta_i C_i^u G_i^\delta, \quad i = 1, 2$$

where $V_i$ = utility of the representative household, region $i$,
$C_i$ = real private consumption per household, region $i$,
$G_i$ = real government-provided consumption per household, region $i$.

Definitions of all variables and parameters are reproduced in Appendix 1.
\( \beta_i, \gamma_i \) and \( \delta_i \) are constants with:

\[
\begin{align*}
\beta_i & > 0 \\
0 & < \gamma_i < 1 \\
0 & < \delta_i < 1 \\
\gamma_i + \delta_i & = 1
\end{align*}
\]

The representative household chooses \( C_i \) so as to maximise \( V_i \), subject to the constraint imposed by its after-tax income, with \( C_i \) taken as given. The solution to the household’s problem is therefore,

\[
C_i = (1-M)J_i, \quad i = 1, 2 \quad (2)
\]

where \( J_i \) is real income before tax per household, region \( i \)

\[ M = \text{rate of federal government income tax.} \]

This assumes that only the federal government imposes income tax.

By definition \( J_i \) is given by:

\[
J_i = \pi_i + W_i^*, \quad i = 1, 2 \quad (3)
\]

where \( \pi_i \) = real profit distribution per household, region \( i \)

\[ W_i^* = \text{real wage income per household, region } i. \]

Real wage income per household in region \( i \) is interpreted as the real wage in region \( i \) weighted by the probability of employment in region \( i \); then \( W_i^* \) can be replaced in (3) by \((1-U_i)W_i\) where \( U_i \) and \( W_i \) are, respectively, the unemployment rate in region \( i \) and the real wage rate in region \( i \). This follows immediately from the definition of the unemployment rate:

\[
U_i = (N_i - L_i) / N_i = 1 - N_i / L_i, \quad i = 1, 2, \quad (4)
\]

where \( N_i \) = population = labour force, region \( i \),

\[ L_i = \text{employment, region } i. \]

From (4) it is clear that \((1-U_i) = L_i / N_i = \text{probability of employment in region } i.\]

**The Representative Firm**

The representative firm of region \( i \) operates with a production function of the form:

\[
Y_i = (L_i)^{\alpha_i}, \quad i = 1, 2 \quad 0 < \alpha_i < 1 \quad (5)
\]

where \( Y_i \) = output of the representative firm, region \( i \). In using \( L_i \) as the argument in (5) rather than \( L_i \) for the representative firm we are tacitly assuming that only one firm operates in each region.

We model the labour market using a bargaining model – the firm and the household (union) bargain over wages and the firm then chooses employment to maximise profits. The outcome of the bargaining process is assumed to be given by the solution to the problem:

\[
\max_{W_i} B = \Pi_i^{\eta_i} (V_i^{1-\eta_i}), \quad 0 < \eta_i < 1
\]

\[ ^3 \text{The seminal paper on the effects of union bargaining in a macro context is McDonald and Solow (1981).} \]
where $\Pi_i$ = profit of the representative firm in region $i$, $\Pi_i = Y_i - W_i L_i (1 + T_i)$, $i = 1, 2$.

$T_i$ = the rate of payroll tax levied by the regional government in region $i$.

and $\eta_i$ is a parameter representing the strength of the firm in the bargaining process in region $i$.

Substituting for $\Pi_i$ and $V_i$ in the expression for $B$, differentiating with respect to $W_i$ and setting the result to zero, we obtain the following necessary condition for a bargaining solution:

$$C_i (1 + T_i) L_i = \left(1 - \frac{\eta_i}{\eta_i}(1-M)(1-U_i)\right) \Pi_i, \quad i = 1, 2. \quad (6)$$

Given the wage decided in the bargaining process, the firm chooses employment to maximize profits. The first-order condition for profit-maximisation produces the usual marginal productivity condition:

$$\alpha_i (L_i)^{\alpha_i-1} = \frac{W_i}{P_i} (1 + T_i) \quad i = 1, 2 \quad (7)$$

The Regional Government

The government of region $i$ purchases output from the firms in its region for the distribution to households and receives revenue from a payroll tax levied at a constant rate in its region. We assume that the government of region $i$ balances its budget so that outlay per household and tax collections per household are equal. This gives:

$$N_i \text{GR}_i = L_i T_i W_i \quad i = 1, 2$$

where $\text{GR}_i$ = the amount of output purchased per household in region $i$.

