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THE REGIONAL ECONOMIC EFFECTS OF IMMIGRATION: SIMULATION RESULTS FROM A SMALL CGE MODEL

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The Regional Economic Effects of Immigration: Simulation Results from a Small CGE Model

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The Regional Economic Effects of Immigration

Abstract:

The effects of immigration on the host country are pervasive and long-term. It is not surprising that they have been extensively analysed, not least the economic effects which have been the subject of both theoretical and empirical research. While some of the empirical research has had a regional dimension, this has often been incidental to the analysis of the labour market – the effects of immigration on wages and employment prospects of the native-born depend on the regional migration response. In contrast, there has been little analysis of the general effects of immigration on regional economies *per se*. This paper contributes to the filling of this gap by constructing a small two-region computable general-equilibrium (CGE) model which is used to analyse the effects of various immigration shocks on regional variables such as output, employment, the labour force, unemployment, wages and welfare. We simulate the effects of different types of immigration shocks and distinguish between short-run and long-run effects. We also consider the effectiveness of government intervention designed to alleviate the adverse regional effects of immigration including the possibility that regional governments behave in a welfare-maximising way.

Key words: immigration, regional, labour market

JEL codes: J61, R13, R23

1. Introduction

"New World" countries such as Australia, the USA, Canada and New Zealand have thrived on, and for all practical purposes built on waves of immigration from countries such as England, Scotland, Ireland, Italy and Holland.

In more recent times the New-World countries have been hit by a wave of immigration from a different direction. Immigration from the Old World has continued. On top of this, however, there has been substantial immigration from Asian and African countries In the last century Australia, for example, has been hit by immigration from countries like China, India, Malaysia, Vietnam, Sri Lanka, Sudan and Ethiopia.

Not surprisingly this rapid expansion of immigration has been accompanied, in recent times, by a similarly rapid expansion of studies aimed at uncovering the economic effects of immigration. Such studies operated both theoretically and empirically.

Existing *theoretical* studies focus primarily on the effect of immigration on the labour-market of the host country (see Borjas, 1999, 2006, and Borjas *et al.*, 1997, for examples of such studies) although they also include some which aim at assessing the *overall* economic benefit to the host country of immigration - the so-called "immigration surplus" introduced by Borjas (1995). This concept has been analysed more recently by Borjas (2003) and extended by Felbermayr and Kohler (2007) to include international trade.

A further extension of the theoretical approach has been to introduce economic growth and so to permit an investigation of the *long-term* effects of immigration on the host country. An early contribution of this type was by Chiswick *et al.* (1992) who analysed the macro-economic effects of immigration in a four-factor growth model. A more recent study by Drinkwater *et al.* (2007) extends the work to encompass endogenous growth.

Hirschman (2005), in an interesting and wide-ranging paper discussing US immigration, pleads for a much longer-term perspective, arguing that the effects of immigration on the host country (the US in this case) should be analysed over centuries, not months or years.

On the *empirical* front, early work (see a review of this by Friedberg and Hunt, 1995) also focussed on the effects of immigration on the labour-market of the host country and this has continued to be the main focus of empirical work, with econometric development aimed at disentangling wage-effects from confounding effects and in extending the analysis from the initial effect on the US (see Borjas, 2006, for example) to other countries including Canada (see Hou and Bourne, 2006, and Ley, 2007), Australia (see Islam, 2007, Ley, 2007), the United Kingdom (see Hatton and Tani, 2005) and Italy (see Venturini and Villosio, 2006), to mention a few.

Thus the work done so far on the economic effects on the host country of immigration from the rest of the world is clearly extensive. There are still, however, questions of an interesting and important type which remain unanswered. The aim of the present paper is to help fill this gap by focussing on the regional effects *per se* of an immigration shock. We pursue this aim by posing five questions relating to the regions of a country:

- Suppose there is an increase in immigration which is evenly spread across the regions of a country. What will be the effects on the regional economies (output, employment, welfare, wages and so on) in the short run and in the long run?
- Suppose that the immigration increase is concentrated in one region. What will be the effects on the regional economies in the short run and in the long run?
- Suppose that regional governments attempt to use expenditure and taxation policy to alleviate the adverse consequences of immigration on the region's economy. Will this be effective?
- Suppose the central government acts to offset the undesirable regional effects of immigration by a regionally-differentiated expenditure policy. Will it be successful?
- Suppose that regional governments act strategically in the face of immigration increases. Will this mitigate the effects of immigration on the region's economy?

The approach used to address these questions is based on a theoretical model which we solve numerically in the manner adopted by computable-general-equilibrium (CGE) researchers. We construct a small two-region general-equilibrium model which we linearise and calibrate and then use to simulate the regional effect on a range of important variables such as output, wages, employment, labour-force, unemployment and welfare of a variety of immigration shocks. A distinction is made between short-run and long-run effects, a distinction which is based on whether inter-regional migration takes place or not. The shocks imposed on the model are chosen to enable us to address the questions posed above and an extensive sensitivity analysis is undertaken to assess the dependence of our results on the closure assumptions and the particular parameterisation assumed for the main simulations.

The structure of the rest of the paper is as follows. In the next section we set out the model. In section three we carry out the linearisation and calibration of the model and in section four present the results of the simulations designed to address our five questions as well as briefly discuss the results of the sensitivity analysis. In section five we summarise our results and draw conclusions about the regional effects of immigration.

2. The model

We use as our framework a two-region general equilibrium model taken from a class which has played an important part in the fiscal-nationalism literature, viz., models of multi-regional federations with a given freely-mobile supply of labour. A model of this class has been used in, e.g., Boadway and Flatters (1982), Myers (1990), Petchey (1993, 1995), Petchey and Shapiro (2000), Groenewold *et al.* (2000, 2003) and Groenewold and Hagger (2005, 2007) . 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 national government. The households and firms are optimisers, for all but the last simulation the regional government is not a maximiser and the national government's behaviour is treated as exogenous.[1]

[1] The regional governments are assumed to be exogenous for all but one of the simulations since we are interested in the effects of regional governments' policy actions which requires exogenous policy variables. It would be possible to assume that the national government also maximises an objective function but since we are interested in the regional effects of exogenous national government immigration decisions, an exogenous national government is required. See Roemer (2006) for an interesting recent model of a two-

The firms in a region produce a single good which we assume to be different to that produced in the other region. It is supplied, in the region in which it is produced, to households and to the regional government as tax revenue. Households consume some, trade some with households in the other region and give some up to the national government as income tax. Governments costlessly transform the good they receive as tax revenue into a government good. The regional government supplies the transformed good in equal amounts 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 national government provides output to households in both regions (possibly different amounts per capita) and finances this by a tax levied at a uniform rate on household incomes in both regions.

Output is produced using a single (variable) factor, labour, which is supplied by households.[2] 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 one of three sources of inter-connectedness between the two regions. We follow the literature cited above and assume migration to be costless and to occur in response to inter-regional utility differentials. Alternatives would be to allow internal migration to equalise wages, consumption or unemployment rates across regions but given that households are assumed to choose consumption to maximise utility it is natural to assume a similar motivation for migration decisions.

We wish to model the labour market to allow for the possibility of unemployment in each region. Since the fear that large immigrant inflows may cause unemployment is an important policy concern in practice, it is important to include equilibrium unemployment in the model. There are many ways in which this has been achieved in recent regional literature: a fixed wage as in the multi-regional model of tax-competition by Ogawa *et al.* (2006) as well as in the two-region model of Fuerst and Huber (2006); an

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country world with an optimising world government which might be adapted to apply to a national government in a two-region country.

[2] It is straightforward to assume that there is a fixed factor (such as land or capital) in each region which is owned by the residents of the region to whom the firms' profits are distributed.

efficiency-wage model as in Zenou (2006); job search as used by Epifani and Gancia (2005) in a model used to investigate spatial productivity differentials and by Moller and Aldashev (2006) in their investigation of participation rates in East and West Germany; or a union-based model used by Roemer (2006). We use a variant of the last; we assume that in each region firms bargain with a union which represents households. Bargaining is assumed to be restricted to wages and, once the wage has been agreed upon, firms choose employment to maximise profits. There is no reason why employment should equal the labour force in equilibrium so that, as required, 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 in a broad sense.

There are therefore three sources of interconnectedness between the regions – inter-regional migration, inter-regional trade and the redistribution carried out by the national government. We abstract from other possible inter-regional connections. So, 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. Further, we assume that each firm is owned by households in the region in which it is located. Given our earlier assumption that firms employ labour only from households in the region, we also abstract completely from inter-regional factor income flows.

Finally, immigration is modelled very simply as an increase in the exogenous national labour force. Our model abstracts from skill differentials which have featured importantly in the literature on the economic effects of immigration so that there is only a single homogeneous type of labour and immigration simply augments the labour supply. In the short run (before inter-regional migration responds to changes in the economic environment) the regional distribution of the immigrants is important so that we need to make an assumption about this distribution. In the long run with free inter-regional migration, the only direct effect of an immigration shock is on the national labour force, which is then distributed via internal migration to equalise welfare across regions in our model.

More formally, we set out the model as follows.[3]

2.1 The representative household

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

(1) $V_i = \beta_i C_{1i}^{\gamma_{1i}} C_{2i}^{\gamma_{2i}} G_i^{\delta_i}$, i = 1, 2

where V_i = utility of the representative household, region i,

C_{1i} = real private consumption of good 1 per household, region i,

C_{2i} = real private consumption of good 2 per household, region i,

G_i = real government-provided consumption per household, region i.

β_i, γ_{ji} and δ_i are constants with:

$\beta_i > 0$, i = 1,2

$0 < \gamma_{ji} < 1$, i, j = 1,2

$0 < \delta_i < 1$ i = 1, 2

$\gamma_{1i} + \gamma_{2i} + \delta_i = 1$, i = 1,2

The representative household in region i takes G_i as given and chooses C_{ji} (j=1,2) so as to maximise V_i subject to the constraint imposed by its after-tax income:

$C_{11} + C_{21}/P = (1-M)J_1$,

$P.C_{12} + C_{22} = (1-M)J_2$,

where M = rate of national government income tax,

P = price of good 1 in terms of good 2, and

J_i = real household income in region i.

Note that each household's income is expressed in terms of output of its own region. The solution to the household's problem is given by:

(2) $C_{ji} = (\gamma_{ji}/(\gamma_{1i}+\gamma_{2i}))(1-M)J_i.P^{j-i}$, i, j = 1,2

Real income per household in region i (expressed in terms of good i) is defined as:

[3] Definitions of all variables are reproduced in Appendix 1.

$J_i = \Pi H_i + W_i^* + U_i.UB_i \qquad i = 1,2$

where ΠH_i = real profit distribution per household, region i

W_i^* = real wage income per household, region i

U_i = unemployment rate, region i

UB_i = real unemployment benefits per unemployed person, region i

W_i^*, the real wage per *household*, is interpreted as, W_i, the real wage per *worker* in region i weighted by the probability of employment in region i. Hence W_i^* can be replaced by $(L_i/N_i)W_i$ where W_i is the real wage rate in region i, L_i is employment in region i and N_i is the workforce (= population) in region i. Using this, J_i can be written as:

(3) $J_i = \Pi H_i + (L_i/N_i).W_i + U_i.UB_i = \Pi H_i + (1-U_i).W_i + U_i.UB_i, \qquad i = 1,2$

where we have used the definition of the unemployment rate:

(4) $U_i = (N_i - L_i)/N_i = 1 - L_i/N_i, \qquad i = 1,2.$

We assume that inter-regional migration of households occurs and that it continues until utility per household is equalised in the two regions so that in (long-run) equilibrium:

(5) $V_1 = V_2$

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 in an environment where migration may occur in either direction but their analysis suggests that the discontinuities introduced in this extension will add considerable complexity. An alternative, less complex, alternative is to assume that one of the regions is poor and the other rich so that migration always moves from the poor to the rich; see Woodland and Yashida (2006) for such an approach in the development literature. While this assumption is theoretically attractive and may be tenable in the case of a dual developing economy, it is too restrictive in our case where migration may occur in either direction, depending on the nature of the initial shock, so we start with the simplest assumption of costless internal migration.

2.2 The representative firm

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

(6) $\quad Y_i = D_i\left(L_i/F_i\right)^{\alpha_i} \qquad i = 1,2 \qquad 0 < \alpha_i < 1$

where Y_i = real output of the representative firm, region i,

D_i = productivity parameter, region i, and

F_i = the (exogenous) number of firms in region i.

Given the assumption of decreasing returns to labour, competition will ensure that all firms are of equal size.

Real firm profits are given by:

(7) $\quad \Pi F_i = Y_i - W_i(L_i/Fi)(1+T_i), \qquad i = 1,2$

where T_i is the rate of payroll tax levied by the regional government in region i.

We model the labour market using a "right-to-manage" bargaining framework in which the wage is determined by the bargaining of firms and unions after which the firms choose employment to maximise profits given the bargained wage. The firm's profit-maximising employment condition is the usual marginal productivity condition:

(8) $\quad \alpha_i D_i\left(L_i/F_i\right)^{\alpha_i - 1} = W_i\left(1+T_i\right) \qquad i = 1,2$

conditional on the wage which emerges from the bargaining process.

