Competition Reforms and Collaborative Federalism: A Dynamic Multiregional Applied General Equilibrium Analysis

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I. Introduction

This paper reports on economic modelling designed to estimate labour market adjustment costs from policy reforms and other economic shocks. The reform modelled in this paper, as an illustration examining adjustment costs, is the introduction of more competitive practices in the Australian utilities sector. In the next section, previous approaches to modelling reforms of this type are considered and a new approach is advanced. The modelling tools used in our analysis are then described. These tools are the large-scale multiregional model, FEDERAL-F, and a regional labour market adjustment index (RELMAI).[1]

II. Approaches to Modelling NCP Reform

Since the 1980's an extensive program of economic reform has been introduced in Australia (Productivity Commission 1999a). A significant impetus to internal-market reform was the 1995 agreement by the Australian federal and state governments, meeting as the Council of Australian Governments (COAG), to introduce a wide reform agenda known as national competition policy (NCP). Prior to the COAG agreement on NCP, there were a number of studies released, which gave support to the concept of NCP. For the most part these studies were focussed on the long-run benefits that microeconomic reform would bring. The most comprehensive study was that by Industry Commission (1995), published shortly before the COAG agreement on NCP. The Industry Commission (IC) modelled all of the NCP reforms as advanced by Hilmer et al. (1993) and certain related reforms.

The IC used a model of the national economy (HILORANI) and did not provide any regional decomposition of results. Estimates of the regional effects of NCP were made at the time by Madden (1995a and 1995b) using the MMRF model. However, like the IC, Madden focussed entirely on the long run. Both the IC and Madden projected significant long run increases in real GDP. The IC study estimated a long run increase in real GDP of 5.5 per cent. Madden found a long run increase in real GDP of 3.4 per cent. The lower impacts found by Madden were due largely to the narrower scope of his study, rather than differences in shocks, model structure, or closure (Madden 2000). Despite the Commission's estimate of the long-run GDP impact being much smaller than some previous studies (e.g Ralph 1994), it was criticised by Quiggin (1996 and 1997) as an overestimate.

The main elements of Quiggin's (1997) detailed critique of the IC study can be summarised under three points. The first was that the IC's assumption that all jobs lost through NCP would be matched by job expansion elsewhere in the economy was contrary to the IC's own evidence on the experience of workers made redundant by labour-shedding. Quiggin cited the IC as suggesting that "about 50 per cent of workers made redundant by microeconomic reform were still unemployed or not in the labour force after three years".

The second of Quiggin's arguments was directed at the method employed by the IC to estimate the direct effect of NCP. The IC assumed that exposure to competition would force Australian government business enterprises to achieve 'world best practice' through internal restructuring. The long run benefits of microeconomic reform were therefore measured by the IC as the gap between current productivity performance and world best practice. World best practice was determined by examining the productivity performances of the top ranked enterprises within each industry. The best practice benchmark was then set between the productivity performance of the top-ranked and second-ranked enterprise within each industry (Quiggin 1997). The productivity improvement to be

[1] The RELMAI was constructed with the support of funds from a Rural and Regional Development Grant from the Department of Transport and Regional Services.

delivered by NCP was then set equal to the gap between the current productivity performance of the Australian enterprise and the best practice benchmark.

Quiggin argued that the IC's approach set the productivity benchmark at the maximal or near maximal observation, while failing to take account of the fact that any sample of productivity measures for selected enterprises will be subject to errors, measurement biases and enterprise-specific factors. Quiggin suggested that one way of overcoming these problems would be the use of the stochastic frontier production (SPF) method. Whiteman (1999) considered this claim. Whiteman estimated technical efficiency for Australian and international electricity suppliers using SPF and data envelopment analysis (DEA), the latter being one of the methods criticised by Quiggin. However contrary to Quiggin's concerns, Whiteman showed that, on average, the DEA estimates of the productivity gaps were approximately half those of the SPF estimates.

The third element of Quiggin's critique of the IC's study related to the latter's choice of counter-factual when calculating the productivity effects of NCP. The productivity effect of NCP should be set equal to the difference between the productivity levels expected to be achieved in the presence of NCP, and the productivity levels expected to be achieved under the counter-factual. The IC's calculations effectively assumed that the level of productivity growth under the counter-factual would be zero. This allowed all of the difference between current productivity and benchmark productivity to be attributed to NCP. No account was taken of the fact that most of the Australian enterprises had experienced steady growth in total factor productivity in the past.

III. The Models

The modelling is undertaken in two stages. In the first, FEDERAL-F is used to model the impact of competition policy reforms on the number of workers in various regional labour market categories. These changes in worker numbers by labour market category are then input to the model that calculates the regional labour market adjustment index (RELMAI), which provides a measure of the extent of labour market disruption following the introduction of competition policy. Each of these models is described below. The FEDERAL-F model is described in detail elsewhere (Giesecke 2000), and so we present only a broad overview of this model in the present paper. The RELMAI model, however, is described in some detail.

FEDERAL-F is too large and detailed for it to be practical to provide a full description of its theoretical structure and database in this paper. The overview in this Section is sufficient to convey an understanding of the structure of the full model to readers already familiar with the ORANI / MONASH school of CGE modelling in Australia. This is because the starting point for the development of the multi-period model FEDERAL-F was the comparative-static multi-regional CGE model FEDERAL (Madden 1992). FEDERAL, in turn, grew out of the single-region comparative-static national model ORANI (Dixon et al. 1982), converting it into a full bottom-up multi-regional model with a detailed fiscal dimension. During the 1990's ORANI was subject to much development work - both to impart it with dynamic capabilities and to allow it to model structural change over historical periods - thus giving rise to the MONASH model (see in particular Adams et al. (1994) and Dixon and Rimmer (2001)). The core of the FEDERAL-F model is essentially an incorporation into the multi-regional FEDERAL model of the key elements of those features of the national MONASH model which relate to its dynamic capabilities and model closure options. Hence FEDERAL-F is a recursive-dynamic multi-regional CGE model, linking a sequence of single-period equilibria via stock-flow relationships. The equilibria thus computed change through time as the values for the model's stock variables change. Flows in previous periods (such as investment, inter-regional migration, and government borrowings) influence the values for the endogenous variables computed in each period through their contribution to the values of the model's stock variables (such as capital, population, and government debt) in each period. The implementation of the model used in this paper features two regions: Tasmania and the rest of Australia. Together, these two regions comprise Australia. Thirty-seven representative cost-minimising firms are identified within each of these two regions. Each of these firms uniquely produces one of thirty-seven commodities. Firms are assumed to operate in a perfectly competitive environment. The taxing and spending activities of two-tiers of government are modelled: a regional government within each region, and a federal government operating Australia-wide. A representative, utility-maximising household resides in each region. Foreign demands for domestic commodities are inversely related to their foreign currency prices. A two-region adaptation of the migration theory of Jones and Whalley (1989) is used to determine regional populations. An ORES[2]- style regional extension decomposes to five Tasmanian sub-state regions the results for the Tasmanian state variables calculated by the FEDERAL-F component of the model. The model also evaluates a full set of national and regional income accounts.

The RELMAI model is based on the LILI (labour input loss index) model of Dixon and Rimmer (1999). The latter model uses the sectoral, geographic, and occupational dimensions of the output on job gains and losses from the MONASH model to calculate an index of labour market adjustment costs for the nation. The RELMAI model is an attempt to apply the LILI methodology to the regional level, in order to provide a means of calculating indices of labour market adjustment costs for individual regions. The weighted-average of these regional labour market adjustment costs is equal to the value of the LILI index as defined in Dixon and Rimmer's model. In the application of the RELMAI model in this paper, we compute both LILI and RELMAI. However we refer the reader to Dixon and Rimmer (1999) for a description of the LILI model. We explain the RELMAI model in detail below.

The variables and parameters of the RELMAI model are defined in Appendix A. Appendix A also sets out the equations of the model. The first equation defines the RELMAI. Like the model on which it is based, LILI, the RELMAI index assigns a value to the labour inputs that are lost as people move between various labour market categories. One can see from Equation (1) that RELMAI is a share weighted sum of the value of the lost labour input per worker associated with each type of labour flow. The share weights are given by the share of the type of labour flow in the regional labour force. The cost of lost labour inputs associated with a particular type of labour market movement is assumed to accrue to the region in which the workers associated with that particular movement were originally resident.

We explain below the weights associated with each labour market flow in Equation (1). Note that currently we assign a weight which reflects only the time that the worker spends outside of the labour force. Also, the cost weights have been set equal to the value of the weight associated with the corresponding flow in the LILI model. This allows the results of the two models to be compared, which provides a check on the computer implementation of the two models. In the future we intend to consider expanding the scope of these weights to include other costs such as moving costs, social disruption, and so on. Each of the variables on the RHS of (1) are now explained in turn:

E_ESC_SR: Workers who are continuously employed throughout the year in the same category in the same region do not contribute to labour market adjustment costs, and so are assigned a zero weight.

E_ESC_OR: Workers who change regions are automatically classified as having changed categories even if they remain within the same occupation and industry, and so this category contains no workers - it is included for completeness only.

E_EOC_SR: Workers who remain employed but who change employment category (i.e. occupation or industry) within the region in which they commenced employment are assumed to require re-

[2] "ORANI Regional Equation System". See Dixon et al. 1982.

training. This re-training period is assumed to be associated with a loss of productive capacity equal to 0.25 worker years.

E_EOC_OR: Workers who remain employed but who change employment category (i.e. occupation or industry) and region of employment are assumed to require re-training, with an associated loss of productive capacity equal to 0.25 worker years..

E_U_SR: Workers who move from employment to unemployment, but remain within the region in which they were originally employed, attract a RELMAI weight of 0.5. This reflects an assumption that people moving from employment to unemployment within the same region are unemployed for half the year.

E_U_OR: Workers who move from employment in one region to unemployment in some other region attract a RELMAI weight of 0.5, reflecting an assumption that such people are unemployed for half the year.

E_NLF_SR: Workers who move from being employed to being outside of the labour force, while still remaining in the same region, attract a RELMAI weight of 0.00. A zero weight is given to these movements because retirement is considered an inevitable occurrence and hence outside of the accounting of labour market adjustment costs.

E_NLF_OR: Workers who move from being employed to being outside of the labour force, while also changing their region of residence, attract a RELMAI weight of 0.00. A zero weight is given to these movements because it is assumed that both the retirement and the change in region of residence are exogenous occurrences.

U_E_SR: Workers who move from being unemployed to being employed, while remaining within their original region of residence, attract a RELMAI weight of 0.75. This weighting reflects two assumptions: first, that workers moving from unemployment to employment are unemployed for half the year; and second, that employment of these workers is associated with re-training costs that are equivalent to 0.25 worker years.

U_E_OR: Workers who move from being unemployed to being employed, while also changing their region of residence, attract a RELMAI weight of 0.75. This weighting reflects two assumptions: first, that workers moving from unemployment to employment are unemployed for half the year; and second, that employment of these workers is associated with re-training costs that are equivalent to 0.25 worker years.

U_U_SR: Workers who remain unemployed within their original region of residence attract a RELMAI weight of 1.0. This reflects the loss of their potential labour for a full worker year.

U_U_OR: Workers who remain unemployed while also moving to another region of residence attract a RELMAI weight of 1.0. This reflects the loss of their potential labour for a full worker year.