Using the definition of the unemployment rate, $U_i$, we can write this condition as:

$$\text{GR}_i = T_i W_i (1 - U_i), \quad i = 1, 2 \quad (8)$$

The Federal Government

The federal government collects income tax at a fixed rate, $M$, from all citizens. Its total tax collections are $M(N_1 J_1 + N_2 J_2)$. It provides output to the citizens of each region, possibly in different amounts. The output provided to households in region $i$ is $G_{Fi}$ per capita or $N_i G_{Fi}$ in total. It too balances its budget so that

$$N_1 G_{F1} + N_2 G_{F2} = M (N_1 J_1 + N_2 J_2). \quad (9)$$

This structure therefore abstracts from the equalisation procedures which are common to federations. While such equalisation arrangements are extensive in Australian, there is no reason to believe that their interaction with traditional anti-unemployment policies would be likely to substantially alter our results in which case to introduce them would be to needlessly complicate the model.

Equilibrium

To complete the GE part of the model, we add three definitional relationships and two equilibrium relationships.

Real government-provided consumption per household in region $i$ ($G_i$) is defined by:
The first of the two equilibrium conditions is a standard migration-equilibrium condition:

\[ V_1 = V_2 \]  

(11)

It is assumed that households move in response to inter-regional differences in utility and that equilibrium occurs when such differences have disappeared. This formulation incorporates the assumption that inter-regional migration is costless. Clearly in practice this is not the case although it is not an uncommon formulation in the literature. There are papers such as Mansoorian and Myers (1993) which explore the implications of relaxing this assumption but we start with the simplest assumption and leave to further research the extension to costly migration; the analysis in Mansoorian and Myers suggests that the discontinuities introduced in this extension will add considerable complexity, especially if the model is to be converted into a CGE form.

The national population (= labour force) is defined by:

\[ N_1 + N_2 = N, \]  

(12)

where \( N \) is the national population.

It is assumed that the representative firm in region \( i \) distributes all its profit to households in region \( i \). The representative household’s profits receipts (\( \pi_i \)) are related to firm profits (\( \Pi_i \)) by the condition:

\[ N_i \pi_i = \Pi_i = Y_i - W_i L_i (1 + T_i), \quad i = 1, 2. \]  

(13)

Note that this excludes the possibility that firms in one region are owned by households in another and while this is undoubtedly unrealistic, it buys considerable simplicity since it reduces the interconnectedness between regions and allows us to focus on the links which result from inter-regional migration. Besides, it is unlikely that in practice cross-border firm ownership is an important channel of influence between regions.

Finally, we have the second of the two equilibrium conditions which takes the form:

\[ Y_i = N_i C_i + N_i GR_i + N_i MJ_i, \quad i = 1, 2. \]  

(14)

This relationship holds because the output of region \( i \) is disposed of by the representative firm either to the regional government in the form of payroll taxes or as income to the representative household. In turn, the payroll tax collection of the regional government is equal to \( N_i GR_i \) from its budget constraint and the income of the household to the sum of consumption (\( N_i C_i \)) and income taxes (\( N_i MJ_i \)).

Relationships (1)-(14) constitute the two-region PEGE model. The endogenous variables are: \( V_r, C_r, G_r, \Pi_r, U_r, W_r, L_r, N_r, Y_r, J_r, T_r \) and \( M \). Thus there are 23 endogenous variables. However, taken together, equations (2), (3), (13) and (14) imply (9). Hence, any two of these equations are redundant and may be dropped leaving 23 equations in 23 endogenous variables.
3. The Linearised Numerical Version of the Two-region GE Model

The two-region GE model set out in the previous section is non-linear in the levels of the variables and for this reason it cannot be easily used to conduct comparative-static exercises which will throw light on the topic of the present paper. We circumvent this problem by using a numerical linearised version of the model which we describe in this section.