2.3 Wage determination

We assume that the wage in region i is determined by a process of negotiation between employers and trade unions. The union's bargaining aim is to push the wage bill as high as possible relative to the figure they believe workers could obtain elsewhere in the region if the bargaining process breaks down. In pursuing this aim, however, they are constrained by the bargaining aim of the employers which is to preserve profits. We formalise this set of assumptions, following Layard *et al.* (1991), by supposing that the bargained wage is the outcome of the following optimisation problem:

$$\max_{\{W_i\}} \quad B_i = (\Pi F_i)\ ((W_i - A_i)L_i)^{\Omega_i}, \qquad 0<\Omega_i<1$$

subject to (6) and (7) where A_i is the income workers expect to be able to obtain elsewhere in region i if an agreement is not reached and Ω_i is a parameter representing union strength in the bargaining process in region i. We assume that A_i depends on both the expected wage in the rest of the region (W^e) as well as unemployment benefits (UB):

$$A_i = (1-U_i)W^e_i + U_i.UB_i$$

where $(1-U_i)$ is taken as the probability of employment elsewhere and U_i the probability of unemployment, should the bargaining process break down. We assume that in solving the bargaining problem both firms and unions are myopic in the sense that they both ignore the effects of wages on employment. Under these assumptions, the first-order condition for the bargaining problem is:

$$\Omega_i\ (\Pi F_i) = (W_i - A_i)(1+T_i)L_i$$

Using the definition of A_i, the marginal productivity condition for profit maximisation, equation (8), and the assumption that in equilibrium the expected wage (W^e) is equal to the actual wage (W), the first-order condition can be rewritten as:

(9) $$W_i,/(W_i-UB_i) = (\alpha_i/(1-\alpha_i))(1/\Omega_i)U_i \quad i = 1,2,$$

so that there is a simple and plausible negative relationship between the equilibrium wage and the unemployment rate which is shifted up by an increase in union power as well as by an increase in the level of unemployment benefits.

2.4 The regional government

The government of region i receives good i from the firms in its region in the form of receipts from a payroll tax which is levied at a constant rate in its region. The regional government uses part of this revenue to pay unemployment benefits to unemployed households in its region and is assumed to convert the remainder costlessly into the government good which it provides to households in its region in equal per capita amounts. We assume that the government of region i balances its budget so that total outlay and tax collections are equal. This gives:

$$N_iGR_i + (N_i-L_i).UB_i = L_iT_iW_i, \qquad i = 1,2$$

where GR_i = the amount of (regional) government good provided per household, region i. Using the definition of the unemployment rate, U_i, we can write this condition as:

(10) $$GR_i + U_i.UB_i = T_iW_i(1-U_i), \qquad i = 1,2$$

For most of our simulations we will assume that the regional governments are exogenous, subject only to their budget constraint. For the analysis of our last question, however, we will assume that they behave strategically. There are various goals they could pursue, including the maximisation of welfare (measured by the utility of the representative household) or the size of the government budget (as measured by expenditure, for example). We will follow existing literature (see, e.g. Petchey, 1993, Petchey and Shapiro, 2000, 2002, and Groenewold *et al.*, 2000, 2003) and assume that they are welfare maximisers. In that case the government of region i chooses GR_i, and T_i to maximise (1) subject to the constraint imposed by the regional economy as well as its own budget constraint, (10). The first-order condition for this maximisation problem can be rewritten as:

(11) $$\frac{\gamma_{1i}}{C_{1i}}\frac{\partial C_{1i}}{\partial T_i}+\frac{\gamma_{2i}}{C_{2i}}\frac{\partial C_{2i}}{\partial T_i}+\frac{\delta_i}{G_i}\frac{\partial G_i}{\partial T_i}=0 \qquad i = 1,2$$

where the partial derivatives with respect to T_i are multipliers implied by the economic structure as captured by the model and are assumed to be taken as given by the regional government. Each regional government also takes the actions of the other as given so that the model solution has the characteristics of a Nash equilibrium in a two-person game.

2.5 The national government

The national government collects income tax at a fixed rate, M, from all citizens. Its tax collections are MN_1J_1 from households in region 1 and MN_2J_2 from households in region 2. Recall that the J_i are measured in terms of region i output. We assume that the national government, like the regional governments, can transform each region's output costlessly into the government good and, further, that the units of the goods are chosen so that one unit of each region's good is converted into one unit of the government good. Under these assumptions we can write the national government's total income tax receipts simply as $MN_1J_1+ MN_2J_2$ which it uses to provide output to the citizens of each region. We allow expenditure per capita to differ across regions. While central governments generally tax at the same rate in each region, their expenditure per capita often differs by region, in many cases as part of a fiscal equalisation arrangement to ensure that residents of poor regions have access to a reasonable level of government services, despite low regional government revenue. The output provided to households in region i is GF_i per capita. The national government, too, balances its budget so that:

(12) $N_1GF_1 + N_2GF_2 = M(N_1J_1 + N_2J_2)$.

While there is an equalisation component in the unequal per capita expenditure levels in (12), we abstract from the more elaborate equalisation procedures which are common to federations such as Canada and Australia since in this paper we are not interested in them *per* se so that to introduce them would be to needlessly complicate the model.

2.7 Model closure

As it stands, the model is incomplete in the sense that there are fewer equations than endogenous variables. We remedy this by adding various definitional equations and marker-clearing conditions which provide extra links between the variables we already have.

We begin with a relationship that defines real government-provided consumption per household in region i, G_i:

(13) $G_i = GR_i + GF_i, \quad i = 1,2.$

Next, national population (= labour force) is defined by:

(14) $N_1 + N_2 = N,$

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. From this it follows that the representative household's profits receipts (ΠH_i) are related to firm profits (ΠF_i) by the condition:

(15) $F_i.\Pi Fi = N_i.\Pi H_i, \quad i = 1,2.$

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 trade and migration. Besides, it is unlikely that in practice cross-border firm ownership is an important channel of influence between regions.

Next, we have a market-clearing condition for the output market in each region:

(16) $F_i.Y_i = N_1C_{i1} + N_2C_{i2} + N_iGR_i + N_iMJ_i, \quad i = 1,2.$

This relationship simply states that output produced in region i is (i) consumed by households in the region, or (ii) traded to households in the other region and consumed by them, or (iii) paid to region i's government to be converted to the government good, or (iv) paid to the national government as income tax and converted to the government good.

Finally, we have a balanced-trade assumption: since there are no assets in the mode, we cannot allow either region to consume in excess of its income. Hence

(17) $C_{21} = P.C_{12}$.

The model with exogenous regional governments consists of the 30 equations (1)-(10), (12)-(17) in 39 variables V_i, C_{ji}, G_i, ΠH_i, ΠF_i, U_i, W_i, UB_i, P, L_i, N_i, F_i, Y_i, J_i, T_i, Ω_i, GR_i, GF_i, N and M of which the 11 variables UB_i, F_i, GR_i, Ω_i, GF_i and N are exogenous. Thus there are 28 endogenous variables. Two equations are redundant since equations (3), (4), (7), (10), (15) and (17) can be used to derive (16). We therefore drop equations (16), leaving 28 equations in 28 endogenous variables and 11 exogenous variables.

To obtain the model with maximising regional governments we simply add the two equations (11) and shift GR_i from the list of exogenous variables to the endogenous category.

2.8 The short-run version of the model

We define "the short run" as the stretch of time before inter-regional migration begins to respond to inequality between V_1 and V_2. Using this definition, we can define a short-run version of the model by deleting equations (5) and (14) from the model in each of its forms (whether exogenous or maximising regional governments) and transferring both N_1 and N_2 from the endogenous to the exogenous category. We shall refer to it as the "short-run version of the model" and to the model itself as the "long-run version of the model".

3. The linearised numerical version of the model

While the structure of the two-region model set out in the previous section is relatively simple, it is non-linear in the levels of the variables and for this reason it cannot easily be 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 briefly 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)-(17) are given in Appendix 2.

As can be seen from Appendix 2, the linearised model contains a number of parameters which have to be evaluated before the model can be simulated. These parameters fall into two groups. The first are parameters which appear in model relationships; γ_{ji} and δ_i appear in the utility function (1) and α_i appears in the production function (6). The remainder are linearisation parameters and are all shares of some sort.

The *model* parameters can be evaluated with the help of model restrictions. Start with α_i. Here we use the marginal productivity condition, equation (8). Similarly for γ_{ji} and δ_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.[4] Since the relative price of C and G is unity, utility maximisation implies that the ratio γ_{ji}/δ_i is equal to C_{ji}/G_i. Then, using the restriction that $\gamma_{1i} + \gamma_{2i} + \delta_i = 1$, we have

$$\gamma_{ji} = C_{ji}/(C_{1i}+C_{2i}+G_i) ,$$

and

$$\delta_i = G_i/(C_{1i}+C_{2i}+G_i).$$

The *linearisation* parameters can be evaluated directly from their definitions, given values for M, ΠH_i, J_i, U_i, W_i, L_i, N_i, T_i, N_iGF_i, N_iJ_i, GR_i, G_i, Y_i, and ΠF_i. All of which can be derived from data on C_i, GR_i, L_iW_i, GF_i, W_i, and N_i and the model definitions.[5]

[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 do not choose G_i but take it as given in maximising utility.
[5] Note that while the parameters σ_{maxji} also fall into the linearisation category, they are not simply shares. They appear only in the version of the model with maximizing regional governments and they depend on the solutions to the GE version of the model which regional governments are assumed to take as given. We therefore evaluate them by simulating the GE model with a tax increase and combine the effects on

All the model and linearization parameters have the subscript i = 1,2 so that they all have to be evaluated separately for regions 1 and 2. The same applies to the data required for their evaluation. To proceed with this evaluation, therefore, the regions need to be defined and appropriate data need to be obtained.

We use Australian data, not because the model is particularly Australian in character or that we wish to comment on specifically Australian issues but simply for convenience's sake. This being the case, the most obvious way of defining the regions is in terms of the Australian states of which there are six: New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania. We take one of these as region 1 and the other five collectively as region 2. Data for each of C_i, GR_i, L_iW_i, GF_i, W_i, and N_i are then obtained for each of the two regions thus defined. The figures we use are the average values for the years 1994-95 to 1998-99. These figures are given in Appendix 3.

To avoid the possibility that the simulation results we are about to report were affected by our choice of the state for region 1, we carry out the above procedure six times with each of the six states taken as region 1 and the remainder collectively as region 2. In this way we simulate six versions of the linearised model.

4. Results

Recall that we will analyse five questions. Briefly, they address:

1. the effects on the regional economies of an increase in immigration which is distributed across regions in proportion to their populations;
2. the effects on regional economies of an increase in immigration which is directed at one region only;
3. the effectiveness of regional government tax and expenditure policies designed to alleviate the adverse regional effects of immigration increases;
4. the effectiveness of national expenditure policies designed to alleviate the adverse effects on one region of immigration increases; and

consumption with other parameters as shown in the formulae Appendix 2. It turns out that σ_{maxji} is approximately 1 for i=j and zero otherwise so that the linearised condition effectively becomes $g_i = c_{ii}$.

5. the effectiveness of regional governments' strategic behaviour in alleviating the adverse effects of immigration increases.

We analyse each of these five questions in turn.

4.1 Question 1

To address question 1 we shock national population by 1 with the assumption that the increase is spread across the two regions equi-proportionately in the short run. Since the model is solved in the proportional changes this simply requires us to set n_1 and n_2 equal to one for the short-run simulation and the value of n equal to one in the long-run simulation. The results, for NSW as region 1 and the rest of the country as region 2, are reported in Table 1. The results are based on a closure assumption that taxes are exogenous and expenditure endogenous at both levels of government.

[Table 1 near here]

In the short run output in both regions increases although by less in region 2 which implies a greater fall in output per head and a greater fall in household income per capita in region 2 given that population increases by the same proportion in each region. Both regions reduce consumption pre head of good 1 by the same proportion and similarly for good 2. The fall in consumption of good 2 is larger than that of good 1 and since region 2's households consume relatively more of good 2, their consumption falls by more resulting in a larger reduction in utility (government expenditure is exogenous and unchanged). Thus, in the short run, households in both regions are worse-off as a result of the immigration increase but households in region 2 fare worse than those in region 1. Both levels of government increase taxes to maintain a constant level of expenditure per capita for the larger population. With the greater fall in the tax base in region 2, the required tax-rate increase is larger than it is in region 1.

Results for each of the other states as region 1 are reported in the Table A4.11 in Appendix 4 and they show that the results in Table 1 above are dependent on the choice of region 1. In particular, they depend on the value of α_i (the exponent of labour in the production function in region i); the values of the α_i are reported in the last two rows of Table A4.11. From these it is clear that region i fares relatively better than region 2 if and only if its α value is greater. The explanation is straightforward: with the same increase in population in each region, the region with the larger α will have a larger increase in total output and therefore a smaller fall in per capita output, therefore a smaller fall in income, consumption and utility.