U_NLF_SR: Workers who move from being unemployed to being outside of the labour force, while remaining within their original region of residence, attract a RELMAI weight of 0.5. This reflects an assumption that retirements occur evenly over the year, so that on average, retiring unemployed workers are unemployed for half the year.

U_NLF_OR: Workers who move from being unemployed to being outside of the labour force, while also moving to another region of residence, attract a RELMAI weight of 0.5. This reflects an assumption that retirements occur evenly over the year, so that on average, retiring unemployed workers are unemployed for half the year.

NLF_E_SR: Workers who move from being outside of the labour force to being employed, while still remaining within their original region of residence, attract a RELMAI weight of 0.25. This reflects an assumption that the employment of these workers is associated with training costs that are equivalent to 0.25 worker years.

NLF_E_OR: Workers who move from being outside of the labour force to being employed, while also moving from their original region of residence, attract a RELMAI weight of 0.25. This reflects an assumption that the employment of these workers is associated with training costs that are equivalent to 0.25 worker years.

NLF_U_SR: Workers who move from outside the labour force into unemployment, while remaining within their original region of residence, attract a RELMAI weight of 0.5. This reflects an assumption that the flow of people from outside of the labour people into unemployment occurs evenly throughout the year, so that on average these people are unemployment for half the year.
NLF_U_OR: Workers who move from outside the labour force into unemployment, while also moving from their original region of residence, attract a RELMAI weight of 0.5. This reflects an assumption that the flow of people from outside of the labour people into unemployment occurs evenly throughout the year, so that on average these people are unemployment for half the year.
NLF_NLF_SR: Workers who remain outside the labour force, while remaining within their original region of residence, attract a RELMAI weight of 0.0. Since these workers are not part of the labour force at any point during the year, they cannot contribute to labour market adjustment costs.
NLF_NLF_OR: Workers who remain outside the labour force, while also moving from their original region of residence, attract a RELMAI weight of 0.0. Since these workers are not part of the labour force at any point during the year, they cannot contribute to labour market adjustment costs.

The remainder of the description of the RELMAI model explains how the numbers of workers in each of the labour market categories in the RELMAI index (E_ESC_SR through to NLF_NLF_OR) are calculated.

Equation (2) defines the number of workers that are employed in the same occupation and industry (o,j) in the same region (r) in both the year (t) and the year (t+1). It is assumed that so long as there are sufficient jobs, all the people who would like to continue in employment in category (o,j) in region (r) are able to do so. Hence the number of workers in (r) who were employed in category (o,j) in both years (t) and (t+1) is the lesser of two amounts: *(i)* The number of people in region (r) who would like to continue in employment in (o,j) between years (t) and (t+1). This is equal to employment in (o,j) in year (t) less retirements and voluntary departures; and *(ii)* Employment in category (o,j) in year (t+1). As a matter of definition, there are no region (r) workers employed in the same labour market category in another region in (t+1), since a change in a worker's region is treated as a change in the worker's labour market category. To make this transparent, we nevertheless define the variable E_ESC_OR(r), but set it equal to zero in (3).

Equation (4) defines the number of region (r) workers moving from employment to retrenchment. That is, (4) defines the number of retrenchments in region (r). Involuntary departures occur when there are insufficient positions in labour market category (o,j) in region (r) in year (t+1) to provide employment for those year (t) workers in category (o,j) in region (r) remaining after making allowance for retirements and voluntary departures from (o,j).

The total number of vacancies in (r) (TVACR(r)) is defined by Equation (5) as the difference between total employment in (r) in year (t+1) and employment in (r) in year (t) adjusted for retirements ($\alpha \times ER\_T_r$) and retrenchments (E_TINVR(r)). Equation (5) introduces total employment in (r) in year (t) (ER_T(r)) and total employment in (r) in year (t+1) (ER_T1(r)). These two variables are defined by Equations (6) and (7).

Equations (8) and (9) define the number of workers who are retrenched in (r) and who find re-employment in either region (r) (TINV_E_SR(r)) or a region other than (r) (TINV_E_OR(r)). Equation (8) defines the number of retrenched workers from region (r) who find re-employment in (r). It is assumed that no more than half of those retrenched workers who remain in region r ($z_r \times E\_TINVR_r$) find re-employment in region (r). Otherwise, it is assumed that retrenched workers have approximately double the probability of employment than that given by the simple share of their numbers in the total of all those retrenched workers, unemployed workers, and workers not in the labour force who are looking to take-up the available vacancies in (r). Equation (8) assumes that potential workers in (r) are one quarter of those not in the labour force. Equation

(8) also assumes that region (r) attacts a proportion of retrenched workers, the unemployed, and potential workers from regions other than (r) equal to its share in the national workforce.

Equation (9) defines the number of retrenched workers from (r) who find re-employment elsewhere. Consistent with Equation (8), it is assumed that no more than half of those retrenched workers who leave region (r) ($((1-\text{æ}_r)\times \text{E\_TINVR}_r$) find re-employment outside of the region. Otherwise, those retrenched workers who leave the region secure a proportion of the available vacancies outside of the region ($\sum_{t\neq r}\text{TVACR}_t$) which is approximately equal to double their share of the total number of people ($\sum_{t\neq r}\text{LDEN}_t$) looking to secure the available vacancies.

Equation (10) defines the total number of retrenched workers from (r) who find re-employment as the sum of those who find employment within (r) and those who find employment outside of (r).

Equation (8) introduces the number of unemployed in region (r). This is calculated by Equation (11) as the difference between the region (r) labour force, and employment in region (r). Equation (8) also introduces region (r)'s share of total employment (E_sh(r)), and the number of people not in the labour force in region (r) (NLFR(r)). These are calculated by Equations (12) and (13) respectively.

Equation (14) defines the total number of people moving from one employment category to another employment category within (r) as the total number of retrenched region (r) workers who find re-employment in (r) ($\text{TINV\_E\_SR}(r)$) plus the total number of region (r) workers making voluntary moves between employment categories in region (r) ($\sum_{o\in OCC}\sum_{j\in IND}\sum_{o\in OCC}\sum_{j\in IND}V^{(o,j,r)}_{(u,k,r)}$) less those voluntary region (r) movers who are moving between the same employment categories in region (r) ($\sum_{i\in OCC}\sum_{t\in IND}V^{(i,t,r)}_{(i,t,r)}$). Equation (15) defines the number of region (r) workers who move to another employment category in another region. This is equal to the number of retrenched region (r) workers who find employment outside of (r) (TINV_E_OR_r), plus the sum of all region (r) workers making voluntary moves ($\sum_{o\in OCC}\sum_{j\in IND}\sum_{u\in OCC}\sum_{k\in IND}\sum_{t\in REG}V^{(o,j,r)}_{(u,k,t)}$), less those region (r) workers making voluntary moves to employment categories within region (r) ($\sum_{o\in OCC}\sum_{j\in IND}\sum_{u\in OCC}\sum_{k\in IND}V^{(o,j,r)}_{(u,k,r)}$). Equation (16) defines the total number of region (r) workers who move to another employment category as the sum of those moving to another employment category within (r) (E_EOC_SR_r) and those moving to another employment category outside of (r) (E_EOC_OR_r).

Equation (17) defines the number of people who move between being employed in (r) and unemployed in (r) as the difference between those region (r) workers who are made redundant and stay in (r) ($\boldsymbol{z}_r\times\text{E\_TINVR}_r$) and those region (r) workers who are made redundant and find re-employment in region (r) (TINV_E_SR_r). Equation (18) defines the number of people who move between being employed in (r) and unemployed in a region other than (r). This is equal to the difference between those region (r) workers who are made redundant and leave (r) ($(1\text{-}\boldsymbol{z}_r)\times\text{E\_TINVR}_r$), and those region (r) workers who are made redundant but find re-employment outside of (r) (TINV_E_OR_r). Equation (19) defines the total number of region (r) workers who move from being employed (in region (r)) to being unemployed (somewhere).

Equation (20) defines the number of people who move from being employed in (r), to being outside of the labour force in (r). This is equal to the number of retirements in (r) ($\text{á}\times\text{ER\_T}_r$), multiplied by the proportion of newly retireds who remain in (r) (ê). Equation (21) defines the number of people who move from being employed in (r), to being outside of the labour force in a region other than (r). This is equal to the number of retirements in (r) ($á \times ER\_T_r$), multiplied by the proportion of newly retireds who leave (r) ($1 - ê_r$). Equation (22) defines the total number of people moving from being employed in (r) to being outside of the labour force either in (r) or some other region.

Equation (23) defines the number of people who retire from unemployment in region (r) and who remain outside of the labour force in region (r) as the number of unemployed people who retire ($á \times UR\_T_r$) multiplied by the proportion of the newly retired who remain in (r) ($ê_r$). Equation (24) defines the number of people who retire from unemployment in region (r) and who leave (r) to be outside of the labour force elsewhere, as the number of unemployed people who retire ($á \times UR\_T_r$) multiplied by the proportion of the newly retired who leave (r) ($1 - ê_r$). Equation (25) defines the total number of unemployed people from (r) who leave the labour force as the sum of those unemployed who leave the labour force and remain in (r), and those unemployed who leave the labour force and leave (r).

Equation (26) defines the number of unemployed people in (r) who move to employment in region (r) as the number of jobs in (r) available to the unemployed and those not in the labour force ($ER\_T1_r - (1-á) \times ER\_T_r + E\_UR_r$) multiplied by both the proportion of these jobs available to the unemployed ($ã$) and the proportion of the unemployed who remain in (r) ($ë_r$). The number of jobs in (r) that are available to the unemployed and those not in the labour force is equal to the excess of employment in (t+1) (ER_T1_r) over the number of people employed in region (r) in (t) who continue to be employed in (t+1) ($(1-á) \times ER\_T_r - E\_UR_r$). Equation (27) defines the number of unemployed workers in (r) who find employment in a region outside of (r). For any given region other than (r) (say, (k)), region (r) workers are assumed to obtain a proportion of the jobs in (k) that are available to unemployed workers from outside (k) ($((1-ë_k)ã)(ER\_T1_k - (1-á) \times ER\_T_k + E\_UR_k)$) which is equal to region (r)'s share in the total number of unemployed workers in all regions other than (k) ($UR\_T_r \big/ \sum_{h \neq k} UR\_T_h$). Equation (28) defines the number of unemployed workers from (r) who find employment (U_ER_r) as the sum of those unemployed region (r) workers who find employment within (r) ($U\_E\_SR_r$), and those unemployed region (r) workers who find employment outside of (r) ($U\_E\_OR_r$).

Equation (29) defines the number of people outside the labour force in (r) who move to employment in region (r) ($NLF\_E\_SR_r$) as the number of jobs in (r) available to the unemployed and those not in the labour force ($ER\_T1_r - (1-á) \times ER\_T_r + E\_UR_r$) multiplied by both the proportion of these jobs available to those outside the labour force ($1 - ã$) and the proportion of those not in the labour force who remain in (r) ($ñ_r$). The number of jobs in (r) that are available to the unemployed and those not in the labour force is equal to the excess of employment in (t+1) (ER_T1_r) over the number of people employed in region (r) in (t) who continue to be employed in (t+1) ($(1-á) \times ER\_T_r - E\_UR_r$). Equation (30) defines the number of those people who are outside the labour force in (r) who find employment in a region outside of (r). For any given region other than (r) (say, (k)), potential region (r) workers are assumed to obtain a proportion of the jobs in (k) that are available to those not in the labour force from outside (k) ($((1-ñ)(1-ã))(ER\_T1_k - (1-á) \times ER\_T_k + E\_UR_k)$) which is equal to region (r)'s share in the total number of people not in the labour force in all regions other than (k) ($NLFR_r \big/ \sum_{h \neq k} NLFR_h$). Equation (31) defines the total number of people from outside the labour force (r) who find employment (NLF_ER_r) as the sum of those potential region (r) workers who find employment within (r) ($NLF\_E\_SR_r$), and those potential region (r) workers who find employment outside of (r) ($NLF\_E\_OR_r$).

