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Modelling Impacts of Infrastructure Industry Change over the 1990s

Supplement to *Review of National Competition Policy Reforms*

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Abbreviations

ABA	Australian Broadcasting Authority
ABS	Australian Bureau of Statistics
ACA	Australian Communications Authority
ACCC	Australian Competition and Consumer Commission
ACT	Australian Capital Territory
ACTEW	Australian Capital Territory Electricity and Water
ACTION	Australian Capital Territory Internal Omnibus Network
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
AGA	Australian Gas Association
ANZSIC	Australian and New Zealand Standard Industrial Classification
AOTC	Australian and Overseas Telecommunications Corporation
ARTC	Australian Rail Track Corporation
ASCO	Australian Standard Classification of Occupations
ASGC	Australian Standard Geographical Classification
AUSTEL	Australian Telecommunications Authority
COAG	Council of Australian Governments
CoPS	Centre of Policy Studies (Monash University)
CPA	Competition Principles Agreement
CPI	Consumer Price Index
CSO	Community service obligation
CURF	Confidentialised unit record file
ESAA	Electricity Supply Association of Australia
ETSA	Electricity Trust of South Australia
EWSD	Engineering and Water Supply Department (South Australia)

GBE	Government business enterprise
GDP	Gross Domestic Product
GFCV	Gas and Fuel Corporation of Victoria
GJ	Gigajoule (10^9 joules)
GNE	Gross National Expenditure
GSP	Gross State Product
GST	Goods and services tax
HEC	Hydro-Electric Corporation (Tasmania)
HES	Household Expenditure Survey
HWC	Hunter Water Corporation (New South Wales)
IC	Industry Commission
ICTs	Information and communications technologies
ID	Income distribution
kWh	Kilowatt hour
LPG	Liquefied petroleum gas
ML	Megalitre (10^6 litres)
MMRF	Monash Multi-Regional Forecasting (model)
MMRF-CR	Competition policy review (CR) version of the MMRF model
MPC	Melbourne Port Corporation (Victoria)
MRES	Monash Regional Equation System
NATSEM	National Centre for Social and Economic Modelling (University of Canberra)
NCC	National Competition Council
NCP	National Competition Policy
NECA	National Electricity Code Administrator
NECG	Network Economics Consulting Group
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NFTkm	Net freight tonne kilometres
NSW	New South Wales

NT	Northern Territory
OECD	Organisation for Economic Co-operation and Development
OTC	Overseas Telecommunications Corporation
PAWA	Power and Water Authority (Northern Territory)
PC	Productivity Commission
PMC	Port of Melbourne Corporation (Victoria)
QCA	Queensland Competition Authority
Qld	Queensland
QPTC	Queensland Power Trading Corporation
QR	Queensland Rail
SA	South Australia
SAGASCO	South Australian Gas Company
SCNPMGTE	Steering Committee on National Performance Monitoring of Government Trading Enterprises
SMHA	Snowy Mountains Hydro-Electric Authority
STD	Subscriber trunk dialling
Tas.	Tasmania
TJ	Terajoule (10^{12} joules)
USO	Universal service obligation
Vic.	Victoria
WA	Western Australia

na	not applicable
n.e.c.	nor elsewhere classified

1 Introduction

The terms of reference for this inquiry ask the Productivity Commission to report on, among other things, the impact of National Competition Policy (NCP) and related reforms undertaken to date by Australian, State and Territory Governments on the Australian economy and the community more broadly. To the extent possible, such an assessment is to include impacts on significant economic indicators such as growth and productivity, and to include significant distributional impacts, including on rural and regional Australia.

To assist in addressing these issues, the Commission undertook a quantitative analysis of the effects of labour productivity and service-price changes that occurred over the 1990s in six key infrastructure activities encompassed by NCP — electricity, gas, urban water and sewerage, urban transport, ports and rail freight and telecommunications. Collectively, the sectors covering these activities accounted for around 17 per cent of GDP and contributed around half of the estimated potential gain from a full implementation of NCP (IC 1995).[1] They were also the focus of the Commission's previous analysis of the impact of NCP on rural and regional Australia (PC 1999). The quantitative analysis of changes in these infrastructure activities, however, provides only a partial perspective on the impacts of NCP and related reforms. For example, it does not cover the effects of some key reforms of relevance to country Australia, such as the liberalisation of statutory marketing regimes for many agricultural products and road transport reform.

Although the NCP framework officially came into effect during April 1995, the package incorporated specific pre-existing reform commitments covering electricity, gas, water and road transport. There were also significant reforms affecting these sectors that went beyond the requirements of NCP. The first year canvassed in this study — 1989-90 — while pre-dating the formal inclusion of all sectors into the NCP framework, enables significant productivity and price changes that occurred in the early 1990s to be included in the analysis. The final year of the analysis — 1999-00 — enables the study to abstract from the impact of the GST,

[1] In addition to the sectors covered in this study, IC (1995) also included projected effects from reforms to statutory marketing arrangements, the unincorporated sector, building regulations, building approvals, competitive tendering, taxi licensing, newsagents, and the regulation of service quality.

introduced in July 2000, on prices and costs. There is also limited data to extend the analysis beyond this year.

The focus of the modelling is on the longer-run effects of change. That is, it is based on the assumption of full adjustment to the effects of labour productivity and service-price changes in infrastructure industries. Transitional effects are not modelled explicitly. However, an indication of possible adjustment issues is provided by the estimated impacts of infrastructure industry change on regional employment and a comparison of these projections with actual employment changes which occurred over the 1990s.

In undertaking the quantitative work, the Commission has adopted a different approach to earlier studies by the Productivity Commission and its predecessor (IC 1995 and PC 1999). The focus of those studies was on the prospective 'outer envelope' effects of NCP reform. That is, it was based on the full implementation of reforms, prospective productivity and price changes and complete adjustment to their effects.

Given the terms of reference, the current modelling exercise began by focusing on what actually happened in key infrastructure industries rather than what might have been possible. However, not all changes in the period canvassed could be attributed to NCP. In the normal course of business, productivity improvements would have been achieved through the adoption of new technologies (eg through the widespread take up of information and communications technologies (ICTs)) and organisational change. On the other hand, NCP and related reforms are widely acknowledged to have been key (but not the only) factors influencing actual outcomes in a number of these sectors during the 1990s. The reforms would have directly affected industry by encouraging improvements in efficiency (such as through the better use of labour in electricity generation and distribution), full cost recovery and price rebalancing between household, and industrial and commercial users to better align service prices with the costs of providing services to each group. The effects of reform and other factors would also have been complementary. For example, reform would have enabled other changes by providing an institutional environment that favoured the introduction of new technologies faster than otherwise (as in telecommunications). Moreover, the availability of new technologies and ways of working would have added to the gains available from reform.

Quantifying the impact of NCP, as such, would require a 'counterfactual' to be specified — that is, the changes that would have occurred in infrastructure industries in the absence of NCP. To create a counterfactual, judgments would be needed about the effect of NCP compared to other influences. Such judgements themselves would determine the outcome of the analysis and would be contentious.

With no firm basis for constructing a counterfactual of what would have happened in the absence of NCP, the approach taken in this study has been to draw on information about all productivity and service-price changes over the 1990s and to assess the economy-wide effects of those changes and their associated regional impacts. Because of the influence of other — non-NCP — factors, this approach obviously captures more than the impact of NCP-induced productivity and price changes in these industries during the period. On the other hand, all benefits of reform undertaken in the 1990s would not be evident in changes during the decade — there may well be further productivity improvements or price changes after the 1990s attributable to reform in the 1990s. Also, the analysis does not capture dynamic gains arising from cultural change that will continue to provide benefits.

As noted, the analysis is confined to the impact of labour productivity and service-price changes. However, observed price changes are typically not fully accounted for by falls in labour costs. Many other factors would inevitably have contributed to price changes during the period, including improved capital productivity which could lower service prices, contracting out which could contribute to overall productivity and increased cost recovery which could raise prices. Comprehensive information about these influences is not currently available, which has precluded the modelling of likely impacts.

The national and regional analysis was finalised after conducting a modelling workshop on 26 July 2004 at which a work-in-progress version of the results was presented. The workshop was attended by representatives of State, Territory and Australian government agencies and researchers with knowledge and experience in assessing the impact of changes in infrastructure industries on the Australian economy and regions. The modelling was refereed by Dr Robert Albon (Senior Economic Advisor, ACCC), Mr John Zeitsch (Principal, of the then NECG), and Associate Professor John Madden (Deputy Director, Centre of Policy Studies, Monash University).

The referees supported the modelling approach adopted to quantify national and regional impacts of infrastructure industry change over the 1990s, and recognised the ambitious nature of the undertaking. The referees and workshop participants noted that the changes observed were influenced by both NCP and other factors and that the results would need to be interpreted with care in that light.

The July workshop was also informed of work in progress by the Commission to quantify the distributional impacts of change and provided encouragement for the continuation of this work. The Commission advanced this work after the release of the discussion draft and conducted a second workshop on 1 February 2005. The workshop was attended by Dr Robert Albon and Associate Professor John Madden. It was also attended by Professor Peter Dixon and Dr Tony Meagher of the Centre

of Policy Studies (CoPS), Mr Linc Thurecht of the National Centre for Social and Economic Modelling (NATSEM), and representatives of the Australian Bureau of Statistics (ABS). Subsequent to the workshop more detailed discussions on HES data were held with the ABS. The workshop was supportive of the work. In particular, the workshop noted the absence of information on the distributional implications of infrastructure industry reform and the importance of this study in filling this gap. It also confirmed the appropriateness of the key measure of household purchasing power adopted in the study. Nevertheless, some concerns were expressed about the rudimentary treatment of investment income in current MMRF-style models. The reconciliation of benchmark MMRF-CR and HES data and the possible implications this may have for the distributional analysis was also discussed. In response, a range of alternative modelling and data assumptions were examined. The results were not found to be sensitive to the alternatives considered. The key sensitivity tests undertaken are reported in the body of this report.

The referees' comments together with a summary of proceedings of the July 2004 and February 2005 workshops are available on request.

1.1 Model framework

Modelling economy-wide effects

In order to quantify the economy-wide effects of changes in infrastructure industry labour productivity and service prices, the Commission used the Monash Multi-Regional Forecasting – Competition Policy Review (MMRF-CR) model, a version of the MMRF model (box 1.1). This model disaggregates national production into eight State and Territory regional economies with 54 industries in each jurisdiction. NCP-related infrastructure activities are covered by 8 of the 54 MMRF-CR industries. Because the infrastructure industry changes modelled differ between jurisdictions, the MMRF model, with its state disaggregation, is especially suited to analysing the effects of those changes. The MMRF-CR model, its industry disaggregation and its application are outlined in appendix A.

The Commission's modelling was built on a particular implementation of the MMRF-CR model presented at the July 2004 modelling workshop. However, as a consequence of comments received at the workshop, the final implementation differs in an important respect.

For the July workshop, it was assumed that price changes not accounted for by labour productivity were due to changes in the productivity of other inputs. This approach is suited to capturing unmeasured productivity improvements in the use of

other inputs and the impact of contracting out, a point acknowledged at the workshop. However, it is unsuited to capturing the impact of changes in price-cost margins due to changes in cost recovery — also of importance in infrastructure activities over the decade.[2] It also ignores leads and lags that may occur between improved labour productivity and resultant service-price changes. As acknowledged above, because comprehensive information about these 'other' influences is not currently available, modelling of their possible impacts was not included in this study.[3] This approach avoids possible attribution biases that may arise from the workshop implementation. It also abstracts from any intergenerational effects associated with transfers of productivity dividends to improving fiscal balances and debt retirement.

Although related, the MMRF modelling framework differs in some important respects from the economy-wide modelling frameworks used in previous Commission studies of the effects of NCP and NCP-related reforms. In particular, the previous analyses (IC 1995; PC 1999) were based on a national model, in which the changes due to NCP and related reforms were averaged across States and Territories. As mentioned, the changes examined in those studies were regarded as 'outer envelope' changes — the maximum (static) gain possible if the reforms were fully implemented. State and Territory results were then estimated using a 'tops-down' methodology, in which the national results were projected down to each State and Territory according to their industrial base, not on their potential for improvement.

While the framework applied in the current study has the advantage of additional regional detail — so that it captures economic geography at the state level — the frameworks applied in the earlier studies had the advantage of additional sectoral detail — the national economy was disaggregated into over 100 industry sectors — had a fuller treatment of government finances and the modelling of substitution in the use of different modes of transport (eg between road and rail transport).

[2] Changes in cost-price margins were explicitly modelled for water and urban transport, in the July 2004 workshop results but not in the final results.

[3] In this study, price changes not accounted for by labour productivity changes are allocated to a 'balancing item' that has no feedback effects on the demand for productive inputs, income or consumption.

Box 1.1 **Overview of the MMRF model**

The Monash Multi-Regional Forecasting (MMRF) model is a multi-regional applied general equilibrium model developed by the Centre of Policy Studies (CoPS) at Monash University. It distinguishes eight Australian regions — six States and two Territories. The model recognises:

- domestic producers classified by industry and domestic region;
- investors similarly classified;
- eight region-specific household sectors;
- an aggregate foreign purchaser of Australia's exports;
- eight State and Territory governments; and
- the Australian government.

The model contains explicit representations of intra-regional, inter-regional and international trade flows based on regional input-output data developed at CoPS, and includes detailed data on State, Territory and Australian governments' budgets. Second round effects are determined on the basis of the model's input-output linkages, assumptions about the economic behaviour of firms and households and resource constraints. Important elements of the theoretical structure of MMRF include:

- Producers respond to changes in the competitiveness of Australian industry.
- Demand for Australian exports responds to the export price of Australian products.
- Producers alter their use of labour, produced capital and agricultural land in response to changes in the relative cost of these factors.
- Households vary consumption of particular commodities in response to changes in household income and relative prices of goods consumed.
- Productivity improvements reduce resource costs.

Outputs from the MMRF model include projected changes in:

- national output as measured by gross domestic product (GDP);
- state gross products and employment;
- sectoral output, value-added and employment by state;
- employment by occupational group, nationally and by state;
- exports and imports by commodity, nationally and by state; and
- government revenues and expenditures by state and for Australia.

The model is described in Peter, Horridge, Meagher, Naqvi and Parmenter (1996).

Source: Based on Centre of Policy Studies web site.

Modelling regional impacts

Both the MMRF-CR and previous modelling frameworks provide results for 57 'regions' — 55 sub-state and two territory regions. There are, however, important differences between the modelling approaches adopted. As mentioned, in the previous study (PC 1999), a 'tops-down' approach was used to disaggregate national results to the State and Territory levels and to further disaggregate State results to 55 sub-state regions using the industry mix of each jurisdiction and region, respectively.

In the current study, state results are modelled directly in MMRF-CR with national results being derived by an aggregation of results for each State and Territory — that is, using a 'bottoms-up' approach. The State results have also been disaggregated to 55 sub-state regions using the industry mix of each region (table 1.1). Using this approach, it has been possible to estimate the impact of economic change on output and employment at the regional level.

The regional classification adopted in this and the previous study (PC 1999) is based on the statistical division classification of the Australian Standard Geography Classification (ASGC). These divisions are shown in table 1.1 with a link to related ABS statistical divisions and a listing of the major townships in each division. As divisions are chosen to reflect '…identifiable social and economic links between inhabitants and between economic units within a region under the unifying influence of one or more major towns or cities' (ABS 1995, p. 18), most contain a significant mix of primary and ancillary service activities and are closely aligned with ABS statistical divisions. The industry mix nevertheless varies significantly between regions and is an important factor in determining the impact of change in infrastructure industries at the regional level. In particular, many non-metropolitan regions have relatively specialised industry structures (such as in agriculture, mining, and infrastructure). Regional impacts will therefore be influenced most by the impact of infrastructure industry change on specialised activities.

In projecting state results to the regional level, a distinction is made between 'national' and 'state', and 'local' industries. National and state industries are those producing commodities that are highly tradable in inter-regional markets (eg agriculture, mining, and most manufacturing commodities). Conversely, local industries are those producing commodities that are predominantly traded in regional markets (eg many services and perishable commodities) and whose prospects are tied largely to general activity levels in the sub-state region in which they are located.

Table 1.1 **Regions in the MMRF-CR model[a]**

	MRES Region	*ABS SD*	*Main centre*	*Other selected urban centres*
D1	Sydney	105	Sydney	Campbelltown, Gosford, Katoomba, Parramatta, Sutherland
D2	Hunter	110	Newcastle	Cessnock, Maitland, Muswellbrook, Port Stephens, Singleton
D3	Illawarra	115	Wollongong	Kiama, Mittagong, Moss Vale, Shellharbour, Shoalhaven
D4	Richmond-Tweed	120	Lismore	Ballina, Byron Bay, Casino, Tweed Heads
D5	Mid-North Coast	125	Coffs Harbour	Grafton, Kempsey, Port Macquarie, Taree
D6	Northern	130	Tamworth	Armidale, Glen Innes, Gunnedah, Inverell, Moree, Tenterfield
D7	North Western	135	Dubbo	Bourke, Cobar, Coonabarabran, Gilgandra, Mudgee, Walgett
D8	Central West	140	Orange	Bathurst, Blayney, Cowra, Forbes, Lithgow, Oberon, Parkes
D9	South Eastern	145	Queanbeyan	Bega, Bombala, Cooma, Crookwell, Goulburn, Yass, Young
D10	Murrumbidgee	150	Wagga Wagga	Cootamundra, Griffith, Gundagai, Hay, Narrandera, Tumut
D11	Murray	155	Albury	Balranald, Deniliquin, Holbrook, Tumbarumba, Wentworth
D12	Far West	160	Broken Hill	Tibooburra, Wilcannia
D13	Melbourne	205	Melbourne	Altona, Dandenong, Lilydale, Mornington Peninsula, Sunbury
D14	Barwon	210	Geelong	Apollo Bay, Colac, Lorne, Queenscliff
D15	Western District	215	Warrnambool	Camperdown, Hamilton, Portland
D16	Central Highlands	220	Ballarat	Ararat, Bacchus Marsh, Daylesford
D17	Wimmera	225	Horsham	Dimboola, St Arnaud, Stawell
D18	Mallee	230	Swan Hill	Kerang, Mildura, Ouyen
D19	Loddon	235	Bendigo	Castlemaine, Maryborough
D20	Goulburn	240	Shepparton	Benalla, Echuca, Kyabram, Rochester
D21	Ovens-Murray	245	Wodonga	Beechworth, Bright, Mount Beauty, Rutherglen, Wangaratta
D22	East Gippsland	250	Sale	Bairnsdale, Omeo, Orbost
D23	Gippsland	255	Traralgon	Moe, Morwell, Wonthaggi
D24	Brisbane	305	Brisbane	Beenleigh, Logan, Mount Gravatt, Redcliffe
D25	Moreton	310	Coolangatta	Burleigh Heads, Caloundra, Ipswich, Noosa, Surfers Paradise
D26	Wide Bay-Burnett	315	Maryborough	Bundaberg, Gympie, Hervey Bay, Mundubbera
D27	Darling Downs	320	Toowoomba	Dalby, Goondiwindi, Stanthorpe, Warwick
D28	South West	325	Charleville	Quilpie, Roma, St George
D29	Fitzroy	330	Rockhampton	Emerald, Gladstone
D30	Central West	335	Longreach	Barcaldine, Blackall, Winton
D31	Mackay	340	Mackay	Clermont, Proserpine
D32	Northern	345	Townsville	Ayr, Bowen, Charters Towers, Ingham
D33	Far North	350	Cairns	Atherton, Cooktown, Innisfail, Mareeba, Mosman, Weipa
D34	North West	355	Mount Isa	Cloncurry, Hughenden, Normanton
D35	Adelaide	405	Adelaide	Glenelg, Henley, Hindmarsh, Marion, Salisbury
D36	Outer Adelaide	410	Mount Barker	Barossa Valley, Kangaroo Island, Onkaparinga
D37	Yorke and Lower North	415	Yorketown	Bute, Riverton, Wallaroo
D38	Murray Lands	420	Renmark	Murray Bridge, Pinnaroo
D39	South East	425	Mount Gambier	Bordertown, Kingston, Naracoorte
D40	Eyre	430	Port Lincoln	Ceduna
D41	Northern	435	Whyalla	Coober Pedy, Port Augusta, Port Pirie, Woomera
D42	Perth	505	Perth	Armadale, Fremantle, Joondalup, Rockingham, Wanneroo
D43	Peel	510(p)	Mandurah	Boddington, Jarrahdale, Pinjarra, Serpentine, Waroona
D44	South West	510(p)	Bunbury	Busselton, Collie, Manjimup, Margaret River, Pemberton
D45	Great Southern	515	Albany	Denmark, Katanning
D46	Wheatbelt	520, 525	Northam	Merredin, Moora, Narrogin
D47	Goldfields-Esperance	530	Kalgoorlie	Boulder, Coolgardie, Esperance
D48	Mid West	535(p)	Geraldton	Meekatharra, Mount Magnet
D49	Gascoyne	535(p)	Carnarvon	Exmouth
D50	Pilbara	540	Port Hedland	Karratha, Newman, Tom Price
D51	Kimberley	545	Broome	Derby, Kununurra, Wyndham
D52	Greater Hobart	605	Hobart	Clarence, Glenorchy, Sorell
D53	Southern	610	Geeveston	Bicheno, Huonville, Triabunna
D54	Northern	615	Launceston	Deloraine, Georgetown, St Helens
D55	Mersey-Lyell	620	Burnie	Devonport, Queenstown, Smithton, Ulverstone, Zeehan
	Northern Territory	7	Darwin	Alice Springs, Katherine, Nhulunbuy, Tennant Creek
	Australian Capital Territory	8	Canberra	

a The Monash Regional Equation System (MRES) statistical division Goldfields-Esperance is referred to as South Eastern in the ASGC.

Sources: Adams and Dixon (1995); ABS (*Australian Standard Geographic Classification (ASGC)*, Cat. no. 1216.0).

The presence of local industries whose prospects are tied to regional activity introduces regional 'multiplier' effects. If a region has a concentration of fast-growing national and state industries, then the effect on its overall regional growth is multiplied through fast growth of associated local industries.

The model produces estimates of the impact of infrastructure industry change on regional gross product, a measure of output or activity and a useful measure of the income generated in a region. It also produces estimates of the impact of change on regional employment. In this study, the estimates are longer-run snap shots showing how gross regional product or employment would differ from what they would have been had the changes not occurred. Regional activity measures are aggregated to the national level to show the economy-wide impact of infrastructure industry change. Change in gross domestic product provides a measure of the national output implications of change, while change in gross national expenditure provides a measure of the additional national purchasing power of output growth. A framework for assessing the implications of infrastructure industry change on living standards is discussed in appendix B.

The assumptions about the nature of longer-run adjustment used in the model are given in appendix A. The key assumption is that sufficient time has elapsed for capital and labour to have moved between activities and regions. Second, the Commission has chosen to assume all labour market gains are taken in the form of real wage increases rather than higher employment. That is, it is assumed that labour supply, the participation rate and unemployment are determined by factors not materially influenced by infrastructure industry changes (such as labour market, social or training policies).

The model's estimates are also made on the presumption that workers in eight occupational groups are mobile between regions in the longer run. In reality, while job mobility may pose few problems for some, it could pose significant adjustment problems for others. For example, in regions with declining employment, mobility may be inhibited by depressed regional real estate markets relative to those in expanding areas.

Estimated employment changes made in this framework provide one indication of adjustment problems. In particular, instances are identified where employment is projected to be lower than otherwise as a result of infrastructure industry change in regions that have experienced actual employment declines over the 1990s. The estimated changes may be contributing to or aggravating those observed changes in regional employment. However, it needs to be stressed that adjustment problems are transitory while income gains are permanent.

It should be noted that changes in regional employment are modelled on the basis of 'place of employment' information recorded in the Australian census of population and housing. According to place of employment definitions, employees are classified, as far as practicable, according to locality of employment. For many people, statistical division of employment would coincide with division of residence. However, for those working according to 'fly-in, fly-out' and other remote working arrangements, the division of employment, which is the subject of the modelling using MMRF, may not coincide with the statistical division of residence.

Another important qualification is that the model captures the initial distribution of activity and makes regional output and employment projections based on this information. The model does not fully capture information outside of its framework, including:

- economic geography, including the balance between factors, such as transport costs, that lead to the location of activity in close proximity to either markets or significant input sources; and other factors, such as economies of scope or agglomeration, that favour the concentration of activities in a particular plant or geographic location; and
- new goods and services (eg mobile telephony, satellite communications and the internet) that may change ways of working and productivity amongst user industries.

Another important qualification is that MMRF does not model the flow of income between regions, such as that associated with fly-in, fly-out working arrangements (mentioned above), or the cross-regional or cross-national ownership of productive capital by individuals and firms.

Modelling distributional impacts

The modelling of the distributional effects of productivity and price changes in key infrastructure industries incorporates the feedback effects of change on wages, business income and subsequent changes operating through the tax and social security systems. It uses a 'tops-down' framework whereby the increased real purchasing power of households generated in MMRF-CR is disaggregated to households using income and expenditure characteristics reported in the 1993 Australian Bureau of Statistics Household Expenditure Survey (HES). The unit record data set used was made available to the Commission on a Confidentialised Unit Record File (CURF). The results for each household were aggregated by income group, based on household *gross* income before the change, using population weights.

The Commission's analysis was built on the Income Distribution (ID) model presented at the February 2005 workshop. Since the workshop, additional detailed data analysis has improved aspects of the modelling and the reconciliation of MMRF-CR and ID results. While worthwhile at a technical level, the refinements have not materially effected the qualitative assessment of the distributional effects of change.