In the labour market, the initial effect is to increase the labour force which results in an "immediate" increase in unemployment which, in turn, puts downward pressure on the wage through the bargaining process. Even though the results in Table 1 show that the wage fall is larger in region 2, the rise in unemployment in region 2 is larger because of the smaller marginal product of labour which dampens the employment-increasing effect of the wage fall. These relative effects on wages, employment and unemployment are again reversed if the relative magnitudes of the αs is reversed.

In the long run remarkably little changes. Most of the action in response to the immigration intake is in the short run and allowing free and complete internal migration response does little to ameliorate the adverse effects of the immigration shock. Since the fall in utility is larger in region 2, there is a population move to region 1 once migration is allowed but compared to the original intake, the effects are small, not surprisingly since both regions' populations increase in the same proportion in the short run.

Thus, all in all, residents in both regions suffer as a result of the increase in immigration – wages, income, consumption and utility all fall and unemployment and taxes rise. Which region suffers most depends on the marginal product of labour – the higher the marginal product, the smaller the drop in income, consumption and output and the smaller the rise in unemployment and taxes.

The closure assumption underlying the results in Table 1 are that taxes are endogenous and expenditure exogenous at both levels of government. We also experimented with alternatives, allowing first regional governments and then the national government to switch from endogenous taxes to endogenous expenditure. The full results (for each state as region 1 in turn) are reported in Tables A4.12 and A4.13 in Appendix 4. The overall conclusions reached above are unaffected by these changes in closure assumptions. In all cases, output, consumption, income and welfare fall in both regions as a result of the immigration increase, with unemployment rising and taxes rising (or government expenditure falling).

4.2 Question 2

Our second question deals with the effects on the two regions of an increase in immigration which occurs in only one region – region 1 in our case. We analyse this by shocking population in region 1, N_1, by $1/\sigma_{n1}$ (σ_{n1} is the share of region 1 in national population) and holding N_2 constant in the short run and shocking national population, N, by 1 in the long run. The magnitude of the short-run shock to N_1 ensures that the population increases in the short and long runs are equal and, in turn, equal to the immigration intake analysed in question 1. The results of this shock are presented in Table 2 which has the same closure assumptions underlying it as did Table 1: endogenous taxes and exogenous government expenditures.

[Table 2 about here]

The short-run effects are quite different to those in the previous simulations but, as expected, the long-run effects are identical – in the long run it doesn't matter were the immigrants arrive as long as there is free internal migration. We focus our discussion, therefore, on the short-run effects.

The short-run effects on region 1 are similar to those in the question1 simulation reported in Table 1 except they are all larger – consumption, income, output per capita, wages and welfare all fall and unemployment and taxes increase. The only noteworthy exception is that the national tax rate increases by less than in the case where the immigrants are evenly spread around the country. This reflects the fact that when NSW is region 1 $\alpha_1 > \alpha_2$ so that in the current simulation the population increase is concentrated in the region with the higher marginal product of labour, the national output increases by more and this is reflected in the larger increase in the income tax base so that the tax rate needs to go up by less than if the immigrants are spread evenly over both regions.

While there are no direct population effects on region 2, some of the adverse effects of immigration in region 1 spill over into region 2 in the short run through relative price and inter-regional trade effects. Since the initial effect of the immigration to region 1 is to increase the demand for good 1 more than for good 2 (since region 1 consumes far more good 1 than good 2), p, the relative price of good 1 in terms of good 2 increases. This disadvantages region 2 which produces good 2 and they therefore suffer a small welfare loss.

In the long run inter-regional migration results in a large movement of people from region 1 to region 2 so transferring a roughly equal share of the overall welfare loss to region 2.

In summary, the increase in immigration has significant adverse effects on the region in which they arrive – both labour market and welfare outcomes deteriorate – but much of this is spread to the other region by internal migration in the long run. Hence internal migration is an important channel by which the costs of immigration on the host region are shifted to other regions.

As with the simulation used to address question 1, we ran a number of further simulations to assess the sensitivity to parameter choice and closure assumptions. On parameter choice, we ran the simulation reported in Table 2 for each other state being region 1 in turn. They are all reported in Appendix 4, Table A4.21 and show that the inferences we drew from Table 2 do not depend on the assumption that NSW is region 1. Further, we also re-ran all six simulations for two different closure assumptions, first making regional government expenditures endogenous and taxes exogenous and then making national government expenditure endogenous and its tax rate exogenous. The results are also reported in Appendix 4, in Tables A4.22 and A4.23. They indicate that nothing much hinges on these assumptions so that the results we describe in Table 2 are quite robust.

4.3 Question 3

We have seen in the previous two sub-sections that immigration results in substantial adverse effects on income, unemployment and welfare in both regions but especially in the region in which the immigration increase is concentrated. It is not unreasonable, therefore, that regional governments may take policy action. In this sub-section we assume, as we did in the previous case, that the immigration increase is concentrated in region 1 and ask whether a tax cut by the government of region 1 can be used to offset the adverse effects on the region's citizens. To do this we run a simulation in which we increase population in region 1 by $1/\alpha_{n1}$ while leaving N_2 constant. In addition we assume that region 1's government increases its expenditure by 1. The results are reported in Table 3.

[Table 3 about here]

In the short run the government's attempt to alleviate the adverse effects of immigration on labour market outcomes is a failure. For region 1 wages, income, consumption and output per capita all fall by more and unemployment rises by more as a result of the government's expenditure increase. The effects on region 2 are smaller but also worse than those reported in Table 2. Surprisingly, though, welfare actually falls less so that, while the policy is a failure from a labour-market point of view, it succeeds in improving the welfare of the representative citizen in region1 although region 2's households are slightly worse-off.

The reason for this seemingly perverse effect is not hard to find and lies in the government's budget constraint – the increase in expenditure by the government in region 1 must be financed by an increase in payroll tax in that region and, not surprisingly, this has adverse consequences for the performance of the labour market. The adverse effects are transmitted to region 2 via relative price effects.

In the long run the ability to migrate leads to a movement of population from region 1 to region 2, thereby shifting some of the consequences to region 2. As a result, region 2's labour market performance worsens and its welfare falls further. The effect of migration on region 1 is generally beneficial – the falls in income, wages and consumption are ameliorated and the unemployment rate improves a little. Thus, in the long run the effect of migration is to spread the effects to region 2.

Similar simulations but with the other states as region 1 in turn are reported in Appendix 4, Table A4.31 and show that the outcomes just described are not dependent on the choice of NSW as region 1.

Another set of simulations is reported in Table A4.32 and is based on the assumption that the government in region 1 reacts to the adverse labour market effects of the immigration increased by cutting payroll taxes rather than by increasing expenditure. Given that the unexpected consequences of an expenditure increase are the result of adjustment via the government's budget constraint, it is not surprising that the effects of a tax cut are the opposite of those following an expenditure increase – the policy is successful in partially off-setting the effects of an immigration increase on labour market performance but does so at the cost of a larger fall in welfare so that in this sense the policy is self-defeating.

All in all, government policy is able to have a substantial short-run effect on the labour-market consequences of an immigration shock (although sometimes in an unexpected direction) but, in the long run, the welfare effects of the government intervention are very modest.

4.4 Question 4

Here we evaluate whether the national government can alleviate the adverse effects of an immigration shock to region 1 by boosting its expenditure in region 1 while holding expenditure in region 2 constant and balancing its budget by adjusting the income tax rate. The results of a simulation of this policy with NSW as region 1 are reported in Table 4; the results for each of the other states being chosen as region 1 in turn are reported in Appendix 4, Table A4.41.

[Table 4 near here]

The results provide an interesting comparison to those which follow from a regional government expenditure increase. In the short run the effect of the national government intervention are slight – none on the labour market compared to the non-intervention case reported in Table 2 and only a minor effect on welfare. In the long run, however, a comparison with Table 3 shows that the national government is much better at alleviating the labour market consequences of an immigration increase by increasing its expenditure than the regional government is. While the welfare effects are more or less the same for each policy, the national government's policy makes for significantly better labour market outcomes in both regions because it relies on the income tax rather than the payroll tax to balance its budget. In our model, the income tax does not have distortionary effects while the payroll tax affects wages and employment choice.

On the whole, the governments are able to do little good by increasing expenditure in the region adversely affected by the immigration increase, especially in the long run. At best, they are able to shift some of the burden to region 2.

4.5 Question 5

We saw in the simulations for question 3 that the regional government, in using an expenditure boost to attempt to offset the labour market deterioration following an immigration increase, might be successful but at the expense of reduced welfare. In our final set of simulations we progress from *ad hoc* policy responses of this type to assuming that regional governments choose their expenditure and tax policies so as to explicitly maximise the welfare of the representative household in their region. In modelling terms, this has the consequence of adding two further equations to the model (a first-order condition for welfare maximisation for each region) and making the both regional government expenditures and taxes endogenous.

The effects of an increase in immigration to region 1 when NSW is region 1 are reported in Table 5 with the full set of simulations reported in Table A4.51 of Appendix 4.

[Table 5 near here]

The results in Table 5 can usefully be compared to two other tables – Table 2 (no reaction by any government to the effects of immigration) and Table 3 (region 1's government increases expenditure in response to the adverse effects of the immigration increase).[6] The first comparison shows that, in the short run, the fall in region 1's welfare is actually larger with maximising regional governments than with exogenous governments although the reduction in region 2's welfare is smaller. This apparently paradoxical results (surely a maximising government can always do at least as well as an exogenous government since it is always free to hold expenditure constant) is explained by the fact that region 2's government also optimises and this actually makes region 1 worse-off; a re-run of this simulation with region 2's government assumed exogenous shows that, indeed, region 1's government does a little better in terms of the welfare of its representative citizen than an exogenous regional government would. In the long run the change in utility is equalised across the two regions by inter-regional migration and falls by less in both regions than it does with exogenous regional governments so that maximising regional governments are unambiguously better in the long run.

The second comparison is to Table 3 which reports results for the case that region 1's government increases expenditure in an attempt to offset the adverse effects of the immigration flow into region 1. This comparison produces the same paradox as the previous one did and can be resolved in the same way. The introduction of maximising governments actually makes region 1 worse-off in the short run than if the governments did nothing but makes region 2 better-off and makes both regions better-off in the long run.

Finally, we also report the effects of an evenly-spread immigration increase in the face of maximising regional governments in Appendix 4, Table A4.52. A comparison to the results in Table 2 shows that in this case the introduction of maximising regional

[6] It will be noted that in Table 5 in the long run the change in welfare for both regions and the change in all four consumption variables (and the change in the government provided good) are all equal. Moreover, income changes in both regions are equal and the relative price is constant. An inspection of the full results in Table A4.51 and Table A4.52 shows that this is a general feature of the results in the present case of maximizing regional governments. Some manipulation of equations (1'), (2'), (5') and (11') of Appendix 2 proves that this is necessarily the case.

governments makes the citizens of both regions better-off in both short and long runs. In addition, the labour-market outcomes are improved for both regions if their governments choose tax rates and expenditure levels to maximise welfare.

We can conclude, therefore, that, generally, welfare maximising regional governments deliver a better outcome for their region although a regional government acting alone without a response by the government of the other region may do better for its citizens if the immigration increase is concentrated in its region rather than evenly spread throughout the country.

5. Conclusions

In this paper we have used a small two-region CGE model to analyse the effects on regional economies of immigration shocks. We have investigated two different shocks, one where an increase in immigration is spread across the regions in proportion to their populations and the other where the increase occurs only in one region. We have also considered these shocks with and without government intervention which attempts to alleviate the adverse effects of the shock. In particular, we have considered the effects of the government of the affected region increasing expenditure or cutting taxes to offset the immigration effects as well as an attempt by the national government to shift expenditure to the adversely affected region. Finally we analysed each type of shock in a situation where regional governments act strategically in that they choose the values of their expenditure and tax instruments so as to maximise the welfare of a representative regional citizen.

Several broad conclusions can be drawn. First, an increase in immigration always has an adverse effect on the welfare of both regions, irrespective of the nature of the shock.

Secondly, without government intervention, the effects of each type of shock on the economy as a whole and on the labour market in particular, can be considered adverse – consumption, wages, income, output per capita all fall and the unemployment rate rises.

Thirdly, when the immigrants are evenly spread across the two regions, the adverse effects on the two regions are similar. In the event that the immigrants are concentrated in one region, the short run effects fall more heavily on the region receiving the immigrants but subsequent internal migration substantially spreads the effects to the other region.

Fourthly, government intervention may or may not help the situation. Thus a regional government expenditure increase in the adversely affected region will improve labour market outcomes in the short run but reduce welfare while a tax cut has the opposite effects – it improves welfare but at the cost of poorer labour market outcomes. A national government expenditure shift to the affected region improves that region's performance but at the expense of the other region's welfare.

Finally, maximising regional governments generally make for smaller welfare losses although the outcomes may be worse for one region in the short run.