Equation (32) defines the number of unemployed workers in (r) who remain unemployed in (r). This is equal to the proportion of unemployed people who remain in (r) ($ë_r$) multiplied by the total of the number of unemployed people in (r) in year (t) (UR_T_r) less those that left the unemployment pool by either finding employment (U_ER_r) or leaving the labour force (U_NLFR_r). Equation (33) defines the number of unemployed workers in (r) who find employment outside of (r). This is equal to the proportion of unemployed people who leave (r) ($1- ë_r$) multiplied by the total of the number of unemployed people in (r) in year (t) (UR_T_r) less those that left the unemployment pool by either finding employment (U_ER_r) or leaving the labour force (U_NLFR_r). Equation (34) defines the total number of unemployed people in (r) who remain unemployed as the total of those who remain unemployed within (r) and those who remain unemployed outside of (r).

Equations (35) - (37) define the number of people in region (r) who move from being outside of the labour force to being unemployed. The derivation of these equations proceeds in a number of steps. First, we note the following relationship between the number of people not in the labour force in (t+1) ($NLFR\_T1_r$) and the movement of people between various labour market categories:

$$NLFR\_T1_r = NLFR_r - NLF\_UR_r - NLF\_ER_r + E\_NLFR_r + U\_NLFR_r$$

which can be re-arranged for NLF_UR_r as follows:

$$NLF\_UR_r = NLFR_r - NLFR\_T1_r - NLF\_ER_r + E\_NLFR_r + U\_NLFR_r$$

Noting that $E\_NLFR_r + U\_NLFR_r = áLFR\_T_r$, and abstracting for the moment from natural population growth, so that $NLFR_r + LFR\_T_r = NLFR\_T1_r + LFR\_T1_r$, we can re-write the above expression as:

$$NLF\_UR_r = LFR\_T1_r - LFR\_T_r + á\,LFR\_T_r - NLF\_ER_r, \text{ or}$$

$$NLF\_UR_r = LFR\_T1_r - (1-á)LFR\_T_r - NLF\_ER_r,$$

which defines the number of people in (r) who move from outside of the workforce to unemployment. A proportion of these people ($ë_r$) are assumed to remain within region (r), with the remainder departing to another region. This provides Equations (35) and (36).

Equation (38) defines the number of people in region (r) who were not in the labour force in period (t) and who remain not in the labour force in region (r) in period (t+1). This is equal to the number of people in (r) who were not in the labour force in period (t) ($NLFR_r$), less those who moved into the labour force in year (t+1) $(NLF\_ER_r + NLF\_UR_r)$, multiplied by the proportion of people not in the labour force who remain in region (r) ($ñ_r$). Equation (39) defines the number of people in region (r) who were not in the labour force in period (t) and who remain not in the labour force in period (t+1) but in a region other than (r). This is equal to the number of people in (r) who were not in the labour force in period (t) ($NLFR_r$), less those who moved into the labour force in year (t+1) $(NLF\_ER_r + NLF\_UR_r)$, multiplied by the proportion of people not in the labour force who move to a region other than (r) (1- $ñ_r$).

Equation (40) defines voluntary moves by workers from occupation (o) in industry (j) in region (r) to employment in occupation (u) in industry (k) in region (t). The last term on the RHS of Equation (40) defines the total number of vacancies in employment category (u,k,t) that are available to those not initially employed in the category. The second term on the RHS of Equation (40) determines how these vacancies are distributed among workers departing from category (o,j,r). The parameter $\text{Ä}^{o,j,r}_{u,k,t}$ is a measure of the closeness of employment categories (o,j,r) and (u,k,r). If these employment categories are very similar (eg. very similar occupations in similar industries in the same region) then $\text{Ä}^{o,j,r}_{u,k,t}$ will be close to or equal to 1. If however the employment categories are very dissimilar (eg. occupations requiring widely different skills, located in different industries and in a different region) then $\text{Ä}^{o,j,r}_{u,k,t}$ will have a value close to or equal to 0. The coefficient $S_{o,j,r}$ is the share of employment category (o,j,r) in total employment. This coefficient weights the share of the total vacancies in category (u,k,t) that are filled by workers from category (o,j,r) towards (o,j,r)'s share of total employment. Hence, if the $\text{Ä}^{o,j,r}_{u,k,t}$ were of equal value, then the share of the vacancies in (u,k,t) that would be filled by workers from category (o,j,r) would be equal to (o,j,r)'s share in total national employment. Finally, the parameter ö is set to ensure that five per cent of the employed workforce makes a voluntary move each year. Equation (41) defines the total voluntary departures from employment category (o,j,r).

Following Dixon and Rimmer (1999) we decompose the RELMAI index into two effects: a swap effect (42) which measures the contribution to the regional RELMAI of training costs arising from people moving between employment categories and with matched moves into and out of employment; and a macroeconomic effect (43) which measures the contribution to the regional RELMAI of regional unemployment and retraining costs arising from aggregate employment growth.

IV Simulations

Calculating the values of the shocks

Three sets of simulations were necessary to model the impact of NCP. The first two of these (the historical and forecast simulations) are only briefly described in this paper[3]. These simulations provide the basecase or counterfactual against which the effects of changes in the rate of productivity improvement in Utilities are measured. The first set of simulations was used to uncover the values of the changes in the model's structural variables (such as productivities, taste changes, positions of export demand schedules, and such like) and policy variables (such as various income, commodity, and production tax rates, rates of personal benefit payment, real regional and Commonwealth outlays on current consumption expenditure, and the like), which together accounted for the observed regional and national economic outcomes over the six year period 1992/93 to 1998/99. The values of many of these structural and policy variables are largely unobservable without the aid of some analytical framework, which in this case is provided by FEDERAL-F. To uncover these values, the model was shocked with the observed values for certain macroeconomic, commodity, industry, and government variables relating to both the national and regional economies over the period 1992/93 to 1998/99. Following the parlance established by the developers of the MONASH model, this will be referred to as the "historical simulation" hereafter.

The second set of simulations involved the generation of baseline forecasts for the Tasmanian and Mainland economies for the period 1999/00 to 2002/03. Different closures of the model were used for different segments of this time period. These different closures reflected the changing availability of extraneous forecasts relating to the macroeconomy and the government accounts, and

[3] Detailed discussions of these simulations are provided in Giesecke (2000).

the need to model the introduction of the GST. At one level, the broad approach used during the forecast simulations mirrored that of the historical simulations. The values for certain national macroeconomic variables, certain variables relating to commodity exports, and certain variables relating to government finances, were determined exogenously. This allowed the model to determine the values for the appropriate structural shift variables and government policy variables. At the same time, certain regional, commodity, and industry level structural variables (such as those relating to productivities, household tastes and such like) were determined exogenously, and shocked equal to the annual average of their values during the historical simulations.

The third set of simulations - and the ones discussed in this paper - sought to determine the effects on observed regional outcomes (for the period 1992/93 to 1998/99) and forecast outcomes (for the period 1999/00 - 2003/04) resulting from a hypothetical situation in which the rate of growth in Utilities productivity declined in the second half of the historical period. To simulate this situation it was necessary to ensure certain structural variables took on different values than those uncovered in the historical simulation.

The modelling of the hypothetical alternative scenario required that a simulation be undertaken in which the structural and policy variables are shocked equal to the values that they were calculated to have attained under the historical and forecast simulations, but with the exception of the few variables we wish to alter. Again following the parlance established by the developers of the MONASH model, this will be referred to as the "deviation simulation" hereafter. In undertaking the historical, forecasting, and deviation simulations, the model was solved one period at a time, commencing with an initial database for the year 1992/93, and terminating with the creation of a database for 2003/04.

It remains to be explained how the values of the hypothetical changes to the structural variables are obtained. The variables in question are those describing primary-factor-saving technical change in the Utilities sector. In comparative static simulations of NCP (e.g. Madden (1995a and 1995b), Productivity Commission (1999) and Whiteman (1999 and 2000)), the normal procedure is to form shocks to this variable for each of the Utilities industries in each of the regions, on the basis of estimated productivity gaps between them and their best-practice counterparts internationally. To take that approach in the present modelling exercise it would be necessary to estimate how much of the productivity gap was closed for the period in question. One way to do this would be to undertake a benchmarking exercise for each of the years of the period under examination. Indeed we do have estimates for productivity gaps for a number of years of the period, but they are not estimated on a consistent basis. Rather than pursuing that approach we have adopted an alternative one. We examined the results for primary-factor-saving technical change in the Utilities sector computed in the historical simulations and then estimated how much of the change in these technical-change variables was due to NCP.

The six years of the historical simulation period were divided in two, the first three years being considered as approximating the pre-NCP period. The average productivity improvements for the two phases were compared, and the differences were assumed to be the impact of NCP as agreed by the Council of Australian Governments in 1995. By using an estimate of the actual increase in the Utilities sectors' annual productivity improvement, the problem of estimating the degree and speed with which NCP will remove efficiency gaps is eased. An obvious limitation of this approach is that only one explanatory variable (NCP) is posited to account for the observed difference in average productivity between the two periods. The method does however allow for ongoing productivity improvement in the counterfactual, thereby avoiding the third of Quiggin's criticisms of the IC's study.

Figures 1 and 2 summarise the percentage changes in primary factor productivity for the Tasmanian and Mainland Utilities sectors over both the historical and forecast periods. The Figures also contain the assumed percentage changes in primary factor productivity in the deviation simulation undertaken below. For Tasmanian Utilities, the average annual additional productivity improvement estimated to be brought out by NCP was 3.0 per cent (an average value for annual primary factor saving technical change of 6.0 per cent for 1993/94 to 1995/96, compared with 9.0 per cent for 1996/97 to 1998/99). The estimated NCP-induced productivity improvement for the Australian Mainland Utilities sector was considerably less. The average value for annual primary factor saving technical change for the Mainland Utilities was 7.0 per cent in the first three years and 7.7 per cent in the second three-year phase. This appears consistent with the substantial microeconomic reform that occurred in Mainland Utilities prior to the introduction of NCP. It is worth noting that over the full six years of the historical period, the annual average productivity improvements for this sector in each of the two regions are almost identical, with Tasmania's at 7.5 per cent and the Mainland's at 7.4 per cent.

In the deviation simulation, the rate of change in primary factor productivity in both the Tasmanian and Mainland Utilities sector is assumed to be the same as in the historical simulation for the period 1993/94 to 1995/96 inclusive. Then, over the second half of the historical period, primary factor productivity growth in this sector is assumed to be 3.0 and 0.7 percentage points per annum lower in Tasmania and the Mainland respectively. Over the forecast period, 1999/00-2003/04, total factor productivity growth is then assumed to return to its assumed rate of growth under the forecast simulations.