To linearise the model of section 2 we use a process of log differentiation. This converts the model from one which is non-linear in the levels to one which is linear in the proportional rates of change of the variables. The resulting linearised versions of equations (1)-(14) are given in Appendix 2.

Numerical Version of the Linearised Model

We now put the linearized GE model into numerical form by evaluating the various coefficients which appear there.

Six numerical versions are constructed, although simulations for only a few are reported in the next section. We construct one with each of Australia’s six states as region 1 in turn, with the rest of the country constituting region 2.

The linearized model contains a number of parameters which have to be evaluated: \( \alpha_i, \gamma_i, \delta_i, \sigma_{\text{w}i}, \sigma_{\text{w}i}', \sigma_{\text{w}i}'', \sigma_{\text{w}i}'', \sigma_{\text{w}i}''', \sigma_{\text{w}i}'''' \). These parameters fall into two groups. The first three appear in model relationships; \( \gamma_i \) and \( \delta_i \) appear in the utility function (1) and \( \alpha_i \) in the production function (5). The remainder, on the other hand, are linearization parameters and are all shares of some sort.

The model parameters can be evaluated with the help of model restrictions and appropriate past information on model aggregates. Start with \( \alpha_i \). We assume that the data base represents a profit-maximising solution and use the marginal productivity condition, equation (7) to evaluate \( \alpha_i \). Similarly for \( \gamma_i \) and \( \delta_i \). Here we follow the approach conventionally adopted by GE modellers and calibrate the utility function to ensure that the initial solution is one of utility maximisation. Since the relative price of C and G is unity, utility maximisation implies that the ratio \( \gamma_i/\delta_i \) is equal to \( C_i/G_i \). Then, using the restriction that \( \gamma_i + \delta_i = 1 \), we have

\[
\gamma_i = C_i/(C_i+G_i),
\]

and

\[
\delta_i = G_i/(C_i+G_i).
\]

The linearization parameters can be evaluated directly from their definitions, given values for the model aggregates involved for each of the six states. To evaluate the linearization parameters we need values for \( M, J_p, U_p, W_p, L_p, N_p, T_p, N_GF_p, N_J_p, GR_p, G_p, Y_p \) and \( N_p \pi_p \) all of which can be derived from data on \( C_p, GR_p, L_p W_p, GF_p, W_p' \), and \( N_p \) and the model definitions. The figures we use for these aggregates are the average values for the years 1994-95 to 1998-99. Data for these are reported in Appendix 3.

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4 It should be noted that, while this parameterisation is conventional, it is not strictly implied by our model specification since in our framework households maximise utility simply by spending all their disposable income on private consumption rather than choosing an optimal combination of C and G.
4. Simulation Results

We present the results of simulating the effects of each of our four policies in turn.

Federal Regional Fiscal Policy

We begin by presenting the results of a simulation of the effects of an increase in GF₁, with GF₂ held constant and M changing to satisfy the federal government’s budget constraint. Although simulations were carried out for all six variants of the model, only the one in which Tasmania is region 1 is presented. From the evidence shown in Figure 1, it is clear that there has been a large and persistent gap between Tasmania’s unemployment rate and the rate for the rest of the country so that this is an obvious situation in which a federal government might attempt to ‘do something’ by increasing expenditure in Tasmania while holding that in the rest of the country constant. The effects of such a policy on the main endogenous variables in the model are reported in Table 1. Similar results for each of the six states as region 1 are reported in Appendix 4.