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Table 1. The effect of an evenly spread increase in immigration; NSW is region 1

Variable	Solution value	
	SR	LR
v_1	-0.2465	-0.2596
v_2	-0.2679	-0.2596
c_{11}	-0.3029	-0.3274
c_{21}	-0.3502	-0.3349
c_{12}	-0.3029	-0.3274
c_{22}	-0.3502	-0.3349
j_1	-0.2729	-0.2977
j_2	-0.3202	-0.3051
πh_1	-0.2669	-0.2911
πh_2	-0.3070	-0.2925
w_1	-0.2696	-0.2941
w_2	-0.3033	-0.2890
u_1	0.1288	0.1405
u_2	0.4796	0.4570
l_1	0.9919	1.0819
l_2	0.9648	0.9192
n_1	1.0000	1.0907
n_2	1.0000	0.9528
y_1	0.7769	0.8474
y_2	0.7425	0.7074
t_1	0.2890	0.3152
t_2	0.3876	0.3693
m	0.3029	0.3004
n	0.0000	1.0000
p	-0.0473	-0.0075

Note: the shock and closure underlying this simulation is given by: $n_1 = n_2 = 1$ in the short run and $n = 1$ in the long run; endogenous: t_1, t_2, m; exogenous: $gr_1 = gr_2 = gf_1 = gf_2 = 0$.

Table 2. The effect of an increase in immigration to region 1; NSW is region 1

Variable	Solution value	
	SR	LR
v_1	-0.5233	-0.2596
v_2	-0.0911	-0.2596
c_{11}	-0.8225	-0.3274
c_{21}	-0.0249	-0.3349
c_{12}	-0.8225	-0.3274
c_{22}	-0.0249	-0.3349
j_1	-0.7977	-0.2977
j_2	0.0000	-0.3051
πh_1	-0.7800	-0.2911
πh_2	0.0000	-0.2925
w_1	-0.7880	-0.2941
w_2	0.0000	-0.2890
u_1	0.3764	0.1405
u_2	0.0000	0.4570
l_1	2.8990	1.0819
l_2	0.0000	0.9192
n_1	2.9228	1.0907
n_2	0.0000	0.9528
y_1	2.2708	0.8474
y_2	0.0000	0.7074
t_1	0.8446	0.3152
t_2	0.0000	0.3693
m	0.2510	0.3004
n	0.0000	1.0000
p	0.7977	-0.0075

Note: the shock and closure underlying this simulation is given by: $n_1=1/\sigma_{n1}$, $n_2=0$ in the short run and $n = 1$ in the long run; endogenous: t_1, t_2, m; exogenous: $gr_1 = gr_2 = gf_1 = gf_2 = 0$.

Table 3. The effect of an increase in immigration to region 1 combined with an expenditure increase by region 1's government; NSW is region 1

Variable	Solution value	
	SR	LR
v_1	-0.4947	-0.2602
v_2	-0.1102	-0.2602
c_{11}	-0.9906	-0.5502
c_{21}	-0.0308	-0.3066
c_{12}	-0.9906	-0.5502
c_{22}	-0.0308	-0.3066
g_1	0.6433	0.6433
j_1	-0.9598	-0.5150
j_2	0.0000	-0.2714
πh_1	-0.7847	-0.3498
πh_2	0.0000	-0.2602
w_1	-1.0027	-0.5633
w_2	0.0000	-0.2571
u_1	0.4789	0.2691
u_2	0.0000	0.4065
l_1	2.8926	1.2760
l_2	0.0000	0.8178
n_1	2.9228	1.2930
n_2	0.0000	0.8476
y_1	2.2657	0.9995
y_2	0.0000	0.6293
t_1	1.9874	1.5164
t_2	0.0000	0.3285
m	0.3105	0.3544
p	0.9598	0.2436

Note: the shock and closure underlying this simulation is given by: n_1=1/σ_{n1}, n_2=0, gr_1 = 1 in the short run and n = 1 and gr_1 = 1 in the long run; endogenous: t_1, t_2, m; exogenous: gr_1, $gr_2 = gf_1 = gf_2 = 0$.

Table 4. The effect of an increase in immigration to region 1 combined with an expenditure increase by the national government; NSW is region 1

Variable	Solution value	
	SR	LR
v_1	-0.4756	-0.2576
v_2	-0.1182	-0.2576
c_{11}	-0.8574	-0.4480
c_{21}	-0.0598	-0.3162
c_{12}	-0.8574	-0.4480
c_{22}	-0.0598	-0.3162
g_1	0.3567	0.3567
j_1	-0.7977	-0.3841
j_2	0.0000	-0.2524
πh_1	-0.7800	-0.3756
πh_2	0.0000	-0.2419
w_1	-0.7880	-0.3795
w_2	0.0000	-0.2390
u_1	0.3764	0.1813
u_2	0.0000	0.3779
l_1	2.8990	1.3962
l_2	0.0000	0.7602
n_1	2.9228	1.4076
n_2	0.0000	0.7880
y_1	2.2708	1.0936
y_2	0.0000	0.5851
t_1	0.8446	0.4068
t_2	0.0000	0.3054
m	0.6034	0.6443
p	0.7977	0.1318

Note: the shock and closure underlying this simulation is given by: $n_1=1/\sigma_{n1}$, $n_2=0$, $gf_1 = 1$ in the short run and $n = 1$ and $gf_1 = 1$ in the long run; endogenous: t_1, t_2, m; exogenous: gf_1, $gf_2 = gr_1 = gr_2 = 0$.

Table 5. The effect of an increase in immigration to region 1 when regional governments are welfare maximisers; NSW is region 1

Variable	Solution value	
	SR	LR
v_1	-0.5507	-0.2528
v_2	-0.0718	-0.2528
c_{11}	-0.6532	-0.2528
c_{21}	-0.0127	-0.2528
c_{12}	-0.6532	-0.2528
c_{22}	-0.0127	-0.2528
j_1	-0.6346	-0.2301
j_2	0.0059	-0.2301
πh_1	-0.7751	-0.2855
πh_2	0.0006	-0.2866
w_1	-0.5721	-0.2059
w_2	0.0074	-0.1931
u_1	0.2733	0.0984
u_2	-0.0117	0.3053
l_1	2.9055	1.0706
l_2	0.0009	0.9376
n_1	2.9228	1.0768
n_2	0.0000	0.9601
y_1	2.2759	0.8386
y_2	0.0007	0.7216
gr_1	-1.0054	-0.3929
gr_2	-0.0296	-0.3908
t_1	-0.3043	-0.1379
t_2	-0.0365	-0.1100
m	0.1875	0.2285
p	0.6405	0.0000

Nχote: the shock and closure underlying this simulation is given by: $n_1=1/\sigma_{n1}$, $n_2=0$, in the short run and n = 1 in the long run; endogenous: t_1, t_2, m, gr_1, gr_2; exogenous: $gf_1 = gf_2 = 0$.

Appendix 1: A list of variables

V_i = utility of the representative household, region i,

C_{1i} = real private consumption of good 1 per household, region i,

C_{2i} = real private consumption of good 2 per household, region i,

G_i = real government-provided consumption per household, region i,

M = rate of national government income tax,

P = price of good 1 in terms of good 2,

J_i = real household income in region i,

ΠH_i = real profit distribution per household, region i,

W_i* = real wage income per household, region i,

U_i = unemployment rate, region i,

UB_i = real unemployment benefits per unemployed person, region i,

W_i, = real wage per worker, region i,

L_i = employment, in region i,

N_i = workforce (= population), region i,

Y_i = output of the representative firm, region i,

D_i = productivity parameter, region i,

F_i = the (exogenous) number of firms in region i,

ΠF_i = real profit pre firm, region i,

T_i = rate of payroll tax levied by the regional government, region i,

A_i = income workers expect to be able to obtain elsewhere, region i,

UB_i = unemployment benefits, region i,

W^e_i = expected wage, region i,

GR_i = amount of regional government good provided per household, region i,

GF_i =amount of national government output provided per household, region i,

N = national population.

Appendix 2: The linearised version of the model

The linearised form of the model is:

(1') $v_i = \gamma_{1i}c_{1i} + \gamma_{2i}c_{2i} + \delta_i g_i$ $i = 1,2$

where lower-case letters represent the proportional changes (log differentials) of their upper-case counterparts.

(2') $c_{ji} = -\sigma_m m + j_i + (j-i)p,$ $i, j = 1,2$

where $\sigma_m = M/(1-M)$

(3') $j_i = \sigma_{j\pi hi}\pi h_i + (\sigma_{jubi} - \sigma_{juwi}\sigma_{ui})u_i + \sigma_{juwi}w_i + \sigma_{jubi}ub_i,$ $i = 1,2$

where $\sigma_{j\pi hi} = \Pi H_i/J_i$, $\sigma_{uwi} = W_i(1-U_i)/J_i$, $\sigma_{jubi} = U_iUB_i/J_i$, $\sigma_{ui} = U_i/(1-U_i)$

(4') $u_i = (1/\sigma_{ui})(n_i-l_i)$ $i = 1,2$

(5') $v_1 = v_2$

(6') $y_i = d_i + \alpha_i(l_i - f_i),$ $i = 1,2$

(7') $\pi f_i = \sigma_{\pi fyi}\, y_i - \sigma_{\pi fwi}(\sigma_{ti}t_i + l_i - f_i + w_i),$ $i = 1,2$

(8') $d_i + (\alpha_i-1)(l_i - f_i) = w_i + \sigma_{ti}t_i,$ $i = 1,2$

(9') $w_i - \sigma_{wwubi}w_i + \sigma_{ubwubi}ub_i - u_i = 0,$ $i = 1,2$

where $\sigma_{wwubi} = W_i/(W_i-UB_i)$, $\sigma_{ubwubi} = UB_i/(W_i-UB_i)$

(10') $(\sigma_{ui} + \sigma_{grubi})u_i + w_i + t_i - \sigma_{grgri}gr_i - \sigma_{grubi}ub_i = 0,$ $i = 1,2$

where $\sigma_{grgri} = GR_i/(GR_i+U_iUB_i)$, $\sigma_{grubi} = U_iUB_i/(GR_i+U_iUB_i)$, $i = 1,2$

(11') $g_i = \sigma_{max1i}c_{1i} + \sigma_{max2i}c_{2i},$ $i = 1,2$

where $\sigma_{maxji} = (-\gamma_{ji}(\partial C_{ji}/\partial T_i)/C_{ji})/(-\gamma_{1i}(\partial C_{1i}/\partial T_i)/C_{1i}-\gamma_{2i}(\partial C_{2i}/\partial T_i)/C_{2i})$

(12') $(\sigma_{gf1}-\sigma_{j1})n_1 + (\sigma_{gf2}-\sigma_{j2})n_2 + \sigma_{gf1}gf_1 + \sigma_{gf2}gf_2 - m - \sigma_{j1}j_1 - \sigma_{j2}j_2 = 0,$

(13') $g_i = \sigma_{ggri}gr_i + \sigma_{ggfi}gf_i$ $i = 1,2$

where $\sigma_{ggri} = GR_i/G_i$, $\sigma_{ggfi} = GF_i/G_i$.

(14') $\sigma_{n1} + \sigma_{n2} = n,$

where $\sigma_{ni} = N_i/N$

(15') $f_i + \pi f_i - n_i - \pi h_i = 0$

(16') $f_i + y_i = \sigma_{yci1}(n_1 + c_{i1}) + \sigma_{yci2}(n_2 + c_{i2}) + \sigma_{ygri}(n_i + gr_i) + \sigma_{ymji}(n_i + j_i + m),$

$i = 1,2$

where $\sigma_{ycij}=N_jC_{ij}/F_iY_i$, $\sigma_{ygri}=N_iGR_i/F_iY_i$, $\sigma_{ymji}=N_iMJ_i/F_iY_i$

(17') $c_{21} = p + c_{12}$

Equations (1´)-(10'), (12')-(17´) constitute a linear system of 30 equation in the 28 endogenous variables: v_i, c_{ij}, g_i, πh_i, πf_i, u_i, w_i, l_i, n_i, p, y_i, j_i, t_i and m and the exogenous variables gr_i and gf_i, ub_i, f_i, d_i and n. Two equations are redundant and we drop equations (16').

When maximising regional governments are added to the model the two equations (11') are added to the 30 above and the gr_i become endogenous.