Closure

For that part of the simulations which relate to the period 1992/93 - 1998/99, the closure of the model is identical to that used in the standard decomposition simulations[4], with the exception only of the CPI-X pricing rule (see below) and the labour market adjustment mechanism.[5] Otherwise, for the period 1999/00 to 2003/04, a closure of the model that is analogous to the standard decomposition closure is employed. As was discussed earlier, certain structural, policy, and external variables were endogenous in the forecasting closure to allow for the exogenous determination of certain variables for which extraneous forecasts were available. These variables are returned to their exogenous status in the policy simulations (with the exception only of those variables relating to the CPI-X rule and the labour market adjustment rule), and shocked equal to the values that they attained under the forecasting simulations. All other exogenous variables are shocked by the same values with which they were shocked in the forecasting simulation.

The same CPI-X rule that was assumed to be operational under the historical closure and forecasting closures is also assumed to remain operational under the deviation closure. This means that the deviations in primary factor productivity will be reflected in lower profits to the regional governments owning the capital in the Utilities sector, while Utility output prices continue to track changes in the regional CPI. The question of how accurate a depiction of reality this is should be considered, given that there were some sales by regional governments of their assets in these industries over the period. Not only will this have reduced their control over output prices, it will have also reduced the sensitivity of their net revenues to the fortunes of the firms subsumed within the Utilities sector. Recall that two industries (25.*Electricity*, and 26.*Other utilities*) are subsumed within the Utilities sector. Beginning with Tasmania, effectively all the enterprises within these industries have remained government owned for the entire historical period, and are likely to remain

[4] The decomposition closure is similar to a standard short run closure. The decomposition closure is described in detail in Section 4.5 of Giesecke (2000).

[5] FEDERAL-F includes a MONASH-style labour market adjustment mechanism. This allows for a gradual return to the forecast value of regional unemployment following some shock to the model. See Section 2.12.14 of Giesecke (2000) for a discussion of the operation of the labour market adjustment mechanism.

so over the forecast period. The situation for the Mainland is less clear-cut. Starting with industry 25.*Electricity*, effectively all of Victoria's electricity assets have been privately owned since 1996/97[6], the first year of the deviation simulation. South Australia has started privatising its generation and transmission assets only in the past year. These two states account for approximately 24 per cent and 6 per cent respectively of value added in the Mainland electricity industry (ABS 1999d). State governments continue to own effectively all of the generation and transmission assets in the remaining states, suggesting that state-owned enterprises still account for roughly 70 per cent of the activity in the Mainland electricity market. Hence, in the present study, the assumption that the Mainland regional governments can set prices for 25.*Electricity*, with their profits from this industry determined endogenously, is a useful working rule although clearly only an approximation of reality. In future work, the problem of government ownership in this industry could be addressed by identifying two separate Mainland electricity industries - one essentially privately owned (and operating in South Australia and Victoria), with the remainder primarily publicly owned.

Effectively all gas industry assets are privately owned in each state, and effectively all water and sewerage assets remain government owned. Gas accounted for one-third of the value added of FEDERAL-F industry 26.*Other utilities* in 1998/99, with water and sewerage accounting for the remaining two-thirds (ABS 1999d). Since there is essentially no gas industry in Tasmania, both the application of the CPI-X rule and the allocation of GBE rentals from this industry to the Tasmanian government, are not unreasonable assumptions. The situation for the Mainland however is similar to that for the industry 25.*Electricity*. A sufficiently high proportion of the activity in *26. Other utilities* (that is, approximately one third) is accounted for by private enterprise. This suggests that for this industry, we can only cautiously proceed with the use of the CPI-X pricing rule and the allocation of GBE rentals to government. Again, in future work, this limitation could be overcome by dividing industry 26.*Other utilities* into its two sub-components (gas, and water and sewerage).

V Results

Two sets of policy simulations are undertaken. In the first set, the borrowing requirements of both the Commonwealth and regional governments are allowed to deviate from their levels in the basecase. In the second set of simulations, it is assumed that the Commonwealth and regional governments take action to ensure that these variables do not deviate from their basecase values. To ensure that government borrowing requirements do not deviate from their base levels, regional governments are assumed to vary their average payroll tax rates, and the Commonwealth government is assumed to vary its average PAYE income tax rate.

In each simulation, the regional governments are assumed to continue to fix the price of the output of Utilities equal to the regional CPI less some fixed amount[7]. In the policy simulation, the rate of productivity improvement in Utilities in each year of the period 1996/97-1998/99 is then increased relative to its basecase level, as already discussed. With the potential for changes in the price of Utilities constrained by the operation of the CPI-X rule, demand for the output of the sector is not directly affected by the productivity increase. Rather, a faster rate of efficiency growth is manifested in decreasing employment in Utilities relative to the basecase, and a falling government borrowing requirement (as the dividend receipts by the regional governments from their ownership of Utilities capital increase in the face of rising productivity and (essentially) fixed Utilities output prices).

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[6] Although the Victorian government continued to collect significant franchise fees (approximately $350m) from retailers under a five year arrangement expiring in December 2000.

[7] That is, the "X" component of the CPI-X pricing rule. As is the case in the base simulations, this continues to be 0.3 for Tasmania, and 1.3 for the Mainland in each year of the simulation period.

(i) Endogenous government financing requirements

Table 1 reports the results of the first simulation. Macroeconomic results are reported for the Tasmanian and Mainland economies, and sectoral level results are reported for Tasmania only. The deviations in the basic price of Utilities output away from it base values track the deviations in the regional consumer price index because of the operation of the CPI-X rule. In the first year of higher productivity growth (1996/97) both the Tasmanian consumer price index and hence the basic price of Utilities fall by 0.16 percentage points, relative to their basecase value. By the final year of higher productivity growth (1998/99), the deviation in both price indices reaches its minimum at 0.42 per cent below than their basecase values. Thereafter, the deviation in the two price indices from their basecase values decline, so that they both end the simulation period 0.33 per cent below their basecase forecast values. The initial fall in the Tasmanian CPI is caused by the fall in Tasmanian consumption expenditure. Real Tasmanian consumption expenditure initially falls by 0.20 per cent, and is then projected to be 0.53 percentage points lower than its basecase value by the final year of the NCP shocks (1998/99). This seems a somewhat counter-intuitive result, given that the underlying shock is one of increasing productivity growth. The key to this result is the assumption that regional governments continue to set the price of Utilities output using the CPI-X pricing rule, while not adjusting any other fiscal instrument. This ensures that none of the cost consequences of the higher rate of productivity growth are reflected in the prices paid by users of Utilities output. Rather, regional governments in this simulation operate to effectively tax away the cost gains from faster productivity growth in Utilities (via higher production tax rates), thereby incurring lower borrowing requirements.

With the price of Utilities output essentially unchanged, the output of the Tasmanian Utilities industry is also projected to be largely unaffected in the deviation run. With primary factor productivity rising in the presence of (essentially) fixed capital stocks, this implies a significant decrease in employment in Utilities. This explains the drop in Tasmanian real consumption spending. In the first year of the policy simulation, just under forty percent of payments to primary factors in the Tasmanian Utilities sector is accounted for by payments to labour. With output initially unchanged and capital stocks fixed, this translates the increase in primary factor productivity of 3 per cent into a decrease in employment of approximately 7.5 per cent in each of the shock years. Hence by the final shock year (1998/99) employment in Tasmanian Utilities is approximately 23 per cent lower than what it would otherwise have been. In the initial year of the deviation simulations, the wage bill in the Tasmanian Utilities sector is approximately 1.8 per cent of that for Tasmania as a whole. Hence the decrease in Utilities employment alone in the initial year reduces Tasmanian employment by 0.13 percentage points - just over half of the total decrease in Tasmanian employment in that year (0.23 per cent). The remaining employment decline is due to the regional multiplier effects of both lower real regional consumption and lower real regional investment expenditure. The fall in real investment reflects the fall in the regional labour / capital ratio, which is associated with a decrease in expected rates of return on capital.

The deviation in Tasmanian employment reaches its lowest point during the final year of the NCP shocks. Thereafter, Tasmanian employment begins to return to its basecase level, so that by the final year of the simulation period it is only 0.01 per cent below this level. The mechanism that returns employment to close to its basecase level is the regional real wage. Since regional populations in the model are determined by the interaction of household locational preferences and differences in inter-regional household income, regional real wages are determined endogenously. In the policy simulations, the regional real wages are assumed to adjust over a period of about five years to return the number of unemployed in each region to its basecase forecast value.

The movements in employment in the Tasmanian sub-regions tend to follow those of the state as a whole, with some divergence in the sub-regional employment growth experience being driven by differences in sub-regional industrial structure (Figure 3). Hobart and Launceston record the largest initial falls, with Northern and Southern being the two least affected regions. The ordering of the employment experiences of the sub-regions remains the same by the end of the simulation period. While Tasmanian employment is essentially unchanged by the final year, the distribution of this employment among the state's sub-regions has changed slightly: employment in Hobart is slightly lower (-0.10 per cent) than its basecase forecast level, and employment in both Southern (+0.15 per cent) and Northern (+0.24 per cent) are higher than their basecase forecast levels. Employment in the latter two regions expands because high proportions of their activity are in the Agriculture sector. The Agricultural sector expands in this simulation because, as its costs fall as a result of both the initial decrease in Tasmanian activity and the later falling real wage, its exports rise. Employment growth in Northern is further stimulated by it having a slightly higher proportion of activity in Manufacturing (the exports of which, and hence the output of which, is also rising) relative to the state as a whole, and a slightly lower proportion of activity in Utilities (employment in which is contracting due to the NCP reforms) relative to the state as a whole.

Turning now to the results for the RELMAI index, we find that all regions experience an increase in this index over the initial period of higher productivity growth (Figure 4). It will be recalled however that we have not yet turned to the fiscal impacts of this policy, so the results in Table 1 and Figure 4 can only be interpreted as the direct effects of the policy change. Figures B1 through to B6 in Appendix B decompose the total movements in RELMAI into their macro and swap effects (see Equations 42 and 43). It is clear from these diagrams that the macro effects dominate the total RELMAI results. These macro effects are driven largely by the movements in employment in each sub-region, and these movements in employment are in large-part driven by the decreasing employment in Utilities and the multiplier effects of the resulting lower level of private consumption spending. Over time however, the regional real wage falls to return the number of unemployed in Tasmania to its basecase level. This leaves total Tasmanian employment relatively unchanged, but alters the industrial composition of total employment. In particular, the decrease in the real wage causes the trade-exposed sectors such as Agriculture, Mining, and to a lesser extent, Manufacturing, to expand. This leaves employment in Southern and Northern above their basecase forecast levels by the end of the period. Hence these regions record decreases in their RELMAI indices relative to their basecase forecast values. For most regions the swap effect acts to slightly reduce the RELMAI index. This is despite the retrenchments taking place in the Utilities sector. This result occurs because voluntary movements are subdued by slower employment growth. Employment growth in the policy simulation is slower in the basecase simulation, and hence so too are the number of voluntary moves. With the number of voluntary moves lower in the policy simulation relative to the basecase, so too is the level of retraining costs.

(ii) Exogenous government financing requirements

Clearly however, the results of the first simulation provide an incomplete picture of the consequences of a faster rate of growth in productivity in the Utilities sector. A reasonable assumption is that regional governments will act to neutralise the impact of rising profits from Utilities on their net financing requirements. In the simulation reported in Table 1, by the end of 1998/99 the Tasmanian government has accumulated surpluses that total \$57 m. and the Mainland government has accumulated surpluses that total \$280 m. Table 2 presents results for simulations in which each regional government and the Commonwealth Government maintain borrowing requirements in the deviation simulation that are identical to those they achieved in the basecase. For each regional government, it is assumed that this is achieved through variations in their average rate of payroll tax. We justify this assumption on the basis of the observation that receipts of payroll tax represent the largest share of own-source revenue for regional governments. The Commonwealth Government is assumed to vary its average rate of household income tax to neutralise the impact of the scenario on its borrowing requirement.