Figure 1 Unemployment Rates (quarterly, trend)

(a) New South Wales

(b) Victoria
(c) Queensland

(d) South Australia

(e) Western Australia
The most surprising result in Table 1 is that the effect on the unemployment gap is exactly the opposite of what was intended – the unemployment rate in region 1 increases while that in region 2 falls, thus widening rather than narrowing the gap. To explain this, consider the way in which the increase in federal government expenditure affects each of the regions. The ‘initial’ effect on region 1 is to increase utility of the representative region 1 household since the effect of the increase in GF1 is only partly offset by the effect of the increase in the federal government tax rate needed to finance the change in GF. The opposite is the case in region 2 – there taxes have risen with no increase in expenditure. The balance between regional utilities has been upset creating an incentive for migration from region 2 to region 1, as is evident in the entries in the row for n, the proportional change in populations (= labour force).

Table 1  Federal Regional Policy* (Region 1 = Tasmania)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Region 1</th>
<th>Region 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>v</td>
<td>0.0017</td>
<td>0.0017</td>
</tr>
<tr>
<td>c</td>
<td>-0.0943</td>
<td>0.0015</td>
</tr>
<tr>
<td>g</td>
<td>0.2692</td>
<td>0.0023</td>
</tr>
<tr>
<td>m</td>
<td>0.0189</td>
<td></td>
</tr>
<tr>
<td>j</td>
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<td>pi</td>
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<td>w</td>
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<td>u</td>
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<td>n</td>
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<td>l</td>
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<td>y</td>
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<td>0.0005</td>
</tr>
<tr>
<td>gr</td>
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<td>0.0039</td>
</tr>
</tbody>
</table>

*Federal regional policy consists of increasing GF1, holding GF2 constant and allowing M to adjust to satisfy the federal government’s budget constraint. The lower-case symbols are the proportional changes in their upper-case counterparts; thus e.g. v represents the proportional change in utility, V.
Unemployment is also determined by employment so some of the explanation must be sought in the labour market. An examination of the first-order condition for the bargaining problem will make it clear that the increase in $G$ in region 1 tilts the bargaining solution in favour of a lower wage and so, from the firm’s marginal productivity condition, to a higher level of employment. Both of these effects are borne out by the signs in the rows for $w$ and $l$. The increase in employment in region 1 is not sufficient, however, to absorb all the extra labour market entrants who have arrived from region 2 seeking a better life – the simulation effects show that the increase in employment is about half that of the increase in the labour force, resulting in a substantial increase in unemployment.

The loss of population in region 2 combined with a small increase in employment serves to reduce the unemployment rate there. Welfare increases by a small amount in both regions. Thus, while the government’s objective of reducing the unemployment gap between the regions was unsuccessful, residents of both regions are better-off. This welfare effect suggests that in the base solution, the government is ‘too small’, overall. This is borne out by further simulations with a higher value of $\gamma$, thus making private consumption more important in the generation of utility – when $\gamma$ is increased by 0.2, welfare falls as a result of the expansion of the size of the federal government although all other effects are qualitatively the same. Thus the sign of the welfare effect is dependent on this particular parameterization chosen but the others, particularly the unemployment effect, are not. Moreover, the results reported in Appendix 4 show that the same results hold no matter which state is chosen as region 1 – in all cases the unemployment rate for region 1 rises while that for region 2 falls so that the disparity is reduced only if region 1 is the low unemployment region in the initial solution.

We turn now to the question of whether the regional government of a high-unemployment region is more effective in reducing the disparity between its region and the rest of the country by the use of expenditure policy.

**Regional Government Fiscal Policy**

Consider whether government of region 1 (Tasmania, again, in our illustration) can successfully reduce the gap between its unemployment rate and that of the rest of the country by increasing its expenditure level, $GR_1$, while federal government expenditure and expenditure by the government of region 2 are assumed to be held fixed in the background. The results of this simulation are reported in Table 2. Similar results for cases when the other states are chosen as region 1 are given in Appendix 5.