For the distributional analysis, changes in household purchasing power were measured in terms of the MMRF-CR aggregate 'household disposable income'. When expressed in real or price-adjusted terms, this measure is equal to projected changes in real household consumption (appendix B). To link changes in household purchasing power, by component, estimated in MMRF-CR with the ID-model income and expenditure categories, concordances were developed. These concordances linked 13 MMRF-CR items of household income with 34 HES items of income and 54 MMRF-CR items of household expenditure with 423 HES items of expenditure.

The ID modelling assumes that increased net revenues of government, resulting from growth in national income, are distributed to households in a 'neutral' fashion — that is, in proportion to *net* income of households before any change. (The government revenues are net of increased public spending in areas such as public administration, defence, health and education which were not distributed in the model.) While this is a conventional approach in this sort of modelling, clearly government could elect to distribute their additional revenue in many ways. Were for example, most additional revenue used to fund increases in social security payments or to fund services mainly used by lower income households, the ultimate income benefits of the modelled infrastructure changes would be more in favour of lower income groups. The sensitivity tests reported in chapter 5 of this volume indicate that alternative spending decisions can materially affect the ultimate distribution of benefits.

As noted, the modelling results reflect distributional changes for households classified by their observed gross income before the change. If the analysis had been conducted using *equivalent* income based on household size — as is sometimes the case in such studies — the ensuing income gains would be somewhat more evenly distributed than the benchmark estimates show. Sensitivity tests indicate that the choice of classification variable has only a modest impact on distributional effects.

The linked MMRF-CR and ID framework adopted for this analysis is described in appendix C.

1.2 Productivity and price changes in infrastructure industries considered

Observed changes in labour productivity and service prices in key infrastructure industries considered in this study are summarised in table 1.2. Details of the changes over the 1990s are provided in chapter 2 and are placed in the context of NCP and related reforms. Supporting information on data sources and methods is provided in appendix D which also provides information on the modelling of the changes in MMRF-CR.

A distinctive feature of the changes modelled in MMRF-CR is the substantial reduction in employment requirements per unit of output (that is, improved labour productivity) in most infrastructure activities. There were also significant reductions in many infrastructure service prices. However, the changes in labour requirements are not uniform between jurisdictions; and also, service-price changes differed between residential (household) and non-residential (industrial and commercial) users. In some instances, service prices increased.

As pointed out above, how these magnitudes would have changed without NCP is difficult to determine. Nevertheless, NCP is likely to have been influential in a number of instances, including in decisions to:

- reduce employment per unit of output, often achieved by lowering manning levels toward industry best practice. Such changes would have reduced costs and potentially lowered service prices.
- move toward full cost recovery and the removal of cross subsidies between users (eg between commercial and household users). Such changes would have led to price rebalancing between users — evident between residential and non-residential users across infrastructure activities — and higher real prices for some.

Other non-NCP factors that could also influence labour productivity, services prices and price-cost margins include scale economies in declining-cost activities, changes in the productivity of non-labour factors and changes in the price of inputs. There are also likely to be leads and lags between labour and other productivity improving changes and associated price changes.

Table 1.2 **Summary of labour productivity and real service-price changes in NCP-related infrastructure activities over the 1990s[a]**

Percentage change

Variable	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*[b]
Electricity									
Employment per unit of output	-65.11	-79.98	-46.82	-69.51	-59.33	-59.42	-54.08	-45.29	-65.02
Non-residential prices (real)	-31.69	-20.92	-10.93	-29.26	-23.33	2.18	-19.71	-23.39	-23.06
Residential prices (real)	-9.99	8.67	-16.80	6.47	-12.42	6.77	-6.87	-2.27	-3.30
Gas									
Employment per unit of output	-76.74	-88.72	-86.31	-44.45	-42.69	na	-39.41	-85.37	-78.90
Non-residential prices (real)	-13.49	-1.73	-1.17	0.68	-5.70	na	1.71	-4.74	-5.63
Residential prices (real)	3.35	-1.85	-8.48	12.35	-10.33	na	na	4.35	0.08
Urban water and sewerage									
Employment per unit of output	-59.03	-78.95	-39.07	-72.75	-60.78	1.82	-62.04	-32.56	-59.80
Non-residential prices (real)	-39.41	-45.08	-29.93	-5.99	3.78	-23.74	29.62	24.97	-31.64
Residential prices (real)	-8.93	-18.65	22.70	4.33	14.83	-3.36	34.40	24.97	-3.67
Urban rail transport									
Employment per unit of output	-37.10	-49.77	-1.12	-46.30	-80.51	na	na	na	-31.33
Residential prices (real)	23.16	10.83	11.22	21.61	47.10	na	na	na	16.82
Urban road transport									
Employment per unit of output	-24.31	-45.28	-16.54	-19.63	-24.70	2.76	na	9.95	-26.74
Residential prices (real)	14.63	16.91	79.52	21.61	47.10	22.24	25.48	45.61	29.92
Urban water transport									
Employment per unit of output	18.90	na	-16.54	na	20.43	na	na	na	11.30
Residential prices (real)	14.52	na	79.52	na	47.10	na	na	na	32.28
Ports									
Employment per unit of output	-83.90	-62.86	-19.67	-61.29	-78.46	-46.73	-61.84	na	-63.06
Supply prices (real)	-38.85	-54.96	-18.98	-29.89	-16.04	-11.60	0.53	na	-34.96
Rail freight									
Employment per unit of output	-84.76	-49.61	-62.96	-47.88	-85.62	-47.72	na	na	-69.12
Supply prices (real)	-29.04	-4.90	-34.84	-18.04	-48.12	-34.43	na	na	-24.53
Telecommunications									
Employment per unit of output	-64.31	-67.91	-71.82	-70.73	-72.26	-63.22	-71.10	-66.70	-67.83
Prices (real)	-22.64	-22.15	-20.24	-23.83	-22.85	-21.71	-27.69	-22.70	-22.25

a The percentage change in real service price is calculated as the percentage change in the nominal service price *less* the percentage change in the consumer price index (the MMRF-CR model numeraire) *divided* by the CPI Index. **b** Calculated using MMRF value added and service flows as weights.

Sources: See chapter 2 and appendix D.

In principle, the net effect of labour productivity and other factors on service prices (such as, changes in capital productivity and cost recovery) should be disaggregated and modelled separately. In practice, the required information is not currently available, and some simplifying assumptions need to be made to complete the analysis. As outlined above, the approach adopted in this study has been to attribute the difference between price changes arising from labour productivity changes and those arising from other factors as having no feedback effects on productive inputs, income or consumption.

The national and regional impacts of labour productivity and service price changes are reported in chapter 3. The effects of change on the distribution of household purchasing power is reported in chapter 5.

1.3 Putting infrastructure industry changes in context

Infrastructure industry changes are only one of a wide range of influences on national and regional activity and employment. The employment effects of infrastructure industry labour productivity and service price changes have been put in context by comparing them with actual employment changes, by region, over the 1990s based on ABS population census data. The details of this analysis are provided in chapter 4.[4]

[4] Actual output or gross regional product data are not available at the regional level to support a comparable analysis for these items.

2 Overview of changes in key infrastructure industries

This chapter presents observed changes in labour productivity and infrastructure service prices over the 1990s and early 2000s for key infrastructure activities affected by National Competition Policy (NCP). The information has been used to derive shocks for modelling the longer-run impacts of changes in labour productivity and service prices over the decade 1989-90 to 1999-00. The activities covered are electricity generation and distribution, gas distribution, urban water and sewerage, urban transport, ports, rail freight and telecommunications.

It also outlines the main institutional reforms in each activity over the same period to place the evolution of labour productivity and service prices in context. Although reform is likely to have had a pervasive influence over infrastructure industries, the Commission is not aware of empirical estimates of the causal links between reforms and labour productivity and price changes, after controlling for the influence of other factors.

The chapter supports the summary of labour productivity and price changes reported in chapter 1. Appendix D provides detailed information on data sources and the modelling of changes reported in this chapter. Chapter 3 presents modelling results of the impact of labour productivity and service price changes.

A full review of NCP reforms, institutions and achievements is provided in chapter 2 and appendix B of the Final Report.

2.1 Electricity

The electricity industry has undergone significant NCP and NCP-related reform over the last two decades across all jurisdictions (table 2.1). The reforms include the corporatisation of electricity utilities, the introduction of competitive neutrality measures and changes in market and tariff structures. Corporatisation involved making managers more accountable for performance evaluated along commercial lines.

Table 2.1 **Selected electricity generation and distribution reforms**

Date	*Jurisdiction*	*Reform and key events*
July 1991	National	COAG agreed to co-operatively improve competitiveness in the Australian electricity supply industry. It agreed to replace separate state markets with a competitive national electricity market and to separate monopoly elements from contestable elements in the industry.
Aug 1991	NSW	Electricity Commission of New South Wales internally restructured into six commercially oriented business units.
Dec 1992	Vic.	Majority interest in Loy Yang B power station sold.
Oct 1993	Vic.	The vertically-integrated State Electricity Commission separated into three businesses — Generation Victoria, National Electricity (transmission and pool) and Electricity Services Victoria (distribution).
1994	National	Snowy Mountains Hydro-Electric Authority (SMHA) corporatised.
Jul 1994	NSW	Pacific Power's network business unit established as a legally separate subsidiary, Pacific Grid.
Jul 1994	Vic.	Commencement of a wholesale electricity market (VicPool).
Jul 1994	Vic.	Office of the Regulator-General established.
Oct 1994	Vic.	Major horizontal and vertical restructuring of the State electricity industry.
Dec 1994	Vic.	Phased introduction of retail competition commenced.
Jan 1995	Vic.	Generation Victoria disaggregated into five regionally-based corporations.
Jan 1995	Qld	Queensland Electricity Commission vertically separated into two companies: Queensland Generation (trading as AUSTA Electric) and Queensland Transmission and Supply Corporation.
Jan 1995	WA	Western Power established as a vertically integrated utility from the electricity operations of State Energy Commission of Western Australia.
Feb 1995	NSW	TransGrid given responsibility for transmission grid, system control activities and to develop and operate the wholesale electricity market.
Apr 1995	National	COAG agrees to the Competition Principles Agreement (CPA).
Jun 1995	Tas.	Legislation passed allowing third party access to the grid. Government Prices Oversight Commission established as an independent regulator.
Jul 1995	SA	ETSA corporatised.
Jul 1995	Tas.	Hydro-Electric Corporation made a government business enterprise.
Jul 1995	ACT	ACTEW corporatised.
Sep 1995	Vic.	Commencement of privatisation of distribution and electricity generation businesses (completed May 1997).
Oct 1995	NSW	25 distribution businesses amalgamated into 6 companies.
Mar 1996	NSW	Pacific Power split into three separate generators.
May 1996	National	National Electricity Market Management Company (NEMMCO) and National Electricity Code Administrator (NECA) established to manage and administer the operations of the national electricity market and code.
May 1996	NSW	Establishment of a wholesale electricity market in NSW.
Jun 1996	SA	Enactment of *National Electricity (South Australian) Act 1996*.
Jul 1996	NT	PAWA fully subject to commercialisation principles.
Oct 1996	NSW	Phased introduction of retail competition commenced.
Jan 1997	SA	Prime generating functions separated from ETSA to form Optima Energy.
Jan 1997	WA	Full open access to the transmission system made available.
May 1997	National	Phase 1 of the National Electricity Market (NEM) commenced, allowing interstate competition between New South Wales, Victoria, the Australian Capital Territory and South Australia.

(Continued next page)

Table 2.1 (**continued)**

Date	*Jurisdiction*	*Reform and key events*
Jul 1997	Qld	Industry restructured for participation in the NEM, included splitting the single government-owned generation corporation into three competing corporations and separating the retail activity from electricity distribution.
Oct 1997	National	Phase 2 of NEM commenced.
Dec 1997	ACT	Phased introduction of retail competition commenced.
Mar 1998	Qld	Establishment of a wholesale electricity market in Queensland.
Jul 1998	Tas.	Hydro-Electric Corporation (HEC) vertically separated into 3 businesses: generation, transmission and retailing and distribution.
Dec 1998	National	Establishment of the NEM.
Feb 1999	Qld	Six regional distributors amalgamated into a single distributor.
Jun 1999	Qld	Benchmark Pricing Agreement established to reduce market risk faced by retail suppliers supplying non-contestable customers at regulated prices.
Jul 1999	NSW	ACCC assumes responsibility for regulating the transmission network
Jul 1999	Qld	Queensland Power Trading Corporation (QPTC) renamed Enertrade.
Dec 2000	Qld	Queensland Competition Authority (QCA) determines the distribution network prices in Queensland.
Dec 2000	National	Federal parliament passed the *Renewable Energy (Electricity) Act 2000*, which established a 2 per cent renewable energy target for electricity supply in Australia.
Jan 2001	NSW	A temporary Electricity Tariff Equalisation Fund established to reduce market risk faced by retail suppliers of electricity.
Jun 2001	National	COAG established a Ministerial Council on Energy (*Parer Review)*.
Jul 2001	NSW	Three government-owned distributors — Greater Southern Energy, North Power and Advance Energy — merged to form Country Energy.
Aug 2001	WA	The WA Government established an independent electricity reform task force to develop recommendations on structural reforms of the State's electricity sector and Western Power.
Jan 2002	Qld	ACCC assumes responsibility for regulating the transmission network.
Jul 2002	NSW	Full retail contestability commenced.
Jul 2002	NT	Power and Water Corporation was established which generates, transmits and retails electricity throughout the NT.
Oct 2002	WA	Announcement that Western Power would be vertically separated into four state-owned businesses: generation, network, retail and regional power.
Dec 2002	National	Parer Review identified significant deficiencies in Australian electricity and gas markets.
Jan 2003	SA	Full retail contestability commenced. Retail pricing powers conferred on the Essential Services Commission of South Australia.
Mar 2003	WA	Plans to proceed with the disaggregation of Western Power deferred.
Apr 2003	Tas.	*Electricity Supply Industry Act 1995* amended to establish regulatory framework required to facilitate Tasmania's entry into the NEM.
Jun 2003	National	Ministerial Council on Energy met to consider the strategy for future energy reforms in Australia.
Jul 2003	ACT	Full retail contestability commenced.
Sept 2003	NSW	Independent Pricing and Regulatory Tribunal determine regulated retail tariffs for small customers supplied under a standard form contract.

(Continued next page)

Table 2.1 (**continued)**

Date	*Jurisdiction*	*Reform and key events*
Dec 2003	National	Ministerial Council on Energy release report to the Council of Australian Governments on energy market reform. Recommendations include the establishment of: the Australian Energy Market Commission (AEMC) as the single energy regulator; and the Australian Energy Regulator (AER) to set revenues for the electricity networks and gas pipelines.
Dec 2003	NSW	Electricity Tariff Equalisation Fund extended to 30 June 2007.
Jan 2004	WA	Economic Regulatory Authority commenced regulating utilities.
Jan 2004	WA	Western Power established four 'strengthened business units' — generation, networks, retail and regional.
Feb 2004	Qld	The Minister for Energy sets prices for small customers.
Jun 2004	National	Legislation passed establishing the Australian Energy Regulator.
Jun 2004	SA	Legislation passed establishing the Australian Energy Market Commission.

Sources: PC (1998, 2004a) and NCC (2003a, 2004).

In some states, such as Victoria, corporatisation has been accompanied by privatisation, while in other states, such as New South Wales, electricity authorities have remained under public ownership. Public electricity utilities are now also required to pay company and other taxes and dividends to government and other shareholders in line with commercial practices.

Changes in market structure consisted mainly of separating contestable market elements from non-contestable market elements. Thus, entry barriers to electricity generation and retailing were largely removed, while electricity transmission and distribution continued to be provided by a regulated monopoly supplier in many jurisdictions. Tariff reforms have focussed on removing cross-subsidies, so that each customer group pays a price that more closely reflects the cost of supplying them. One aspect of these changes has been an increase in the weight given to access charges relative to usage charges. Another aspect has been the introduction of time-of-use tariffs, where usage charges vary depending on the time of day. All jurisdictions have created independent price regulators, which impose controls on prices or revenues for some customers.

The introduction of competition in generation and retailing has seen the establishment of a trading pool made up of generators, retailers and wholesale customers across participating jurisdictions through the National Electricity Market (NEM). Participating jurisdictions are New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory, while Tasmania expects to join in 2005 on completion of a link to the mainland. Significant benefits of the NEM include provision for customers to choose suppliers, the ability of generation and retail suppliers to enter the market and the capacity for interstate and intrastate trade in electricity. Although outside the NEM, Western Australia has planned to

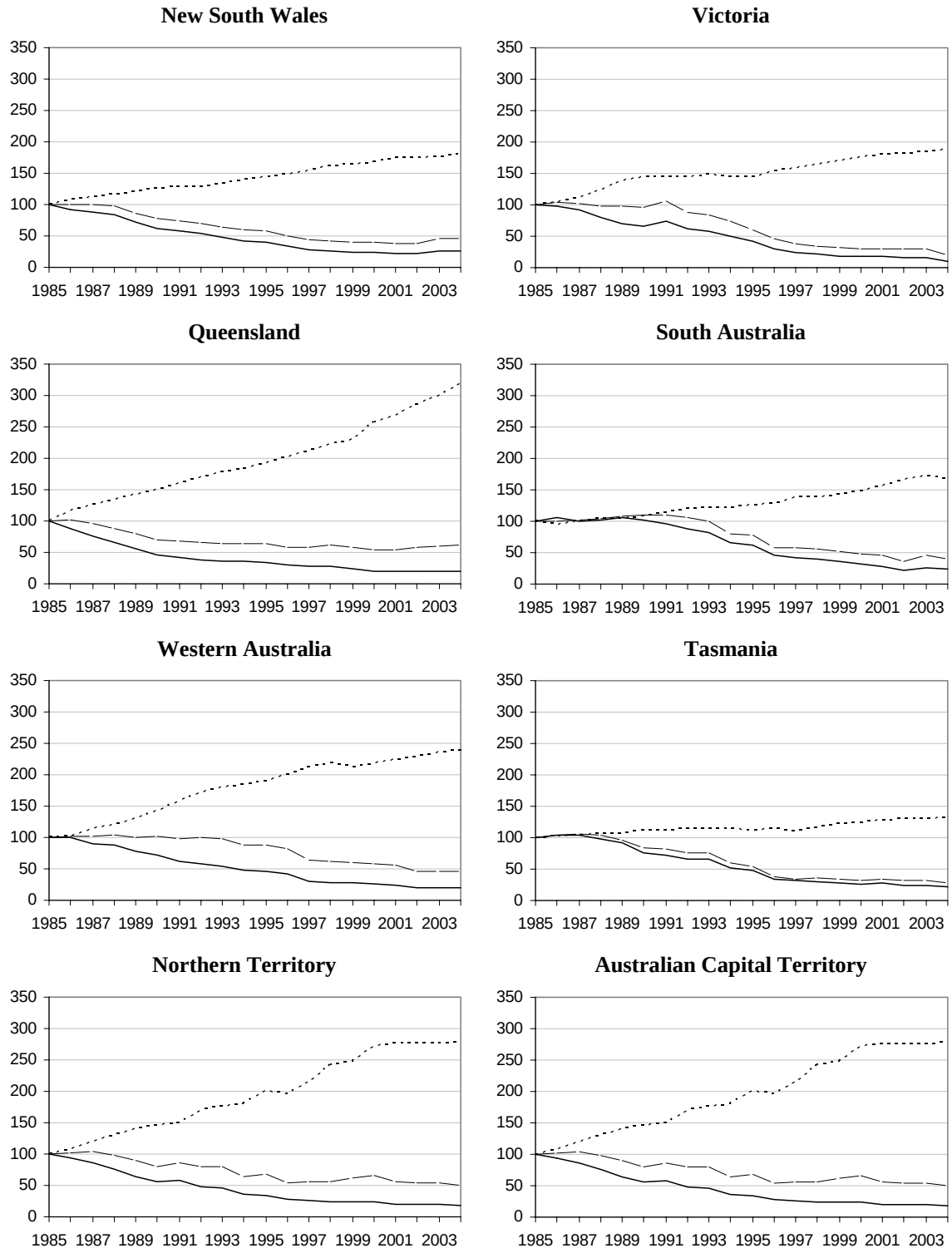
undertake some restructuring. Similarly, the Northern Territory has introduced an access regime for transmission, distribution and a licensing scheme to enable competition in electricity generation and retail distribution (NCC 2003a).

Before NCP and related reforms, it was widely recognised that electricity production and distribution activities were working well below best practice. In particular, the activities were characterised by significant over manning and sub-optimal reserve plant margins. Changing work practices and improvements in the efficiency of workforce utilisation over the last two decades has seen significant reductions in manning levels across jurisdictions. Over the same period, output has risen. Labour requirements per unit of output, measured in million kilowatt hours, have declined accordingly in all jurisdictions (figure 2.1). The largest improvement in labour productivity has been observed in Victoria followed by South Australia and New South Wales.

Reform has also seen reductions in real electricity prices, measured as cents per kilowatt hour, to users in most jurisdictions (figure 2.2). There have been some differences between jurisdictions. For example, in New South Wales, the removal of cross-subsidies and associated price rebalancing was accompanied by a steady decline in non-residential electricity unit prices and, to a lesser extent, residential electricity prices. In comparison, real non-residential unit prices in Tasmania have remained relatively stable and have declined, to varying degrees, in Victoria, Queensland, Western Australia, Northern Territory and the ACT. Real residential prices increased in Victoria, South Australia and Tasmania. In contrast with other jurisdictions, average non-residential unit prices were historically higher than residential prices in the Northern Territory and the Australian Capital Territory. The prices to the respective markets have converged in recent years through declines in non-residential prices in these jurisdictions.

Figure 2.1 **Electricity industry output, employment and employment requirements per unit of output, 1984-85 to 2003-04**

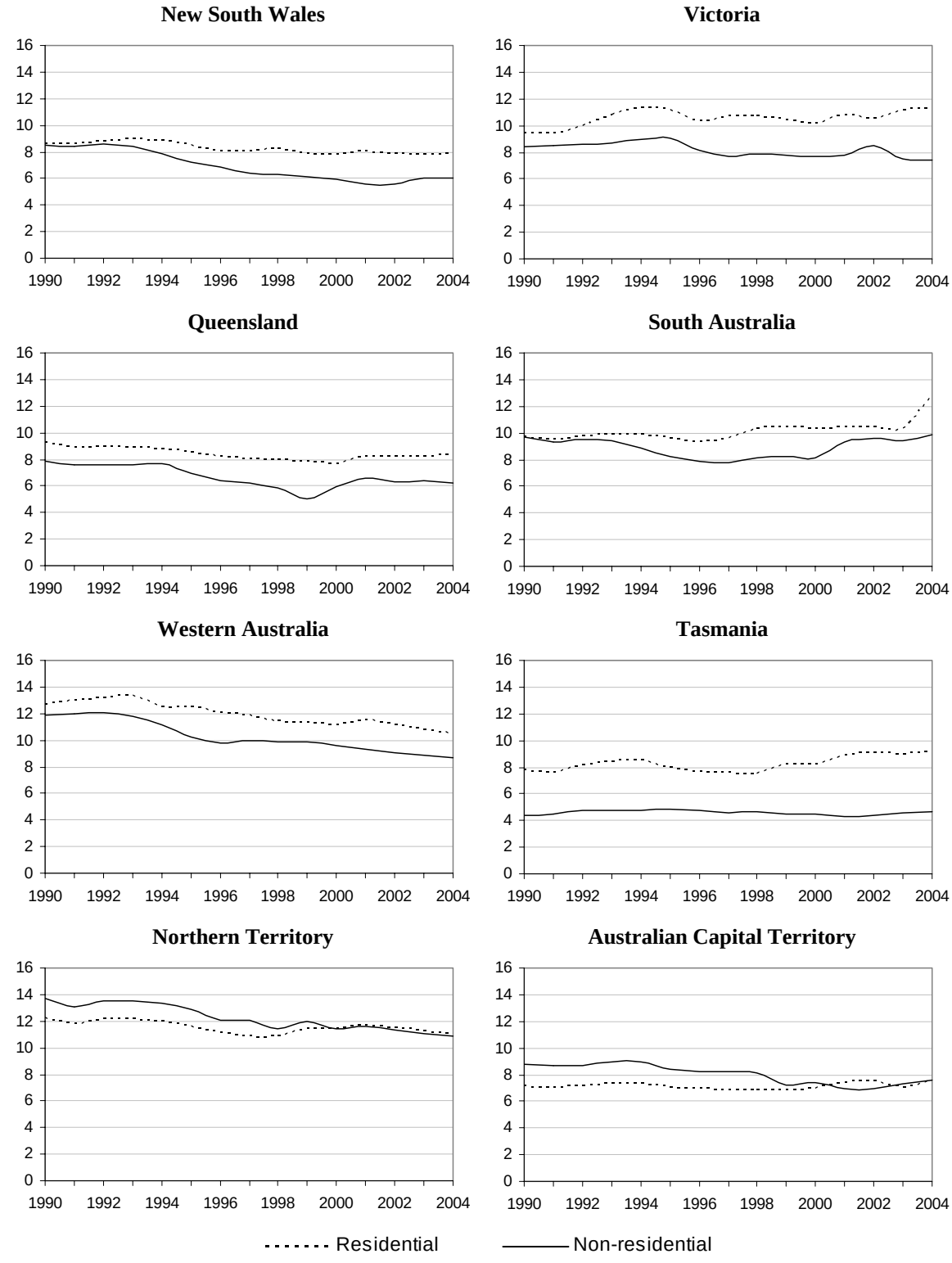
Indexes, 1984-85 = 100



Source: See appendix D.

Figure 2.2 **Real electricity prices, 1989-90 to 2003-04**

Cents per kilowatt hour



Source: See appendix D.