In the first year of the simulation, the Tasmanian government must disburse approximately $16 m. in revenue through a lower rate of payroll tax. This sum represents approximately 10 per cent of total payroll tax collections for that year. However the required decrease in the average rate of payroll tax turns out to be slightly higher than this, at approximately 13 per cent in the first year. This is due in part to the fact that employment rises when the payroll tax rate is reduced. However a more important factor is that there is a change in the industrial composition of employment towards those industries subject to relatively high payroll tax rates and away from those industries subject to relatively low payroll tax rates[8]. While in absolute terms the amount of revenue that must be disbursed by the Mainland government is significantly higher than that for Tasmania, this represents a much smaller proportion of total payroll tax collections. In the first year, the Mainland regional government is only required to reduce its average payroll tax rate by 1.5 per cent. As a result, by the end of the three years of the shock period, the Tasmanian government's average payroll tax rate is projected to be 39 per cent lower than its historical value for that year. In comparison, that of the Mainland government is projected to be only 3.3 per cent lower than its historical value. The difference reflects the smaller reduction in productivity shocks to which the Mainland is subject in the deviation simulations, and the greater importance of receipts from GBE's in the total revenues of the Tasmanian regional government.

The decrease in payroll tax rates in the two regions initially causes activity in both economies to expand. For example, in the first year of the deviation simulations, real gross regional product in Tasmania and the Mainland expand by 0.16 and 0.03 per cent respectively. By the end of the three years in which the productivity shocks are administered, the increases in activity away from their historical values have increased to 0.49 and 0.05 per cent for Tasmania and the Mainland respectively. Moving into the forecast period, Tasmanian real GRP is left higher by approximately 0.2 per cent by the final year of the simulation period.

Real Tasmanian household consumption expenditure initially rises at approximately half the rate of the rise in Tasmanian employment. This reflects the fact that the non-wage income components of Tasmanian household disposable income (such as unemployment benefits, rental receipts from Mainland capital, and other government transfers) are relatively unaffected by the shock. There is a small fall in Tasmanian investment, during the first three years of the simulation period. This reflects the net effect of falling investment in Utilities, where rates of return are falling because of the decrease in the sector's labour / capital ratio. Over time, the effects of rising investment in other sectors comes to dominate the aggregate Tasmanian investment result, leaving the Tasmanian investment result equal to its basecase value by the final year of the simulation period. Real regional and Commonwealth government consumption expenditure is assumed to be unchanged from its basecase level. With Tasmanian real investment expenditure, and real private and public consumption expenditure, all growing more slowly than real GSP, Tasmania's balance of trade surplus must increase. The interstate balance of trade surplus is relatively unaffected by the shock. Interstate import volumes rise at about the same rate as the rise in real GSP, and the rise in interstate export volumes is ultimately slightly lower than the rise in interstate import volumes. Hence the requirement for Tasmania's overall balance of trade surplus to increase is manifested in an increase in the state's international balance of trade surplus. This reflects the much higher price elasticity of demand for foreign exports relative to interstate exports. Foreign import volumes into Tasmania rise

[8] For example, in 1996/97, employment in Utilities contracts by 6.63 per cent, however this industry is subject to a zero rate of payroll tax. Employment in Mining expands by 1.33 per cent, and this industry is subject to a 5.25 per cent payroll tax.

at just under twice the rate of the expansion in real output, rising by 0.29 per cent in the first year, and finishing 0.31 per cent above their basecase value in 2003/04. Real Tasmanian foreign exports initially rise by 1.11 per cent. By the last year of the productivity shocks, the expansion in real Tasmanian foreign exports peaks at 3.15 per cent. Thereafter, as the contraction in real investment expenditure begins to diminish and the regional real wage begins to rise, the expansion in foreign export volumes declines, until by 2003/04 they are 0.97 per cent higher than their basecase forecast value for that year.

The expansion in total Tasmanian foreign exports is reflected in rising exports by the more trade exposed sectors such as Mining and Manufacturing. The increase in Mining and Manufacturing exports leave the output of these two sectors the most favourably affected among the Tasmanian sectors. By the final year of the simulation period, the output of the Mining sector is 1.48 per cent above its basecase value, leaving employment in the sector 1.83 per cent above its forecast value. Around half of this expansion is attributable to the rise in the sector's export sales, with the next most important factor being rising intermediate sales to the Tasmanian Manufacturing sector. By 2003/04, output in the latter sector is projected to rise by 0.33 per cent higher than its basecase value, leaving employment in the sector higher by 0.68 per cent. Approximately two-thirds of the expansion in this sector's output is due to the rise in its foreign export volumes, with the remaining third being attributable, in approximately equal parts, to rising intermediate sales to Tasmanian and Mainland firms. The increases in activity experienced by the Agriculture, Utilities, and Finance sectors are all largely explicable in terms of rising intermediate input sales to Tasmanian firms. The rise in the output of the Margins sector tracks relatively closely the rise in aggregate activity, and reflects rising sales to both current producers and users of margin services. The increase in activity in the Entertainment sector is due largely to increasing sales to consumers, in addition to a smaller effect from rising sales to Tasmanian producers. Outputs of Public Administration and Community Services are largely unaffected, reflecting the fact that real government expenditure in the policy simulation does not change from its level in the base historical and forecast simulations. At first the output of the Construction sector contracts, tracking the decrease in Tasmanian investment expenditure, until it is 0.54 per cent below its basecase value for 1998/99. Thereafter, the sector's output begins to return towards its basecase level, again reflecting the movement in Tasmanian real investment expenditure back towards its basecase level over the same period.

Table 2 also describes the employment experiences of the Tasmanian sub-regional economies over the simulation period. These results are graphed in Figure 5. The chart shows sub-regional employment rising at first, as the payroll tax rate is reduced to disburse the extra state government revenue arising from the productivity gains in the Utilities sector. Then, over the remainder of the simulation period, the deviation in sub-regional employment begins to decline, as the real Tasmanian wage rises. As in the first simulation, the sub-regional RELMAI indices (Figure 6) follow a similar path to the sub-regional employment results, first falling as sub-regional employment rises, and then rising as the Tasmanian real wage adjusts to return Tasmanian unemployment to its basecase level.

Of the Tasmanian sub-regions, we find Launceston to be the most positively affected, in terms of labour market adjustment costs. The deviation in this region's RELMAI index peaks at 3 per cent below its basecase level, and is approximately one per cent below its basecase level by the final year of the simulation period. The deviation in Launceston's RELMAI index is due almost entirely to the macro effect (Figure 5, Appendix C), which can in turn be traced to the employment result for this sub-region. Examining the employment results for Launceston, we find that this region experiences the largest positive deviation in employment (+0.35 per cent), and employment in the region remains above (+0.07 per cent) its basecase level in the final year of the simulation, by which time the Tasmanian employment deviation has returned to zero. The expansion in Launceston's employment is attributable to the region having relatively high shares of its activity in the Manufacturing and Margins sectors (both of which are expanding) and a relatively low share of its activity in the Utilities sector (which is experiencing significant employment contraction). The Tasmanian sub-region that benefits the least from the shocks, in terms of labour market adjustment costs, is Southern. Again, the results for this sub-region's RELMAI index tracks its employment experience: of the Tasmanian sub-regions, Southern (along with Hobart in the first three years of the period) tends to be the region that experiences the lowest gain in employment, reflecting the relatively large share of its activity in Utilities (which is contracting) and the relatively low share of its activity in Manufacturing (which is expanding).

VI Conclusions

The modelling in this paper has introduced four new features to the CGE modelling of NCP. First, the calculation of the NCP related shocks was informed by a comparison of the pre- and post-NCP productivity performances of the Utilities industries. Previous studies have based these shocks on estimates of the gaps between actual and best-practice productivity, raising questions about the legitimacy of attributing the closure in this productivity gap to NCP, and the proper specification of the counter-factual. The second novel feature of this study is the use of a multi-regional dynamic model. Previous studies of the regional consequences of NCP have used comparative static models. Thirdly, the modelling has been informed by a greater attention to the fiscal dimension of microeconomic reform than has been paid in previous studies. In particular, both the role of regional governments in setting the price of Utilities output, and the impact of changing GBE profitability on the fiscal positions of regional governments, were explicit elements of the modelling. Finally, to investigate the regional consequences of NCP for Tasmania, a top-down decomposition of the Tasmanian results to sub-state regions using an ORES style regional extension was undertaken, with the results from this modelling exercise then being input to a model which calculated an index of regional labour market adjustment costs.

Madden (2000) noted that one of the factors blamed for the widely perceived increase in the economic divide between capital cities and regional Australia has been NCP. The Productivity Commission (1999c) also stated that "NCP is widely perceived as being responsible for the withdrawal of government services, the demise of local businesses, the closure of country bank branches and is regarded by some as a major factor behind the population decline in parts of country Australia". The results of the modelling in this paper do not lend any clear support to the proposition that a higher pace of productivity growth in the Utilities sector has added significantly to either the economic or social disadvantage of Tasmania and its sub-regions. On the contrary, it is apparent that the increase in productivity growth between 1996/97 and 1998/99 improved the major Tasmanian indicators of economic advantage. The state's population is projected to be approximately 0.01 per cent higher than what it would otherwise have been. Real consumption per capita is projected to be approximately 0.2 per cent higher than what it would otherwise have been. Real gross regional product is projected to be approximately 0.25 per cent higher than what it would otherwise have been.

Overall, the benefits of NCP appear to outweigh the costs for an economy like Tasmania. However, NCP is clearly associated with adjustment costs, as is borne out by the substantial employment declines in the Utilities sector. However adjustment costs are mitigated in other sectors, where employment is projected to be higher in the presence of faster productivity growth. Moreover, overall adjustment costs in Tasmania and its sub-regions are dominated by what happens to total regional employment. At the sub-regional level, all regions initially gained in employment during the initial period of the simulation, before tending back towards their baseline levels as the Tasmanian real wage adjusts to clear the Tasmanian labour market. This caused the deviations in all the regional RELMAI indices to be negative initially, before tending towards zero change as the Tasmanian real wage adjusted upwards to clear the Tasmanian labour market.

These benign findings should however be qualified by noting that they relate only to the particular case examined here, and may be sensitive to the modelling assumptions that are employed. There are two main points to be made in this regard. First, the sub-regional employment results (and hence the sub-regional RELMAI indices) were strongly influenced by our assumption on how the extra state government revenue generated by the reforms was recycled. Just as in any type of economic impact analysis, one's conclusions about the impact of the policy on the variable of interest will be influenced by what relationships are, and what relationships are not, included in the analysis. In the example in this paper, the initial impact of NCP on regional labour market adjustment costs were relatively large. Using the results in Table 1, we can see that the higher rates of productivity growth in the Utilities sectors under NCP would have been associated with significant labour shedding in this sector and a consequent decrease in regional employment. Over time, the deviation in the value of regional lost labour inputs tends to return to its basecase level as the real wage adjusts, but the results in Table 1 nevertheless tell a story of relatively large initial increases in labour market adjustment costs, and, furthermore, a relatively diverse range of regional labour market experiences by the final year of the simulation period (by which time the Tasmanian real wage has returned to close to its equilibrium value). In the present simulations we have been careful to consider the fiscal impacts of the NCP reforms. In particular, we modelled Utilities pricing as being determined by an indexing relationship with the regional CPI, with the profitability of the sector adjusting to accommodate this pricing rule. The introduction of a faster rate of productivity growth in the Utilities sector under this pricing rule causes the dividend receipts of the Tasmanian government to increase. We modelled the Tasmanian government as following a policy of no-change in its borrowing requirement (relative to its basecase borrowing requirement), and so the extra receipts of Utilities dividends were disbursed in the form of lower rates of payroll taxation. Since nearly all industries in all regions pay payroll tax, in the short-run the employment gains from this instrument were widely diffused. However, if the revenue gains from NCP had been disbursed in a more geographically-focussed manner (for example, increased public consumption expenditure in, say, Hobart) then for some regions the initial effects of the NCP reforms (characterised by falling employment as employment in Utilities contracts) would have dominated the sub-regional RELMAI results.