The effects reported in Table 2 are again unexpected – the unemployment rate in the expanding region rises while that in the contracting regions falls. In this case the ‘initial’ effect is an increase in $GR$, which increases utility in region 1. However, the regional government’s budget must be balanced so that the regional tax rate rises in region 1. Given the distortionary effect of regional government payroll taxes, the resulting fall in consumption more that offsets the beneficial effects on utility of the rise in $GR$, making residents of region 1 worse-off and inducing migration from region 1 to region 2.
Table 2 Regional Fiscal Policy* (Region 1 = Tasmania)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Region 1</th>
<th>Region 2</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>t</td>
<td>1.4105</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

*Regional fiscal policy consists of increasing GR\textsubscript{1}, allowing T\textsubscript{1} to adjust to satisfy the regional government’s budget constraint. Region 2’s government and the federal government hold their expenditure constant.

In region 1 the effect of the tax rise on the bargaining process is to reduce the wage to partially offset the higher employment costs of the payroll tax. The wage reduction is, however, insufficient to absorb the tax hike so that employment falls and, in our simulations, falls by more than the loss of labour force through migration to region 2. Thus the unemployment rate rises in region 1 and falls slightly in region 2. In contrast to the federal regional policy case discussed above, welfare falls slightly in both regions, suggesting that the regional government is ‘too big’. This conjecture is again borne out by further simulations with a lower value of \( \gamma \) – when \( \gamma \) is reduced by 0.1 the sign of the welfare effect is reversed, although, importantly, the signs for the employment, unemployment and wage effects are not altered; in fact, the rise in unemployment in region 1 is approximately three times that reported in Table 2.

Unlocking the Forests

We consider now a policy which governments have often been urged to undertake in regions with high unemployment and large untapped natural resources – to reduce the restrictions on the use of the resource for productive purposes and so add to the resources available and increase employment, reducing unemployment. For the Tasmanian case we think of the restrictions on the use of native forests and interpret the results in terms of a policy by the government to reduce restrictions on the use of forests for logging purposes.

We model this by including a second factor in the production function which we assume to be exogenous and subject to a positive shock in region 1 and leave unchanged in region 2. The production function for region i then becomes:

\[
Y_i = A_i (L_i) ^{\alpha_i} \quad i = 1, 2 \quad 0 < \alpha_i < 1
\]
and in the linearised form of the model we simply include an additive shift
dummy in this equation and to the marginal productivity condition,
equation (7). The effects of shocking the shift variable for region 1 while
leaving exogenous variables for region 2 unchanged are reported in Table
3. Results obtained when other states were chosen as region 1 are in
Appendix 6.

In this case there is no ‘initial’ effect on welfare. Instead, the impact is on
output, which rises for given employment, and on wages. The effect on
wages occurs due to the higher productivity allowing firms to increase their
wage offers as well as increase employment – both effects are evident in
Table 3 where both employment and output rise substantially. The increase
in output increases per capita consumption for a given population which
increases welfare in region 1 and draws migrants from region 2 – substantial
numbers in the simulation reported in Table 2. The overall effect is that the
unemployment rate rises sharply despite the increase in employment. Taxes
also increase as the new arrivals from region 2 require government services
(GR is exogenous) and eventually the consumption gains are reversed
although there is a small increase in welfare. So much for unlocking the
forests!

Table 3 Unlocking the Forests* (Region 1 = Tasmania)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Region 1</th>
<th>Region 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>v</td>
<td>0.0199</td>
<td>0.0199</td>
</tr>
<tr>
<td>c</td>
<td>-0.0042</td>
<td>0.0228</td>
</tr>
<tr>
<td>g</td>
<td>0.0870</td>
<td>0.0106</td>
</tr>
<tr>
<td>m</td>
<td>-0.0221</td>
<td></td>
</tr>
<tr>
<td>j</td>
<td>-0.0071</td>
<td>0.0199</td>
</tr>
<tr>
<td>pi</td>
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<td>0.0218</td>
</tr>
<tr>
<td>w</td>
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</tr>
<tr>
<td>u</td>
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</tr>
<tr>
<td>n</td>
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<td>-0.0319</td>
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<tr>
<td>l</td>
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<td>-0.0179</td>
</tr>
<tr>
<td>y</td>
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<td>-0.0137</td>
</tr>
<tr>
<td>t</td>
<td>0.1294</td>
<td>0.0182</td>
</tr>
</tbody>
</table>

*Unlocking the forests consists of increasing non-labour factors in region 1 but leaving
region 2’s factor supplies unchanged.