2.2 Gas

Historically, state governments owned gas utilities which controlled gas reticulation or pipeline network systems that took gas from city gate stations to homes, offices and factories. The reform process in gas distribution began in 1992 when COAG agreed to open the gas supply industry to greater competition (table 2.2). In 1994, the Council of Australian Governments (COAG) made a commitment to 'free and fair trade in natural gas'. In the following years, publicly owned gas utilities were either corporatised or privatised. Policy and regulatory impediments to interstate trade and retail competition have been gradually reduced or removed.

With reform, there have been widespread organisational and regulatory changes in the gas industry. Vertically integrated gas transmission and distribution activities were separated. Gas prices to residential and non-residential users were gradually deregulated. Customers were given the freedom to choose their gas retailer. In some jurisdictions, price rebalancing between customer classes was also undertaken to make gas prices more reflective of the cost of supplying different customer types.

Reform has seen substantial reductions in employment per unit of output, measured in terra joules, in all jurisdictions except Tasmania, which did not have a gas industry (figure 2.3).[1] In New South Wales, Victoria, Queensland and the Australian Capital Territory, the number of workers employed to provide a unit of natural gas fell by more than 70 per cent with lesser decreases in the remaining jurisdictions. The changes were driven by reductions in manning levels in each jurisdiction and increases in output.

While information on residential prices is available from 1989-90 to the year 2003-04 across jurisdictions (from consumer price index series), information on prices to non-residential users is only available for sub-periods (figure 2.4). Consumer price information indicates that while the real residential prices declined by around 10 per cent in Western Australia over the period 1989-90 to 1999-00, they rose, to varying degrees, in the other jurisdictions. For the sub-period 1989-90 to 1997-98, real non-residential gas prices, measured as dollars per gigajoule declined in New South Wales and to a lesser extent the ACT. For other jurisdictions, real gas prices remained broadly in line with 1989-90 levels for the sub-periods for which data are available.

[1] In 2002, a transmission pipeline was completed that enables the supply of gas to Tasmania from Victoria. Gas is now being used by a number of large-scale industrial and commercial customers and the Bell Bay Power Station is using gas to generate electricity for the Tasmanian grid. Before that, residential gas consumption in Tasmania (and Northern Territory) was drawn from bottled rather than reticulated natural gas.

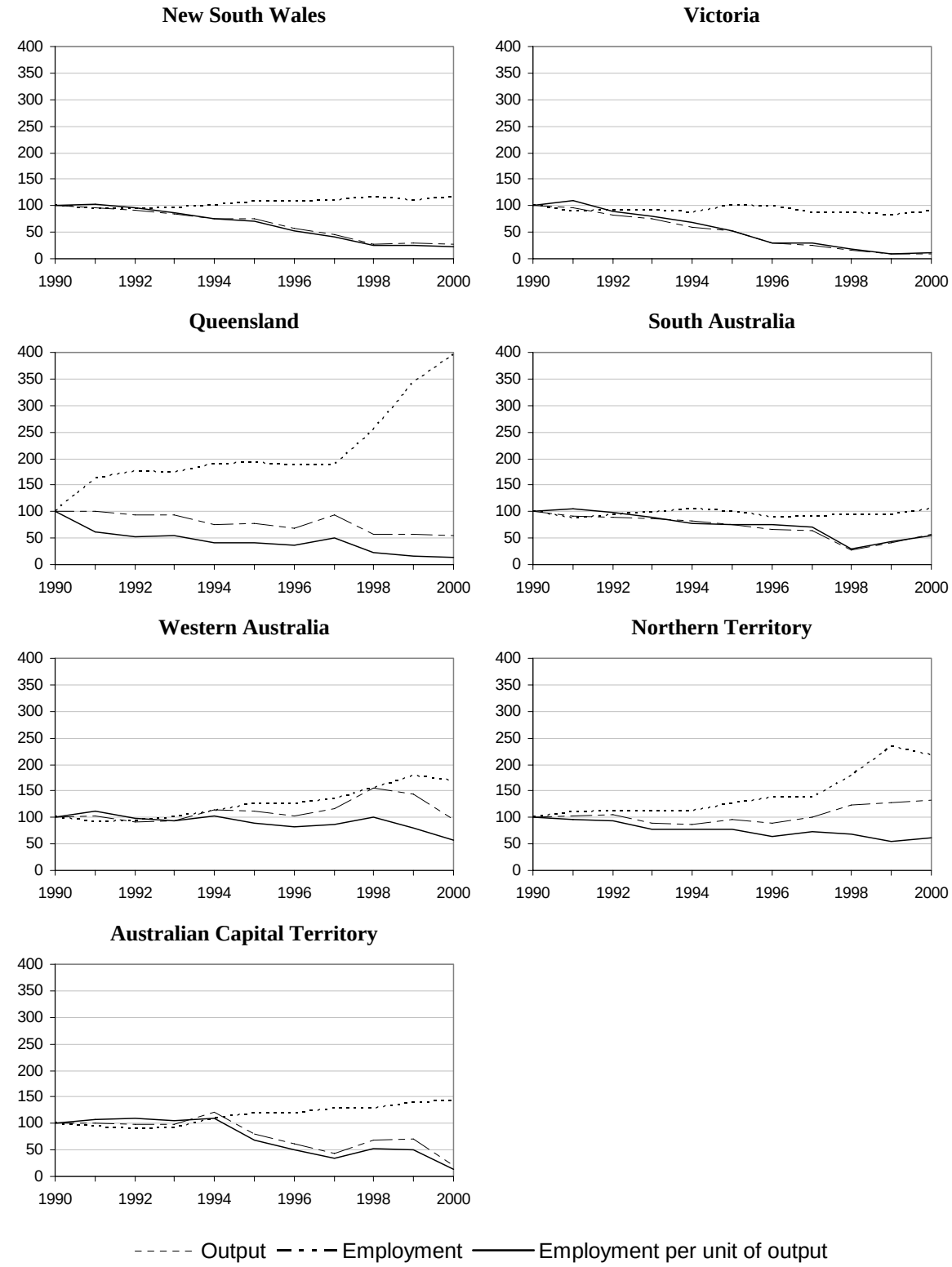
Table 2.2 **Selected gas distribution reforms**

Date	*Jurisdiction*	*Reform and key events*
Dec 1992	National	COAG agreed to open the gas supply industry to greater competition.
Oct 1993	SA	South Australian Government sold its holding in SAGASCO.
Feb 1994	National	COAG agree to remove impediments to 'free and fair' trade in natural gas.
Dec 1994	Vic.	Gas and Fuel Corporation of Victoria (GFCV) vertically separated into transmission and distribution businesses.
Jan 1995	WA	AlintaGas established as a vertically-integrated gas utility from the gas operations of the State Energy Commission of Western Australia.
Apr 1995	National	COAG agrees to the Competition Principles Agreement (CPA).
Jun 1995	Vic.	GFCV wound up.
Jun 1995	SA	Assets of the Pipeline Authority of South Australia sold.
Jan 1996	WA	Phased deregulation of the retail market allowing progressively smaller users to deal directly with gas producers and wholesalers.
Jul 1996	Vic.	Gas distribution operations and marketing 'ring-fenced'.
1997	National	Jurisdictions are required to seek certification of their gas access regimes under part IIIIA of the *Trade Practices Act 1974.*
March 1998	WA	The sale of the Dampier to Bunbury Natural Gas Pipeline removed AlintaGas from the gas transmission market.
Dec 1998	SA	Enactment and certification of gas access regime for 15 years.
1998-99	Vic.	A seasonal component to unit charges was introduced with higher charges applying between June and September.
Jan 2000	WA	Regulations related to Dampier to Bunbury pipeline repealed.
May 2000	WA	Enactment and certification of gas access regime for 15 years.
Jul 2000	NSW	Full retail contestability commenced, but customers were unable to choose their suppliers until Jan 2002 because the necessary market structure was not in place.
Sep 2000	ACT	Enactment and certification of gas access regime for 15 years.
Oct 2000	WA	Privatisation of AlintaGas.
Mar 2001	NSW	Enactment and certification of gas access regime for 15 years.
Mar 2001	Vic.	Enactment and certification of gas access regime for 15 years.
Jun 2001	WA	Restrictions on LPG trading removed with the enactment of the *Energy Coordination Amendment Act* and *Gas Corporation Act*.
Oct 2001	NT	Enactment and certification of gas access regime for 15 years.
Jan 2002	ACT	Full retail contestability commenced.
Jun 2002	Tas.	Gas Safety Regulations made under the *Gas Act 2000*.
Sep 2002	Tas.	Gas transmission pipeline completed linking Tasmania with Victoria.
Oct 2002	National	Petroleum (submerged Lands) Amendment Act enacted.
Oct 2002	Vic.	Full retail contestability commenced.
Jan 2003	Qld	Full retail contestability delayed for an unspecified period.
Apr 2003	SA	Access regime approved for gas distribution network.
May 2004	WA	Full retail contestability commenced.
Jul 2004	SA	Full retail contestability commenced.

Sources: PC (1998, 2004a) and NCC (2003a, 2004).

Figure 2.3 **Gas distribution industry output, employment and employment requirements per unit of output, 1989-90 to 1999-00**

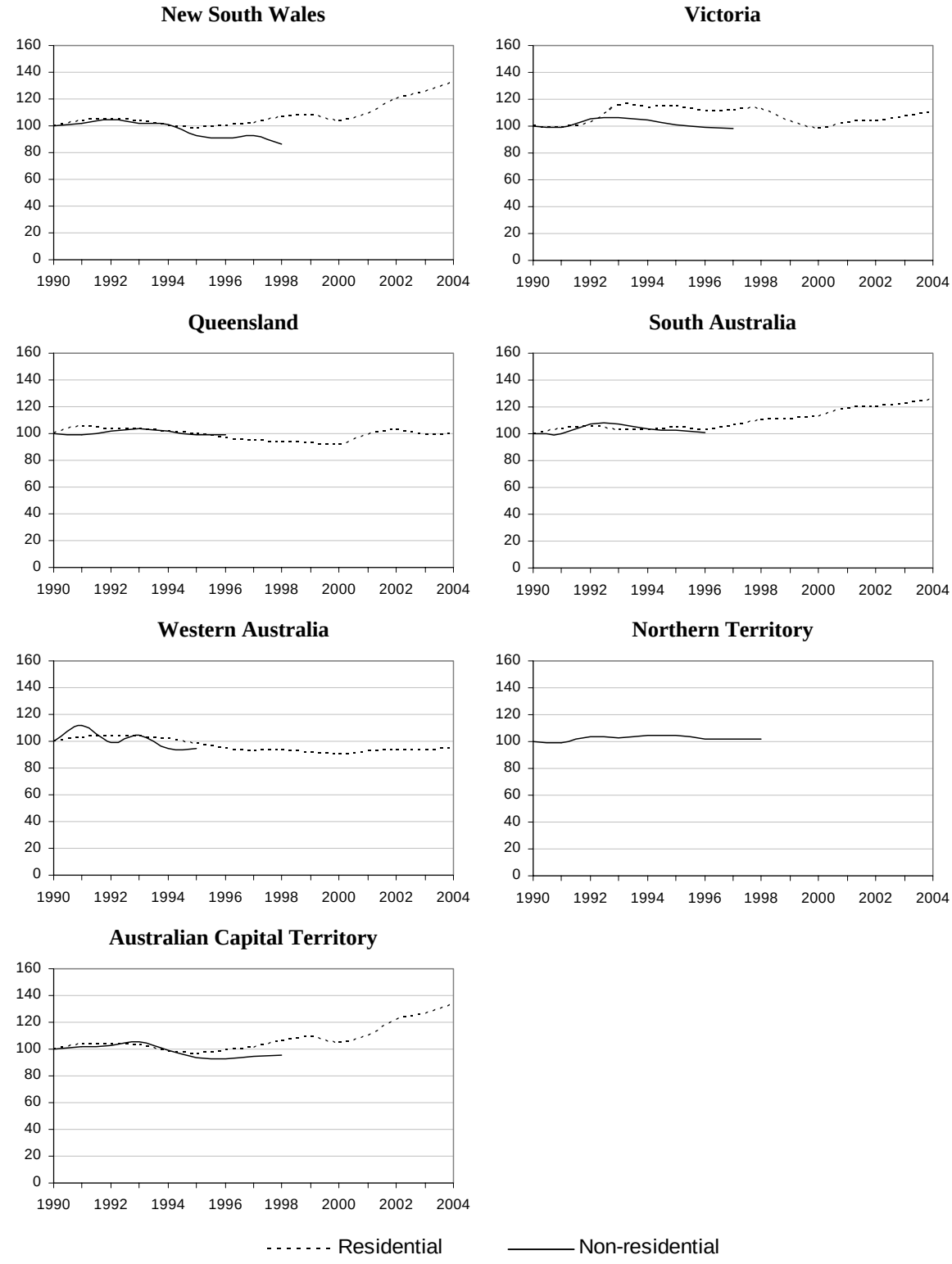
Indexes, 1989-90 = 100



Source: See appendix D.

Figure 2.4 **Real gas prices, 1989-90 to 2003-04[a]**

Indexes, 1989-90 = 100



a Non-residential prices only available to the mid-1990s. Residential prices inclusive of bottled gas.

Source: See appendix D.

While the reductions in costs associated with labour productivity improvements would, on average, tend to lower gas prices, the general absence of real price declines indicates that other factors are coming into play in determining prices. Such factors could include changes in the productivity of capital, increased cost recovery, contracting out of functions formerly performed in-house and changes in the real cost of gas supplies.

2.3 Urban water and sewerage

The water sector experienced significant changes during the 1990s. NCP-related water reform commenced in New South Wales in January 1992 with the corporatisation of the Hunter Water Corporation (table 2.3). In 1994, the Council of Australian Governments (COAG) endorsed a National Water Reform Framework that had the objective of improving the economic efficiency of the industry and environmental outcomes through a number of institutional and pricing changes. In 1995, COAG included the National Water Reform Framework as a related development to NCP, and linked NCP payments to the progress of jurisdictions in implementing the NCP water reform framework (PC 2002).

Changes to the governance arrangements of urban water and sewerage utilities were one element of the NCP water reform framework. Most metropolitan water and sewerage utilities were corporatised during the 1990s. Some services were contracted out, such as Adelaide's water supply and wastewater treatment. In Victoria, the government-owned water and sewerage utility was divided into a single wholesaler and three retailers. In general, service provision was decoupled from standard setting, resource management and pricing functions, and water and sewerage utilities were encouraged to earn commercial rates of return.

The NCP water reform framework also required the introduction of prices monitoring, the introduction of competitive neutrality measures, reform of public monopolies to conform to Corporations Law, review of legislation to identify anti-competitive elements, and, where applicable, access to nationally significant infrastructure by services providers.

Water and sewerage tariffs were also restructured to improve the economic efficiency of water and sewerage pricing. Traditionally, water and sewerage services were paid for by levies on property values that included a water allowance. Under such a pricing scheme, water and sewerage charges did not reflect the level of service delivery and business users tended to cross-subsidise residential users.

Reform saw major urban water utilities adopt two-part pricing strategies. Two-part pricing includes a fixed charge to recover capital costs and a volumetric charge

based on usage for water supplied and sewerage treated. However, Western Australia applies residential wastewater charges based on gross rental value.[2] Pricing reform has been more limited in non-major urban water utilities owned and operated by local government. The introduction of consumption-based pricing, along with a more commercial focus, has led to most urban water utilities achieving full cost recovery (NCC 2003c).

Reform saw significant reductions in manning levels and employment per unit of output, measured in megalitres of water supplied or sewerage treated, in all jurisdictions (figure 2.5). In Victoria, South Australia, Western Australia and the Northern Territory, the number of workers employed per megalitre fell by more than 60 per cent. Tasmania and the ACT posted smaller declines in labour requirements.

Changes in real water and sewerage prices over the 1990s paid by the residential and non-residential users differed significantly between jurisdictions and class of user (figure 2.6). Real non-residential prices declined variously in New South Wales, Victoria, South Australia, and Tasmania, while they rose in the other states. Real residential prices rose in over half of the jurisdictions.

The water reform program, which was brought under the ambit of the NCP in 1995, required that prices charged for water and waste-water services cover the full cost of providing those services. Sufficient provision for asset maintenance and refurbishment was also required. Increased cost recovery would have seen an increase in the price-cost margins, measured as the average unit revenue per unit cost of water supplied and sewerage treated, all other things remaining equal. Protection against monopoly pricing by suppliers was also to be afforded.

[2] The gross rental value is defined as estimated gross annual rent determined by the Valuer General's Office for the property.

Table 2.3 **Selected water and sewerage reforms**

Date	*Jurisdiction*	*Reform and key events*
Jan 1992	NSW	Hunter Water Corporation (HWC) established.
Jul 1992	NSW	Government Pricing Tribunal established to review and determine maximum prices charged by water authorities.
1993–1994	WA	Commencement of phasing out of the free water consumption allowance and phasing in of water charges based on meter size and volume of water consumed for non-residential metropolitan customers.
Oct 1993	Vic.	Office of Water Reform established to oversee management of water.
1994–1995	NSW	Regulatory reform of the HWC.
Feb 1994	National	COAG endorsed a framework of initiatives for the water industry over a seven year period covering water pricing based on consumption-based pricing and full cost recovery, elimination of cross-subsidies and making cross-subsidies transparent. Also covered water allocation and entitlement, reform of irrigation systems, allocating water for environmental purposes and institutional reform.
Dec 1994	SA	Volumetric water pricing for residential users announced.
Jun 1994	Vic.	Increase in the user pays proportion of water bills for customers in the Melbourne metropolitan region.
Apr 1995	National	COAG agrees to the Competition Principles Agreement (CPA).
1995	NSW	Privatisation of all government irrigation areas in the Murray and Lachlan Valley and two smaller schemes in the Murrumbidgee Valley.
1995–1996	NSW	Water reform package announced covering water quality and river flow objectives for all rivers and new charges for all water users.
1995–1996	Tas.	User-pays water pricing policy for Hobart Regional Water Board.
Jan 1995	NSW	Sydney Water Corporation established.
Jan 1995	Vic.	Melbourne Water Corporation disaggregated into three retail water businesses — City West Water, South East Water and Yarra Valley Water — and a wholesale water and sewerage business.
Jul 1995	Vic.	Legislation enables temporary interstate trade in irrigation water.
Jul 1995	Qld	Brisbane Water established as a business unit of Brisbane City Council.
Jul 1995	SA	EWSD corporatised and renamed the South Australian Water Corporation.
Jan 1996	SA	Management, operation and maintenance of Adelaide's water and sewerage network contracted out for 15 years.
Jul 1995	Tas.	Hobart Regional Water Board, North West Regional Water Authority and Rivers and Water Supply Commission become government business enterprises.
Jul 1995	ACT	ACTEW corporatised.
Jan 1996	WA	Water Corporation replaces Water Authority of Western Australia.
1996	National	COAG water agreement extended to incorporate groundwater and storm/wastewater.
Jan 1997	Tas.	New Hobart Regional Water Board was established.
May 1997	Qld	Water reform pricing principles applied to 17 largest local governments.
Jul 1997	SA	Transferable entitlements implemented and greater devolution of water resource management to local communities.

(Continued next page)

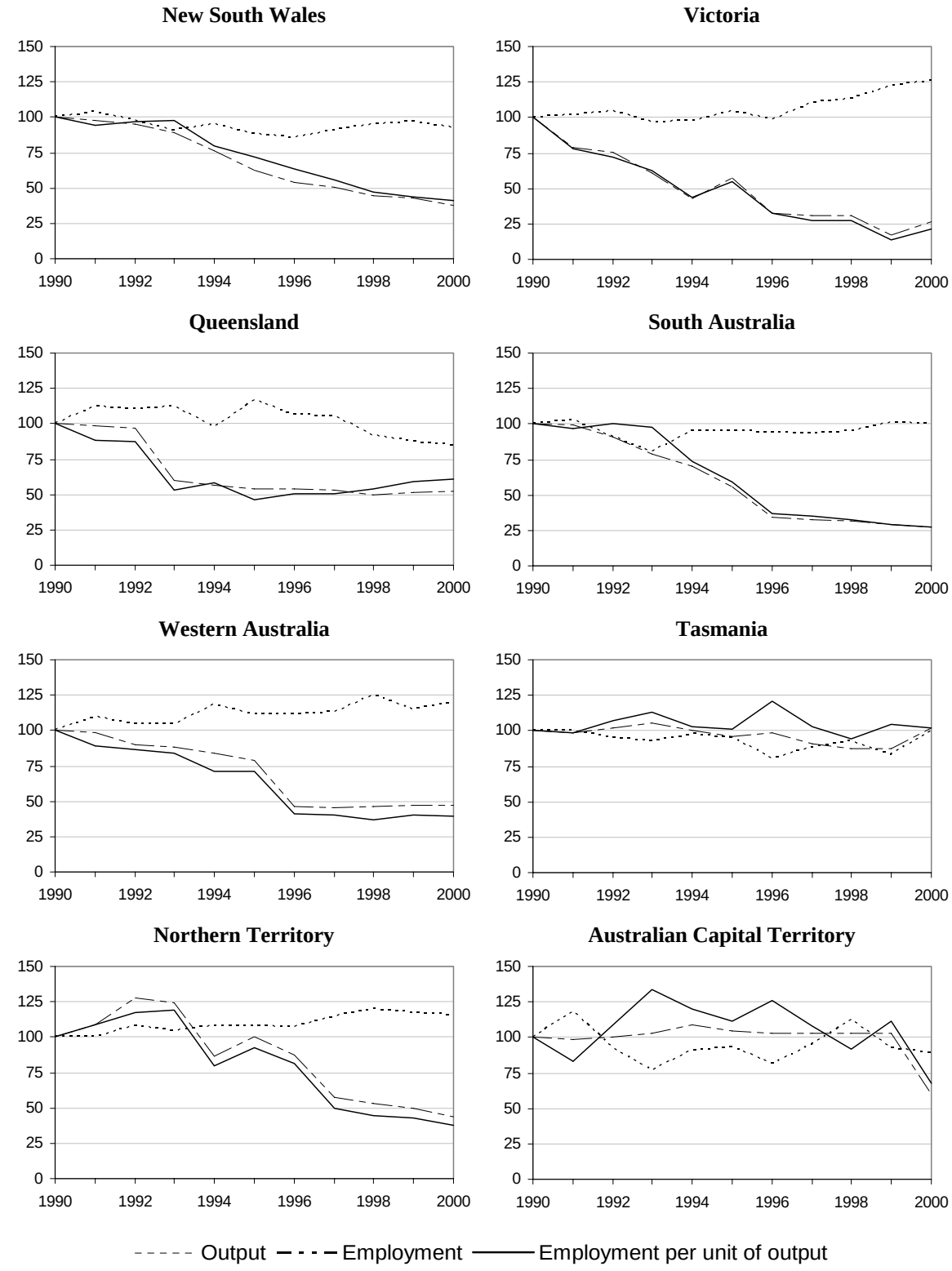
Table 2.3 **(continued)**

Date	*Jurisdiction*	*Reform and key events*
Jul 1997	Tas.	Regional water supply schemes transferred to regional water authorities.
Aug 1997	NSW	Upgrade of resource allocation framework to provide clearer specification of water entitlements, including those allocated for environmental use.
Oct 1997	Vic.	Water reform to reduce average domestic water prices; abolish property value-based water charges and a debt restructure package for metropolitan and non-metropolitan urban water authorities.
Jan 1999	NSW	Sydney and Hunter Water Corporations changed from companies to state owned corporation to give the responsible minister greater power to access information.
Jul 1999	NSW	Resource management functions were transferred from Sydney Water Corporation to the Sydney Catchment Authority.
Feb 2003	NSW	Introduced best practice pricing guidelines to assist the remaining utilities to move to full cost recovery and adopt consumption-based pricing.
Jan 2004	Vic.	Water industry brought under the jurisdiction of the Essential Services Commission.
Jun 2004	National	The Australian, NSW, Victorian, Queensland, SA, NT and ACT governments agreed to the National Water Initiative, which extends and complements NCP.
Jul 2004	NSW	New water sharing plans and licensing provisions commence for river systems.

Sources: PC (1998, 2004a). NCC (2003c).