Appendix 3: Data-Base

	Total corresponding to						
	C ($m)	GR ($m)	LW ($m)	GF ($m)	W ($'000)	L ('000)	Y/L ($'000)
Region 1 NSW	112265.4	20189.8	92160.8	-192.3	32.8618	2804.5	47.2295
Region 2 ROC	195152.8	36096.6	15227.8	192.3	29.0498	5343.5	43.2768
Nation	307418.2	56286.4	247388.6	0.0	30.3619	8148	44.6373
Region 1 Vic	80040.8	13545.4	65680.6	-686.9	31.3078	2097.9	44.6095
Region 2 ROC	227377.4	42741	181708	686.9	30.0339	6050.1	44.6469
Nation	307418.2	56286.4	247388.6	0.0	30.3619	8148	44.6373
Region 1 Qld	55026	9662.6	42041.6	-83.3	27.2096	1545.1	41.8669
Region 2 ROC	252392.2	46623.8	205347	83.3	31.0995	6602.9	45.2856
Nation	307418.2	56286.4	247388.6	0.0	30.3619	8148	44.6373
Region 1 SA	23339.2	4906.8	18088.6	826.0	27.7773	651.2	43.3753
Region 2 ROC	284079	51379.6	229300	-826.0	30.5864	7496.8	44.7469
Nation	307418.2	56286.4	247388.6	0.0	30.3619	8148	44.6373
Region 1 WA	29616	6259.6	24236.8	-383.0	28.4236	852.7	42.0729
Region 2 ROC	277802.2	50026.8	223151.8	383.0	30.5884	7295.3	44.9370
Nation	307418.2	56286.4	247388.6	0.0	30.3619	8148	44.6373
Region 1 Tas	7130.8	1722.2	5180.2	519.4	26.3489	196.6	45.0305
Region 2 ROC	300287.4	54564.2	242208.4	-519.4	30.4611	7951.4	44.6276
Nation	307418.2	56286.4	247388.6	0.0	30.3619	8148	44.6373

Sources: C_i, L_i, LW_i and GR_i are from ABS times series averaged over the period 1994/95 - 1998/99. Time-series data on interstate imports are not reported by the ABS so that in each case C_{11} was set at 80% of C_1 and C_{21} at 20% of C_1. C_{12} was then chosen to ensure a zero balance of trade in the initial equilibrium and C_{22} was chosen as $C_2 - C_{12}$. GF_i is computed as L_i (MGF_i/L_i - MGF/L) where MGF_i is final consumption expenditure by the national government plus grants to state i. All other data are calculated from these figures to ensure that the model constraints hold: $L = L_1 + L_2$, $W_i = W_iL_i/L_i$, $Y_i = GR_i + C_i$, $G_i = GR_i+GF_i$, $T_i = GR_i/W_iL_i$. It should be noted that, as the model excludes investment and net overseas exports, Y_i will not conform with official figures. P_i was set at 1 for each i in the initial equilibrium.

Appendix 4: Full Simulation Results

Table A4.11 Question 1, version 1: n_1=n_2=1; endogenous: t_1, t_2, m; exogenous: gr_1, gr_2, gf_1, gf_2

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.2465	-0.2596	-0.2468	-0.2607	-0.2725	-0.2615	-0.2955	-0.2629	-0.2192	-0.2609	-0.3153	-0.2641
v_2	-0.2679	-0.2596	-0.2664	-0.2607	-0.2590	-0.2615	-0.2608	-0.2629	-0.2684	-0.2609	-0.2633	-0.2641
c_{11}	-0.3029	-0.3274	-0.3053	-0.3299	-0.3565	-0.3376	-0.3992	-0.3452	-0.2717	-0.3426	-0.4426	-0.3568
c_{21}	-0.3502	-0.3349	-0.3446	-0.3349	-0.3297	-0.3339	-0.3321	-0.3357	-0.3442	-0.3329	-0.3361	-0.3375
c_{12}	-0.3029	-0.3274	-0.3053	-0.3299	-0.3565	-0.3376	-0.3992	-0.3452	-0.2717	-0.3426	-0.4426	-0.3568
c_{22}	-0.3502	-0.3349	-0.3446	-0.3349	-0.3297	-0.3339	-0.3321	-0.3357	-0.3442	-0.3329	-0.3361	-0.3375
j_1	-0.2729	-0.2977	-0.2752	-0.2998	-0.3264	-0.3075	-0.3689	-0.3150	-0.2413	-0.3126	-0.4121	-0.3264
j_2	-0.3202	-0.3051	-0.3145	-0.3048	-0.2996	-0.3038	-0.3017	-0.3055	-0.3138	-0.3029	-0.3056	-0.3071
πh_1	-0.2669	-0.2911	-0.2720	-0.2963	-0.3133	-0.2953	-0.3352	-0.2862	-0.2529	-0.3277	-0.3660	-0.2899
πh_2	-0.3070	-0.2925	-0.3012	-0.2920	-0.2893	-0.2933	-0.2926	-0.2962	-0.3009	-0.2905	-0.2951	-0.2965
w_1	-0.2696	-0.2941	-0.2703	-0.2945	-0.3218	-0.3033	-0.3754	-0.3205	-0.2320	-0.3006	-0.4238	-0.3357
w_2	-0.3033	-0.2890	-0.2986	-0.2894	-0.2844	-0.2884	-0.2854	-0.2890	-0.2980	-0.2877	-0.2896	-0.2910
u_1	0.1288	0.1405	0.1372	0.1495	0.2105	0.1983	0.2549	0.2177	0.1343	0.1740	0.3181	0.2519
u_2	0.4796	0.4570	0.4638	0.4495	0.4320	0.4381	0.4372	0.4426	0.4580	0.4421	0.4452	0.4474
l_1	0.9919	1.0819	0.9909	1.0796	0.9828	0.9260	0.9802	0.8370	0.9909	1.2839	0.9697	0.7681
l_2	0.9648	0.9192	0.9670	0.9373	0.9710	0.9847	0.9697	0.9818	0.9679	0.9344	0.9691	0.9739
n_1	1.0000	1.0907	1.0000	1.0895	1.0000	0.9423	1.0000	0.8539	1.0000	1.2957	1.0000	0.7921
n_2	1.0000	0.9528	1.0000	0.9692	1.0000	1.0141	1.0000	1.0124	1.0000	0.9654	1.0000	1.0049
y_1	0.7769	0.8474	0.7757	0.8452	0.7396	0.6969	0.7056	0.6025	0.8135	1.0541	0.6779	0.5370
y_2	0.7425	0.7074	0.7462	0.7232	0.7568	0.7675	0.7555	0.7649	0.7449	0.7191	0.7523	0.7561
t_1	0.2890	0.3152	0.2927	0.3189	0.3637	0.3427	0.4205	0.3591	0.2532	0.3280	0.4892	0.3875
t_2	0.3876	0.3693	0.3767	0.3651	0.3533	0.3582	0.3580	0.3625	0.3751	0.3621	0.3635	0.3653
m	0.3029	0.3004	0.3042	0.3038	0.3044	0.3038	0.3067	0.3056	0.3070	0.3024	0.3079	0.3068
n	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
p	-0.0473	-0.0075	-0.0393	-0.0050	0.0268	0.0038	0.0671	0.0095	-0.0725	0.0097	0.1065	0.0193
α_1	0.7833		0.7829		0.7526		0.7198		0.8210		0.6991	
α_2	0.7696		0.7716		0.7794		0.7791		0.7696		0.7763	

Table A4.12 Question 1, version 2: $n_1=n_2=1$; exogenous: m, gr_1, gr_2; endogenous: $gf_1=gf_2=gf$, t_1, t_2

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.2580	-0.2722	-0.2557	-0.2693	-0.2794	-0.2669	-0.2986	-0.2649	-0.2203	-0.2631	-0.3195	-0.2647
v_2	-0.2814	-0.2722	-0.2748	-0.2693	-0.2642	-0.2669	-0.2628	-0.2649	-0.2709	-0.2631	-0.2639	-0.2647
c_{11}	-0.2729	-0.3000	-0.2752	-0.2991	-0.3264	-0.3052	-0.3689	-0.3130	-0.2413	-0.3146	-0.4121	-0.3202
c_{21}	-0.3202	-0.3037	-0.3145	-0.3051	-0.2996	-0.3043	-0.3017	-0.3056	-0.3138	-0.3027	-0.3056	-0.3072
c_{12}	-0.2729	-0.3000	-0.2752	-0.2991	-0.3264	-0.3052	-0.3689	-0.3130	-0.2413	-0.3146	-0.4121	-0.3202
c_{22}	-0.3202	-0.3037	-0.3145	-0.3051	-0.2996	-0.3043	-0.3017	-0.3056	-0.3138	-0.3027	-0.3056	-0.3072
g_1	-0.1668	-0.1653	-0.1540	-0.1539	-0.1352	-0.1349	-0.1129	-0.1125	-0.1042	-0.1026	-0.1077	-0.1073
g_2	-0.1652	-0.1638	-0.1444	-0.1442	-0.1324	-0.1322	-0.1184	-0.1180	-0.1213	-0.1195	-0.1121	-0.1116
j_1	-0.2729	-0.3000	-0.2752	-0.2991	-0.3264	-0.3052	-0.3689	-0.3130	-0.2413	-0.3146	-0.4121	-0.3202
j_2	-0.3202	-0.3037	-0.3145	-0.3051	-0.2996	-0.3043	-0.3017	-0.3056	-0.3138	-0.3027	-0.3056	-0.3072
πh_1	-0.2669	-0.2933	-0.2720	-0.2956	-0.3133	-0.2930	-0.3352	-0.2845	-0.2529	-0.3297	-0.3660	-0.2844
πh_2	-0.3070	-0.2912	-0.3012	-0.2922	-0.2893	-0.2939	-0.2926	-0.2963	-0.3009	-0.2902	-0.2951	-0.2966
w_1	-0.2696	-0.2964	-0.2703	-0.2938	-0.3218	-0.3010	-0.3754	-0.3185	-0.2320	-0.3025	-0.4238	-0.3293
w_2	-0.3033	-0.2877	-0.2986	-0.2896	-0.2844	-0.2888	-0.2854	-0.2891	-0.2980	-0.2874	-0.2896	-0.2911
u_1	0.1288	0.1416	0.1372	0.1491	0.2105	0.1968	0.2549	0.2163	0.1343	0.1751	0.3181	0.2472
u_2	0.4796	0.4549	0.4638	0.4499	0.4320	0.4389	0.4372	0.4428	0.4580	0.4417	0.4452	0.4476
l_1	0.9919	1.0903	0.9909	1.0771	0.9828	0.9190	0.9802	0.8319	0.9909	1.2920	0.9697	0.7536
l_2	0.9648	0.9150	0.9670	0.9381	0.9710	0.9864	0.9697	0.9822	0.9679	0.9335	0.9691	0.9743
n_1	1.0000	1.0992	1.0000	1.0870	1.0000	0.9351	1.0000	0.8487	1.0000	1.3038	1.0000	0.7771
n_2	1.0000	0.9484	1.0000	0.9701	1.0000	1.0158	1.0000	1.0128	1.0000	0.9645	1.0000	1.0053
y_1	0.7769	0.8540	0.7757	0.8432	0.7396	0.6916	0.7056	0.5988	0.8135	1.0607	0.6779	0.5268
y_2	0.7425	0.7042	0.7462	0.7239	0.7568	0.7688	0.7555	0.7652	0.7449	0.7184	0.7523	0.7563
gf	-0.4677	-0.4636	-0.4142	-0.4138	-0.3751	-0.3743	-0.3328	-0.3316	-0.3373	-0.3321	-0.3159	-0.3147
t_1	0.2890	0.3176	0.2927	0.3181	0.3637	0.3401	0.4205	0.3569	0.2532	0.3301	0.4892	0.3802
t_2	0.3876	0.3676	0.3767	0.3654	0.3533	0.3588	0.3580	0.3626	0.3751	0.3617	0.3635	0.3655
p	-0.0473	-0.0037	-0.0393	-0.0060	0.0268	0.0009	0.0671	0.0074	-0.0725	0.0119	0.1065	0.0130

Table A4.13 Question 1, version 3: n_1=n_2=1, exogenous: t_1, t_2, m; endogenous: gr_1, gr_2, gf_1, gf_2 with gf1=gf2=gf