Finally, we consider what will be the effects of a general expansionary fiscal
policy on the part of the federal government.

Federal Fiscal Policy

In this simulation we consider a general increase in federal government
expenditure – GF₁ and GF₂ are increased by the same proportion and M is
allowed to adjust to balance the federal government’s budget. The results
are reported in Table 4.
The effect on unemployment is to reduce it in both regions. However, the fall in region 2 exceeds that in region 1 so that, even while reducing unemployment in general, the disparity between the two regions is increased. The mechanism through which this effect works is as follows. The ‘immediate’ effect is to increase welfare but roughly by the same proportion in each region so that there is no immediate incentive for inter-regional migration. The effect on the unemployment rate is through the bargaining process where the wage/employment balance is tilted towards a reduction in W and an increase in employment in each region. This serves to reduce the unemployment rate in both regions but by more in region 2 than in region 1. The simulation results show that there is a substitution of government expenditure for private consumption expenditure in both regions and that this improves welfare, suggesting, as we have conjectured above, that the federal government is ‘too small’. This is confirmed by further simulations in which the value for $\gamma$ is increased by 0.2 for both regions (making private consumption relatively more valuable and government expenditure relatively less valuable in the ‘production’ of utility) – the result is that welfare now falls following the government expansion although the other effects are not qualitatively different.

### Table 4 Federal Fiscal Policy* (Region 1 = Tasmania)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Region 1</th>
<th>Region 2</th>
</tr>
</thead>
<tbody>
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<tr>
<td>c</td>
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<td>g</td>
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<td>0.4670</td>
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<tr>
<td>m</td>
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<td>j</td>
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<td>u</td>
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<td>-1.2267</td>
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<td>t</td>
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</table>

*An equal increase in GF$_1$ and GF$_2$.

### 5. Conclusions

In this paper we have simulated a small two-region GE model to evaluate the effects on regional unemployment disparities of various policies designed to reduce them. The model is relatively conventional in that there are maximizing households and firms but governments at both the regional and state levels were assumed to be exogenous. The two regions

---

5 The full results reported in Appendix 7 show that this is so only when Tasmania or South Australia is region 1 – when any of the other states is region 1, the reduction in the unemployment rate for region 1 exceeds that for region 2. However, in these cases the policy also generally serves to widen the disparity since it is Tasmania and South Australia which have been the high unemployment states for most of the period reported in Figure 1.
are linked by inter-regional migration which occurs in response to differences in welfare in the two regions. In equilibrium the utility of the representative household is equalized across regions.

We analysed the effects of four different policies:

1) A federal government regional fiscal policy in which the federal government increases expenditure in one region while keeping expenditure in the other region constant, with its budget being balanced by a general increase in income tax;

2) A regional government fiscal policy in which a regional government increases its expenditure in an attempt to reduce unemployment in its region;

3) An increase in a region’s stock of non-labour productive resources. We think of this as a policy of ‘unlocking the forests’ in which a regional government would increase substantially the extent of forest which may be used for logging;

4) A federal government general fiscal policy in which the federal government increases expenditure in both regions equally.