Figure 2.5 **Urban water and sewerage industry output, employment and employment requirements per unit of output, 1989-90 to 1999-00**

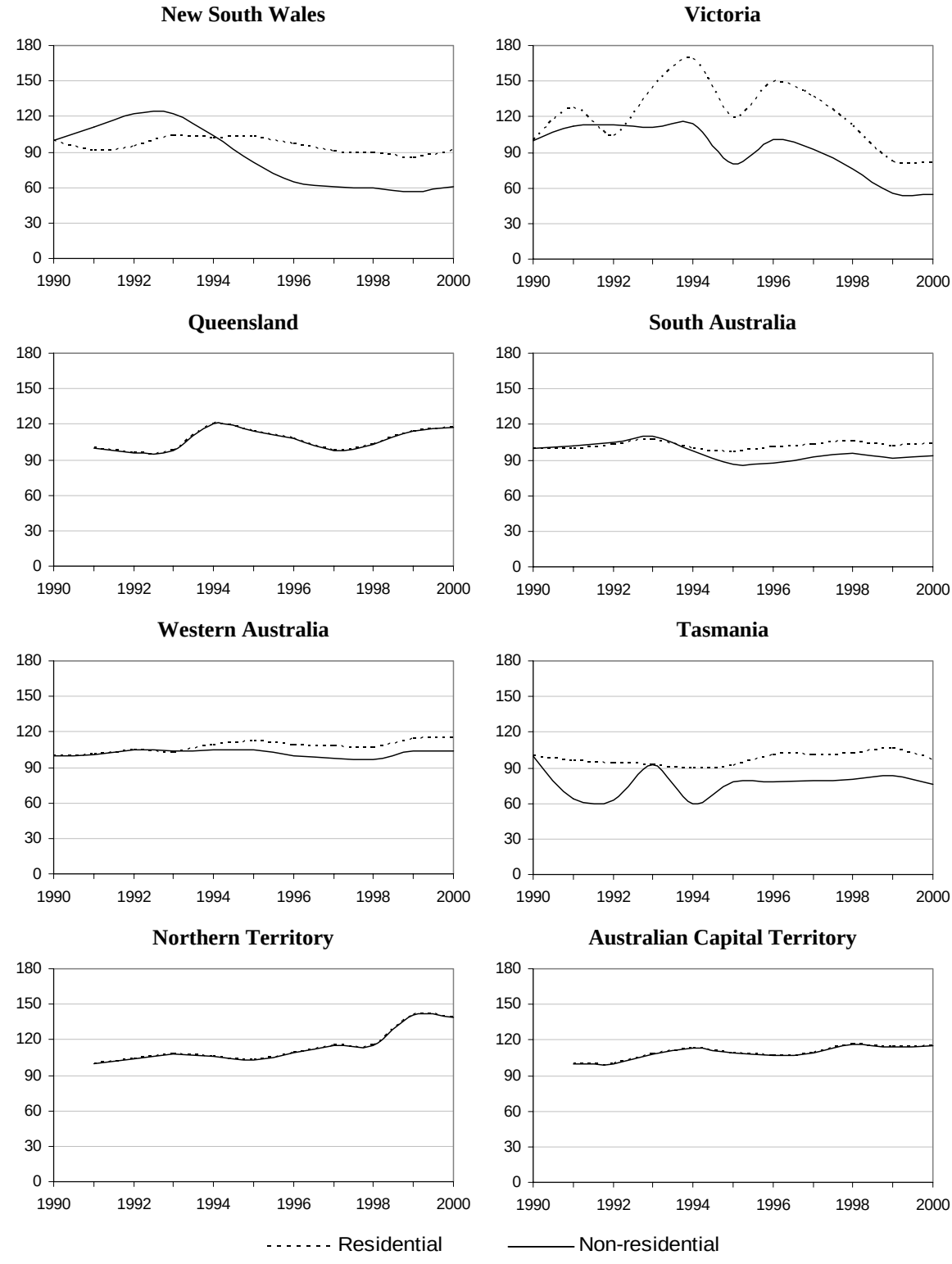
Indexes, 1989-90 = 100



Source: See appendix D.

Figure 2.6 **Real urban water and sewerage prices, 1989-90 to 1999-00**

Indexes, 1989-90 = 100



Source: See appendix D.

2.4 Urban transport

Urban transport as defined for this study includes bus, tram, train and ferry services in metropolitan areas, but excludes taxi services. Many reforms occurred in urban transport across jurisdiction through the 1990s (table 2.4).

These urban transport services had been provided almost exclusively by governments prior to the 1990s. Governments often lowered urban transport costs to users through publicly-owned service providers and through the regulation of other service providers' fares. Institutional and regulatory changes introduced during the 1990s sought to reduce the reliance of service providers on government funding by commercialising, and sometimes privatising, publicly-owned services and by exposing service providers to market competition.

Reform saw marked reductions in the employment requirements per unit of output, measured as millions of boardings, in urban rail and road transport in most jurisdictions over the 1990s. (figures 2.7 and 2.8).[3] There was, however, significant variability between jurisdictions and modes of urban transport. For example, available data suggest that while labour requirements per unit of output were relatively constant for Queensland urban rail, they declined substantially in the other jurisdictions. There was a fall of around 50 per cent in measured employment per unit of output in Victoria's public rail transport sector.

Against these trends, available information suggests that labour productivity in urban water transport declined over the period in New South Wales and Western Australia, that is, labour requirements per unit of output increased. In Queensland labour productivity improved (figure 2.9).

Despite the cost-lowering labour productivity improvements, real prices generally rose for all modes of urban transport over the 1990s (figures 2.7 to 2.9). A significant factor influencing this divergence is likely to have been reform of pricing structures to better align average ticket prices with service costs. The magnitude of the price increases, however, varied across jurisdictions.

[3] The changes in employment per unit of output in each of these industries in all states cover the period 1989-90 to 1996-97, except for ferry services in Western Australia, which covers the period 1989-90 to 1994-95.

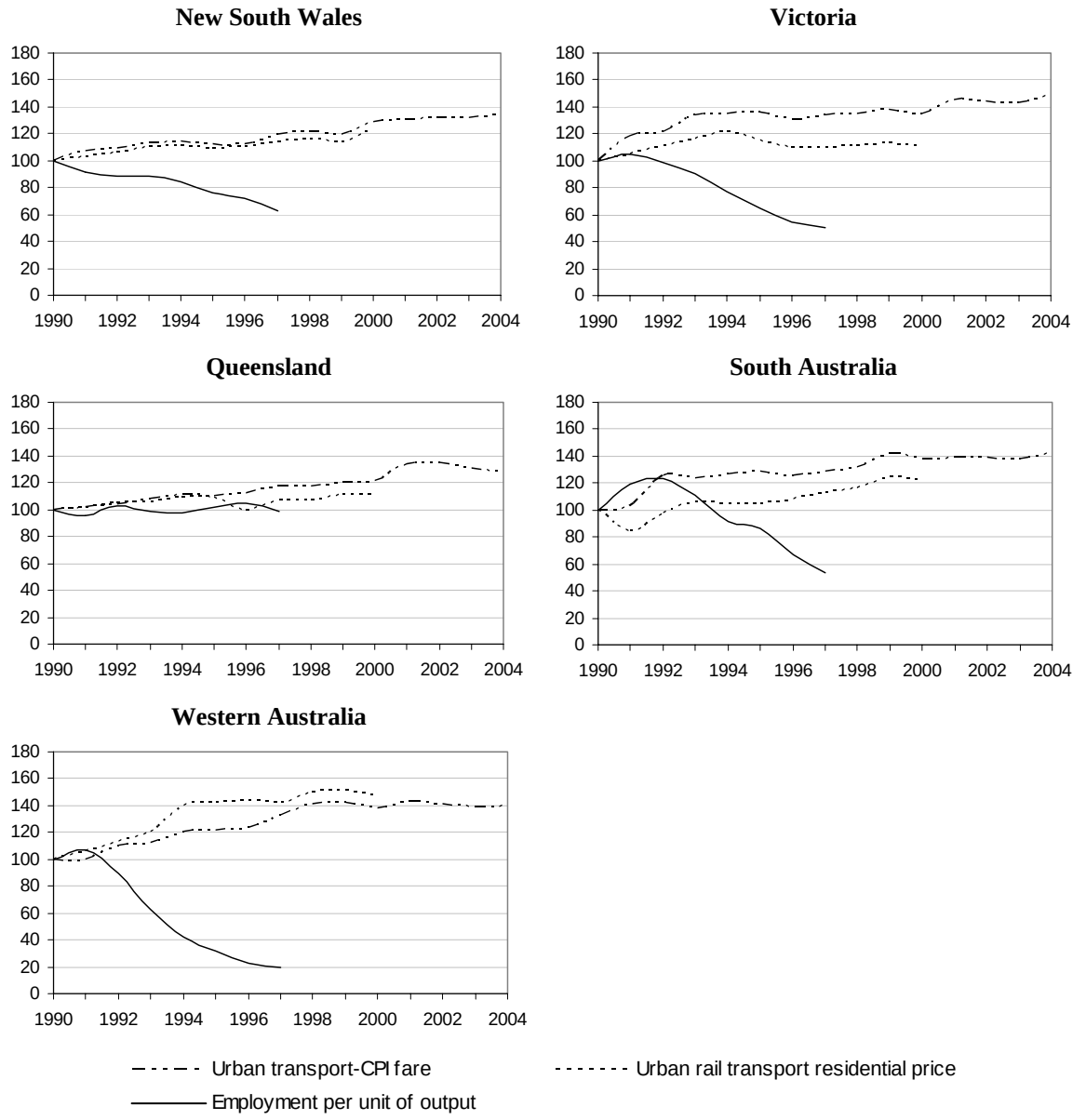
Table 2.4 **Selected urban transport reforms**

Date	*Jurisdiction*	*Reform and key events*
1992-93	NSW	Commercialisation initiatives introduced for the State Transit Authority, including performance monitoring arrangements, transparent funding for community service obligations provided under contract, and restructuring to enhance accountability and debt reduction. State Transit Authority required to operate under the same conditions as private bus operators.
1992-93	WA	Pricing reforms for Transperth with fares based on distance-based costs.
1992-93	ACT	ACTION required to improve efficiency and operating cost savings to reduce the real level of government contributions.
1993-94	Vic.	Restructuring of the Public Transport Corporation into business units.
1993-94	Vic.	80 per cent of former government bus services in Melbourne contracted to a private operator. Introduction of driver-only suburban trains and trams.
1993-94	WA	Transperth restructured.
Jul 1994	SA	TransAdelaide assumed operating functions of State Transport Authority.
1994-95	NSW	Integration of ticketing across various public transport modes. State Rail Authority prepared for restructure.
1994-95	SA	Passenger Transport Board to oversee the creation and maintenance of an integrated network of passenger transport services.
1994-95	WA	Bus services around Perth put up for tender.
Feb 1995	WA	Transperth ferry services contracted out to a private operator.
Mar 1995	SA	Selected public bus transport routes competitively tendered.
Apr 1995	National	COAG agrees to the Competition Principles Agreement (CPA).
1995-96	Qld	Brisbane Transport commercialised.
1995-96	Tas.	Metropolitan Transport Trust made a GBE with application of competitive neutrality, identification, costing and funding of CSOs and prices oversight.
1995-96	ACT	ACTION required to operate on a more commercial basis.
May 1997	Qld	Competitive neutrality reform of Brisbane Transport.
1996-97	Tas.	Tasmanian Government negotiate a three year contract with Metropolitan Transport Trust to provide bus services at the then current levels, conditional on achieving annual savings of $2 million.
1997-98	Vic.	Public Transport Corporation's passenger services split into five corporations — two train, two tram and intrastate country services.
Aug 1999	Vic.	Corporatised passenger transport businesses sold to individual franchises.
Jun 2000	WA	Office of the Independent Rail Access Regulator established to oversee the implementation of a rail access regime.
Apr 2001	NSW	Glenbrook inquiry recommended that rail safety regulation arrangements be established separately from the provider of rail network services.
Jan 2002	ACT	ACTION changed from a division of the Department of Urban Services to a statutory authority.
Feb 2002	National	National railways privatised.
Dec 2003	NSW	Australian Rail Track Corporation granted 60-year lease of NSW rail lines.
Jan 2004	NSW	Rail Corporation commences operations.
Jan 2005	NSW	New contract regime for private bus operators.

Sources: PC (1998) and NCC (2003b).

Figure 2.7 **Urban rail transport employment requirements per unit of output and real prices, 1989-90 to 2003-04[a]**

Indexes, 1989-90 = 100

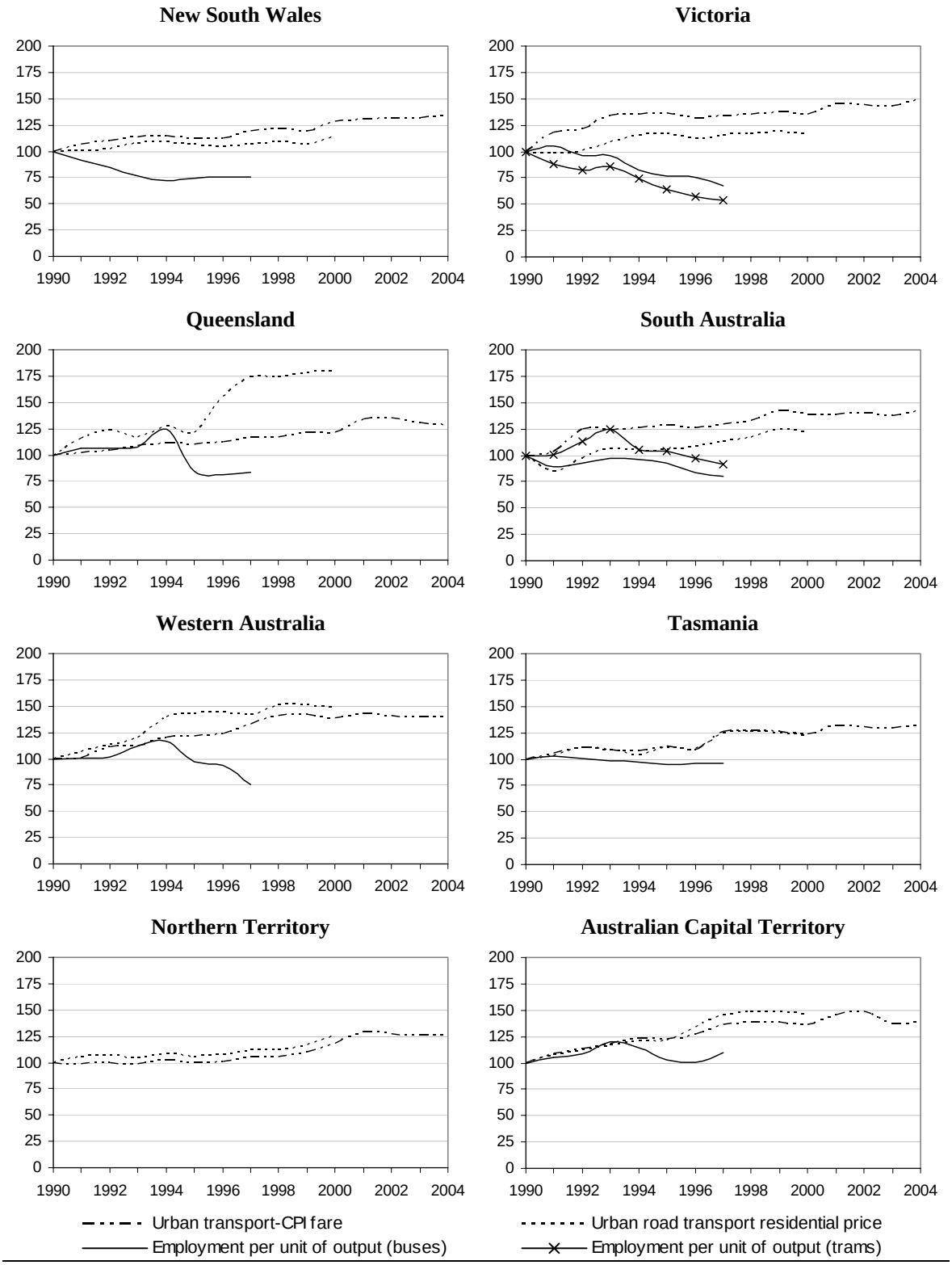


a Productivity information is only available to the mid-1990s.

Source: See appendix D.

Figure 2.8 **Urban road transport employment requirements per unit of output and real prices, 1989-90 to 2003-04[a]**

Indexes, 1989-90 = 100

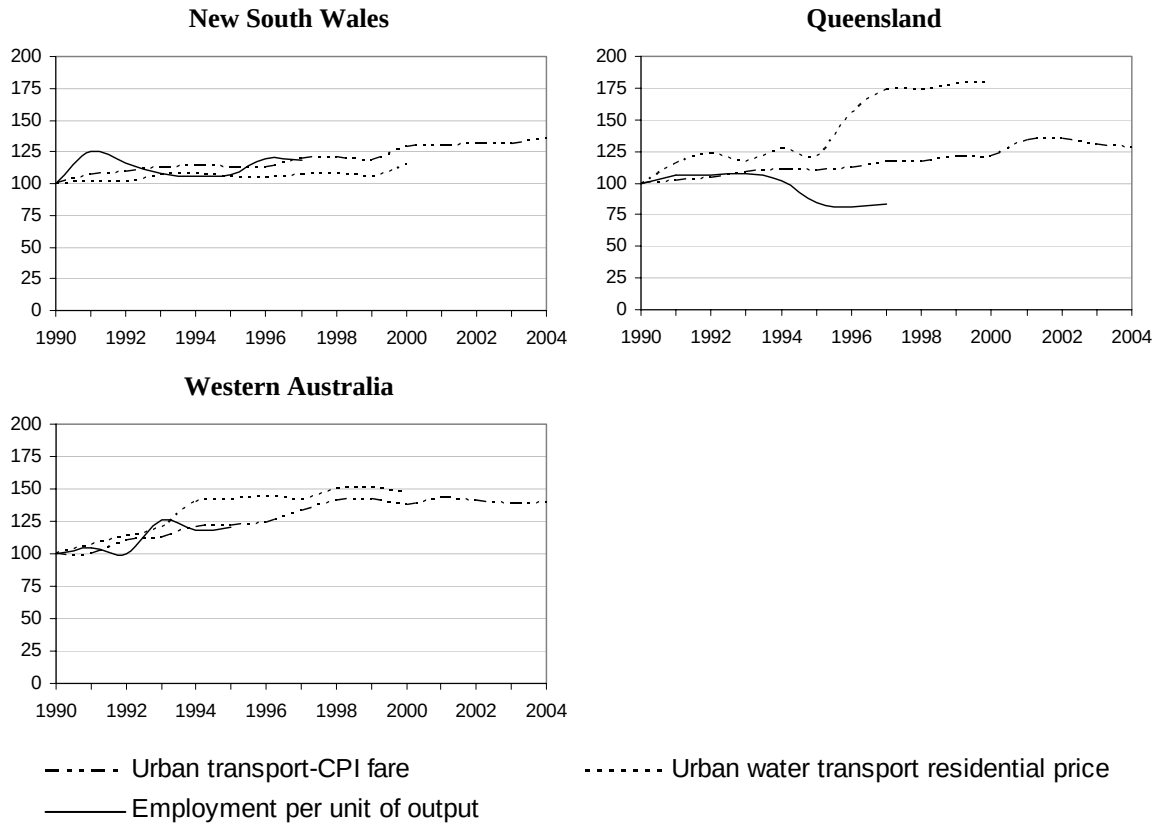


[a] Productivity information is only available to the mid-1990s and is not available for the Northern Territory.

Source: See appendix D.

Figure 2.9 **Urban water transport employment requirements per unit of output and real prices, 1989-90 to 2003-04[a]**

Indexes, 1989-90 = 100



a Productivity information is only available to the mid-1990s.

Source: See appendix D.

2.5 Ports

Ports reform has comprised corporatisation and privatisation and, in some jurisdictions, the introduction of third party access regimes to cover various port services (table 2.5). The reforms were aimed at creating incentives to improve productivity and efficiency of port services.

The corporatisation of ports has involved separating commercial and regulatory functions, allowing for the identification and costing of CSOs, and the introduction of dividend and tax equivalent regimes. Restructuring has, in many cases, involved port authorities becoming statutory bodies, so that they operate outside the departmental structure of government. The landlord model of operation has also been applied in many cases. Contracting out and privatisation of non-core activities and the sale of non-core assets has also been adopted by many port authorities.

Changes in the pricing of port services have also been implemented as part of the process of commercialisation. Ports have progressively introduced service cost-based charging for services rendered, moving away from charges based on the value or volume of cargo handled.

In most jurisdictions, the board of each trading enterprise now determines port charges, with these being generally subject to the approval of the relevant Minister. Independent bodies to oversee the pricing of port services have also been established in each jurisdiction. In Victoria, the Essential Services Commission (formerly the Office of Regulator General) regulates port charges.

Reform saw substantial reductions in labour requirements per unit of output, measured as thousand mass tonnes, in all jurisdictions having port facilities (figure 2.10). The productivity improvements were mainly associated with reductions in manning levels.

Over the 1990s, real supply prices, measured as a weighted average of container and bulk cargo charges, fell in most jurisdictions (figure 2.10). There was some variability evident in price changes between jurisdictions, with the largest real price declines being recorded for New South Wales and Victoria.

Table 2.5 **Selected ports' reforms**

Date	*Jurisdiction*	*Reform and key events*
1991-92	NSW	Closure of Balmain Coal Loader and Goat Island shipyard.
Jun 1993	Tas.	Competitive neutrality principles applied to main port authorities requiring payment of income tax-equivalents and guarantee fees on new borrowings.
1993	SA	Marine and Harbours Agency's pricing policy reformed.
1993-94	NSW	Closure of Sydney maintenance workshop and increase in contracting out.
1994	Vic.	Reduction of port authority charges, abolition of the State tonnage duty and 15 per cent reduction in wharfage charges at the Port of Melbourne.
Jul 1994	Qld	Brisbane Port Authority, Gladstone Port Authority and Ports Corporation of Queensland corporatised.
Nov 1994	SA	Marine and Harbours Agency corporatised to form SA Ports Corporation.
1994-95	SA	Pricing reform undertaken with an increased focus on user-pays.
Apr 1995	National	COAG agrees to the Competition Principles Agreement (CPA).
Apr 1995	NT	Darwin Port Authority classified as a government business division.
Jun 1995	NSW	Maritime Services Board replaced by three independent port corporations in Sydney, the Hunter and the Illawarra regions.
Jul 1995	Qld	Bundaberg, Cairns, Mackay, Rockhampton and Townsville port authorities corporatised.
Jul 1995	SA	SA Ports Corporation subject to an income tax-equivalent regime.
1996	Vic.	Port of Melbourne Authority disaggregated into the Melbourne Port Corporation (MPC) and its subsidiary Melbourne Port Services, and the separate statutory authority, Victorian Channels Authority.
1996-97	Vic.	Port of Hastings management contracted out.
Mar 1996	Vic.	Port of Portland privatised.
May 1996	Vic.	Port of Geelong privatised.
Jun 1996	NSW	NSW port corporations adopt a new capital structure based on commercial principles, resulting in clearer commercial objectives and enabling them to compete for business.
Jul 1996	WA	Fremantle Port Authority commercialised and subject to an income tax-equivalent regime.
Jul 1996	NT	Darwin Port Authority subject to an income tax-equivalent regime. Government funded CSOs provided to the Authority for the first time.
Oct 1996	WA	Fremantle Port Authority and Bunbury Port Authority commercialised.
Dec 1996	Vic.	Victorian Government applied to the National Competition Council to consider the effectiveness of its access regime for Victorian commercial shipping channels. (Certification granted in August 1997.)
Dec 1996	SA	Access regime adopted for the sale of bulk handling facilities.
May 1997	Vic.	Melbourne Port Services privatised.
Jul 1997	Tas.	Burnie Port Authority, Marine Board of Hobart, Port of Devonport Authority and the Marine Board of Launceston corporatised.

(Continued next page)

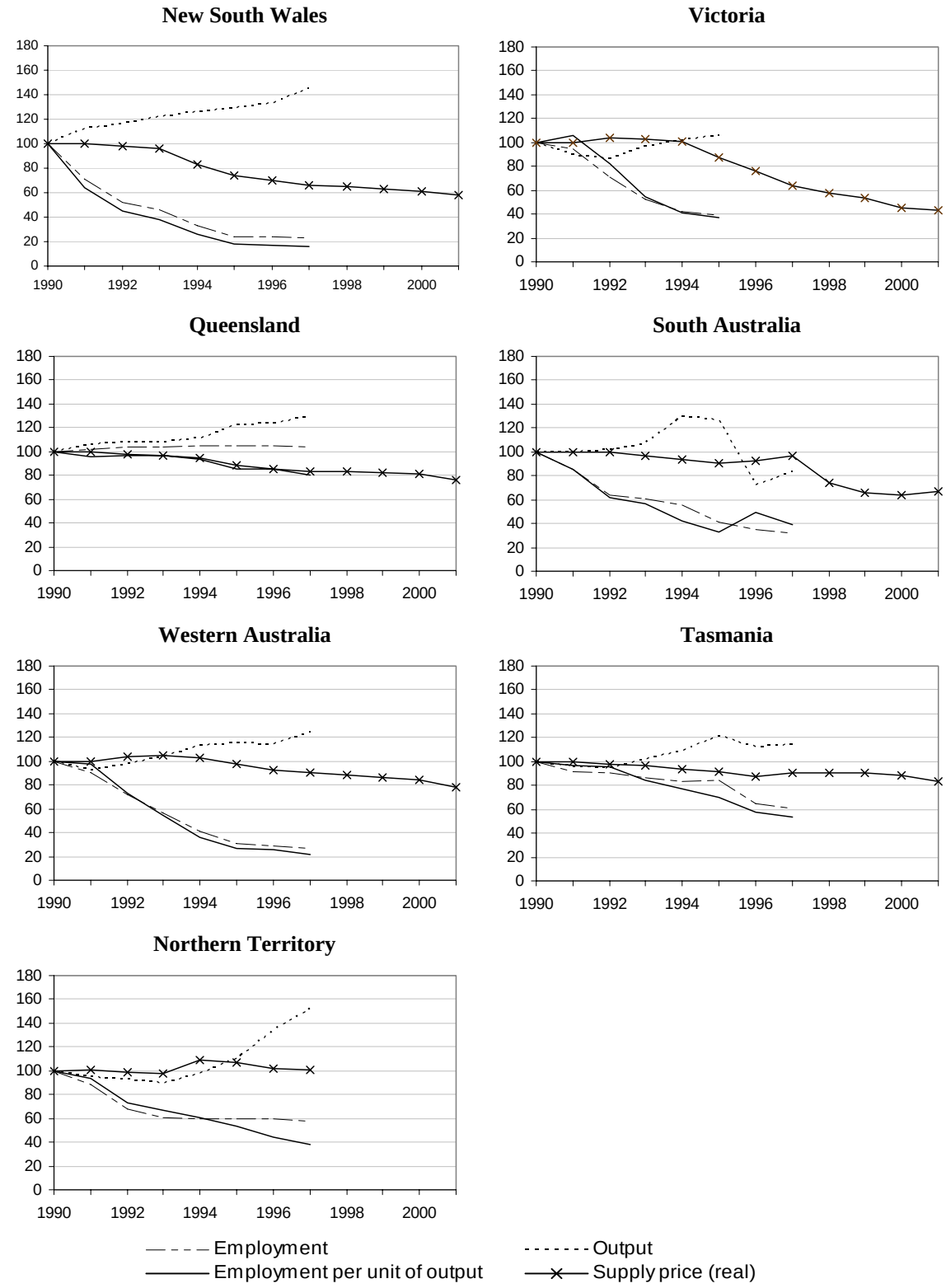
Table 2.5 **(continued)**

Date	*Jurisdiction*	*Reform and key events*
Oct 2000	National	Trade Practices Amendment (International Liner Cargo Shipping) Act 2000 enacted, changing the arrangements for the stevedoring conferences.
2001	SA	Seven ports privatised.
Apr 2003	Vic.	Port of Melbourne Corporation (PMC) vested with the management responsibility for the water and channels that serve the port.
Jun 2003	Vic.	Port of Melbourne Corporation takes over the roles and responsibilities of the Melbourne Port Corporation (MPC), the Victorian Channels Authority and Port of Melbourne.
Jan 2004	Vic.	Port of Hastings Corporation established.
Apr 2004	Vic.	Victorian Regional Channels Authority established.