The second qualification to our benign conclusion regarding the regional adjustment costs of NCP relates to the fact that, in the Tasmanian case at least, the differences in the importance of Utilities activity between the Tasmanian sub-regions is relatively small. Hence, in the present simulations, no region suffered a large contraction in employment arising from decreased Utilities employment, relative to any other Tasmanian region. However it seems unlikely that this is a result peculiar to the Tasmanian case. The Productivity Commission (1999b), also using an ORES-style decomposition (although of national, not regional, results) found that NCP increased gross regional product in all statistical divisions other than Gippsland in Victoria. A large share of activity in the latter region is accounted for by electricity generation, a sector directly affected by the simulations they undertook. For all other statistical divisions however, indirect employment gains offset the direct employment losses from NCP.

In the present simulations, we found that the bulk of the changes in the RELMAI indices were accounted for by the macro effect. The macro effect is determined by what happens to aggregate employment in the region in question. This suggests that modelling the regional employment results from a given policy change may often be a good proxy for the amount of labour market adjustment imposed on a region by a policy reform. Further work might be warranted on the calculation of the regional RELMAI index however, particularly in considering further whether additional costs should be incorporated into the calculation to capture migration costs and social disruption. It may turn out, however, that even a RELMAI index augmented in this way would still be largely determined by the regional employment result.

The development of the RELMAI model can proceed in a number of ways in the future. First, in the present paper, the weights in Equation (1) were set equal to their values in Dixon and Rimmer (1999). This approach for assigning values to these weights had the two advantages of, firstly, allowing the modelling work in the project to proceed without spending large amounts of time on the less important task of fine-tuning the values for these weights, and, second, allowing the weighted sum of the values for the RELMAI index to be compared with the national LILI index. While we have been satisfied with the values for these weights for the purpose of the present paper, future work could focus on obtaining better estimates for the values of these weights. Also, the scope of the types of costs that are covered by these weights could be expanded to include costs other than just the foregone labour input. These costs might be as simple as moving costs (transport and storage), but might also include an attempt to consider the less tangible costs (such as social disruption as people leave existing communities to join unfamiliar ones) of regional adjustment. Without wanting to prematurely rule-out the utility of investigating these types of costs, our expectation is that while their inclusion may change the base levels of adjustment costs, they are unlikely to materially affect the direction or size of the change (in percentage change terms) of these costs in the policy simulations.

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APPENDIX A: (I) VARIABLES AND PARAMETERS OF THE RELMAI MODEL

NAME	DESCRIPTION
$RELMAI_r$	Regional LILI index.
$E\_ESC\_SR_r$	Number of workers remaining employed in the same category in the same region.
$E\_ESC\_OR_r$	This set is empty of workers.
α	Fraction of workforce that retires.
E_TINVR_r	Number of retrenchments in region (r).
$TVACR_r$	Vacancies in year (t) to (t+1), i.e. jobs available to those without jobs.
ER_T1_r	Employment in (r) in (t+1).
ER_T_r	Employment in (r) in (t).
$TINV\_E\_SR_r$	Number of retrenched workers in (r) who are re-employed in (r).
ζ_r	Proportion of retrenched (r) workers who remain in (r).
λ_r	Proportion of unemployed in region (r) who stay in (r)
ρ_r	Proportion of those not in the labour force in region (r) who remain in (r).
E_sh_r	Region (r)'s share of total employment.
UR_T_r	Number of unemployed in region (r).
$NLFR_r$	People of working age who are not in the labour force.
$TINV\_E\_OR_r$	Number of retrenched workers from (r) re-employed in a region other than (r).
$TINV\_ER_r$	Total number of retrenched workers from (r) who find re-employment.
$E\_EOC\_SR_r$	Movement of workers to employment in another category, within the same region.
$E\_EOC\_OR_r$	Movement of workers to employment in another category, within another region.
E_EOCR_r	People from (r) moving from emp. in one category to emp. in another category.
$E\_U\_SR_r$	Movement of people from employment to unemployment, within the same region.
$E\_U\_OR_r$	Movement of people from employment in (r) to unemployment in some other region.
E_UR_r	Total number of region (r) persons moving from employment to unemployment.
$E\_NLF\_SR_r$	Movement from employment to outside the labour force, within the same region.
$E\_NLF\_OR_r$	Movement from employment in (r) to outside of the labour force in some other region.
κ_r	Proportion of newly retireds who stay in their region.
E_NLFR_r	Movement from employed in (r) to NLF in any region.
$U\_NLF\_SR_r$	Movement of unemployed to NLF from (r) who stay in (r).
$U\_NLF\_OR_r$	Movement of unemployed to NLF from (r) who move to another region.
U_NLFR_r	Movement from unemployed in (r) to NLF in any region.
$U\_E\_SR_r$	Movement of unemployed from (r) to employment in (r).
$U\_E\_OR_r$	Movement of unemployed from (r) to employment elsewhere.
U_ER_r	Total movement of unemployed from (r) to employment somewhere.
$NLF\_E\_SR_r$	Movement of NLF from (r) to employment in (r).
$NLF\_E\_OR_r$	Movement of NLF from (r) to employment elsewhere.
NLF_ER_r	Total movement of NLF from (r) to employment somewhere.
U_UR_r	Number of unemployed workers in (r) who remain unemployed somewhere.
$U\_U\_SR_r$	Number of unemployed workers in (r) who remain unemployed in (r).
$U\_U\_OR_r$	Number of unemployed workers in (r) who remain unemployed outside(r).
NLF_UR_r	Number of NLF in (r) who become unemployed somewhere.
$NLF\_U\_SR_r$	Number of NLF in (r) who become unemployed in (r).
$NLF\_U\_OR_r$	Number of NLF in (r) who become unemployed outside(r).
$NLF\_NLF\_R_r$	NLF from (r) who remain NLF somewhere.
$NLF\_NLF\_SR_r$	NLF from (r) who remain NLF in (r).
$NLF\_NLF\_OR_r$	NLF from (r) who remain NLF somewhere other than (r).
$V^{o,j,r}_{u,k,t}$	Voluntary moves from employment in category (ojr) to employment in category (ukt).
φ	Controls the extent of overall voluntary moves, set so that 5 per cent of workers move.
$S_{o,j,r}$	Share of employment in category (ojr) in total employment.
$\Delta^{o,j,r}_{u,k,t}$	Measure of the closeness of employment categories (o,j,r) and (u,k,t).

$VD_{o,j,r}$	Voluntary departures from category (ojr) to employment elsewhere.
γ	Proportion of jobs available to unemployed and n.l.f. taken by the unemployed.
SER_r	Regional swap effect.
MER_r	Regional macro effect.
U_AVG_r	Average regional unemployment.
Range: o∈ OCC, u∈ OCC, j∈ IND, k∈ IND, r∈ REG, t∈ REG.	

(II) EQUATIONS OF THE RELMAI MODEL

(1)
$$\begin{aligned} RELMAI_r &= (100/LFR\_T_r)\times \\ &(E\_ESC\_SR_r \times [0.00] + E\_ESC\_OR_r \times [0.00] + E\_EOC\_SR_r \times [0.25] + E\_EOC\_OR_r \times [0.25] + \\ &E\_U\_SR_r \times [0.50] + E\_U\_OR_r \times [0.50] + E\_NLF\_SR_r \times [0.00] + E\_NLF\_OR_r \times [0.00] + \\ &U\_E\_SR_r \times [0.75] + U\_E\_OR_r \times [0.75] + U\_U\_SR_r \times [1.00] + U\_U\_OR_r \times [1.00] + \\ &U\_NLF\_SR_r \times [0.50] + U\_NLF\_OR_r \times [0.50] + NLF\_E\_SR_r \times [0.25] + NLF\_E\_OR_r \times [0.25] + \\ &NLF\_U\_SR_r \times [0.50] + NLF\_U\_OR_r \times [0.50] + NLF\_NLF\_SR_r \times [0.00] + NLF\_NLF\_OR_r \times [0.00]); \end{aligned}$$

(2) $$E\_ESC\_SR_r = \sum_{o\in OCC}\sum_{j\in IND} MIN\left[(1-á)\times E\_T_{ojr} - VD_{ojr},\ E\_T1_{ojr}\right]$$

(3) $$E\_ESC\_OR_r = 0$$

(4) $$E\_TINVR_r = \sum_{o\in OCC}\sum_{j\in IND} MAX\left[0, (1-á)\times E\_T_{ojr} - VD_{ojr} - E\_T1_{ojr}\right]$$

(5) $$TVACR_r = ER\_T1_r - [(1-á)\times ER\_T_r - E\_TINVR_r]$$

(6) $$ER\_T_r = \sum_{o\in OCC}\sum_{j\in IND} E\_T_{ojr}$$

(7) $$ER\_T1_r = \sum_{o\in OCC}\sum_{j\in IND} E\_T1_{ojr}$$

(8) $$TINV\_E\_SR_r = MIN\left[\boldsymbol{z}_r \times E\_TINVR_r/2,\ TVACR_r \times \left(2\times E\_TINVR_r \times \boldsymbol{z}_r\right)/LDEN_r\right]$$

where $$LDEN_r = (2\times E\_TINVR_r \times \boldsymbol{z}_r) + (E\_Sh_r \times \sum_{i\neq r}(1-\boldsymbol{z}_i)\times E\_TINVR_i) + (\boldsymbol{l}_r \times UR\_T_r + E\_sh_r \times \sum_{i\neq r}(1-\boldsymbol{l}_i)\times UR\_T_i) + (0.25\times[\boldsymbol{r}_r \times NLFR_r + E\_Sh_r \times \sum_{i\neq r}(1-\boldsymbol{r}_i)\times NLFR_i)$$

(9) $$TINV\_E\_OR_r = MIN[(1-æ_r)E\_TINVR_r/2, \sum_{t\neq r} TVACR_t\ \left(2\ E\_TINVR_r\ (1-æ_r)\right)\Big/\sum_{t\neq r} LDEN_t]$$

(10) $$TINV\_ER_r = TINV\_E\_OR_r + TINV\_E\_SR_r$$

(11) $$UR\_T_r = LFR\_T_r - ER\_T_r$$

(12) $$E\_Sh_r = ER\_T_r \Big/ \sum_k ER\_T_k$$

(13) $$NLFR_r = WPOPR\_T_r - LFR\_T_r$$

(14) $$E\_EOC\_SR(r) = TINV\_E\_SR(r) + \sum_{o\in OCC}\sum_{j\in IND}\sum_{o\in OCC}\sum_{j\in IND} V_{(u,k,r)}^{(o,j,r)} - \sum_{i\in OCC}\sum_{t\in IND} V_{(i,t,r)}^{(i,t,r)}$$