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.2503	-0.2647	-0.2487	-0.2627	-0.2754	-0.2618	-0.2970	-0.2590	-0.2151	-0.2571	-0.3187	-0.2593
v_2	-0.2737	-0.2647	-0.2681	-0.2627	-0.2589	-0.2618	-0.2566	-0.2590	-0.2643	-0.2571	-0.2584	-0.2593
c_{11}	-0.2319	-0.2532	-0.2338	-0.2533	-0.2702	-0.2523	-0.3013	-0.2526	-0.1982	-0.2536	-0.3272	-0.2522
c_{21}	-0.2581	-0.2457	-0.2547	-0.2474	-0.2450	-0.2489	-0.2463	-0.2497	-0.2562	-0.2478	-0.2492	-0.2505
c_{12}	-0.2319	-0.2532	-0.2338	-0.2533	-0.2702	-0.2523	-0.3013	-0.2526	-0.1982	-0.2536	-0.3272	-0.2522
c_{22}	-0.2581	-0.2457	-0.2547	-0.2474	-0.2450	-0.2489	-0.2463	-0.2497	-0.2562	-0.2478	-0.2492	-0.2505
g_1	-0.2995	-0.3134	-0.2884	-0.3020	-0.3107	-0.2972	-0.3192	-0.2821	-0.2324	-0.2722	-0.3397	-0.2815
g_2	-0.3388	-0.3280	-0.3209	-0.3151	-0.3050	-0.3079	-0.2904	-0.2926	-0.2981	-0.2901	-0.2903	-0.2909
j_1	-0.2319	-0.2532	-0.2338	-0.2533	-0.2702	-0.2523	-0.3013	-0.2526	-0.1982	-0.2536	-0.3272	-0.2522
j_2	-0.2581	-0.2457	-0.2547	-0.2474	-0.2450	-0.2489	-0.2463	-0.2497	-0.2562	-0.2478	-0.2492	-0.2505
πh_1	-0.2656	-0.2901	-0.2706	-0.2932	-0.3104	-0.2899	-0.3316	-0.2780	-0.2513	-0.3215	-0.3600	-0.2774
πh_2	-0.3004	-0.2861	-0.2952	-0.2867	-0.2842	-0.2888	-0.2872	-0.2911	-0.2952	-0.2856	-0.2895	-0.2911
w_1	-0.2153	-0.2351	-0.2155	-0.2335	-0.2442	-0.2280	-0.2761	-0.2315	-0.1778	-0.2274	-0.2945	-0.2270
w_2	-0.2244	-0.2137	-0.2228	-0.2164	-0.2158	-0.2192	-0.2159	-0.2188	-0.2248	-0.2175	-0.2185	-0.2197
u_1	0.1028	0.1123	0.1094	0.1185	0.1597	0.1491	0.1875	0.1572	0.1029	0.1317	0.2211	0.1704
u_2	0.3549	0.3379	0.3460	0.3361	0.3278	0.3331	0.3307	0.3352	0.3455	0.3342	0.3359	0.3377
l_1	0.9935	1.0849	0.9927	1.0754	0.9869	0.9215	0.9855	0.8262	0.9931	1.2703	0.9789	0.7545
l_2	0.9739	0.9273	0.9754	0.9475	0.9780	0.9938	0.9771	0.9905	0.9758	0.9439	0.9767	0.9820
n_1	1.0000	1.0920	1.0000	1.0833	1.0000	0.9337	1.0000	0.8384	1.0000	1.2792	1.0000	0.7707
n_2	1.0000	0.9522	1.0000	0.9713	1.0000	1.0161	1.0000	1.0137	1.0000	0.9673	1.0000	1.0054
y_1	0.7782	0.8498	0.7772	0.8419	0.7428	0.6935	0.7094	0.5947	0.8153	1.0429	0.6844	0.5275
y_2	0.7495	0.7136	0.7527	0.7311	0.7623	0.7746	0.7612	0.7717	0.7510	0.7264	0.7582	0.7624
gr_1	-0.2529	-0.2761	-0.2583	-0.2798	-0.3126	-0.2919	-0.3436	-0.2880	-0.2131	-0.2726	-0.3823	-0.2946
gr_2	-0.3142	-0.2992	-0.3110	-0.3021	-0.3036	-0.3085	-0.3008	-0.3049	-0.3109	-0.3007	-0.3084	-0.3100
gf_1	-0.3837	-0.3806	-0.3394	-0.3394	-0.3075	-0.3066	-0.2717	-0.2705	-0.2755	-0.2714	-0.2573	-0.2562
p	-0.0262	0.0075	-0.0209	0.0059	0.0253	0.0034	0.0550	0.0029	-0.0579	0.0058	0.0781	0.0017

Table A4.21 Question 2 version 1: $n_1=1/\sigma_1$, $n_2=0$; endogenous: m, t_1, t_2; exogenous: gr_1, gr_2, gf_1, gf_2

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.5233	-0.2596	-0.7007	-0.2607	-1.0613	-0.2615	-2.9202	-0.2629	-1.4246	-0.2609	-10.6874	-0.2641
v_2	-0.0911	-0.2596	-0.0824	-0.2607	-0.0839	-0.2615	-0.0906	-0.2629	-0.0511	-0.2609	-0.1033	-0.2641
c_{11}	-0.8225	-0.3274	-1.1044	-0.3299	-1.7008	-0.3376	-4.7564	-0.3452	-2.3207	-0.3426	-17.8388	-0.3568
c_{21}	-0.0249	-0.3349	-0.0291	-0.3349	-0.0341	-0.3339	-0.0395	-0.3357	-0.0174	-0.3329	-0.0530	-0.3375
c_{12}	-0.8225	-0.3274	-1.1044	-0.3299	-1.7008	-0.3376	-4.7564	-0.3452	-2.3207	-0.3426	-17.8388	-0.3568
c_{22}	-0.0249	-0.3349	-0.0291	-0.3349	-0.0341	-0.3339	-0.0395	-0.3357	-0.0174	-0.3329	-0.0530	-0.3375
j_1	-0.7977	-0.2977	-1.0753	-0.2998	-1.6667	-0.3075	-4.7169	-0.3150	-2.3034	-0.3126	-17.7859	-0.3264
j_2	0.0000	-0.3051	0.0000	-0.3048	0.0000	-0.3038	0.0000	-0.3055	0.0000	-0.3029	0.0000	-0.3071
πh_1	-0.7800	-0.2911	-1.0627	-0.2963	-1.6001	-0.2953	-4.2864	-0.2862	-2.4143	-0.3277	-15.7978	-0.2899
πh_2	0.0000	-0.2925	0.0000	-0.2920	0.0000	-0.2933	0.0000	-0.2962	0.0000	-0.2905	0.0000	-0.2965
w_1	-0.7880	-0.2941	-1.0562	-0.2945	-1.6435	-0.3033	-4.8001	-0.3205	-2.2150	-0.3006	-18.2917	-0.3357
w_2	0.0000	-0.2890	0.0000	-0.2894	0.0000	-0.2884	0.0000	-0.2890	0.0000	-0.2877	0.0000	-0.2910
u_1	0.3764	0.1405	0.5360	0.1495	1.0747	0.1983	3.2596	0.2177	1.2822	0.1740	13.7279	0.2519
u_2	0.0000	0.4570	0.0000	0.4495	0.0000	0.4381	0.0000	0.4426	0.0000	0.4421	0.0000	0.4474
l_1	2.8990	1.0819	3.8717	1.0796	5.0188	0.9260	12.5353	0.8370	9.4603	1.2839	41.8552	0.7681
l_2	0.0000	0.9192	0.0000	0.9373	0.0000	0.9847	0.0000	0.9818	0.0000	0.9344	0.0000	0.9739
n_1	2.9228	1.0907	3.9074	1.0895	5.1067	0.9423	12.7883	0.8539	9.5468	1.2957	43.1632	0.7921
n_2	0.0000	0.9528	0.0000	0.9692	0.0000	1.0141	0.0000	1.0124	0.0000	0.9654	0.0000	1.0049
y_1	2.2708	0.8474	3.0311	0.8452	3.7771	0.6969	9.0234	0.6025	7.7666	1.0541	29.2620	0.5370
y_2	0.0000	0.7074	0.0000	0.7232	0.0000	0.7675	0.0000	0.7649	0.0000	0.7191	0.0000	0.7561
t_1	0.8446	0.3152	1.1436	0.3189	1.8575	0.3427	5.3780	0.3591	2.4167	0.3280	21.1170	0.3875
t_2	0.0000	0.3693	0.0000	0.3651	0.0000	0.3582	0.0000	0.3625	0.0000	0.3621	0.0000	0.3653
m	0.2510	0.3004	0.2936	0.3038	0.3446	0.3038	0.3982	0.3056	0.1751	0.3024	0.5347	0.3068
n	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
p	0.7977	-0.0075	1.0753	-0.0050	1.6667	0.0038	4.7169	0.0095	2.3034	0.0097	17.7859	0.0193

Table A4.22 Question 2, version 2: $n_1=1/\sigma_1$, $n_2=0$; exogenous: m, gr_1, gr_2; endogenous: t_1, t_2, gf_1, gf_2 with $gf_1=gf_2=gf$

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.5328	-0.2722	-0.7093	-0.2693	-1.0691	-0.2669	-2.9243	-0.2649	-1.4252	-0.2631	-10.6949	-0.2647
v_2	-0.1022	-0.2722	-0.0905	-0.2693	-0.0897	-0.2669	-0.0931	-0.2649	-0.0526	-0.2631	-0.1042	-0.2647
c_{11}	-0.7977	-0.3000	-1.0753	-0.2991	-1.6667	-0.3052	-4.7169	-0.3130	-2.3034	-0.3146	-17.7859	-0.3202
c_{21}	0.0000	-0.3037	0.0000	-0.3051	0.0000	-0.3043	0.0000	-0.3056	0.0000	-0.3027	0.0000	-0.3072
c_{12}	-0.7977	-0.3000	-1.0753	-0.2991	-1.6667	-0.3052	-4.7169	-0.3130	-2.3034	-0.3146	-17.7859	-0.3202
c_{22}	0.0000	-0.3037	0.0000	-0.3051	0.0000	-0.3043	0.0000	-0.3056	0.0000	-0.3027	0.0000	-0.3072
g_1	-0.1382	-0.1653	-0.1486	-0.1539	-0.1530	-0.1349	-0.1466	-0.1125	-0.0595	-0.1026	-0.1870	-0.1073
g_2	-0.1369	-0.1638	-0.1393	-0.1442	-0.1499	-0.1322	-0.1537	-0.1180	-0.0692	-0.1195	-0.1946	-0.1116
j_1	-0.7977	-0.3000	-1.0753	-0.2991	-1.6667	-0.3052	-4.7169	-0.3130	-2.3034	-0.3146	-17.7859	-0.3202
j_2	0.0000	-0.3037	0.0000	-0.3051	0.0000	-0.3043	0.0000	-0.3056	0.0000	-0.3027	0.0000	-0.3072
πh_1	-0.7800	-0.2933	-1.0627	-0.2956	-1.6001	-0.2930	-4.2864	-0.2845	-2.4143	-0.3297	-15.7978	-0.2844
πh_2	0.0000	-0.2912	0.0000	-0.2922	0.0000	-0.2939	0.0000	-0.2963	0.0000	-0.2902	0.0000	-0.2966
w_1	-0.7880	-0.2964	-1.0562	-0.2938	-1.6435	-0.3010	-4.8001	-0.3185	-2.2150	-0.3025	-18.2917	-0.3293
w_2	0.0000	-0.2877	0.0000	-0.2896	0.0000	-0.2888	0.0000	-0.2891	0.0000	-0.2874	0.0000	-0.2911
u_1	0.3764	0.1416	0.5360	0.1491	1.0747	0.1968	3.2596	0.2163	1.2822	0.1751	13.7279	0.2472
u_2	0.0000	0.4549	0.0000	0.4499	0.0000	0.4389	0.0000	0.4428	0.0000	0.4417	0.0000	0.4476
l_1	2.8990	1.0903	3.8717	1.0771	5.0188	0.9190	12.5353	0.8319	9.4603	1.2920	41.8552	0.7536
l_2	0.0000	0.9150	0.0000	0.9381	0.0000	0.9864	0.0000	0.9822	0.0000	0.9335	0.0000	0.9743
n_1	2.9228	1.0992	3.9074	1.0870	5.1067	0.9351	12.7883	0.8487	9.5468	1.3038	43.1632	0.7771
n_2	0.0000	0.9484	0.0000	0.9701	0.0000	1.0158	0.0000	1.0128	0.0000	0.9645	0.0000	1.0053
y_1	2.2708	0.8540	3.0311	0.8432	3.7771	0.6916	9.0234	0.5988	7.7666	1.0607	29.2620	0.5268
y_2	0.0000	0.7042	0.0000	0.7239	0.0000	0.7688	0.0000	0.7652	0.0000	0.7184	0.0000	0.7563
gf	-0.3876	-0.4636	-0.3998	-0.4138	-0.4246	-0.3743	-0.4321	-0.3316	-0.1924	-0.3321	-0.5485	-0.3147
t_1	0.8446	0.3176	1.1436	0.3181	1.8575	0.3401	5.3780	0.3569	2.4167	0.3301	21.1170	0.3802
t_2	0.0000	0.3676	0.0000	0.3654	0.0000	0.3588	0.0000	0.3626	0.0000	0.3617	0.0000	0.3655
p	0.7977	-0.0037	1.0753	-0.0060	1.6667	0.0009	4.7169	0.0074	2.3034	0.0119	17.7859	0.0130

Table A4.23 Question 2, version 3: $n_1=1/\sigma_1$, $n_2=0$; exogenous: t_1, t_2, m; endogenous: gr_1, gr_2, gf_1, gf_2 with $gf_1=gf_2=gf$