Sources: PC (1998) and NCC (2003b).

Figure 2.10 **Ports industry output, employment, employment requirements per unit of output and real prices, 1989-90 to 2000-01[a]**

Indexes, 1989-90 = 100



a Productivity information is only available to the mid-1990s.

Source: See appendix D.

2.6 Rail freight

Rail freight reform has included the commercialisation and corporatisation and, in some instances, privatisation of government trading enterprises, changes to governance arrangements, the introduction of third party access arrangements and the deregulation of selected routes (table 2.6). With these changes, new trading and financial arrangements and explicit funding of CSOs were also introduced.

The National Rail Track Corporation was established to manage access to the interstate standard gauge rail network between Brisbane and Perth, and to manage access to, and maintain of, the networks in South Australia and Victoria and parts of New South Wales and Western Australia. The provision of rail freight services also became more contestable with the establishment of a national third party access regime for rail infrastructure in 1996. This regime is jointly administered by the National Competition Council and the Australian Competition and Consumer Commission. These arrangements have allowed the entry of a number of private operators, including interstate freight operators.

Rail freight reforms saw significant reductions in labour requirements per unit of output, measured as net freight-tonne kilometres, in each jurisdiction (figure 2.11). The available data indicate that reduced manning levels were instrumental in those productivity improvements. Nevertheless, the largest productivity improvements occurred in Western Australia and Queensland, where output also increased significantly. There were also significant year-to-year variation in New South Wales, Victoria and Tasmania indicating that other non-reform (demand and supply) factors may have influenced the evolution of the industry over the period.

Over the 1990s, real rail freight service prices declined across jurisdictions (figure 2.11). With some variability between states, available data suggest that real price reductions in Queensland, Western Australia and Tasmania were somewhat greater than in other jurisdictions.

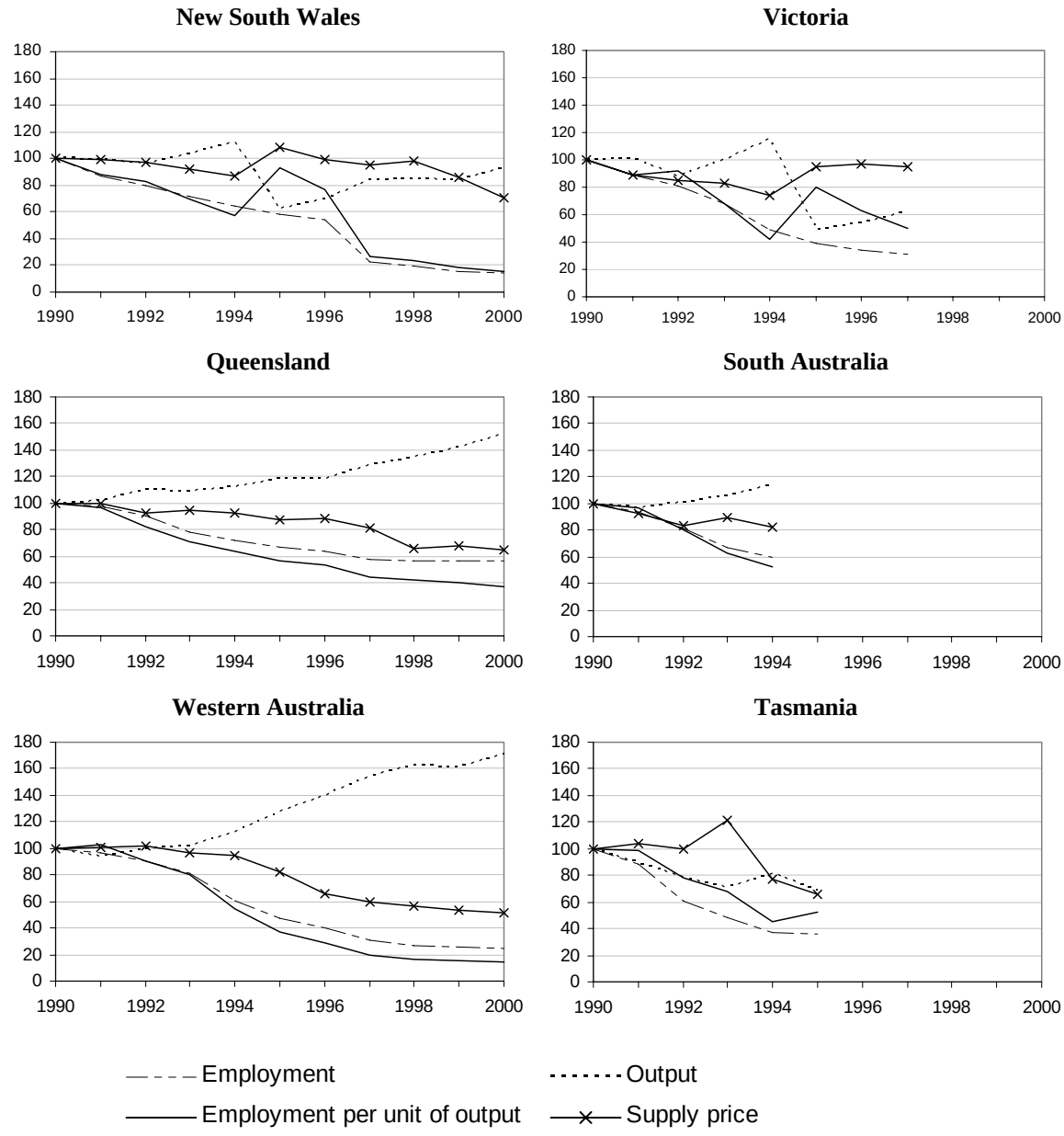
Table 2.6 **Selected rail freight reforms**

Date	*Jurisdiction*	*Reform and key events*
1991-92	National	National Rail Corporation established, to operate the interstate rail freight business in Australia, with the Commonwealth, New South Wales and Victorian Governments as shareholders.
1991-92	NSW	State Rail Authority receives payments for community service obligations for the provision of non-commercial services directed by government.
1991-92	Qld	Queensland Rail established as a corporate body.
1992-93	WA	Transport of bulk fuels, minor bulks and timber deregulated.
1993-94	NSW	Leasing arrangements introduced for new rolling stock and locomotives, owned and maintained by private firms.
1993-94	Qld	Phased removal of 'de-facto' royalties collected through rail freight rates commenced. Transparent funding of CSOs introduced.
1993-94	National	Australian National interstate freight business transferred to National Railway Corporation.
1993–1995	Vic.	Removal of restrictions applying to the transport by road of bulk oil, minor bulk commodities, timber, cement and briquettes.
Apr 1995	National	COAG agrees to the Competition Principles Agreement (CPA).
1994-95	NSW	Access fees to operate on the New South Wales rail network.
1994-95	WA	Transport of major bulk ore, minerals and woodchips deregulated.
1995-96	National	Third party access arrangements to Australian National's track finalised.
1995-96	National	Two private operators begin providing freight services across the Melbourne–Adelaide–Perth corridor.
1995-96	NSW	Open access regime created allowing accredited operators (both public and private) to obtain access to the New South Wales rail network.
1995-96	Vic.	V/Line Freight and Victorian Rail Track established as body corporates. Access to Victoria's rail infrastructure for private freight operators.
1995-96	Qld	Queensland Rail (QR) corporatised, becoming subject to a tax equivalent regime and receiving explicit funding for CSOs.
1995-96	Qld	Network access unit established for all dealings with third party operators.
Jul 1996	NSW	Rail Access Corporation and Freight Rail Corporation corporatised.
1995-96	WA	Financial reform of Westrail, including explicit funding of CSOs, the reduction of debt through a land rationalisation program, and the introduction of income tax equivalent and dividend regimes.
Sept 1997	National	Commonwealth, State and Territory governments agreed to develop arrangements established through ARTC that would facilitate inter state rail services.
Nov 1998	WA	Westrail access regime opened to competition by rail freight operators.
1999	Vic	Victoria privatised its intra-state rail freight network (V/Line Freight).
Dec 2000	WA	Westrail's freight business, consisting of rolling stock and freight contracts sold to a private consortium, the Australian Railroad Group.
July 2001	Vic.	Victoria established an access regime to cover track services used to transport freight over the intrastate and leased to Freight Australia.
Feb 2002	Vic	National Rail privatised in Victoria.
Mar 2003	Qld	A public benefit test of the rail safety provisions of the *Transport Infrastructure Act 1994* and the related regulation undertaken.

Sources: PC (1998) and NCC (2003b).

Figure 2.11 **Rail freight industry output, employment, employment requirements per unit of output and real prices, 1989-90 to 1999-00[a]**

Indexes, 1989-90 = 100



a Productivity information is only available to the mid-1990s in Victoria, South Australia and Tasmania.

Source: See appendix D.

2.7 Telecommunications

Over the last two decades, the telecommunication industry has undergone significant reform (table 2.7). It has also seen the uptake of new technologies in the supply of telecommunication services and the provision of new services. The main reforms have included the introduction of competition in service provision, telecommunications-specific access and conduct arrangements, the partial privatisation of Telstra, the transfer of regulatory responsibilities from the Australian Telecommunications Authority to the Australian Communications Authority (ACA) and the Australian Competition and Consumer Commission (ACCC), and contributions by Telstra and new carriers to the funding of universal service obligations (USO).

The telecommunication markets were made more contestable by the removal of regulatory barriers to entry and the introduction of network access arrangements. Initially, the removal of entry barriers saw the industry move from a monopoly (Telecom only) to a duopoly arrangement (Telecom and Optus). Since then, other carriers have entered the market and now compete for the provision of local, STD and long-distance calls. The provision of network access arrangements was essential to the introduction of competitive service provision in telecommunications because of the high fixed costs of network infrastructure and the decreasing cost-nature of that infrastructure. Further, competition in telecommunications markets was increased by the introduction of mobile telephony services.

The introduction of the USO has required that Telstra (as the universal service provider) make standard telephone services, payphone services and digital data services available to all customers equitably. This usually means that charges are imposed uniformly across all areas, so that some services are provided at below cost. Telstra is reimbursed for providing the USO by a levy imposed upon each carrier in proportion to its revenue share in telecommunications markets.

While there have been significant changes, liberalisation of the telecommunication industry has not included the removal of price regulation. Telecommunication carriers are still required to provide untimed local calls for business and household voice services, and for household data, facsimile and internet access. Further, retail price caps on service charges also exist and Telstra is subject to retail price controls. It is subject to the 'CPI – X' formula, where the percentage change in service prices over a particular period must be kept below the percentage change in the CPI by 'X' per cent, where X is an amount related to expected productivity improvements.

Reform together with other changes saw steady reductions in labour requirements per unit of output, measured as real value added, across operations in each

jurisdiction (figure 2.12). The improved productivity was accompanied by reductions in manning levels in operations in each jurisdiction.

Over the 1990s, there was a steady decline in real service prices, measured by the ABS capital city consumer price index for telecommunications services adjusted for changes in the general price level. The CPI-X regulation of telecommunications service prices is likely to have contributed to the steady flow of price reductions over the period 1989-90 to 2003-04.

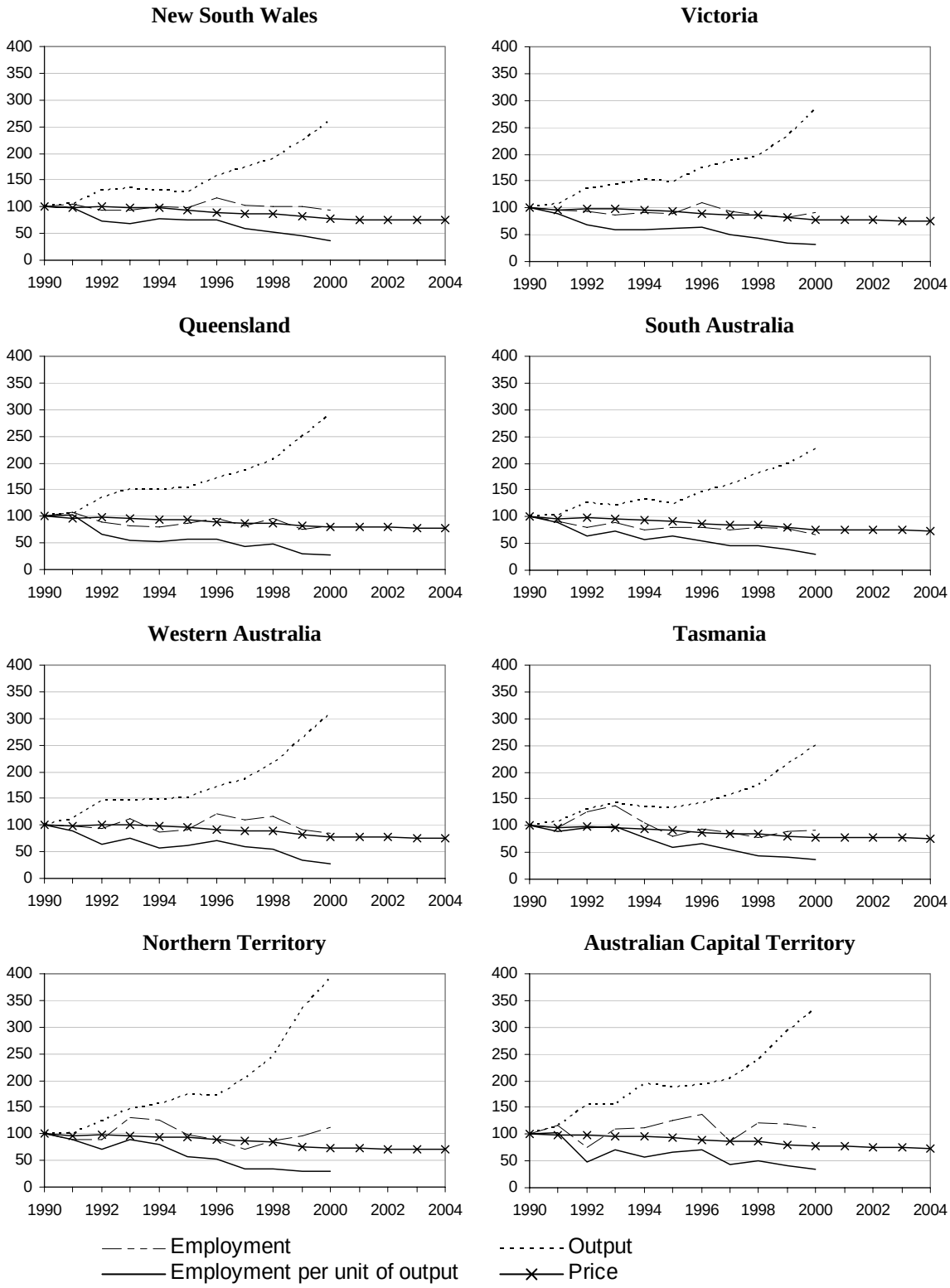
Table 2.7 **Selected telecommunications reforms**

Date	*Jurisdiction*	*Reform and key events*
Aug 1987	National	Corporatisation of the Australian Telecommunications Commission (Telecom Australia).
July 1989	National	Australian Telecommunications Authority (AUSTEL) established as an independent industry-specific regulator with responsibility for technical regulation, protecting the carriers' exclusive rights, protecting competitors from unfair carrier practices, protecting consumers' interests, administering price control and universal service levy arrangements and promoting carrier efficiency.
Jun 1991	National	Commencement of gradual transition to open competition with the introduction of a duopoly on fixed network provision (until 30 June 1997); the merger of Telecom and Overseas Telecommunications Corporation (OTC), and the sale of AUSSAT to the second national carrier; the issuing of three public mobile telephone licences; the full resale of domestic and international capacity; and extended responsibilities and powers for the industry-specific regulator AUSTEL.
Feb 1992	National	Telecom Australia and OTC merged to form the Australian and Overseas Telecommunications Corporation (AOTC).
Jun 1992	National	Optus commenced mobile telephone service operations.
Nov 1992	National	Optus interconnected with the AOTC network to provide domestic long distance and international services.
Oct 1993	National	Vodafone commenced operations, competing with Optus and Telstra in the provision of digital mobile telephone services.
Apr 1995	National	COAG agrees to the Competition Principles Agreement (CPA).
Jul 1995	National	Access regime established for broadband cable infrastructure, which allowed access to third parties so that they may provide telephony and broadband services.
Jul 1997	National	Introduction of full and open competition. ACCC given specific powers to regulate anticompetitive conduct in telecommunication markets and to administer a telecommunications specific access regime.
Nov 1997	National	One third of Telstra sold to the public and shares listed.
Oct 1999	National	Second tranche of Telstra sold to the public and shares listed.
Aug 2002	National	Government announced a review of the roles of the ACA and ABA with a focus on arrangements for the management of broadcasting and telecommunications spectrum.
Dec 2002	National	Government introduced the *Telecommunications Competition Bill 2002*.

Sources: PC (1998) and NCC (2003b).

Figure 2.12 **Telecommunications industry output, employment, employment requirements per unit of output and real prices, 1989-90 to 2003-04**

Indexes, 1989-90 = 100



Source: See appendix D.

3 Impacts of changes in infrastructure industries

This chapter reports on the modelling of the economy-wide and regional effects of infrastructure industry labour productivity and service-price changes outlined in chapter 2. The changes are summarised in table 1.2 of chapter 1.

The impact of change on wellbeing can be measured in a number of different ways — by the value of production, employment, income and expenditure levels or 'standard of living'. For a given level of aggregate employment, MMRF-CR produces two broad measures of change at the national level — gross national production and gross national expenditure. These measures are supported by measures of change in consumption and investment spending, real wages, imports and exports.

With the specified no-change in aggregate employment, achieving higher labour productivity and national output involves some relocation of jobs between industries and regions. MMRF-CR produces two key measures of the regional implications of change — gross regional product and employment. From these two measures a third measure can be inferred — change in value added output (ie income generated) per person employed. Each of these measures reflect different aspects of the income generating potential of regions.

3.1 National and sectoral changes

The changes in infrastructure industries considered here were projected to cumulatively increase the level of real GDP by about 2.5 per cent above what it would otherwise be (table 3.1). Each industry positively contributes to output growth, with the largest contribution arising from changes in the electricity and telecommunications industries.

With lower labour costs due to improved labour productivity, export volumes were projected to expand significantly. The increase in export volumes comes at the expense of slightly lower export prices, resulting in a small deterioration in the terms of trade. Higher exports would increase the nation's capacity to import and sustain higher levels of national spending than would be otherwise possible.

Table 3.1 **Estimated macroeconomic effects of changes in infrastructure industries over the 1990s**

Percentage change

Variable	*Electricity*	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*	*All sectors*
Real GDP	0.67	0.10	0.35	0.14	0.51	0.78	2.53
Real GNE	0.59	0.00	0.14	0.00	0.27	0.53	1.54
of which							
Real consumption	0.52	-0.01	0.10	-0.02	0.17	0.52	1.28
Real investment	0.90	0.06	0.33	0.10	0.70	0.59	2.69
Export volumes	1.06	0.59	1.35	0.82	1.86	2.17	7.85
Import volumes	0.67	0.08	0.27	0.09	0.63	0.84	2.58
GDP deflator	-0.11	-0.02	-0.02	-0.04	-0.05	0.03	-0.21
Nominal exchange rate[a]	-0.12	0.02	0.14	-0.04	-0.18	0.28	0.11
Terms of trade[b]	-0.03	-0.03	-0.06	-0.03	-0.18	-0.47	-0.80
Real wages	0.43	-0.08	0.01	-0.27	-0.21	0.55	0.44
Sectoral value added output:							
Agriculture	-0.96	0.04	0.02	0.17	0.03	0.44	-0.25
Mining	2.23	0.25	0.69	0.63	5.92	1.47	11.18
Manufacturing	0.88	0.32	0.53	0.37	0.06	1.03	3.19
Services	0.67	0.06	0.34	0.07	0.35	0.75	2.23

[a] Defined as units of A$ per unit of foreign currency. [b] Defined as the change in the export price index less the change in the import price index in A$.

Source: MMRF-CR estimates.

The model measure of national spending — gross national expenditure — was projected to be higher than otherwise with positive changes in all sectors except gas and urban transport. For gas and urban transport, the projected increase in investment spending associated with lower labour costs and higher business returns was just balanced by fractionally lower consumption. This result needs to be qualified, however, by the assumed no-change in the productivity of capital and other non-labour factors of production and the preclusion of the effects of increased cost recovery (see chapter 1). Modelling of these factors would tend to raise projected increases in national spending for gas and urban transport as well as for the other activities considered.

Productivity and service-price changes in the infrastructure industries lead to labour market changes in total and for each occupation group. With aggregate employment and employment by occupational group assumed unchanged, the key impact of infrastructure industry changes on the labour market is reflected in variations in real

wages, which were projected to rise overall.[1] Nevertheless, real wages were projected to decline with changes in urban transport and ports and rail freight, in particular. This decline reflects the wedge between slightly lower nominal wages associated with the redeployment of labour from infrastructure activities and slightly higher consumer prices arising from increased cost recovery in infrastructure industry service provision.

The infrastructure industry changes were projected to increase the level of output in mining, manufacturing and service industry sectors above levels that would otherwise prevail. On the other hand, the level of agricultural output was projected to decline. This reflects the constraint on growth in this sector relative to other sectors imposed by the limited supply of agricultural land (assumed fixed in the modelling). Therefore, while lower costs would help farmers to remain competitive, the agricultural sector would not have the same flexibility to respond to lower costs that it is assumed the other sectors have.

There is also significant variation in the output responses of MMRF-CR industries within these sectors (see tables 3.5 to 3.6 at the end of this chapter). In particular, the industries that were estimated to benefit most from infrastructure industry change are export-oriented activities — such as mining (table 3.2). These activities benefit from improved international competitiveness arising from lower service prices and increased availability of labour flowing from lower manning requirements in the infrastructure industries. The activities projected to benefit least tended to be domestic-market focused activities such as retail trade and health, or, as just mentioned, rural land-based activities.

Labour productivity growth would reduce the demand for labour in key infrastructure industries, all other things being equal. However, to at least some extent, in reality, this would have been offset by growth in the general demand for infrastructure services induced by population increases and industrial growth. For example, while employment requirements per unit of output declined nationally by 66 per cent in the electricity industry over the 1990s, higher demand for electricity with general population and industrial growth saw observed output increase by 36 per cent. Overall, actual employment in the electricity industry declined by 53 per cent.

[1] To the extent that the additional demand for labour is reflected by higher real wages, incentives would be for people to join the workforce or move from unemployment to employment. Hence, the benefit of infrastructure industry change could be spread between higher paid employment and increased real wages.

Table 3.2 **Impact of productivity and service-price changes in infrastructure industries over the 1990s on non-infrastructure industries**

Measure	*Industries with largest increases*		*Industries with smallest increases or declines*	
Gross output	Mining	(+11.3%)	Agriculture	(-0.3%)
	Iron and steel	(+7.5%)	Leather	(+0.2%)
	Non-ferrous metal products	(+6.6%)	Food products	(+0.2%)
	Non-electrical machinery	(+5.5%)	Retail trade	(+1.0%)
	Air transport	(+5.2%)	Health	(+1.2%)
Employment	Mining	(+12.9%)	Agriculture	(-0.5%)
	Iron and steel	(+7.6%)	Leather	(+0.2%)
	Non-ferrous metal products	(+6.7%)	Food products	(+0.2%)
	Non-electrical machinery	(+5.5%)	Dwellings	(+0.5%)
	Air transport	(+5.3%)	Retail trade	(+0.9%)

Source: MMRF-CR estimates.

3.2 State and regional results

Detailed regional results are presented in tables 3.7 to 3.9 at the end of this chapter.

Broad results

The changes in infrastructure industries considered here were estimated to increase output in all states above levels that would otherwise prevail (table 3.3). The strongest estimated increases in output were projected to occur in New South Wales (3.7 per cent) and Western Australia (2.4 per cent) reflecting both the observed changes in infrastructure industries and the concentration of export-oriented activities in those jurisdictions.

While services output was projected to increase broadly in line with state product, improved labour productivity in infrastructure industries lowers the average employment requirement per unit of output in these industries, flowing through to a reduction in the share of service sector employment in national employment. For the non-service sector, projected increases in state-industry employment are closely aligned to projected changes in output. Nevertheless, because the creation of jobs at a rate faster than use of other inputs is instrumental in increasing output through the relocation of labour, state-industry employment changes tend to be larger than output changes in the expanding sectors.

Higher labour productivity in infrastructure industries was projected to increase production income generated per person employed across *all* jurisdictions.