(15) $$E\_EOC\_OR_r = TINV\_E\_OR_r + \sum_{o\in OCC}\sum_{j\in IND}\sum_{u\in OCC}\sum_{k\in IND}\sum_{t\in REG} V_{(u,k,t)}^{(o,j,r)} - \sum_{o\in OCC}\sum_{j\in IND}\sum_{u\in OCC}\sum_{k\in IND} V_{(u,k,r)}^{(o,j,r)}$$

(16) $$E\_EOCR_r = E\_EOC\_OR_r + E\_EOC\_SR_r$$

$$(17)\ \ E\_U\_SR_{r} = \boldsymbol{z}_{r} \times E\_TINVR_{r} - TINV\_E\_SR_{r}$$
$$(18)\ \ E\_U\_OR_{r} = (1 - \boldsymbol{z}_{r}) \times E\_TINVR_{r} - TINV\_E\_OR_{r}$$
$$(19)\ \ E\_UR_{r} = E\_U\_SR_{r} + E\_U\_OR_{r}$$
$$(20)\ \ E\_NLF\_SR_{r} = [á \times ER\_T_{r}] \times ê_{r}$$
$$(21)\ \ E\_NLF\_OR_{r} = [á \times ER\_T_{r}] \times (1 - ê_{r})$$
$$(22)\ \ E\_NLFR_{r} = E\_NLF\_SR_{r} + E\_NLF\_OR_{r}$$
$$(23)\ \ U\_NLF\_SR_{r} = [á \times UR\_T_{r}] \times ê_{r}$$
$$(24)\ \ U\_NLF\_OR_{r} = [á \times UR\_T_{r}] \times (1 - ê_{r})$$
$$(25)\ \ U\_NLFR_{r} = U\_NLF\_SR_{r} + U\_NLF\_OR_{r}$$
$$(26)\ \ U\_E\_SR_{r} = MAX\left[0, ë_{r} \times ã \times \left(ER\_T1_{r} - (1 - á) \times ER\_T_{r} + E\_UR_{r}\right)\right]$$
$$(27)\ \ U\_E\_OR_{r} = \sum_{k \neq r} \left(UR\_T_{r} \Big/ \sum_{h \neq k} UR\_T_{h} \right) \times MAX\left[0, \left((1 - ë_{k})ã\right)\left(ER\_T1_{k} - (1 - á) \times ER\_T_{k} + E\_UR_{k}\right)\right]$$
$$(28)\ \ U\_ER_{r} = U\_E\_SR_{r} + U\_E\_OR_{r}$$
$$(29)\ \ NLF\_E\_SR_{r} = MAX\left[0, ñ_{r} \times (1 - ã) \times \left(ER\_T1_{r} - (1 - á) \times ER\_T_{r} + E\_UR_{r}\right)\right]$$
$$(30)\ \ NLF\_E\_OR_{r} = \sum_{k \neq r} \left(\frac{NLFR_{r}}{\sum_{h \neq k} NLFR_{h}} \right) \times MAX\left[0, \left((1 - ñ_{k})(1 - ã)\right)\left(ER\_T1_{k} - (1 - á) \times ER\_T_{k} + E\_UR_{k}\right)\right]$$
$$(31)\ \ NLF\_ER_{r} = NLF\_E\_SR_{r} + NLF\_E\_OR_{r}$$
$$(32)\ \ U\_U\_SR_{r} = ë_{r} \times \left(UR\_T_{r} - U\_ER_{r} - U\_NLFR_{r}\right)$$
$$(33)\ \ U\_U\_OR_{r} = (1 - ë_{r}) \times \left(UR\_T_{r} - U\_ER_{r} - U\_NLFR_{r}\right)$$
$$(34)\ \ U\_UR_{r} = U\_U\_SR_{r} + U\_U\_OR_{r}$$
$$(35)\ \ NLF\_U\_SR_{r} = ë_{r}\left[\left(LFR\_T1_{r} - (1 - á)LFR\_T_{r}\right) - NLF\_ER_{r}\right]$$
$$(36)\ \ NLF\_U\_OR_{r} = \left(1 - ë_{r}\right)\left[\left(LFR\_T1_{r} - (1 - á)LFR\_T_{r}\right) - NLF\_ER_{r}\right]$$
$$(37)\ \ NLF\_UR_{r} = NLF\_U\_SR_{r} + NLF\_U\_OR_{r}$$
$$(38)\ \ NLF\_NLF\_SR_{r} = ñ_{r} \times [NLFR_{r} - NLF\_ER_{r} - NLF\_UR_{r}]$$
$$(39)\ \ NLF\_NLF\_OR_{r} = (1 - ñ_{r}) \times [NLFR_{r} - NLF\_ER_{r} - NLF\_UR_{r}]$$
$$(40)\ \ V_{u,k,t}^{o,j,r} = ö\left(S_{o,j,r} \times Ä_{u,k,t}^{o,j,r}\right) \times MAX\left[0, E\_T1_{u,k,t} - (1 - á) \times E\_T_{u,k,t} + VD_{u,k,t}\right]$$
$$(41)\ VD_{o,j,r} = \sum_{u \neq o} \sum_{k \neq j} \sum_{t \neq r} V_{u,k,t}^{o,j,r}$$
$$(42)\ \ SER_{r} = 0.25 * \left(E\_EOCR_{r} + MIN\left[U\_ER_{r} + NLF\_ER_{r}, E\_UR_{r} + E\_NLFR_{r}\right]\right) \times 100 / LFR\_T_{r}$$
$$(43)\ \ MER_{r} = \left(U\_AVG_{r} + 0.25 \times MAX\left[0, ER\_T1_{r} - ER\_T_{r}\right]\right) \times 100 / LFR\_T_{r}$$

where: $U\_AVG_{r} = UR\_T_{r} + 0.5 \times \left(E\_UR_{r} + NLF\_UR_{r} - U\_ER_{r} - U\_NLFR_{r}\right)$

Table 1

Percentage Deviation from Baseline, PSBR's Endogenous

Variable*	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Real GDP (factor cost)	-0.08	-0.11	-0.11	-0.01	0.08	0.11	0.13	0.17
	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04
Real investment	-0.68	-1.03	-1.36	-0.86	-0.60	-0.42	-0.35	-0.21
	-0.05	-0.09	-0.16	-0.11	-0.06	-0.05	-0.03	0.00
Real consumption	-0.20	-0.37	-0.53	-0.43	-0.30	-0.33	-0.34	-0.24
	-0.03	-0.04	-0.05	-0.04	-0.01	-0.01	-0.01	0.01
Real foreign exports	0.50	0.93	1.62	1.80	1.98	2.08	2.20	2.19
	0.17	0.26	0.40	0.30	0.23	0.20	0.18	0.15
Real foreign imports	-0.02	0.03	0.12	0.22	0.31	0.36	0.38	0.38
	-0.01	-0.02	-0.03	-0.01	0.01	0.02	0.02	0.03
Real regional government	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Real Commonwealth	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
government consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Real interstate exports	0.06	0.12	0.24	0.26	0.30	0.31	0.32	0.32
	-0.20	-0.32	-0.38	-0.20	-0.07	-0.03	-0.02	0.05
Real interstate imports	-0.20	-0.32	-0.38	-0.20	-0.07	-0.03	-0.02	0.05
	0.06	0.12	0.24	0.26	0.30	0.31	0.32	0.32
GSP deflator	-0.15	-0.28	-0.42	-0.40	-0.38	-0.43	-0.47	-0.40
	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Employment	-0.23	-0.38	-0.50	-0.33	-0.19	-0.13	-0.08	-0.01
	-0.01	-0.01	-0.02	-0.01	0.00	0.00	0.01	0.01
Capital stock (rental	0.02	0.05	0.12	0.19	0.27	0.37	0.46	0.53
weights)	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
Capital stock (asset value	0.00	-0.04	-0.10	-0.16	-0.20	-0.22	-0.23	-0.24
weights)	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.03	-0.03
Consumer price index	-0.16	-0.29	-0.42	-0.40	-0.36	-0.38	-0.39	-0.33
	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Population	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
State borrowing	-16.33	-17.58	-23.43	-1.65	-5.09	-3.39	-2.55	-3.46
requirements	-101.20	-80.36	-98.49	4.61	-15.67	-3.80	-5.41	-24.35
Payroll tax rates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Federal borrowing requirement	49.10	44.18	63.55	-33.14	-55.13	-11.25	-10.37	-27.35
Federal income tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unemployment	1.81	2.91	4.19	3.20	2.10	1.32	0.88	-0.09
	0.09	0.15	0.24	0.15	-0.01	-0.06	-0.10	-0.12
**unless otherwise indicated, the first row contains the Tasmanian results and the second row contains the Mainland results*								
Tasmanian Sectoral Outputs								
1. Agriculture	0.11	0.25	0.44	0.47	0.56	0.59	0.62	0.62
2. Mining	0.38	0.95	1.47	1.85	1.96	2.10	2.27	2.10
3. Manufacturing	0.09	0.25	0.45	0.51	0.63	0.69	0.76	0.75
4. Utilities	0.05	0.10	0.25	0.29	0.36	0.38	0.43	0.49
5. Construction	-0.65	-0.99	-1.36	-0.86	-0.60	-0.44	-0.37	-0.22
6. Margin industries	-0.16	-0.27	-0.32	-0.20	-0.07	-0.06	-0.05	0.03
7. Communications	-0.25	-0.43	-0.61	-0.48	-0.30	-0.33	-0.34	-0.22
8. Finance	-0.12	-0.21	-0.26	-0.16	-0.05	-0.04	-0.02	0.03
9. Dwellings	0.00	-0.05	-0.12	-0.16	-0.20	-0.23	-0.24	-0.26
10. Public administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11. Community services	-0.11	-0.19	-0.25	-0.19	-0.11	-0.12	-0.12	-0.06
12. Entertainment and recreation	-0.20	-0.36	-0.51	-0.38	-0.21	-0.21	-0.21	-0.10