In all cases the result was to increase the unemployment disparity – in the first three the unemployment rate in region 1 actually increased and that in region 2 decreased while in the fourth the unemployment rate in both regions fell but it fell by more in region 2 than in region 1. The results cast doubt on the effectiveness with which traditional fiscal policy can be used to address regional unemployment disparities.
Variables and Parameters Used in the GE Model

Variables (in the order in which they appear):
\[ V_i = \text{utility of the representative household, region } i, \]
\[ C_i = \text{real private consumption per household, region } i, \]
\[ G_i = \text{real government-provided consumption per household, region } i. \]
\[ J_i = \text{real income before tax per household, region } i \]
\[ M = \text{rate of federal government income tax.} \]
\[ \pi_i = \text{real profit distribution per household, region } i \]
\[ W_i^* = \text{real wage income per household, region } i. \]
\[ N_i = \text{population = labour force, region } i, \]
\[ L_i = \text{employment, region } i. \]
\[ U_i = \text{the unemployment rate in region } i \]
\[ W_i = \text{the real wage rate in region } i. \]
\[ Y_i = \text{output of the representative firm, region } i. \]
\[ \Pi_i = \text{profit of the representative firm in region } i, \]
\[ \Pi_i = Y_i - W_i L_i (1 + T_i), i = 1, 2 \]
\[ T_i = \text{the rate of payroll tax levied by the regional government in region } i, \]
\[ GR_i = \text{the amount of output purchased by the regional government per household in region } i. \]
\[ GF_i = \text{the amount of output provided to households in region } i \]
\[ \text{per capita by the federal government} \]
\[ N = \text{national population}. \]

Parameters:
Utility function parameters:
\[ \beta_i > 0 \]
\[ 0 < \gamma_i < 1 \]
\[ 0 < \delta_i < 1 \]
\[ \gamma_i + \delta_i = 1 \]
Production function parameter:
\[ 0 < \alpha_i < 1 \]
The firm’s bargaining strength parameter:
\[ 0 < \eta_i < 1 \]
Appendix 2

The Linearised Model

The linearised versions of equations (1) to (14) are given by:

(1') \[ v_i = \gamma_i c_i + \delta_i g_i, \quad i = 1, 2 \]
where \( v_i = dV_i/V_i, c_i = dC_i/C_i, g_i = dG_i/G_i. \)

(2') \[ c_i = -\sigma_m m + j_i, \quad i = 1, 2 \]
where \( \sigma_m = M/(1-M), m = dM/M, j_i = dJ_i/J_i. \)

(3') \[ j_i = \sigma_{mji} \pi_i + \sigma_{wij}(w_i - \sigma_{ui} u_i), \quad i = 1, 2 \]
where \( \sigma_{mji} = \Pi_i/J_i, \pi_i = d\Pi_i/\Pi_i, \sigma_{wij} = (1-U_i)W_i/J_i, w_i = dW_i/W_i, u_i = dU_i/U_i. \)

(4') \[ u_i = \sigma_{ui}(n_i - 1), \quad i = 1, 2 \]
where \( \sigma_{ui} = L_i/(N_i-L_i), n_i = dN_i/N_i, l_i = dL_i/L_i. \)

(5') \[ y_i = \alpha_i l_i \]
where \( y_i = dY_i/Y_i. \)

(6') \[ c_i + \sigma_{ti} t_i + l_i = \sigma_m m + \sigma_{ui} u_i + \pi_i, \quad i = 1, 2 \]
where \( \sigma_{ti} = T_i/(1+T_i). \)

(7') \[ (\alpha_i-1)l_i = w_i + \sigma_{ti} t_i \quad i = 1, 2 \]

(8') \[ g_i = t_i + w_i - \sigma_{ui} u_i \quad i = 1, 2 \]
where \( g_i = dGR_i/GR_i. \)

(9') \[ \sigma_{gf1}(g_i + n_1) + \sigma_{gf2}(g_i + n_2) = m + \sigma_{ji}(j_1 + n_1) + \sigma_{j2}(j_2 + n_2) \]
where \( \sigma_{gf1} = N_iGF_i/(N_iGF_i + N_iGF_2), \sigma_{j1} = N_iJ_1/(N_iJ_1 + N_iJ_2) \)