Table 3.3 **Estimated state and sectoral effects of changes in infrastructure industries over the 1990s**

Percentage change

Variable	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
Real GSP	3.70	2.28	1.23	2.01	2.44	0.13	1.48	1.59	2.53
				Sectoral effects					
Value added output									
Agriculture	0.12	0.17	-0.63	-0.21	-1.24	-0.19	-0.12	0.48	-0.25
Mining	19.41	5.28	9.55	6.69	12.84	1.50	5.92	3.70	11.18
Manufacturing	4.87	3.66	0.42	2.89	0.19	-0.05	1.55	1.97	3.19
Services	3.43	2.09	1.03	1.92	1.13	0.20	0.94	1.60	2.23
Total	3.70	2.28	1.23	2.01	2.44	0.13	1.48	1.59	2.53
Employment									
Agriculture	0.05	0.07	-0.99	-0.45	-1.87	-0.34	-0.37	0.59	-0.47
Mining	19.63	5.66	9.87	6.98	13.08	1.59	6.19	3.77	12.91
Manufacturing	4.99	3.78	0.53	2.88	0.14	0.03	1.61	2.00	3.23
Services	0.32	-1.68	-1.53	-0.78	-1.38	-1.85	-1.14	0.54	-1.14
Total	1.23	-0.69	-0.89	-0.09	-0.39	-1.41	-0.64	0.57	..
Output per person employed	2.51	2.92	2.20	2.08	2.83	1.65	2.07	1.03	2.53

.. Zero by assumption.

Source: MMRF-CR estimates.

Regional results

Output

The modelling results indicate that regional output is likely to increase in all but one of the 57 regions covered within the MMRF model (table 3.7). Those regions experiencing the greatest projected increases tend to be heavily reliant on mining, steel making or minerals processing — Goldfields-Esperance and Pilbara in Western Australia, and Hunter, Illawarra and Far-West in New South Wales (table 3.4).[2] The relocation of labour and lower service costs associated with changes in electricity supply and ports and rail freight services are important in the projected changes for these regions.

[2] The MMRF-CR database pre-dates the 1999 closure of the Newcastle steelworks in the Hunter Valley and, hence, the gain to the Hunter region from the changes in infrastructure industries would differ from that indicated.

Table 3.4 **Summary of key regional differences from changes in infrastructure industries over the 1990s**

Measure	*Regions with largest increases*		*Regions with smallest increases or declines*	
Value added output	Goldfields-Esperance (WA)	(+8.3%)	Great Southern (WA)	(-0.7%)
	Pilbara (WA)	(+7.2%)	Southern (Tas.)	(..)
	Hunter (NSW)	(+5.7%)	Greater Hobart (Tas.)	(..)
	Illawarra (NSW)	(+5.1%)	Gippsland (Vic.)	(..)
	Far-West (NSW)	(+4.6%)	Darling Downs (Qld)	(+0.3%)
Employment	Goldfields-Esperance (WA)	(+5.8%)	Gippsland (Vic.)	(-11.3%)
	Far West (NSW)	(+5.2%)	Wheatbelt (WA)	(-4.2%)
	Pilbara (WA)	(+3.4%)	South West (Qld)	(-2.5%)
	North West (Qld)	(+2.9%)	Great Southern (WA)	(-2.3%)
	Illawarra (NSW)	(+2.6%)	Central West (Qld)	(-2.2%)
Output per person employed	Gippsland (Vic.)	(+11.4%)	Far West (NSW)	(-0.6%)
	Wheatbelt (WA)	(+4.7%)	ACT (ACT)	(+1.0%)
	Northern (SA)	(+4.1%)	Mersey-Lyell (Tas.)	(+1.2%)
	Pilbara (WA)	(+3.8%)	Northern (Tas.)	(+1.3%)
	Fitzroy (Qld)	(+3.7%)	Moreton (Qld)	(+1.3%)

.. Less than ± 0.05 per cent.

Source: MMRF-CR estimates.

The regions that were projected to expand the least or to contract from infrastructure industry change tend to be specialised in agricultural production (eg Great Southern in Western Australia and Darling Downs in Queensland), benefit less than other regions from infrastructure service-price reductions (eg Southern and Greater Hobart in Tasmania), or be subject to reductions in manning levels in a key regional infrastructure industry (Gippsland in Victoria).

Employment

Assuming that change in national employment is determined by factors beyond the control of infrastructure industries, higher output from labour productivity improvements requires some reallocation of labour between regional activities. After the reallocation of labour is taken into account, employment in 41 of the 57 regions was projected to be lower than otherwise with infrastructure industry change. Conversely, employment was projected to be higher than otherwise in 16 regions.

With the assumption that national employment is affected by non-infrastructure industry factors, there are two main forces at work in determining regional differences. First, the location of activities directly affected by infrastructure industries differs. When change has a substantial labour-saving component, employment opportunities would fall in regions where these activities are located.

Where there is not sufficient industrial diversity in the region reducing infrastructure industry manning levels, projected declines in infrastructure jobs could translate to net declines in regional employment. For example, the move towards best practice manning levels in electricity generation in Gippsland, Victoria, was projected to result in employment being 11 per cent lower than otherwise.

Second, there are indirect and general equilibrium employment effects arising as industries respond to lower labour costs and infrastructure service-price changes. More specifically, employment was estimated to be higher than otherwise in the Hunter region of New South Wales where employment generating effects of change were projected to offset the labour saving productivity improvements in electricity generation.

Overall, regions estimated to increase employment the most tend to be those with the greatest output gains (table 3.4). Because of the land constraint facing agriculture but not other industries, regions specialising in agricultural production were projected to experience some of the most significant reductions in employment from levels that would otherwise prevail (eg Wheatbelt of Western Australia and Central West in Queensland).

Income generated per person employed

Either increases in regional output or the relocation of labour away from slow-growing activities would raise labour productivity and the generation of regional income per worker.

At the national level, changes in infrastructure industries were projected to raise real gross product per person employed by around 2.5 per cent. When the combined effects of projected output and employment changes were taken into account, output per person employed was projected to increase in nearly all regions (table 3.9).

Reflecting the relatively diversified industrial and commercial bases of metropolitan regions, output per person employed was projected to change at around the national average rate. There is a much larger range of outcomes in non-metropolitan areas where the prospects of the regions are linked to a smaller range of rural, industrial and commercial activities and sectoral changes are more apparent. For example, the projected growth in income generated per worker in Gippsland in Victoria — the centre of electricity generation in that State — was heavily influenced by improved labour productivity in the electricity industry.

Table 3.5 **Estimated industry output implications of changes in infrastructure industries over the 1990s**
Percentage change

	Electricity	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*	*All sectors*
Agriculture	-0.96	0.04	0.02	0.17	0.03	0.44	-0.26
Mining	2.29	0.24	0.71	0.66	5.97	1.45	11.31
Food products	-0.78	0.15	0.22	0.28	-0.40	0.77	0.24
Beverages	-0.10	0.10	0.20	0.25	0.18	1.04	1.68
Tobacco	0.08	0.05	0.21	0.20	0.86	0.63	2.04
Textiles	-0.74	0.19	0.44	0.65	0.40	1.40	2.35
Clothing	-0.73	0.08	0.25	0.53	0.44	1.04	1.61
Leather	-2.94	0.74	1.68	1.25	-1.05	0.54	0.22
Footwear	-1.78	0.18	0.50	1.24	0.82	1.54	2.49
Wood products	0.22	0.18	0.59	0.47	0.50	1.46	3.43
Furniture	0.85	0.09	0.40	0.13	0.12	0.57	2.16
Paper products	0.56	0.18	0.36	0.30	0.20	0.96	2.57
Printing	0.47	0.09	0.37	0.14	0.24	0.88	2.18
Industrial chemicals	1.09	0.44	0.61	0.58	-0.26	1.42	3.88
Other chemicals	-0.24	0.17	0.59	0.40	0.45	1.63	2.99
Petrol	0.49	0.17	0.33	0.16	0.16	0.97	2.28
Rubber	0.44	0.24	0.65	0.50	1.18	1.60	4.61
Plastics	0.16	0.23	0.55	0.52	0.44	1.66	3.56
Pottery	0.43	0.54	0.36	0.29	0.38	0.95	2.95
Glass	-0.14	0.53	0.44	0.43	0.20	1.35	2.81
Other non-metallic products	0.62	0.09	0.33	0.14	0.41	0.67	2.27
Iron and steel	4.13	0.90	0.74	0.54	0.60	0.63	7.53
Non-ferrous metal products	8.04	1.20	0.08	0.22	-2.45	-0.43	6.65
Metal products	1.29	0.39	0.77	0.36	0.24	1.10	4.17
Non-electrical machinery	1.49	0.45	1.24	0.51	0.63	1.22	5.54
Electrical machinery	0.75	0.33	0.91	0.43	0.27	2.02	4.71
Transport equipment	0.98	0.32	0.92	0.32	0.38	0.94	3.85
Scientific equipment	0.30	0.06	0.20	0.08	0.13	0.51	1.28
Other manufactured products	-0.69	0.42	1.10	0.94	0.21	2.43	4.42
Electricity	1.23	0.15	0.27	0.12	0.43	0.51	2.71
Gas	0.69	0.34	0.12	0.07	0.05	0.25	1.52
Water	0.50	0.04	0.65	0.05	0.25	0.44	1.94
Construction	0.86	0.04	0.29	0.05	0.55	0.54	2.33
Wholesale	0.57	0.20	0.44	0.26	0.33	1.06	2.86
Retail trade	0.39	0.01	0.07	0.01	0.20	0.35	1.03
Repairs	0.44	0.03	0.15	0.08	0.51	0.64	1.86
Restaurants, hotels and clubs	0.71	0.17	1.00	0.22	-0.39	0.23	1.94
Road transport	0.49	0.14	0.30	0.11	0.70	0.82	2.57
Rail transport	1.15	0.11	0.38	-0.80	3.35	0.90	5.09
Water transport	0.33	0.09	0.24	-0.52	1.31	0.42	1.87
Air transport	-0.96	0.15	1.02	0.42	3.52	1.07	5.23
Services to transport	0.19	0.07	0.20	0.11	1.81	0.38	2.74
Communications	0.17	0.04	0.13	0.07	0.20	7.00	7.62
Finance	0.67	0.10	0.62	0.13	0.42	1.02	2.96
Insurance	-0.60	0.07	0.24	0.25	0.45	1.39	1.80
Dwellings	0.79	0.00	0.31	0.00	0.17	0.40	1.66
Public administration	0.51	0.00	0.10	0.00	0.20	0.59	1.40
Defence	0.52	0.00	0.11	-0.01	0.14	0.53	1.30
Health	0.60	-0.01	0.11	-0.01	0.23	0.27	1.18
Education	1.49	0.02	0.14	-0.03	-0.13	-0.18	1.32
Welfare	0.60	0.01	0.16	0.01	0.28	0.59	1.65
Entertainment	0.93	0.02	0.44	0.06	0.17	0.94	2.56
Personal services	0.82	0.04	0.25	0.06	0.17	0.34	1.68
Other services	1.10	0.02	0.15	0.34	-0.25	0.02	1.38

Source: MMRF-CR estimates.

Table 3.6 **Estimated industry employment implications of changes in infrastructure industries over the 1990s**
Percentage change

	Electricity	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*	*All sectors*
Agriculture	-1.41	0.05	0.00	0.23	0.04	0.61	-0.47
Mining	2.63	0.21	0.79	1.00	6.72	1.56	12.91
Food products	-0.93	0.17	0.22	0.32	-0.38	0.83	0.23
Beverages	-0.38	0.11	0.20	0.35	0.28	1.15	1.70
Tobacco	-0.11	0.06	0.22	0.27	0.93	0.76	2.11
Textiles	-0.92	0.21	0.46	0.73	0.49	1.51	2.48
Clothing	-0.84	0.09	0.26	0.58	0.49	1.11	1.68
Leather	-2.95	0.75	1.70	1.26	-1.06	0.50	0.20
Footwear	-1.86	0.18	0.50	1.27	0.85	1.58	2.53
Wood products	0.14	0.19	0.61	0.52	0.56	1.52	3.54
Furniture	0.88	0.10	0.43	0.15	0.12	0.53	2.20
Paper products	0.16	0.20	0.39	0.48	0.39	1.17	2.79
Printing	0.45	0.10	0.37	0.16	0.23	0.81	2.12
Industrial chemicals	0.89	0.45	0.62	0.67	-0.25	1.44	3.81
Other chemicals	-0.39	0.18	0.58	0.43	0.47	1.64	2.91
Petrol	0.39	0.18	0.35	0.24	0.22	1.00	2.37
Rubber	0.30	0.25	0.67	0.55	1.21	1.67	4.65
Plastics	0.00	0.24	0.56	0.57	0.49	1.75	3.60
Pottery	0.24	0.55	0.37	0.37	0.45	1.06	3.04
Glass	-0.41	0.53	0.45	0.54	0.30	1.52	2.93
Other non-metallic products	0.41	0.11	0.33	0.22	0.49	0.78	2.33
Iron and steel	4.10	0.91	0.75	0.55	0.61	0.63	7.55
Non-ferrous metal products	7.88	1.20	0.11	0.29	-2.41	-0.37	6.70
Metal products	1.27	0.40	0.79	0.38	0.25	1.10	4.18
Non-electrical machinery	1.50	0.45	1.25	0.51	0.63	1.20	5.54
Electrical machinery	0.73	0.33	0.91	0.44	0.28	2.00	4.70
Transport equipment	0.98	0.33	0.94	0.32	0.38	0.93	3.87
Scientific equipment	0.26	0.07	0.21	0.09	0.13	0.51	1.26
Other manufactured products	-0.74	0.43	1.11	0.97	0.23	2.44	4.44
Electricity	-65.51	0.42	0.76	0.32	1.23	1.46	-61.31
Gas	2.30	-76.81	0.37	0.23	0.14	0.78	-72.98
Water	1.30	0.11	-60.72	0.13	0.65	1.14	-57.39
Construction	0.88	0.05	0.32	0.06	0.55	0.51	2.37
Wholesale	0.43	0.20	0.41	0.29	0.36	1.05	2.75
Retail trade	0.34	0.01	0.06	0.02	0.21	0.31	0.95
Repairs	0.39	0.03	0.14	0.09	0.52	0.62	1.80
Restaurants, hotels and clubs	0.66	0.17	0.96	0.22	-0.36	0.16	1.81
Road transport	0.66	0.18	0.41	-1.86	0.95	1.12	1.46
Rail transport	1.35	0.13	0.45	-12.34	-39.53	1.06	-48.88
Water transport	0.44	0.12	0.32	-0.21	1.83	0.58	3.09
Air transport	-1.13	0.17	1.12	0.48	3.73	0.92	5.30
Services to transport	0.27	0.10	0.28	0.15	-5.72	0.54	-4.39
Communications	0.31	0.06	0.24	0.12	0.37	-35.26	-34.16
Finance	0.56	0.10	0.56	0.13	0.40	0.93	2.70
Insurance	-0.65	0.06	0.22	0.26	0.45	1.38	1.73
Dwellings	0.10	-0.02	-0.26	0.05	0.37	0.24	0.48
Public administration	0.48	0.00	0.09	0.00	0.20	0.59	1.37
Defence	0.52	0.00	0.11	-0.01	0.14	0.53	1.30
Health	0.58	0.00	0.11	0.00	0.23	0.24	1.15
Education	1.53	0.02	0.13	-0.03	-0.14	-0.21	1.31
Welfare	0.59	0.01	0.16	0.01	0.28	0.57	1.63
Entertainment	0.92	0.02	0.42	0.08	0.18	0.88	2.50
Personal services	0.82	0.05	0.26	0.09	0.18	0.26	1.65
Other services	1.05	0.03	0.17	0.39	-0.27	0.01	1.38

Source: MMRF-CR estimates.

Table 3.7 **Estimated regional output implications of changes in infrastructure industries over the 1990s**

Percentage change

	Electricity	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*	*All sectors*
New South Wales	**1.50**	**0.12**	**0.51**	**0.16**	**0.50**	**0.90**	**3.70**
Sydney	1.42	0.13	0.53	0.18	0.39	1.03	3.68
Hunter	2.37	0.22	0.51	0.37	1.33	0.87	5.67
Illawarra	2.39	0.26	0.50	0.28	0.82	0.81	5.06
Richmond-Tweed	1.17	0.06	0.46	0.15	0.24	0.76	2.83
Mid-North Coast	1.07	0.07	0.44	0.11	0.16	0.78	2.64
Northern	0.79	0.04	0.37	0.15	0.32	0.73	2.39
North Western	0.99	0.03	0.41	0.19	0.51	0.75	2.88
Central West	1.01	0.04	0.44	0.17	0.49	0.80	2.95
South Eastern	0.92	0.03	0.44	0.13	0.24	0.77	2.53
Murrumbidgee	0.70	0.03	0.25	0.10	0.15	0.75	1.98
Murray	0.85	0.05	0.31	0.14	0.19	0.74	2.28
Far West	1.93	0.02	0.50	0.28	1.09	0.77	4.60
Victoria	**-0.09**	**0.13**	**0.83**	**0.16**	**0.47**	**0.79**	**2.28**
Melbourne	-0.02	0.13	0.84	0.20	0.44	0.93	2.52
Barwon	0.56	0.17	0.54	0.13	0.24	0.61	2.25
Western District	0.51	0.11	0.63	0.09	0.13	0.44	1.90
Central Highlands	0.16	0.07	0.65	0.06	0.24	0.58	1.77
Wimmera	0.18	0.05	0.66	0.04	0.23	0.46	1.62
Mallee	0.03	0.07	0.42	0.07	0.20	0.49	1.27
Loddon	0.00	0.09	0.58	0.09	0.33	0.60	1.70
Goulburn	-0.04	0.07	0.52	0.08	0.23	0.60	1.46
Ovens-Murray	0.05	0.06	0.73	0.09	0.22	0.60	1.75
East Gippsland	0.27	0.17	0.78	0.16	0.56	0.48	2.42
Gippsland	-1.85	0.15	0.64	0.16	0.44	0.56	..
Queensland	**0.27**	**0.08**	**0.00**	**0.12**	**0.28**	**0.49**	**1.23**
Brisbane	0.24	0.07	-0.01	0.10	0.14	0.52	1.07
Moreton	0.20	0.09	0.03	0.12	0.15	0.47	1.06
Wide Bay-Burnett	-0.03	0.07	-0.12	0.11	-0.03	0.44	0.43
Darling Downs	-0.04	0.06	-0.10	0.10	-0.14	0.45	0.32
South West	0.12	0.02	-0.24	0.09	0.12	0.31	0.42
Fitzroy	0.48	0.08	0.10	0.21	0.79	0.46	2.12
Central West	0.30	0.01	-0.31	0.04	0.00	0.19	0.23
Mackay	0.22	0.12	0.11	0.30	1.70	0.58	3.03
Northern	0.31	0.06	-0.02	0.12	0.16	0.45	1.07
Far North	0.18	0.09	0.03	0.13	0.45	0.43	1.31
North West	0.52	0.11	0.08	0.38	2.66	0.53	4.28
South Australia	**0.32**	**-0.04**	**-0.29**	**0.18**	**0.52**	**1.31**	**2.01**
Adelaide	0.31	-0.03	-0.26	0.21	0.49	1.36	2.07
Outer Adelaide	0.14	-0.01	-0.28	0.20	0.41	1.22	1.68
Yorke and Lower North	0.07	-0.02	-0.26	0.16	0.35	1.00	1.30
Murray Lands	-0.02	-0.02	-0.41	0.17	0.29	1.07	1.08
South East	0.15	-0.03	-0.26	0.17	0.41	1.10	1.53
Eyre	0.11	-0.03	-0.35	0.14	0.31	0.99	1.17
Northern	0.86	-0.03	-0.10	0.16	0.40	0.93	2.23
Western Australia	**1.03**	**0.09**	**-0.18**	**0.07**	**1.04**	**0.39**	**2.44**
Perth	0.98	0.08	-0.18	0.06	0.62	0.32	1.89
Peel	1.47	0.11	-0.18	0.04	-0.01	-0.21	1.23
South West	1.31	0.14	-0.09	0.13	1.20	0.50	3.18
Great Southern	0.08	0.02	-0.34	0.01	-0.25	-0.27	-0.74
Wheatbelt	-0.08	0.04	-0.29	0.06	0.59	0.23	0.54
Goldfields-Esperance	1.78	0.11	0.12	0.22	4.72	1.35	8.31
Mid West	0.93	0.06	-0.11	0.11	2.49	0.53	4.01
Gascoyne	0.72	0.01	-0.33	-0.02	0.70	-0.51	0.58
Pilbara	1.50	0.09	0.04	0.18	4.32	1.07	7.20
Kimberley	1.02	0.04	-0.21	0.06	1.96	0.04	2.91
Tasmania	**-1.47**	**0.06**	**0.37**	**0.10**	**0.35**	**0.73**	**0.13**
Greater Hobart	-1.30	0.03	0.31	0.05	0.18	0.68	..
Southern	-1.32	0.04	0.30	0.04	0.22	0.64	..
Northern	-1.28	0.08	0.32	0.11	0.29	0.70	0.23
Mersey-Lyell	-1.58	0.09	0.32	0.12	0.43	0.83	0.20
Northern Territory	**0.55**	**0.11**	**-0.54**	**-0.23**	**0.58**	**1.00**	**1.48**
Australian Capital Territory	**0.71**	**-0.01**	**-0.21**	**0.01**	**0.25**	**0.85**	**1.59**

.. Less than ± 0.005 per cent. *Source:* MMRF-CR estimates.

Table 3.8 **Estimated regional employment implications of changes in infrastructure industries over the 1990s**
Percentage change

	Electricity	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*	*All sectors*
New South Wales	**0.88**	**0.04**	**0.16**	**-0.01**	**-0.04**	**0.19**	**1.23**
Sydney	0.97	0.04	0.15	0.01	-0.17	0.21	1.21
Hunter	1.04	0.15	0.14	0.12	0.63	0.41	2.49
Illawarra	1.75	0.17	0.16	0.09	0.25	0.24	2.65
Richmond-Tweed	0.68	0.03	0.33	0.07	0.05	0.06	1.21
Mid-North Coast	0.26	0.07	0.20	-0.08	-0.33	0.03	0.15
Northern	-0.05	-0.02	0.18	-0.01	-0.09	0.10	0.11
North Western	0.31	0.00	0.23	0.01	0.08	0.17	0.81
Central West	-0.35	-0.03	0.24	-0.11	-0.21	0.26	-0.21
South Eastern	-0.28	-0.06	0.24	-0.05	-0.23	0.06	-0.33
Murrumbidgee	-0.25	-0.05	-0.39	-0.14	-0.44	0.19	-1.09
Murray	0.00	-0.01	-0.41	0.05	-0.02	0.34	-0.05
Far West	2.63	0.05	-0.16	0.36	1.91	0.40	5.19
Victoria	**-0.98**	**-0.08**	**0.33**	**-0.07**	**0.26**	**-0.14**	**-0.69**
Melbourne	-0.42	-0.13	0.43	-0.04	0.20	-0.14	-0.09
Barwon	-0.11	0.05	-0.21	-0.11	0.05	-0.15	-0.49
Western District	-0.20	0.03	0.34	-0.10	0.03	-0.29	-0.20
Central Highlands	-0.40	-0.11	-0.06	-0.26	0.02	-0.33	-1.13
Wimmera	-0.64	0.01	-0.35	-0.29	0.00	-0.24	-1.51
Mallee	-0.70	0.10	-1.35	-0.15	0.10	-0.15	-2.14
Loddon	-0.64	-0.01	-0.20	-0.19	0.12	-0.23	-1.16
Goulburn	-0.79	-0.07	-0.30	-0.19	0.11	-0.17	-1.40
Ovens-Murray	-0.92	-0.01	0.39	-0.09	0.15	0.02	-0.45
East Gippsland	-1.02	0.08	-0.07	-0.01	0.34	-0.18	-0.87
Gippsland	-11.73	0.04	0.10	-0.01	0.32	0.01	-11.27
Queensland	**-0.10**	**0.04**	**-0.15**	**0.09**	**-0.51**	**-0.26**	**-0.89**
Brisbane	-0.06	0.02	-0.21	0.09	-0.45	-0.43	-1.04
Moreton	-0.05	0.07	-0.11	0.11	-0.06	-0.23	-0.27
Wide Bay-Burnett	-0.71	0.05	-0.24	0.11	-0.84	-0.14	-1.78
Darling Downs	-0.42	-0.01	-0.15	0.09	-0.89	-0.14	-1.53
South West	-0.60	-0.07	-0.31	0.12	-1.25	-0.34	-2.46
Fitzroy	-0.41	0.05	0.00	0.18	-1.34	-0.02	-1.54
Central West	-0.65	0.04	-0.28	0.09	-1.24	-0.17	-2.22
Mackay	-0.20	0.11	0.06	0.29	0.19	0.13	0.58
Northern	-0.12	0.03	-0.13	0.10	-1.25	-0.21	-1.59
Far North	-0.03	0.05	-0.09	0.10	-0.10	-0.16	-0.23
North West	0.06	0.07	0.04	0.48	1.85	0.39	2.90
South Australia	**0.01**	**-0.13**	**-0.70**	**0.06**	**0.12**	**0.54**	**-0.09**
Adelaide	0.07	-0.12	-0.62	0.09	0.12	0.52	0.08
Outer Adelaide	-0.22	-0.06	-0.72	0.11	0.17	0.55	-0.16
Yorke and Lower North	-0.60	-0.02	-0.58	0.11	0.11	0.13	-0.85
Murray Lands	-0.52	-0.06	-1.59	0.07	-0.03	0.49	-1.64
South East	-0.27	-0.10	-0.71	0.08	0.30	0.60	-0.11
Eyre	-0.53	-0.04	-1.20	0.06	-0.20	0.21	-1.71
Northern	0.06	-0.21	-0.55	-0.23	-1.22	0.31	-1.84
Western Australia	**0.31**	**0.07**	**-0.52**	**-0.04**	**0.15**	**-0.37**	**-0.39**
Perth	0.48	0.07	-0.50	-0.05	0.01	-0.54	-0.53
Peel	0.89	0.14	-0.29	-0.01	-0.61	-0.46	-0.34
South West	-0.41	0.15	-0.50	0.04	0.29	-0.02	-0.45
Great Southern	-0.55	0.03	-0.64	-0.03	-0.49	-0.60	-2.27
Wheatbelt	-2.44	-0.10	-1.04	-0.06	-0.41	-0.15	-4.19
Goldfields-Esperance	1.36	0.13	-0.09	0.13	3.37	0.93	5.82
Mid West	0.19	0.05	-0.39	0.04	1.43	0.08	1.40
Gascoyne	-0.26	0.02	-0.65	-0.05	0.22	-0.45	-1.18
Pilbara	-0.15	0.07	-0.28	0.12	3.05	0.57	3.38
Kimberley	0.31	0.03	-0.65	0.05	1.41	-0.14	1.02
Tasmania	**-2.32**	**0.07**	**0.39**	**0.14**	**0.23**	**0.09**	**-1.41**
Greater Hobart	-2.32	0.04	0.33	0.07	0.12	-0.14	-1.90
Southern	-3.10	0.07	0.34	0.14	0.24	0.15	-2.15
Northern	-1.85	0.09	0.34	0.15	0.10	0.13	-1.04
Mersey-Lyell	-2.31	0.10	0.34	0.17	0.29	0.39	-1.02
Northern Territory	**-0.21**	**0.09**	**-0.94**	**-0.10**	**0.33**	**0.20**	**-0.64**
Australian Capital Territory	**0.33**	**-0.06**	**-0.30**	**0.08**	**0.25**	**0.28**	**0.57**

Source: MMRF-CR estimates.