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.5522	-0.2647	-0.7372	-0.2627	-1.1146	-0.2618	-3.0687	-0.2590	-1.4996	-0.2571	-11.2319	-0.2593
v_2	-0.0861	-0.2647	-0.0771	-0.2627	-0.0750	-0.2618	-0.0768	-0.2590	-0.0425	-0.2571	-0.0852	-0.2593
c_{11}	-0.6778	-0.2532	-0.9135	-0.2533	-1.3800	-0.2523	-3.8525	-0.2526	-1.8926	-0.2536	-14.1235	-0.2522
c_{21}	0.0000	-0.2457	0.0000	-0.2474	0.0000	-0.2489	0.0000	-0.2497	0.0000	-0.2478	0.0000	-0.2505
c_{12}	-0.6778	-0.2532	-0.9135	-0.2533	-1.3800	-0.2523	-3.8525	-0.2526	-1.8926	-0.2536	-14.1235	-0.2522
c_{22}	0.0000	-0.2457	0.0000	-0.2474	0.0000	-0.2489	0.0000	-0.2497	0.0000	-0.2478	0.0000	-0.2505
g_1	-0.5895	-0.3134	-0.7610	-0.3020	-1.1512	-0.2972	-3.0254	-0.2821	-1.4523	-0.2722	-11.0329	-0.2815
g_2	-0.1130	-0.3280	-0.1191	-0.3151	-0.1275	-0.3079	-0.1287	-0.2926	-0.0539	-0.2901	-0.1656	-0.2909
j_1	-0.6778	-0.2532	-0.9135	-0.2533	-1.3800	-0.2523	-3.8525	-0.2526	-1.8926	-0.2536	-14.1235	-0.2522
j_2	0.0000	-0.2457	0.0000	-0.2474	0.0000	-0.2489	0.0000	-0.2497	0.0000	-0.2478	0.0000	-0.2505
πh_1	-0.7764	-0.2901	-1.0574	-0.2932	-1.5853	-0.2899	-4.2410	-0.2780	-2.3990	-0.3215	-15.5370	-0.2774
πh_2	0.0000	-0.2861	0.0000	-0.2867	0.0000	-0.2888	0.0000	-0.2911	0.0000	-0.2856	0.0000	-0.2911
w_1	-0.6293	-0.2351	-0.8422	-0.2335	-1.2469	-0.2280	-3.5306	-0.2315	-1.6973	-0.2274	-12.7133	-0.2270
w_2	0.0000	-0.2137	0.0000	-0.2164	0.0000	-0.2192	0.0000	-0.2188	0.0000	-0.2175	0.0000	-0.2197
u_1	0.3006	0.1123	0.4274	0.1185	0.8153	0.1491	2.3975	0.1572	0.9825	0.1317	9.5413	0.1704
u_2	0.0000	0.3379	0.0000	0.3361	0.0000	0.3331	0.0000	0.3352	0.0000	0.3342	0.0000	0.3377
l_1	2.9038	1.0849	3.8790	1.0754	5.0400	0.9215	12.6022	0.8262	9.4805	1.2703	42.2541	0.7545
l_2	0.0000	0.9273	0.0000	0.9475	0.0000	0.9938	0.0000	0.9905	0.0000	0.9439	0.0000	0.9820
n_1	2.9228	1.0920	3.9074	1.0833	5.1067	0.9337	12.7883	0.8384	9.5468	1.2792	43.1632	0.7707
n_2	0.0000	0.9522	0.0000	0.9713	0.0000	1.0161	0.0000	1.0137	0.0000	0.9673	0.0000	1.0054
y_1	2.2745	0.8498	3.0367	0.8419	3.7931	0.6935	9.0716	0.5947	7.7832	1.0429	29.5408	0.5275
y_2	0.0000	0.7136	0.0000	0.7311	0.0000	0.7746	0.0000	0.7717	0.0000	0.7264	0.0000	0.7624
gr_1	-0.7391	-0.2761	-1.0091	-0.2798	-1.5963	-0.2919	-4.3935	-0.2880	-2.0347	-0.2726	-16.5008	-0.2946
gr_2	0.0000	-0.2992	0.0000	-0.3021	0.0000	-0.3085	0.0000	-0.3049	0.0000	-0.3007	0.0000	-0.3100
gf_1	-0.3198	-0.3806	-0.3418	-0.3394	-0.3611	-0.3066	-0.3618	-0.2705	-0.1499	-0.2714	-0.4668	-0.2562
p	0.6778	0.0075	0.9135	0.0059	1.3800	0.0034	3.8525	0.0029	1.8926	0.0058	14.1235	0.0017

Table A4.31 Question 3 version 1: $n_1=1/\sigma_1$, $gr_1=1$; endogenous: m, t_1, t_2, m; exogenous: gr_1, gr_2, gf_1, gf_2

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.4947	-0.2602	-0.6718	-0.2611	-1.0321	-0.2632	-2.8872	-0.2643	-1.3880	-0.2593	-10.6548	-0.2647
v_2	-0.1102	-0.2602	-0.0946	-0.2611	-0.0925	-0.2632	-0.0943	-0.2643	-0.0559	-0.2593	-0.1045	-0.2647
c_{11}	-0.9906	-0.5502	-1.2689	-0.5459	-1.8836	-0.5732	-4.9546	-0.6006	-2.5245	-0.6060	-18.0613	-0.6350
c_{21}	-0.0308	-0.3066	-0.0333	-0.3188	-0.0373	-0.3254	-0.0409	-0.3334	-0.0192	-0.3253	-0.0535	-0.3371
c_{12}	-0.9906	-0.5502	-1.2689	-0.5459	-1.8836	-0.5732	-4.9546	-0.6006	-2.5245	-0.6060	-18.0613	-0.6350
c_{22}	-0.0308	-0.3066	-0.0333	-0.3188	-0.0373	-0.3254	-0.0409	-0.3334	-0.0192	-0.3253	-0.0535	-0.3371
g_1	0.6433	0.6433	0.6282	0.6282	0.6397	0.6397	0.6607	0.6607	0.6910	0.6910	0.6590	0.6590
j_1	-0.9598	-0.5150	-1.2357	-0.5117	-1.8462	-0.5398	-4.9137	-0.5687	-2.5053	-0.5745	-18.0078	-0.6040
j_2	0.0000	-0.2714	0.0000	-0.2846	0.0000	-0.2920	0.0000	-0.3015	0.0000	-0.2938	0.0000	-0.3061
πh_1	-0.7847	-0.3498	-1.0679	-0.3525	-1.6094	-0.3551	-4.2967	-0.3484	-2.4218	-0.3980	-15.8136	-0.3552
πh_2	0.0000	-0.2602	0.0000	-0.2726	0.0000	-0.2820	0.0000	-0.2924	0.0000	-0.2818	0.0000	-0.2956
w_1	-1.0027	-0.5633	-1.2683	-0.5572	-1.8920	-0.6037	-5.0890	-0.6675	-2.4695	-0.6128	-18.6298	-0.7310
w_2	0.0000	-0.2571	0.0000	-0.2702	0.0000	-0.2772	0.0000	-0.2852	0.0000	-0.2790	0.0000	-0.2901
u_1	0.4789	0.2691	0.6437	0.2828	1.2372	0.3947	3.4558	0.4533	1.4295	0.3547	13.9816	0.5486
u_2	0.0000	0.4065	0.0000	0.4197	0.0000	0.4211	0.0000	0.4369	0.0000	0.4288	0.0000	0.4460
l_1	2.8926	1.2760	3.8646	1.2579	5.0055	1.0714	12.5201	0.9733	9.4504	1.5204	41.8311	0.8750
l_2	0.0000	0.8178	0.0000	0.8750	0.0000	0.9465	0.0000	0.9690	0.0000	0.9062	0.0000	0.9708
n_1	2.9228	1.2930	3.9074	1.2767	5.1067	1.1037	12.7883	1.0085	9.5468	1.5443	43.1632	0.9272
n_2	0.0000	0.8476	0.0000	0.9048	0.0000	0.9748	0.0000	0.9993	0.0000	0.9363	0.0000	1.0017
y_1	2.2657	0.9995	3.0255	0.9848	3.7671	0.8063	9.0125	0.7006	7.7585	1.2482	29.2451	0.6117
y_2	0.0000	0.6293	0.0000	0.6752	0.0000	0.7377	0.0000	0.7550	0.0000	0.6974	0.0000	0.7536
t_1	1.9874	1.5164	2.2768	1.5069	3.0211	1.5651	6.6020	1.6482	3.6045	1.5787	22.3967	1.7334
t_2	0.0000	0.3285	0.0000	0.3408	0.0000	0.3443	0.0000	0.3578	0.0000	0.3512	0.0000	0.3642
m	0.3105	0.3544	0.3357	0.3453	0.3768	0.3377	0.4129	0.3215	0.1941	0.3176	0.5395	0.3124
p	0.9598	0.2436	1.2357	0.2272	1.8462	0.2478	4.9137	0.2672	2.5053	0.2807	18.0078	0.2979

Table A4.32 Question 3, version 2: $n_1=1/\sigma_1$, $t_1=-1$; exogenous: t_1, t_2, m; endogenous: gr_1, gr_2, gf_1, gf_2 with $gf_1=gf_2=gf$

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.5752	-0.2618	-0.7616	-0.2611	-1.1391	-0.2597	-3.0956	-0.2578	-1.5304	-0.2581	-11.2573	-0.2588
v_2	-0.0670	-0.2618	-0.0653	-0.2611	-0.0671	-0.2597	-0.0737	-0.2578	-0.0384	-0.2581	-0.0843	-0.2588
c_{11}	-0.5359	-0.0730	-0.7720	-0.0756	-1.2257	-0.0628	-3.6917	-0.0559	-1.7226	-0.0443	-13.9501	-0.0460
c_{21}	0.0000	-0.2679	0.0000	-0.2610	0.0000	-0.2567	0.0000	-0.2522	0.0000	-0.2537	0.0000	-0.2511
c_{12}	-0.5359	-0.0730	-0.7720	-0.0756	-1.2257	-0.0628	-3.6917	-0.0559	-1.7226	-0.0443	-13.9501	-0.0460
c_{22}	0.0000	-0.2679	0.0000	-0.2610	0.0000	-0.2567	0.0000	-0.2522	0.0000	-0.2537	0.0000	-0.2511
g_1	-1.1238	-0.8228	-1.2965	-0.8123	-1.6886	-0.8080	-3.5607	-0.7900	-2.0286	-0.8203	-11.5465	-0.7697
g_2	-0.0846	-0.3190	-0.1015	-0.3082	-0.1154	-0.3014	-0.1241	-0.2896	-0.0476	-0.2895	-0.1642	-0.2899
j_1	-0.5359	-0.0730	-0.7720	-0.0756	-1.2257	-0.0628	-3.6917	-0.0559	-1.7226	-0.0443	-13.9501	-0.0460
j_2	0.0000	-0.2679	0.0000	-0.2610	0.0000	-0.2567	0.0000	-0.2522	0.0000	-0.2537	0.0000	-0.2511
πh_1	-0.7722	-0.2420	-1.0527	-0.2466	-1.5773	-0.2415	-4.2325	-0.2300	-2.3927	-0.2654	-15.5247	-0.2290
πh_2	0.0000	-0.3119	0.0000	-0.3024	0.0000	-0.2978	0.0000	-0.2940	0.0000	-0.2924	0.0000	-0.2918
w_1	-0.4414	-0.0116	-0.6550	-0.0130	-1.0334	0.0173	-3.2946	0.0376	-1.4830	0.0221	-12.4491	0.0667
w_2	0.0000	-0.2330	0.0000	-0.2282	0.0000	-0.2261	0.0000	-0.2210	0.0000	-0.2227	0.0000	-0.2202
u_1	0.2108	0.0056	0.3324	0.0066	0.6757	-0.0113	2.2373	-0.0255	0.8585	-0.0128	9.3431	-0.0500
u_2	0.0000	0.3684	0.0000	0.3545	0.0000	0.3435	0.0000	0.3385	0.0000	0.3422	0.0000	0.3385
l_1	2.9095	0.9263	3.8853	0.9282	5.0514	0.8045	12.6147	0.7209	9.4889	1.0819	42.2730	0.6753
l_2	0.0000	1.0111	0.0000	0.9994	0.0000	1.0248	0.0000	1.0004	0.0000	0.9665	0.0000	0.9844
n_1	2.9228	0.9266	3.9074	0.9286	5.1067	0.8036	12.7883	0.7190	9.5468	1.0811	43.1632	0.6706
n_2	0.0000	1.0382	0.0000	1.0246	0.0000	1.0478	0.0000	1.0238	0.0000	0.9905	0.0000	1.0078
y_1	2.2790	0.7255	3.0417	0.7266	3.8017	0.6055	9.0806	0.5190	7.7901	0.8882	29.5540	0.4721
y_2	0.0000	0.7781	0.0000	0.7712	0.0000	0.7987	0.0000	0.7794	0.0000	0.7438	0.0000	0.7642
gr_1	-1.6141	-1.1094	-1.8915	-1.1222	-2.4557	-1.1106	-5.2104	-1.0640	-2.8766	-1.0723	-17.2822	-1.0378
gr_2	0.0000	-0.3262	0.0000	-0.3186	0.0000	-0.3182	0.0000	-0.3080	0.0000	-0.3079	0.0000	-0.3108
gf_1	-0.2394	-0.3058	-0.2912	-0.2886	-0.3269	-0.2707	-0.3488	-0.2565	-0.1322	-0.2567	-0.4629	-0.2518
p	0.5359	-0.1950	0.7720	-0.1854	1.2257	-0.1938	3.6917	-0.1963	1.7226	-0.2094	13.9501	-0.2051

Table A4.41 Question 4: n_1=1/σ_1, gf_1=1; endogenous: m, t_1, t_2, m; exogenous: gr_1, gr_2, gf_1, gf_2