Variable	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Tasmanian Sectoral Basic Prices								
1. Agriculture	0.00	-0.02	-0.06	-0.09	-0.13	-0.13	-0.13	-0.14
2. Mining	-0.01	-0.07	-0.15	-0.18	-0.24	-0.27	-0.29	-0.29
3. Manufacturing	-0.03	-0.06	-0.12	-0.15	-0.19	-0.20	-0.22	-0.22
4. Utilities	-0.16	-0.29	-0.42	-0.40	-0.36	-0.38	-0.39	-0.33
5. Construction	-0.12	-0.21	-0.31	-0.34	-0.39	-0.42	-0.44	-0.43
6. Margin industries	-0.14	-0.25	-0.37	-0.38	-0.40	-0.42	-0.44	-0.42
7. Communications	-0.04	-0.10	-0.18	-0.22	-0.26	-0.27	-0.27	-0.26
8. Finance	-0.11	-0.23	-0.37	-0.42	-0.46	-0.50	-0.52	-0.50
9. Dwellings	-0.54	-0.91	-1.23	-0.95	-0.63	-0.68	-0.68	-0.42
10. Public administration	-0.08	-0.19	-0.33	-0.42	-0.48	-0.52	-0.54	-0.52
11. Community services	-0.08	-0.19	-0.33	-0.43	-0.50	-0.54	-0.56	-0.55
12. Entertainment and recreation	-0.18	-0.33	-0.50	-0.53	-0.56	-0.60	-0.62	-0.60
Tasmanian Sectoral Employments								
1. Agriculture	0.18	0.42	0.71	0.81	0.93	0.99	1.05	1.04
2. Mining	0.47	1.11	1.69	2.16	2.24	2.38	2.54	2.34
3. Manufacturing	0.12	0.35	0.62	0.75	0.89	0.98	1.06	1.06
4. Utilities	-7.26	-14.83	-23.17	-22.93	-22.62	-22.34	-22.07	-21.61
5. Construction	-0.72	-1.07	-1.44	-0.91	-0.65	-0.48	-0.41	-0.25
6. Margin industries	-0.22	-0.36	-0.42	-0.24	-0.09	-0.08	-0.07	0.02
7. Communications	-0.25	-0.44	-0.62	-0.48	-0.31	-0.33	-0.34	-0.23
8. Finance	-0.16	-0.25	-0.30	-0.17	-0.06	-0.04	-0.03	0.03
9. Dwellings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Public administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11. Community services	-0.11	-0.19	-0.26	-0.19	-0.11	-0.12	-0.12	-0.07
12. Entertainment and recreation	-0.27	-0.47	-0.65	-0.47	-0.27	-0.27	-0.27	-0.14
Regional GDP								
Hobart	-0.12	-0.19	-0.23	-0.13	-0.02	0.00	0.02	0.07
Southern	-0.05	-0.06	-0.04	0.04	0.15	0.18	0.22	0.28
Launceston	-0.08	-0.11	-0.09	0.03	0.14	0.18	0.21	0.24
Northern	-0.03	0.01	0.07	0.18	0.28	0.32	0.35	0.38
Mersey_Lyell	-0.03	-0.03	-0.02	0.05	0.11	0.12	0.14	0.16
Regional Employment								
Hobart	-0.25	-0.42	-0.57	-0.41	-0.27	-0.22	-0.18	-0.10
Southern	-0.19	-0.30	-0.37	-0.21	-0.06	0.01	0.08	0.15
Launceston	-0.23	-0.38	-0.50	-0.33	-0.18	-0.12	-0.07	0.00
Northern	-0.15	-0.22	-0.25	-0.09	0.05	0.13	0.19	0.24
Mersey_Lyell	-0.21	-0.35	-0.46	-0.28	-0.15	-0.08	-0.03	0.03
RELMAI Index								
Hobart	0.11	2.83	4.64	5.75	4.81	3.72	2.80	2.43
Southern	0.22	1.37	2.13	2.52	1.53	0.39	-0.41	-1.46
Launceston	0.14	2.26	3.66	4.36	3.36	2.16	1.32	0.72
Northern	0.17	1.04	1.51	1.54	0.48	-0.72	-1.83	-3.70
Mersey_Lyell	0.00	2.11	2.64	3.18	2.10	1.17	0.59	0.08
Rest of Australia	0.01	0.02	0.02	0.01	-0.08	-0.21	-0.25	-0.24

Table 2

Percentage Deviation from Baseline, PSBR's Exogenous

Variable*	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Real GDP (factor cost)	0.16	0.34	0.49	0.39	0.32	0.26	0.23	0.21
	0.03	0.04	0.05	0.03	0.03	0.03	0.03	0.03
Real investment	-0.16	-0.17	-0.48	-0.24	-0.13	-0.11	-0.09	0.00
	0.01	-0.04	-0.11	-0.07	-0.07	-0.06	-0.03	-0.01
Real consumption	0.05	0.12	0.19	0.18	0.21	0.17	0.17	0.22
	0.02	0.03	0.03	0.02	0.03	0.02	0.03	0.04
Real foreign exports	1.11	1.97	3.15	2.50	1.89	1.61	1.38	0.97
	0.10	0.16	0.28	0.15	0.10	0.08	0.04	0.01
Real foreign imports	0.29	0.60	0.93	0.72	0.55	0.47	0.40	0.31
	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05
Real regional government	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Real Commonwealth government	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Real interstate exports	0.21	0.36	0.56	0.39	0.28	0.22	0.18	0.13
	0.13	0.29	0.39	0.34	0.29	0.23	0.19	0.18
Real interstate imports	0.13	0.29	0.39	0.34	0.29	0.23	0.19	0.18
	0.21	0.36	0.56	0.39	0.28	0.22	0.18	0.13
GSP deflator	-0.14	-0.20	-0.27	-0.09	0.04	0.04	0.06	0.12
	0.01	0.03	0.03	0.04	0.04	0.04	0.04	0.03
Employment	0.09	0.19	0.25	0.16	0.08	0.04	0.01	0.00
	0.02	0.03	0.02	0.01	-0.01	-0.01	0.00	0.00
Capital stock (rental weights)	0.03	0.09	0.22	0.32	0.43	0.56	0.67	0.76
	0.01	0.02	0.04	0.05	0.06	0.06	0.07	0.08
Capital stock (asset value weights)	0.00	-0.01	-0.02	-0.04	-0.05	-0.05	-0.05	-0.05
	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.02
Consumer price index	-0.09	-0.14	-0.20	-0.12	-0.05	-0.05	-0.04	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Population	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
State borrowing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
requirements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Payroll tax rates	-13.11	-25.90	-39.41	-35.54	-34.97	-30.56	-28.89	-25.32
	-1.47	-2.39	-3.28	-2.51	-2.24	-1.94	-1.75	-1.77
Federal borrowing requirement	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Federal income tax	-0.08	-0.08	-0.07	0.02	0.02	0.03	0.02	-0.01
Unemployment	-0.73	-1.46	-2.07	-1.49	-0.79	-0.23	0.00	0.12
	-0.26	-0.28	-0.31	-0.08	0.10	0.09	0.04	-0.01
**unless otherwise indicated, the first row contains the Tasmanian results and the second row contains the Mainland results*								
Tasmanian Sectoral Outputs								
1. Agriculture	0.16	0.30	0.41	0.18	0.07	0.01	-0.02	-0.08
2. Mining	1.09	2.39	3.28	2.95	2.37	2.14	1.95	1.48
3. Manufacturing	0.43	0.88	1.31	0.95	0.70	0.59	0.49	0.33
4. Utilities	0.30	0.61	0.99	0.76	0.56	0.46	0.40	0.33
5. Construction	-0.19	-0.23	-0.54	-0.28	-0.16	-0.14	-0.12	-0.01
6. Margin industries	0.13	0.28	0.45	0.39	0.36	0.30	0.28	0.28
7. Communications	0.06	0.16	0.22	0.20	0.21	0.16	0.15	0.21
8. Finance	0.13	0.28	0.40	0.33	0.29	0.23	0.20	0.19
9. Dwellings	0.00	0.01	0.04	0.06	0.07	0.09	0.10	0.11
10. Public administration	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00
11. Community services	0.01	0.04	0.05	0.04	0.06	0.03	0.03	0.06
12. Entertainment and recreation	0.10	0.22	0.31	0.26	0.26	0.20	0.18	0.22

Variable	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Tasmanian Sectoral Basic Prices								
1. Agriculture	-0.02	-0.02	-0.03	0.01	0.02	0.04	0.04	0.04
2. Mining	-0.12	-0.28	-0.45	-0.33	-0.27	-0.24	-0.21	-0.17
3. Manufacturing	-0.13	-0.23	-0.35	-0.25	-0.20	-0.18	-0.16	-0.14
4. Utilities	-0.09	-0.14	-0.20	-0.12	-0.05	-0.05	-0.04	0.01
5. Construction	-0.18	-0.32	-0.47	-0.34	-0.26	-0.22	-0.19	-0.14
6. Margin industries	-0.16	-0.29	-0.41	-0.31	-0.23	-0.21	-0.18	-0.13
7. Communications	-0.09	-0.15	-0.20	-0.11	-0.07	-0.05	-0.04	-0.02
8. Finance	-0.21	-0.38	-0.57	-0.42	-0.31	-0.27	-0.22	-0.16
9. Dwellings	0.01	0.08	0.10	0.11	0.16	0.07	0.07	0.18
10. Public administration	-0.05	-0.07	-0.07	0.02	0.08	0.10	0.11	0.13
11. Community services	-0.04	-0.05	-0.04	0.04	0.10	0.12	0.13	0.15
12. Entertainment and recreation	-0.16	-0.28	-0.42	-0.29	-0.20	-0.17	-0.13	-0.08
Tasmanian Sectoral Employments								
1. Agriculture	0.26	0.49	0.67	0.40	0.22	0.15	0.09	-0.01
2. Mining	1.33	2.77	3.76	3.46	2.80	2.55	2.33	1.83
3. Manufacturing	0.57	1.20	1.78	1.41	1.11	0.99	0.87	0.68
4. Utilities	-6.63	-13.45	-20.95	-21.35	-21.62	-21.64	-21.64	-21.43
5. Construction	-0.20	-0.24	-0.57	-0.30	-0.17	-0.15	-0.13	-0.02
6. Margin industries	0.19	0.40	0.62	0.55	0.49	0.41	0.38	0.38
7. Communications	0.06	0.16	0.23	0.20	0.22	0.16	0.16	0.21
8. Finance	0.17	0.35	0.49	0.41	0.36	0.30	0.26	0.25
9. Dwellings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Public administration	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00
11. Community services	0.01	0.04	0.05	0.04	0.06	0.03	0.03	0.06
12. Entertainment and recreation	0.13	0.28	0.40	0.33	0.31	0.25	0.22	0.26
Regional GDP								
Hobart	0.12	0.26	0.38	0.29	0.24	0.19	0.16	0.15
Southern	0.14	0.29	0.40	0.26	0.19	0.14	0.12	0.11
Launceston	0.22	0.45	0.68	0.52	0.41	0.33	0.28	0.22
Northern	0.20	0.43	0.61	0.46	0.36	0.29	0.25	0.21
Mersey_Lyell	0.17	0.37	0.50	0.44	0.37	0.33	0.30	0.28
Regional Employment								
Hobart	0.06	0.13	0.17	0.10	0.05	0.01	0.00	0.00
Southern	0.08	0.16	0.20	0.08	-0.01	-0.06	-0.08	-0.09
Launceston	0.11	0.25	0.35	0.25	0.17	0.12	0.09	0.07
Northern	0.13	0.26	0.34	0.20	0.09	0.03	0.00	-0.04
Mersey_Lyell	0.11	0.22	0.29	0.18	0.08	0.03	0.00	-0.02
RELMAI Index								
Hobart	-0.15	-0.71	-1.44	-1.64	-1.08	-0.45	0.03	0.18
Southern	-0.12	-0.64	-1.16	-1.29	-0.46	0.31	0.81	1.31
Launceston	-0.28	-1.21	-2.40	-3.04	-2.59	-1.93	-1.28	-1.13
Northern	-0.17	-1.00	-1.85	-2.20	-1.46	-0.68	-0.18	0.36
Mersey_Lyell	-0.09	-1.27	-1.66	-1.98	-1.29	-0.52	-0.09	0.17
Rest of Australia	-0.09	-0.38	-0.48	-0.50	-0.25	-0.10	-0.11	-0.12

APPENDIX B: DECOMPOSITION OF RELMAI INDICES INTO MACRO AND SWAP EFFECTS (PSBR ENDOGENOUS)

APPENDIX C: DECOMPOSITION OF RELMAI INDICES INTO MACRO AND SWAP EFFECTS (PSBR EXOGENOUS)