Table 3.9 **Estimated implications for regional output per person employed of changes in infrastructure industries over the 1990s**
Percentage change

	Electricity	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*	*All sectors*
New South Wales	**0.62**	**0.08**	**0.35**	**0.18**	**0.54**	**0.71**	**2.47**
Sydney	0.45	0.10	0.37	0.17	0.56	0.82	2.47
Hunter	1.33	0.07	0.37	0.25	0.70	0.46	3.18
Illawarra	0.64	0.09	0.35	0.19	0.57	0.57	2.41
Richmond-Tweed	0.49	0.03	0.13	0.08	0.19	0.70	1.62
Mid-North Coast	0.81	0.00	0.24	0.20	0.50	0.75	2.50
Northern	0.83	0.06	0.19	0.16	0.41	0.63	2.28
North Western	0.67	0.03	0.18	0.17	0.43	0.59	2.07
Central West	1.36	0.08	0.20	0.28	0.70	0.55	3.16
South Eastern	1.21	0.09	0.20	0.18	0.47	0.71	2.86
Murrumbidgee	0.96	0.09	0.64	0.24	0.59	0.56	3.07
Murray	0.85	0.06	0.72	0.09	0.21	0.41	2.33
Far West	-0.70	-0.03	0.67	-0.08	-0.81	0.37	-0.59
Victoria	**0.90**	**0.21**	**0.50**	**0.23**	**0.20**	**0.92**	**2.96**
Melbourne	0.40	0.26	0.40	0.23	0.24	1.06	2.60
Barwon	0.68	0.12	0.75	0.24	0.19	0.76	2.74
Western District	0.71	0.08	0.30	0.19	0.10	0.72	2.10
Central Highlands	0.55	0.18	0.71	0.32	0.22	0.92	2.90
Wimmera	0.82	0.05	1.01	0.33	0.23	0.70	3.13
Mallee	0.73	-0.04	1.77	0.21	0.09	0.65	3.41
Loddon	0.65	0.10	0.79	0.27	0.21	0.84	2.86
Goulburn	0.75	0.13	0.82	0.27	0.12	0.77	2.86
Ovens-Murray	0.97	0.08	0.34	0.18	0.06	0.58	2.20
East Gippsland	1.29	0.10	0.85	0.17	0.22	0.67	3.29
Gippsland	9.87	0.12	0.54	0.16	0.12	0.55	11.36
Queensland	**0.37**	**0.04**	**0.15**	**0.02**	**0.78**	**0.76**	**2.12**
Brisbane	0.30	0.05	0.21	0.02	0.59	0.95	2.12
Moreton	0.25	0.02	0.14	0.01	0.21	0.70	1.33
Wide Bay-Burnett	0.68	0.01	0.12	0.00	0.80	0.58	2.21
Darling Downs	0.39	0.07	0.05	0.01	0.75	0.59	1.85
South West	0.73	0.10	0.07	-0.04	1.37	0.65	2.88
Fitzroy	0.89	0.02	0.10	0.03	2.13	0.48	3.65
Central West	0.95	-0.02	-0.03	-0.04	1.24	0.36	2.45
Mackay	0.42	0.02	0.05	0.01	1.51	0.44	2.45
Northern	0.43	0.03	0.11	0.02	1.41	0.65	2.66
Far North	0.21	0.04	0.11	0.02	0.56	0.59	1.54
North West	0.46	0.04	0.04	-0.10	0.81	0.14	1.39
South Australia	**0.31**	**0.08**	**0.41**	**0.12**	**0.40**	**0.77**	**2.10**
Adelaide	0.24	0.09	0.36	0.12	0.37	0.83	2.00
Outer Adelaide	0.36	0.05	0.45	0.08	0.23	0.67	1.84
Yorke and Lower North	0.67	0.00	0.33	0.05	0.24	0.87	2.15
Murray Lands	0.50	0.04	1.18	0.10	0.32	0.58	2.72
South East	0.42	0.07	0.46	0.09	0.11	0.49	1.64
Eyre	0.64	0.01	0.86	0.08	0.51	0.78	2.88
Northern	0.81	0.18	0.45	0.39	1.62	0.62	4.07
Western Australia	**0.72**	**0.02**	**0.34**	**0.11**	**0.89**	**0.76**	**2.83**
Perth	0.49	0.02	0.32	0.11	0.61	0.87	2.42
Peel	0.58	-0.03	0.11	0.06	0.60	0.25	1.57
South West	1.72	-0.01	0.41	0.09	0.91	0.52	3.63
Great Southern	0.63	-0.01	0.30	0.04	0.24	0.33	1.53
Wheatbelt	2.36	0.14	0.75	0.12	1.00	0.37	4.73
Goldfields-Esperance	0.43	-0.01	0.21	0.09	1.36	0.42	2.49
Mid West	0.74	0.01	0.29	0.07	1.05	0.46	2.62
Gascoyne	0.99	-0.01	0.32	0.03	0.48	-0.05	1.76
Pilbara	1.65	0.02	0.32	0.06	1.27	0.50	3.81
Kimberley	0.71	0.01	0.43	0.01	0.56	0.18	1.89
Tasmania	**0.85**	**-0.01**	**-0.01**	**-0.04**	**0.12**	**0.64**	**1.54**
Greater Hobart	1.01	-0.01	-0.02	-0.03	0.06	0.82	1.85
Southern	1.78	-0.04	-0.04	-0.10	-0.01	0.49	2.08
Northern	0.57	-0.02	-0.01	-0.04	0.19	0.58	1.26
Mersey-Lyell	0.73	-0.02	-0.02	-0.05	0.14	0.44	1.22
Northern Territory	**0.76**	**0.02**	**0.40**	**-0.12**	**0.25**	**0.80**	**2.11**
Australian Capital Territory	**0.38**	**0.05**	**0.09**	**-0.07**	**0.01**	**0.57**	**1.02**

Source: MMRF-CR estimates.

4 Comparison between actual changes in regional employment and effects of infrastructure industry change

The analysis of the longer-term effects of labour productivity and service-price changes in infrastructure industries — electricity, gas, urban water, urban transport, ports and rail freight and telecommunications — provided a disaggregation of the State and Territory changes to the regional level (chapter 3).

As the changes analysed in chapter 3 were based on actual observations for the 1990s, the projected impacts would, to some extent, have been realised in national output and regional industry growth over the decade. However, as noted in chapter 1, there is insufficient information to objectively specify the link between reforms in the 1990s and the changes analysed to quantify the impact of NCP on growth.[1] Moreover, as the estimated impacts of infrastructure industry change refer to the longer-term effects, *all* adjustments consequential on those changes are unlikely to be fully reflected in national growth over the 1990s.

Comparison between actual changes in regional employment and the estimated impact of infrastructure industry change show that five out of the eight regions that experienced an actual decline in net employment from 1991 to 2001 (based on Population Census data) were estimated to also have employment lower than otherwise as a result of changes in NCP-related infrastructure industries (top left quadrant in table 4.1). The other three regions that have experienced employment declines in the recent past are estimated to have employment higher than otherwise as a result of changes in the key infrastructure industries.

The Pilbara, for example, specialises in export-oriented mining activities. However, the estimated impacts of NCP-related changes on employment in such regions needs to be treated with caution, as the model does not account for the move towards fly-in, fly-out modes of operation.[2] It also does not take account of new mine

[1] For example, in the telecommunications sector, the changes considered during the 1990s would be heavily influenced by technological developments.

[2] Changes in regional employment in the model are based on 'place of employment' information as recorded in the Australian census of population and housing. According to the place of

developments, mine closures or changes in technology which, in the normal course of events, would not necessarily be affected by productivity and price changes in pre-existing infrastructure activities.

The majority of regions (ie 49 of the 57) experienced employment growth from 1991 to 2001. Of these, it is estimated that 13 would also gain in employment terms from changes in infrastructure industries (bottom right hand quadrant of table 4.1). This group includes the Australian Capital Territory, the metropolitan regions of Sydney and Adelaide and a number of mining regions of Western Australia.

On the other hand, 36 regions with employment growth in the recent past would have employment lower than otherwise because of estimated changes in NCP-related infrastructure industries. Most of these are rural and regional areas, although the capital city regions of Melbourne, Brisbane, Perth and Greater Hobart were also projected to have lower employment because of changes in infrastructure industries.

While table 4.1 compares the direction of past employment trends with the direction of the estimated effects of changes in infrastructure industries, it does not capture the relative magnitudes of longer-term employment effects of the actual changes.

Table 4.2 presents information on the magnitudes for each region, categorised according to whether regional employment has grown or declined from 1991 to 2001, and whether the changes in infrastructure industries are estimated to raise or lower regional employment in the longer term from levels that would otherwise prevail.

For most regions, the estimated total employment effect of infrastructure industry change is equivalent to less than one year's actual employment change. For these regions, infrastructure change is likely to have a relatively small role to play in regional employment growth.

However, there are a few regions in which employment was slow growing and in which projected changes in infrastructure industries are equivalent to more than five years' growth (based on actual changes) — Wimmera in Victoria, South West and Central West in Queensland, Yorke and Lower North in South Australia, and the Wheatbelt in Western Australia. The projected employment declines for Loddon and Gippsland in Victoria are also of importance relative to average annual declines for the regions over the 1990s.

employment definition, as far as practicable, employees are classified according to the locality of employment. For many people, the statistical division of employment is likely to coincide with the division of residence.

Table 4.1 **Comparison of the modelled employment effects with actual changes in regional employment**

	Regions projected to experience negative employment effects from infrastructure industry change		*Regions projected to experience positive employment effects from infrastructure industry change*
Regions with actual overall employment declines in the 1990s	**Victoria** Loddon Gippsland	**South Australia** Northern **Tasmania** Mersey Lyell Southern	**New South Wales** Northern Far West **Western Australia** Pilbara
Regions with actual overall employment increases in the 1990s	**New South Wales** South Eastern Central West Murrumbidgee Murray **Victoria** Melbourne Barwon Western District Central Highlands Wimmera Mallee Goulburn Ovens-Murray East Gippsland **Tasmania** Greater Hobart Northern	**Queensland** Brisbane Moreton Wide Bay-Burnett Darling Downs South West Fitzroy Central West Northern Far North **South Australia** Outer Adelaide Yorke and Lower North Murray Lands South East Eyre **Western Australia** Perth Peel South West Great Southern Wheatbelt Gascoyne **Northern Territory**	**New South Wales** Sydney Hunter Illawarra Richmond-Tweed Mid-North Coast North Western **Queensland** Mackay North West **South Australia** Adelaide **Western Australia** Goldfields-Esperance Mid-West Kimberley **Australian Capital Territory**

Sources: MMRF-CR estimates; ABS (*Population Census*, Cat. no. 1502.0).

Table 4.2 **Actual regional employment growth and estimated employment changes due to changes in infrastructure industries**

			Actual employment declines		*Actual employment increases*	
	Actual	*Estimated change in infrastructure industries*	*Decline with infrastructure change*	*Increase with infrastructure change*	*Decline with infrastructure change*	*Increase with infrastructure change*
	% per year	%	yrs	yrs	yrs	yrs
New South Wales	**1.33**	**1.23**				**0.93**
Sydney	1.49	1.21				0.81
Hunter	0.94	2.49				2.64
Illawarra	1.49	2.65				1.78
Richmond-Tweed	2.08	1.21				0.58
Mid-North Coast	1.60	0.15				0.09
Northern	-0.17	0.11		0.64		
North Western	0.52	0.81				1.55
Central West	0.76	-0.21			0.27	
South Eastern	1.01	-0.33			0.32	
Murrumbidgee	1.06	-1.09			1.03	
Murray	0.52	-0.05			0.10	
Far West	-1.89	5.19		2.75		
Victoria	**1.40**	**-0.69**			**0.49**	
Melbourne	1.54	-0.09			0.06	
Barwon	1.73	-0.49			0.28	
Western District	0.50	-0.20			0.39	
Central Highlands	1.13	-1.13			1.00	
Wimmera	0.17	-1.51			8.72	
Mallee	1.59	-2.14			1.35	
Loddon	-0.04	-1.16	32.08			
Goulburn	2.66	-1.40			0.53	
Ovens-Murray	0.33	-0.45			1.36	
East Gippsland	1.93	-0.87			0.45	
Gippsland	-0.55	-11.27	20.33			
Queensland	**2.44**	**-0.89**			**0.36**	
Brisbane	2.52	-1.04			0.42	
Moreton	4.19	-0.27			0.06	
Wide Bay-Burnett	1.90	-1.78			0.93	
Darling Downs	1.60	-1.53			0.96	
South West	0.25	-2.46			9.76	
Fitzroy	1.13	-1.54			1.36	
Central West	0.25	-2.22			8.95	
Mackay	2.64	0.58				0.22
Northern	0.82	-1.59			1.94	
Far North	1.91	-0.23			0.12	
North West	0.20	2.90				14.55

(Continued next page)

Table 4.2 **(continued)**

			Actual employment declines		*Actual employment increases*	
	Actual	*Estimated change in infrastructure industries*	*Decline with infrastructure change*	*Increase with infrastructure change*	*Decline with infrastructure change*	*Increase with infrastructure change*
	% per year	%	yrs	yrs	yrs	yrs
South Australia	**0.51**	**-0.09**			**0.18**	
Adelaide	0.54	0.08				0.14
Outer Adelaide	2.04	-0.16			0.08	
Yorke and Lower North	0.07	-0.85			12.16	
Murray Lands	0.38	-1.64			4.28	
South East	0.55	-0.11			0.20	
Eyre	0.73	-1.71			2.36	
Northern	-1.79	-1.84	1.03			
Western Australia	**2.18**	**-0.39**			**0.18**	
Perth	2.33	-0.53			0.23	
Peel	4.25	-0.34			0.08	
South West	3.58	-0.45			0.13	
Great Southern	1.52	-2.27			1.49	
Wheatbelt	0.22	-4.19			19.48	
Goldfields-Esperance	1.43	5.82				4.07
Mid-West	0.65	1.40				2.16
Gascoyne	0.61	-1.18			1.92	
Pilbara	-0.89	3.38		3.79		
Kimberley	3.94	1.02				0.26
Tasmania	**0.22**	**-1.41**			**6.29**	
Greater Hobart	0.71	-1.90			2.68	
Southern	-0.77	-2.15	2.81			
Northern	0.26	-1.04			4.07	
Mersey-Lyell	-0.44	-1.02	2.32			
Northern Territory	**1.93**	**-0.64**			**0.33**	
Australian Capital Territory	**1.39**	**0.57**				**0.41**

Sources: MMRF-CR estimates; ABS (*Population Census*, Cat. no. 1502.0).

5 Distributional impacts of changes in infrastructure industries

This chapter reports on modelling of the impact of observed productivity improvements and changes in infrastructure service prices over the 1990s on consumers — measured in terms of changes in household purchasing power.

With the assumption of no change in the aggregate number of households — a parallel specification to no change in national employment — achieving higher labour productivity involves some re-location of households. This study nets out the effects of household relocations to report changes in purchasing power on a per household basis.

The national measure of change in household purchasing power per household is disaggregated to household income decile to estimate the impact of change on the distribution of income. Households were divided into 10 equal groups — termed deciles — based on their gross income (ie household income before the deduction of income taxes) before the change. The households in the first income group were those with the lowest household gross income, while households in the tenth income group were those with the highest household gross incomes. For summary presentations, the decile classification of households was aggregated to five equal groups — termed quintiles.

5.1 Economy-wide changes in household purchasing power

With the assumption that infrastructure industry change does not affect consumer-prices in aggregate, projected longer-run changes in aggregate purchasing power of households come from growth in income from labour, business and investments and government benefits payments less any changes in income taxation. Nationally, infrastructure industry change over the 1990s was projected to increase real household purchasing power by upward of 1.2 per cent (table 5.1), with the largest contributions to this measure arising from projected changes in the electricity and telecommunications industries. The increase in household purchasing power amounts to $6 billion per year in current (2003-04) values.

Table 5.1 **Estimated household income effects of changes in infrastructure industries over the 1990s**

Percentage points

Variable	*Electricity*	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*	*All sectors*
Real household disposable income	0.52	-0.01	0.10	-0.02	0.17	0.52	1.28

Source: MMRF-CR estimates.

The model measure of household purchasing power was projected to be higher in all sectors, except gas and urban transport, where projected declines in labour income associated with the relocation of labour just outweighed higher returns from business and investment activities of households. As indicated in chapter 3, these slightly negative results need to be qualified by the assumed no-change in the productivity of capital and other non-labour factors. Modelling of these factors would tend to raise projections of household purchasing power.

With the assumption that infrastructure industry change does not affect aggregate consumer prices, infrastructure industry changes were modelled as influencing the relative price of consumer goods and services. The relative price changes will have differing distributional effects depending on how consumers in different groups spend their disposable incomes.

Changes in infrastructure industries over the 1990s had a direct impact on the prices paid by residential consumers of those services. While there was significant variation in observed real — that is, inflation adjusted — price changes between states (table 1.2), overall, prices faced by residential consumers were estimated to have declined on average for electricity, urban water and telecommunications services but to have risen for gas and urban transport services (table 5.2). Changes in the price of port and rail freight services appeared not to materially affect residential prices.

Table 5.2 **Estimated consumer-price effects of changes in infrastructure industry prices over the 1990s[a]**

Per cent

Variable	*Electricity*	*Gas*	*Urban water*	*Urban Transport*[b]	*Ports & rail freight*	*Telecomm-unications*[c]
Infrastructure service prices	-3.26	0.08	-3.66	27.10	..	-22.25

.. Less than 0.005 per cent. [a] Weighted to national totals using the value of MMRF-CR service flows. [b] Measured as the weighted sum of the impact of changes in consumer prices for road, rail and water services. [c] The main component of the MMRF-CR commodity 'communications'.

Sources: Table 1.2, MMRF-CR database and model estimates.

Observed infrastructure industry changes also generally involved lower service prices to non-residential users (table 1.2). These lower prices would have improved the competitiveness of infrastructure service users and indirectly affected household incomes. Lower prices to industry would also tend to reduce the price of consumer items more intensive in the use of infrastructure services (particularly electricity and telecommunications services) relative to other goods and services.

Ultimately, higher activity levels and income generated by infrastructure industry change would feed through to higher demand for goods and services and upward pressure on consumer prices for products in demand. With the assumption of no change in aggregate consumer prices, these changes would impact on relative prices rather than price levels. Table 5.7 at the end of this chapter reports estimates of change in consumer prices by MMRF-CR commodity.

5.2 Income and expenditure patterns by income group

Sources of income

How changes in infrastructure activities affect the distribution of income across income groups depends on the relative importance of income from employment, business and investments, government benefits and income taxation for households with different income levels. It also depends on how changes in infrastructure industries impact on returns from each source.

As might be expected, income from government benefit payments was of more importance to households in lower relative to higher income groups (figure 5.1). For households in the lowest income group these payments were the single most important source of income, while government benefits were of negligible importance to households in the highest income group. Higher income households were more reliant on labour income so that their purchasing power would be more influenced by changes in income from this source. Households across all income groups draw significant income from business and investments — with income from these sources being fractionally more important in the fourth and highest income groups.

Figure 5.1 **Composition of income by household income decile, 1993-94[a]**

Per cent of net income

a Excludes households with zero or negative gross income (see box 5.1).

Source: ID model database.

Loss making business and investment activities of a significant minority of households pose problems in distributional analysis — particularly in lower income groups where such households would ordinarily be classified on the basis of gross income alone. While households with zero or negative income are included in underlying database calculations and modelling, final data for such households are not included in the results reported in figure 5.1 or subsequent analysis (box 5.1).[1]

With the national supply of labour assumed fixed for the eight occupational groups modelled, achievement of higher labour productivity involves some relocation of labour between regions and changes in wage relativities across occupational groups.

[1] A consequence of this convention is that each 'income decile' in this paper refers to 10 per cent of the population of households with positive gross income.

Box 5.1 **Treatment of households with negative or zero income**

A small minority of households — estimated to be around 1 per cent of the population of households represented in the 1993-94 HES — report negative or zero gross income mainly due to the incidence of negative business or property income (ie losses). These households often have substantial expenditure relative to income and pose significant problems for quantifying the distributional effects of change. The convention adopted in this study has been to include households with negative income in aggregate estimates of change in household purchasing power, but to exclude them from reports of effects of change classified by income group (see appendix C). The reported impact of infrastructure industry change across income groups therefore only reports results for households with positive income (ie around 99 per cent of the 6.6 million households covered).

Accordingly, for the presentation of results, only households with positive income were divided into income groups. Although the application of this approach involved the re-ranking of all households, the lowest income decile, naturally, is the main decile affected by this reporting convention.

Source: Appendix C.

In this context, two labour market dimensions are of importance to the distributional impacts of infrastructure industry change. First, labour market adjustment will be driven by reductions in the employment requirements of infrastructure industries per unit of output and the occupations of people employed in those industries.[2] For example, employment in the electricity industry was concentrated in the professional and tradespersons categories, while employment in the communications sector was concentrated in the clerical, plant and machinery operators and labourers and related workers categories (table 5.3). Other things being equal, households specialising in these activities and occupations would be modelled as facing the greatest adjustment pressures.

Second, the impact of labour market adjustment across income groups would be influenced by the occupational characteristics of households in each income group. For example, the prospects of households in higher income groups would be influenced more by changes impacting on managers and administrators and professionals than households in other groups (table 5.4). Similarly, households in the third and fourth income groups would be somewhat more influenced by changes impacting on clerks, sales personal and labourers and related workers.

[2] In MMRF-CR, it is assumed that employment in each occupation for Australia as a whole does not change and that any reduction in employment in an industry in a state is re-absorbed by other activities either within the state or in other jurisdictions.

Table 5.3 Contribution of occupational groups to labour inputs for selected infrastructure industries and all industries in total, 1993-94

Percentage share[a]

Occupational group	*Elect-ricity*	*Gas*	*Water & sew-erage*	*Road transport*	*Rail transport*	*Water transport*	*Services to transport*	*Comm-unicat-ions*	*All indust-ries*
Managers & administrators	..	..	3.6	11.6	4.7	5.3	9.8	11.9	13.4
Professionals	50.7	9.4	14.7	1.6	3.5	4.6	5.7	1.9	17.1
Para-professionals	8.6	5.7	12.2	0.8	11.2	6.6	15.7	1.6	8.5
Tradespersons	40.8	25.7	30.5	5.5	15.4	15.7	8.2	6.1	14.8
Clerks	..	21.2	14.3	10.1	8.8	12.9	20.2	27.9	16.6
Sales & personal service workers	..	..	1.4	6.3	11.5	3.6	14.8	3.1	9.2
Plant & machinery operators, drivers	..	15.5	11.5	59.5	35.5	25.0	12.3	23.4	9.0
Labourers & related workers	..	22.6	11.7	4.6	9.3	26.3	13.3	24.1	11.4

.. Less than 0.05 per cent. [a] Based on wage bill shares.

Source: MMRF-CR model database.

Table 5.4 Shares of occupational wages in labour income by household income decile, 1993-94[ab]

Per cent share

Income decile	*Managers & administ-rators*	*Profess-ionals*	*Para-profess-ionals*	*Trades-persons*	*Clerks[c]*	*Sales-& personal service workers*	*Plant & machine operators, drivers*	*Labourers & related workers*
Lowest	24.9	14.6	11.7	6.3	10.7	16.2	11.7	3.9
Second	15.0	11.3	1.2	13.9	18.0	22.1	2.0	16.6
Third	9.5	4.9	2.0	15.6	17.3	17.2	6.5	27.1
Fourth	8.4	3.8	4.3	12.3	22.8	14.9	13.2	20.4
Fifth	7.6	5.3	5.7	20.5	21.7	13.1	9.9	16.3
Sixth	8.7	13.3	7.9	17.9	23.1	8.0	10.6	10.3
Seventh	11.4	17.5	11.3	15.9	16.4	8.7	7.9	10.8
Eighth	12.3	15.9	10.1	17.6	19.9	7.3	8.3	8.7
Ninth	18.2	20.6	9.8	13.9	14.5	5.7	8.3	9.0
Highest	30.5	31.0	8.6	5.8	10.1	5.9	5.3	2.8

[a] Excludes households with zero or negative income (see box 5.1). [b] Labour income was classified by occupational group on the basis of the occupation of the reference person in each household. [c] Labour income of households having a reference person without a defined occupation was classified to the occupational group ‘clerks’.

Source: ID model database.