(10') \[ \sigma_{gfi} = \sigma_{gf} g_i, \quad i = 1, 2 \]
where \( \sigma_{gf} = GR_i/G, \sigma_{gfi} = GF_i/G. \)

(11') \[ v_1 = v_2 \]

(12') \[ \sigma_{n1} n_1 + \sigma_{n2} n_2 = 0 \]
where \( \sigma_{ni} = N_i/N. \)

(13') \[ n_i + \pi_i = \sigma_{yn} y_i - \sigma_{wn}(w_i + l_i + \sigma_{nt} t_i), \quad i = 1, 2 \]
where \( \sigma_{yn} = Y_i/(N_i\pi_i), \sigma_{wn} = W_iL_i(1+T_i)/N_i\pi_i. \)

(14') \[ y_i = n_i + \sigma_{cy} c_i + \sigma_{gry} g_i + \sigma_{jy}(j_i + m), \quad i = 1, 2 \]
where \( \sigma_{cy} = C_i/(C_i+GR_i+M_i), \sigma_{gry} = GR_i/(C_i+GR_i+M_i), \sigma_{jy} = M_i/(C_i+GR_i+M_i). \)
### Appendix 3

**Data-Base**

<table>
<thead>
<tr>
<th>Region</th>
<th>C ($m)</th>
<th>GR ($m)</th>
<th>LW ($m)</th>
<th>GF ($m)</th>
<th>W ($'000)</th>
<th>L ( '000)</th>
<th>Y/L ($'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 1 NSW</td>
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<td>20189.8</td>
<td>92160.8</td>
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<td>32.8618</td>
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<td>195152.8</td>
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<td>44.6373</td>
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<tr>
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<td>65680.6</td>
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<td>30.3619</td>
<td>8148</td>
<td>44.6373</td>
</tr>
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<td>42041.6</td>
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<td>Region 2 ROC</td>
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<td>0.0</td>
<td>30.3619</td>
<td>8148</td>
<td>44.6373</td>
</tr>
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<td>8148</td>
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<td>8148</td>
<td>44.6373</td>
</tr>
</tbody>
</table>

Sources: C, L, LW and GR are from ABS times series averaged over the period 1994/95 - 1998/99. GF is computed as L (MGF/L - MGF/L) where MGF is final consumption expenditure by the federal government plus grants to state i. All other data is calculated from these figures to ensure that the model constraints hold: L = L_i + L_o, W = W/L, Y = GR + C_i, G = GR + GF, T = GR/W/L. It should be noted that, as the model excludes investment and net interstate and overseas exports, Y_i will not conform with official figures.
## Appendix 4

**Effects of Federal Regional Policy: A one per cent Increase in GF₁ with GF₂ Constant and M Adjusting to Satisfy the Budget Constraint**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Region 1 = NSW</th>
<th>Region 1 = VIC</th>
<th>Region 1 = QLD</th>
<th>Region 1 = SA</th>
<th>Region 1 = WA</th>
<th>Region 1 = TAS</th>
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</tr>
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<td>0.0265</td>
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</table>

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*Note: The table continues with additional columns and values.*
### Appendix 5

Effects of Regional Policy: A one per cent Increase in $GR_1$ with $T_1$, Adjusting to Satisfy the Budget (Regional) Constraint

<table>
<thead>
<tr>
<th>Variable</th>
<th>Region 1 = NSW</th>
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<th>Region 1 = QLD</th>
<th>Region 1 = SA</th>
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<th>Region 1 = TAS</th>
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Appendix 6
Unlocking the Forests: A one per cent Increase in $A_1$

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<th>Region 1 = QLD</th>
<th>Region 1 = SA</th>
<th>Region 1 = WA</th>
<th>Region 1 = TAS</th>
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### Appendix 7

**Effects of Federal Fiscal Policy: An Equi-proportionate (one per cent) Increase in GF₁ and GF₂ with M Adjusting to Satisfy the Budget Constraint**

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References