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.4756	-0.2576	-0.6425	-0.2586	-0.9952	-0.2614	-2.8467	-0.2642	-1.3591	-0.2568	-10.6035	-0.2648
v_2	-0.1182	-0.2576	-0.1030	-0.2586	-0.0985	-0.2614	-0.0967	-0.2642	-0.0581	-0.2568	-0.1053	-0.2648
c_{11}	-0.8574	-0.4480	-1.1307	-0.4548	-1.7195	-0.4690	-4.7641	-0.4771	-2.3296	-0.4559	-17.8413	-0.5012
c_{21}	-0.0598	-0.3162	-0.0554	-0.3223	-0.0528	-0.3278	-0.0472	-0.3352	-0.0263	-0.3252	-0.0555	-0.3377
c_{12}	-0.8574	-0.4480	-1.1307	-0.4548	-1.7195	-0.4690	-4.7641	-0.4771	-2.3296	-0.4559	-17.8413	-0.5012
c_{22}	-0.0598	-0.3162	-0.0554	-0.3223	-0.0528	-0.3278	-0.0472	-0.3352	-0.0263	-0.3252	-0.0555	-0.3377
g_1	0.3567	0.3567	0.3718	0.3718	0.3603	0.3603	0.3393	0.3393	0.3090	0.3090	0.3410	0.3410
j_1	-0.7977	-0.3841	-1.0753	-0.3985	-1.6667	-0.4199	-4.7169	-0.4388	-2.3034	-0.4177	-17.7859	-0.4681
j_2	0.0000	-0.2524	0.0000	-0.2660	0.0000	-0.2787	0.0000	-0.2969	0.0000	-0.2870	0.0000	-0.3046
πh_1	-0.7800	-0.3756	-1.0627	-0.3938	-1.6001	-0.4031	-4.2864	-0.3987	-2.4143	-0.4378	-15.7978	-0.4158
πh_2	0.0000	-0.2419	0.0000	-0.2548	0.0000	-0.2691	0.0000	-0.2879	0.0000	-0.2752	0.0000	-0.2941
w_1	-0.7880	-0.3795	-1.0562	-0.3914	-1.6435	-0.4140	-4.8001	-0.4465	-2.2150	-0.4017	-18.2917	-0.4814
w_2	0.0000	-0.2390	0.0000	-0.2526	0.0000	-0.2645	0.0000	-0.2808	0.0000	-0.2725	0.0000	-0.2887
u_1	0.3764	0.1813	0.5360	0.1986	1.0747	0.2707	3.2596	0.3032	1.2822	0.2325	13.7279	0.3613
u_2	0.0000	0.3779	0.0000	0.3923	0.0000	0.4019	0.0000	0.4302	0.0000	0.4188	0.0000	0.4438
l_1	2.8990	1.3962	3.8717	1.4348	5.0188	1.2643	12.5353	1.1660	9.4603	1.7155	41.8552	1.1016
l_2	0.0000	0.7602	0.0000	0.8180	0.0000	0.9033	0.0000	0.9541	0.0000	0.8851	0.0000	0.9660
n_1	2.9228	1.4076	3.9074	1.4481	5.1067	1.2865	12.7883	1.1896	9.5468	1.7312	43.1632	1.1360
n_2	0.0000	0.7880	0.0000	0.8459	0.0000	0.9302	0.0000	0.9839	0.0000	0.9145	0.0000	0.9968
y_1	2.2708	1.0936	3.0311	1.1233	3.7771	0.9515	9.0234	0.8394	7.7666	1.4084	29.2620	0.7701
y_2	0.0000	0.5851	0.0000	0.6312	0.0000	0.7040	0.0000	0.7433	0.0000	0.6812	0.0000	0.7499
t_1	0.8446	0.4068	1.1436	0.4238	1.8575	0.4679	5.3780	0.5003	2.4167	0.4382	21.1170	0.5558
t_2	0.0000	0.3054	0.0000	0.3186	0.0000	0.3286	0.0000	0.3523	0.0000	0.3430	0.0000	0.3624
m	0.6034	0.6443	0.5592	0.5682	0.5331	0.4957	0.4766	0.3866	0.2650	0.3856	0.5598	0.3338
p	0.7977	0.1318	1.0753	0.1325	1.6667	0.1412	4.7169	0.1419	2.3034	0.1307	17.7859	0.1635

Table A4.51 Question 5, version 1: $n_1=1/\sigma_1$; exogenous: gf_1, gf_2 ; endogenous: gr_1, gr_2, t_1, t_2, m (maximising regional governments)

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.5507	-0.2528	-0.7390	-0.2542	-1.1194	-0.2562	-3.0983	-0.2557	-1.5173	-0.2535	-11.3339	-0.2573
v_2	-0.0718	-0.2528	-0.0654	-0.2542	-0.0659	-0.2562	-0.0694	-0.2557	-0.0383	-0.2535	-0.0769	-0.2573
c_{11}	-0.6532	-0.2528	-0.8765	-0.2542	-1.3252	-0.2562	-3.6661	-0.2557	-1.7958	-0.2535	-13.3681	-0.2573
c_{21}	-0.0127	-0.2528	-0.0156	-0.2542	-0.0182	-0.2562	-0.0153	-0.2557	-0.0052	-0.2535	-0.0014	-0.2573
c_{12}	-0.6532	-0.2528	-0.8765	-0.2542	-1.3252	-0.2562	-3.6661	-0.2557	-1.7958	-0.2535	-13.3681	-0.2573
c_{22}	-0.0127	-0.2528	-0.0156	-0.2542	-0.0182	-0.2562	-0.0153	-0.2557	-0.0052	-0.2535	-0.0014	-0.2573
j_1	-0.6346	-0.2301	-0.8537	-0.2312	-1.2983	-0.2331	-3.6360	-0.2327	-1.7839	-0.2307	-13.3284	-0.2342
j_2	0.0059	-0.2301	0.0072	-0.2312	0.0087	-0.2331	0.0148	-0.2327	0.0067	-0.2307	0.0383	-0.2342
πh_1	-0.7751	-0.2855	-1.0554	-0.2905	-1.5811	-0.2891	-4.2296	-0.2767	-2.3950	-0.3167	-15.4804	-0.2788
πh_2	0.0006	-0.2866	0.0007	-0.2858	0.0008	-0.2872	0.0014	-0.2895	0.0007	-0.2844	0.0037	-0.2895
w_1	-0.5721	-0.2059	-0.7632	-0.2051	-1.1339	-0.2013	-3.2127	-0.2025	-1.5603	-0.1998	-11.5022	-0.1980
w_2	0.0074	-0.1931	0.0091	-0.1956	0.0109	-0.1994	0.0186	-0.1976	0.0085	-0.1956	0.0483	-0.1992
u_1	0.2733	0.0984	0.3873	0.1041	0.7414	0.1316	2.1817	0.1375	0.9032	0.1156	8.6324	0.1486
u_2	-0.0117	0.3053	-0.0141	0.3039	-0.0166	0.3030	-0.0285	0.3026	-0.0131	0.3006	-0.0742	0.3062
l_1	2.9055	1.0706	3.8816	1.0692	5.0460	0.9239	12.6190	0.8267	9.4858	1.2555	42.3407	0.7646
l_2	0.0009	0.9376	0.0010	0.9522	0.0011	0.9956	0.0020	0.9928	0.0009	0.9481	0.0051	0.9840
n_1	2.9228	1.0768	3.9074	1.0761	5.1067	0.9346	12.7883	0.8374	9.5468	1.2633	43.1632	0.7787
n_2	0.0000	0.9601	0.0000	0.9738	0.0000	1.0159	0.0000	1.0138	0.0000	0.9692	0.0000	1.0053
y_1	2.2759	0.8386	3.0388	0.8370	3.7976	0.6953	9.0837	0.5951	7.7876	1.0307	29.6014	0.5345
y_2	0.0007	0.7216	0.0008	0.7348	0.0009	0.7760	0.0015	0.7735	0.0007	0.7297	0.0040	0.7639
gr_1	-1.0054	-0.3929	-1.3816	-0.4046	-2.0512	-0.4004	-5.4938	-0.3870	-2.5729	-0.3668	-20.0831	-0.3905
gr_2	-0.0296	-0.3908	-0.0372	-0.3902	-0.0483	-0.3960	-0.0804	-0.3969	-0.0361	-0.3958	-0.2093	-0.3988
t_1	-0.3043	-0.1379	-0.4222	-0.1436	-0.5294	-0.1260	-1.3468	-0.1216	-0.6393	-0.1159	-4.5845	-0.1188
t_2	-0.0365	-0.1100	-0.0451	-0.1058	-0.0562	-0.1018	-0.0957	-0.1095	-0.0435	-0.1141	-0.2467	-0.1048
m	0.1875	0.2285	0.2300	0.2315	0.2712	0.2324	0.3036	0.2321	0.1201	0.2294	0.4003	0.2334
p	0.6405	0.0000	0.8609	0.0000	1.3070	0.0000	3.6508	0.0000	1.7906	0.0000	13.3667	0.0000

Table A4.52 Question 5, version 2: n_1=1 n_2=1; exogenous: gf_1, gf_2 ; endogenous: gr_1, gr_2, t_1, t_2, m (maximising regional governments)

Variable	NSW as region 1		Vic as region 1		Qld as region 1		SA as region 1		WA as region 1		Tas as region 1	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
v_1	-0.2404	-0.2528	-0.2412	-0.2542	-0.2697	-0.2562	-0.2944	-0.2557	-0.2133	-0.2535	-0.3152	-0.2573
v_2	-0.2603	-0.2528	-0.2593	-0.2542	-0.2532	-0.2562	-0.2532	-0.2557	-0.2603	-0.2535	-0.2564	-0.2573
c_{11}	-0.2361	-0.2528	-0.2375	-0.2542	-0.2729	-0.2562	-0.3021	-0.2557	-0.2045	-0.2535	-0.3258	-0.2573
c_{21}	-0.2628	-0.2528	-0.2606	-0.2542	-0.2524	-0.2562	-0.2524	-0.2557	-0.2614	-0.2535	-0.2560	-0.2573
c_{12}	-0.2361	-0.2528	-0.2375	-0.2542	-0.2729	-0.2562	-0.3021	-0.2557	-0.2045	-0.2535	-0.3258	-0.2573
c_{22}	-0.2628	-0.2528	-0.2606	-0.2542	-0.2524	-0.2562	-0.2524	-0.2557	-0.2614	-0.2535	-0.2560	-0.2573
j_1	-0.2133	-0.2301	-0.2145	-0.2312	-0.2498	-0.2331	-0.2790	-0.2327	-0.1814	-0.2307	-0.3026	-0.2342
j_2	-0.2400	-0.2301	-0.2377	-0.2312	-0.2293	-0.2331	-0.2294	-0.2327	-0.2383	-0.2307	-0.2328	-0.2342
πh_1	-0.2651	-0.2855	-0.2700	-0.2905	-0.3094	-0.2891	-0.3305	-0.2767	-0.2507	-0.3167	-0.3582	-0.2788
πh_2	-0.2985	-0.2866	-0.2935	-0.2858	-0.2827	-0.2872	-0.2855	-0.2895	-0.2935	-0.2844	-0.2879	-0.2895
w_1	-0.1907	-0.2059	-0.1901	-0.2051	-0.2159	-0.2013	-0.2434	-0.2025	-0.1565	-0.1998	-0.2570	-0.1980
w_2	-0.2014	-0.1931	-0.2011	-0.1956	-0.1961	-0.1994	-0.1946	-0.1976	-0.2021	-0.1956	-0.1979	-0.1992
u_1	0.0911	0.0984	0.0965	0.1041	0.1412	0.1316	0.1653	0.1375	0.0906	0.1156	0.1929	0.1486
u_2	0.3185	0.3053	0.3125	0.3039	0.2980	0.3030	0.2981	0.3026	0.3106	0.3006	0.3042	0.3062
l_1	0.9943	1.0706	0.9936	1.0692	0.9884	0.9239	0.9872	0.8267	0.9939	1.2555	0.9816	0.7646
l_2	0.9766	0.9376	0.9778	0.9522	0.9800	0.9956	0.9794	0.9928	0.9782	0.9481	0.9789	0.9840
n_1	1.0000	1.0768	1.0000	1.0761	1.0000	0.9346	1.0000	0.8374	1.0000	1.2633	1.0000	0.7787
n_2	1.0000	0.9601	1.0000	0.9738	1.0000	1.0159	1.0000	1.0138	1.0000	0.9692	1.0000	1.0053
y_1	0.7788	0.8386	0.7779	0.8370	0.7439	0.6953	0.7106	0.5951	0.8160	1.0307	0.6863	0.5345
y_2	0.7516	0.7216	0.7545	0.7348	0.7638	0.7760	0.7630	0.7735	0.7528	0.7297	0.7599	0.7639
gr_1	-0.3674	-0.3929	-0.3784	-0.4046	-0.4263	-0.4004	-0.4565	-0.3870	-0.2967	-0.3668	-0.4933	-0.3905
gr_2	-0.4059	-0.3908	-0.3997	-0.3902	-0.3905	-0.3960	-0.3926	-0.3969	-0.4073	-0.3958	-0.3979	-0.3988
t_1	-0.1309	-0.1379	-0.1361	-0.1436	-0.1323	-0.1260	-0.1383	-0.1216	-0.0993	-0.1159	-0.1421	-0.1188
t_2	-0.1130	-0.1100	-0.1074	-0.1058	-0.1011	-0.1018	-0.1093	-0.1095	-0.1163	-0.1141	-0.1055	-0.1048
m	0.2302	0.2285	0.2316	0.2315	0.2330	0.2324	0.2331	0.2321	0.2329	0.2294	0.2343	0.2334
p	-0.0266	0.0000	-0.0231	0.0000	0.0205	0.0000	0.0497	0.0000	-0.0569	0.0000	0.0698	0.0000