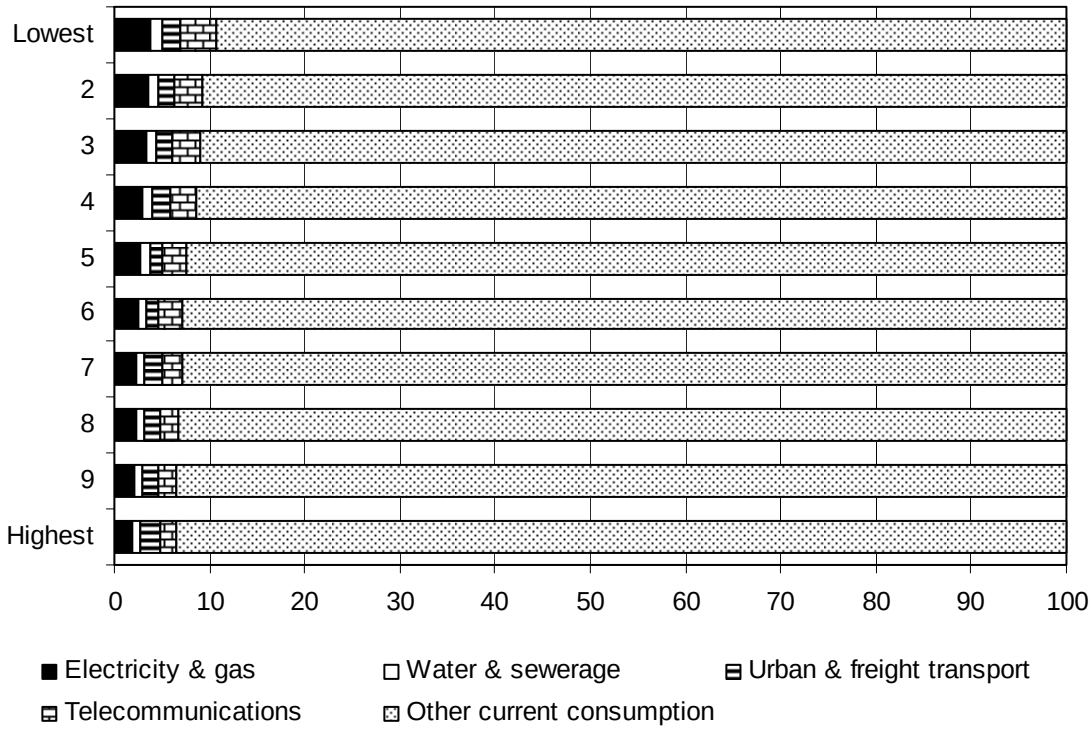
Expenditure

The significance of changes in infrastructure prices would depend, in the first instance, on the importance of those services in household expenditure and how this varies across income groups. Household spending on infrastructure services considered in this study is estimated to be less than 11 per cent of total household consumer spending across all income deciles. Within this relatively narrow band, spending on infrastructure services was, in general, of more importance across households in the lower income ranges (figure 5.2).

The flow on, or indirect effects, of infrastructure industry change would be spread over the bulk of consumption spending of all household groups. While variation between income groups in relative prices of consumer purchases would have some distributional consequences, these are likely to be modest relative to the distributional impact of income changes.

Figure 5.2 **Household consumption shares by household income decile, 1993-94**[a]

Per cent of household consumption expenditure[b]



a Excludes households with zero or negative income (see box 5.1). **b** Excludes non-current outlays such as mortgage repayments, asset purchases and superannuation contributions

Source: ID model database.

The HES also identifies expenditure by households on non-current items of expenditure such as mortgage repayments, asset purchases and superannuation contributions. Because the demand for such items is governed mainly by inter-temporal household saving behaviour, the consumer services associated with these expenditures (eg dwelling services of a home or home improvements financed by a mortgage loan) would only be coincidentally captured in the models used in this study (eg as current services of owner-occupied dwellings). Proportionally more is expended on non-current items by higher income households than by lower income households.

5.3 Distributional effects

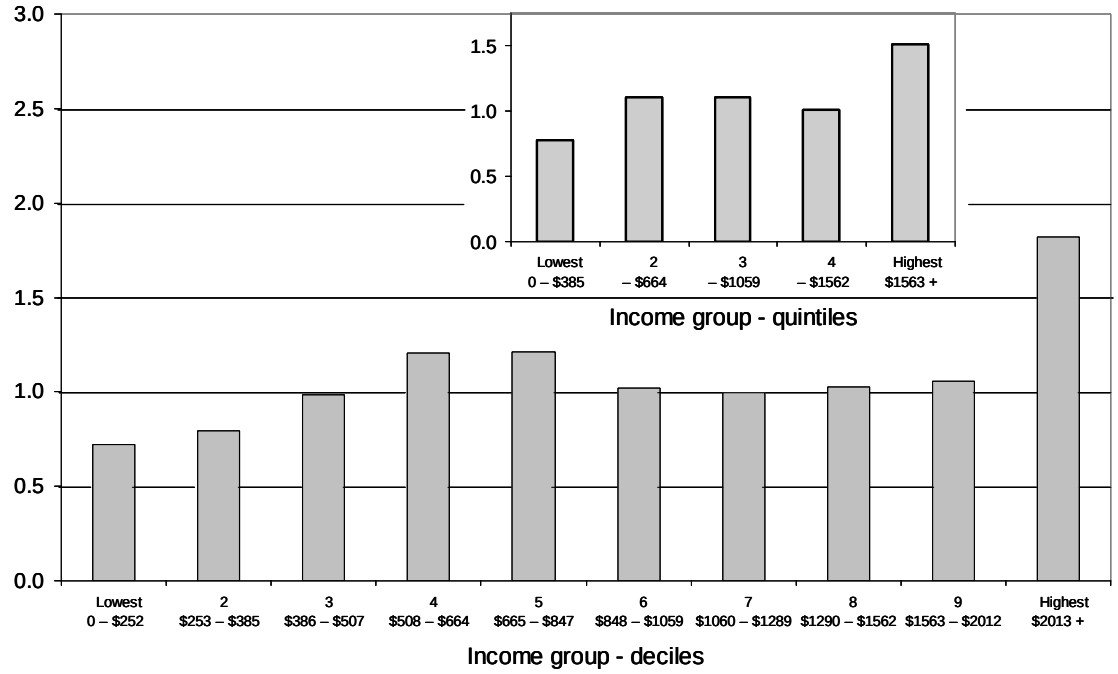
The changes in infrastructure industries modelled were estimated to increase average purchasing power per household across all income groups above levels that would otherwise prevail (figure 5.3). The estimated increases in purchasing power were proportionately greater for households in the highest income group followed by households in the middle income group.

Households can benefit from infrastructure industry change via growth in real income *in situ* and by relocating away from slow growing regions in favour of regions affording higher real income growth. Projections in the current study suggested that the top income group — the group with the largest increase in income per household — also had the largest projected increase in the number of households from initial levels. Collectively, there was some interstate relocation of households away from the first, fourth and eighth income groups based on income before the change. These projections reflect labour market adjustments associated, in particular, with the occupational groups: managers, clerks, plant and machinery operators, labourers and tradespersons, and adjustments in infrastructure industries employing these groups.

With the movement of households from slower growing areas to faster growing areas, additional real household purchasing power is generated by increased resources available to each household, including capital growth and higher real returns, particularly to household labour. As each income group earns significant business income, the employment of additional capital was estimated to contribute to higher real income per household in each income group (as indicated by the positive impact of additions to 'primary factor inputs' in figure 5.4). Moreover, increased investment income from projected higher activity levels was estimated to raise household income across income groups with the changes being of most importance to households in lower income groups (including self-funded retirees).

Figure 5.3 **Distributional effects of estimated changes in real disposable income per household by household income group[a]**

Per cent



a Households have been allocated to income group on the basis of gross income as reported in the 1993-94 HES. The income values shown for each group are indicative of average weekly gross income in 2003-04 levels. They were derived by rebasing 1993-94 values to 2003-04 values according to changes in average weekly earnings of employed persons.

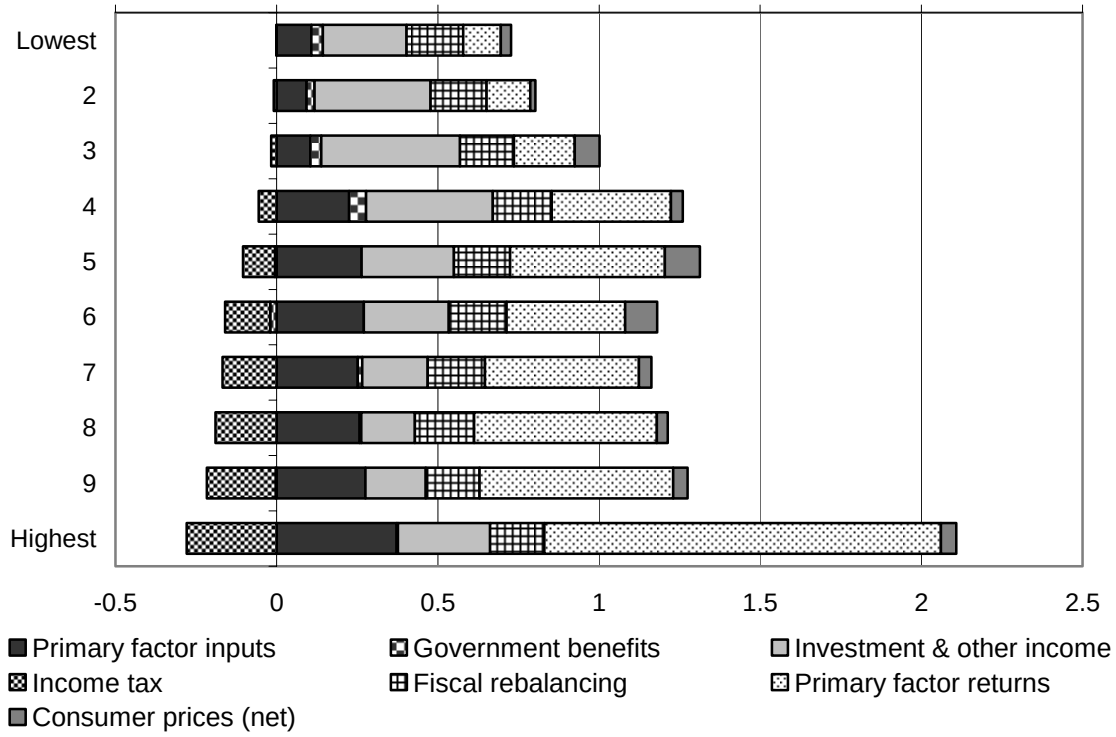
Sources: ID model estimates; EconData (2005, *Table 6302-03: Average Weekly Earnings, Australia: Original)*.

With the assumption of no change in aggregate employment by occupational group, increased activity associated with infrastructure industry change was projected to raise average labour income receipts per households across income groups (as indicated by increased 'primary factor returns' in figure 5.4).[3] Higher labour income was projected to be of more importance for mid- to higher income groups — the groups for which returns from employment were of greatest significance (figure 5.1).

[3] In the analysis, it has been assumed that the distribution of households across regional activity groups was 'in equilibrium' before the changes considered. In this case, although regional income differences prevailed between regional activities, the incentives modelled related to changes from these initial levels rather than responses to these differences in regional income levels.

Figure 5.4 **Decomposition of estimated changes in real disposable income per household by household income group**[a]

Percentage points



a The estimated impact of consumer prices — consumer prices (net) — incorporates the effects of real price changes estimated in MMRF-CR adjusted to take account of differences in consumption patterns, in aggregate, between the MMRF-CR and ID model databases.

Source: ID model estimates (see appendix table C.4).

Changes in government benefit receipts and the return of projected higher government revenues to households (the distributionally neutral fiscal balancing item in figure 5.4) also added to disposable income. Projected higher income tax payments had a lowering effect — particularly for the higher income groups.

Sectoral impacts

The modelling results indicate that the distributional impact of infrastructure industry change differs significantly between industries, with, as noted, changes in the electricity and telecommunications industries having the largest effect (figure 5.5). Changes in the electricity sector were projected to increase real purchasing power for households across income groups, with the largest increases accruing to household in the fourth and fifth deciles. Projected increases in demand and consequential higher real wages for workers in the clerical and labouring

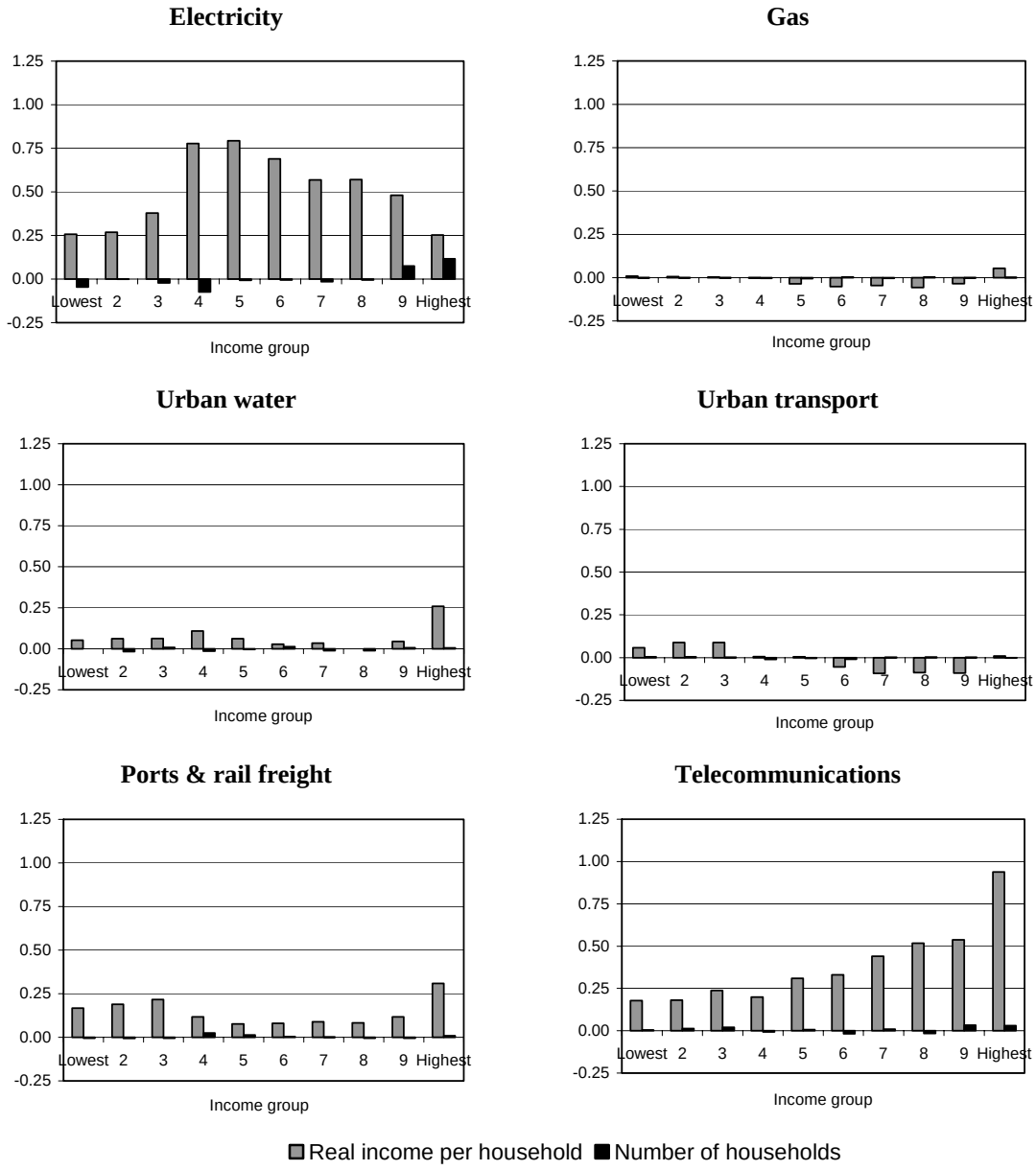
occupational groups employed in activities benefiting from lower electricity prices (eg some manufacturing activities) were the main influence behind these changes. Reduced demand for labour by the electricity industry, including for professional workers traditionally concentrated in the higher income groups, attenuated the increase in real wages and household purchasing power projected for those groups relative to others.

Changes in telecommunications services were also projected to afford increased purchasing power for all income groups, with the largest increases accruing to higher income groups. This predominantly reflects two labour market effects. First, higher productivity in telecommunications was estimated to reduce demand for workers concentrated in lower income groups, moderating the impact of the increase in real wages received by households in these groups relative to others. Second, lower telecommunications prices tended to favour activities intensive in the use of telecommunications services (eg financial services). These activities were characteristically more intensive employers of professional labour, increasing the overall demand for labour in these groups and hence their real wages, relative to other groups. Due to similar productivity and price changes across jurisdictions, only minimal (net) interstate relocation of labour was projected from the changes in the telecommunications sector.

The projected distributional effects for the other industries modelled were generally minimal. Nevertheless, there was a tendency, if anything, for the projected effects to favour higher income groups. The main influences underlying this tendency relate to infrastructure industry changes that were projected to increase demand for activities employing professional and managerial labour and those generating business and investment income. One noticeable result contrary to this trend is the projected decline in purchasing power for households in the seventh to ninth deciles from the changes in urban transport. This reflects the relatively high reliance on labour income (which was projected to decline for workers represented in these groups) and the diminishing importance of government benefit payments that were not offset by higher business and investment income. The households in these groups are also more than proportionally affected by the higher user charges on urban transport services.

Figure 5.5 **Sectoral impacts by household income group**

Per cent



Source: ID model estimates.

5.4 Sensitivity testing

Modelling investment

At the modelling workshops, it was observed that additional capital could involve increased foreign investment and drive a wedge between increases in GDP and changes in household disposable income. A particular concern was that MMRF-style models may not adequately capture the effects of foreigners owning more (or less) new capital than currently modelled. The potential significance of this concern was examined by re-estimating the impact of changes in infrastructure industries on household disposable income using different assumptions concerning the distribution of 'investment income' (such as through interest and dividends) to households. In the re-estimation, the current treatment, whereby households were assumed to receive a proportion of additional national income as investment income in line with historical averages, was replaced with a treatment whereby households were assumed not to receive any additional investment income from higher national income.

The projected changes in aggregate value added output were not sensitive to the changed treatment. However, with the assumed attenuation of income appropriated to households, the projected change in real household disposable income was around one-fifth lower than in the reference case (table 5.1).

Impact of family size and composition

For the chapter analysis, households were ranked according to gross income. This ranking emphasises the total 'earnings' of households. It focuses on the question: 'How has infrastructure industry change affected households with different earnings potential?' However, household size and composition will affect household costs and feasible spending of individual members. Adjusting household income according to an equivalence scale and ranking households by that adjusted income provides a perspective of change that takes account of differences in household size and composition.

A common element of equivalence scales is that the income of larger units tends to be deflated more than income of smaller units. A simple way of adjusting income for household differences is to express income on a per capita basis. Other scales have been devised (see for example, Greenwell, Lloyd and Harding 2001 and ABS 2004).

To assess the sensitivity of results presented in this study to different measures of income, households were re-ordered by two measures of equivalised gross income:

- income per person in a household; and
- income derived by the 'modified OECD' equivalence scale built by allocating points to each household and applied by the ABS in the publication of results from the 2002-03 Survey of Income and Housing (ABS 2004).

Because larger households tend to be concentrated in the higher income groups, ranking households by equivalised income tends to move those households down the income scale. On the other hand, the ranking of households by equivalised income tends to move household with fewer members up the scale — whether they be lower or higher income households.

The change in household purchasing power by income quintiles for each of these cases and the reference case reported above are reported in table 5.5.

With the re-ranking of households, the progression of estimated income gains was projected to be somewhat more evenly distributed than shown in figure 5.3. Nevertheless, the broad distributional effects of change were not projected to be very sensitive to the alternative rankings considered.

Table 5.5 **Sensitivity of estimated change in household disposable income to alternate rankings of households by income group**

Per cent

Household ranking	*Lowest*	*Second*	*Third*	*Fourth*	*Highest*	*Correlation*
Reference case (figure 5.3)	0.77	1.10	1.11	1.01	1.51	1.00
Gross income per person	0.83	0.88	1.12	1.17	1.62	0.88
Equivalised income[a]	0.72	1.02	1.06	1.10	1.60	0.97

a According to ABS practice, this scale assigns a weight of 1 to the first adult in a household, a weight of 0.5 for each additional person 15 years or older and a weight of 0.3 to each household member under 15. Equivalised income is derived by dividing total household income by a factor equal to the sum of the equivalence points allocated to household members.

Source: ID model estimates.

Modelling changes in fiscal balances

The ultimate distributional effects of change would depend on the sources of household income, the size of estimated changes in income in aggregate and the management of the resulting change. The modelling assumes that increased net revenues to government, resulting from growth in national incomes, are distributed to households in a neutral fashion — that is, in proportion to the after tax income of

households before the price and productivity changes in infrastructure industries. (The government revenues are net of increased public spending on public administration, defence, health and education which is not distributed in the model.)

While this approach is conventionally adopted in this sort of modelling, clearly government could elect to distribute any additional revenue from higher national income in other ways. Two sensitivity tests were conducted using alternative assumptions about the distribution of additional revenues. In the first, additional government revenues were distributed in the form of personal benefit payments (which would tend to advantage the lower income groups relative to higher income groups). In the second, additional revenues were distributed as proportional reductions in income taxation (which would tend to benefit higher income groups relative to lower income groups).

The tests indicate that alternative treatments could have important consequences for the distribution of income (table 5.6). In particular, distribution of additional revenue through higher personal benefits could raise average income in the first quintile by 0.58 of a percentage point, while lowering the purchasing power of the highest quintile by 0.16 of a percentage points. On the other hand, distribution of additional revenue through lower income taxes could raise average income of the highest quintile group by 0.09 of a percentage point from the reference case, while lowering the purchasing power of the lowest quintile group by 0.16 of a percentage point.

Table 5.6 **Sensitivity of estimated change in household disposable income to alternate fiscal assumptions by income group**

Per cent

Household ranking	*Lowest*	*Second*	*Third*	*Fourth*	*Highest*	*Correlation*
Reference case (figure 5.3)	0.77	1.10	1.11	1.01	1.51	1.00
Fiscal balance distributed as increased government benefit payments	1.35	1.41	1.11	0.89	1.35	0.19
Fiscal balance distributed as reductions in average income taxation	0.61	0.97	1.06	1.03	1.60	0.98

Source: ID model estimates.

Table 5.7 **Estimated changes in consumer prices by MMRF-CR item**

Per cent

	Electricity	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*
Agriculture	0.21	0.04	0.17	-0.06	-0.02	0.24
Mining	-0.10	0.00	0.03	-0.11	-0.08	0.06
Food products	0.08	0.00	0.08	-0.10	-0.10	0.11
Beverages	0.02	-0.02	0.03	-0.12	-0.11	0.10
Tobacco	0.27	-0.02	-0.01	-0.19	-0.22	-0.08
Textiles	0.14	-0.01	0.06	-0.12	-0.16	0.02
Clothing	0.29	-0.01	0.03	-0.19	-0.25	-0.11
Leather	0.10	0.01	0.08	-0.04	-0.12	0.11
Footwear	0.20	0.00	0.05	-0.13	-0.19	0.01
Wood products	0.10	-0.02	0.04	-0.15	-0.15	-0.04
Furniture	-0.05	-0.03	-0.03	-0.12	-0.08	0.11
Paper products	-0.05	-0.01	0.08	-0.11	-0.10	0.08
Printing	0.04	0.00	0.04	-0.10	-0.08	0.05
Industrial chemicals	-0.05	-0.01	0.09	-0.09	-0.12	0.16
Other chemicals	0.12	-0.01	0.04	-0.10	-0.13	-0.01
Petrol	0.03	0.00	0.06	-0.09	-0.09	0.07
Rubber	0.02	-0.01	0.06	-0.11	-0.17	0.05
Plastic	0.06	-0.01	0.07	-0.13	-0.16	0.02
Pottery	0.16	-0.01	0.08	-0.06	-0.11	0.07
Glass	0.11	-0.02	0.09	-0.07	-0.12	0.09
Other non-metallic products	0.19	-0.01	0.10	-0.11	-0.09	0.10
Iron and steel	-0.31	-0.06	0.08	-0.10	-0.14	0.18
Non-ferrous metal products	-1.13	-0.20	0.19	-0.04	0.05	0.42
Metal products	-0.12	-0.04	0.04	-0.10	-0.11	0.12
Non-electrical machinery	-0.05	0.00	0.06	-0.06	-0.15	0.15
Electrical machinery	0.04	0.00	0.07	-0.06	-0.13	0.09
Transport equipment	-0.10	-0.01	0.04	-0.08	-0.14	0.16
Scientific equipment	-0.02	-0.01	0.07	-0.07	-0.13	0.09
Other manufactured products	0.08	0.00	0.06	-0.08	-0.15	0.06
Electricity	-3.26	0.95	2.27	0.94	3.77	5.23
Gas	7.19	0.07	0.90	0.45	-0.23	1.92
Water	5.08	0.38	-3.66	0.37	2.63	5.19
Construction	-0.14	-0.01	0.03	-0.07	-0.14	0.29
Wholesale	0.23	-0.02	-0.01	-0.13	-0.18	-0.17
Retail trade	0.19	0.00	0.02	-0.13	-0.12	-0.01
Repairs	0.19	0.01	0.12	-0.16	-0.18	0.31
Restaurants, hotels and clubs	-0.16	-0.02	-0.06	-0.08	-0.04	0.31
Road transport	2.20	0.21	0.54	7.12	0.56	0.92
Rail transport	0.52	0.07	0.28	16.50	0.00	0.85
Water transport	0.30	0.05	0.08	3.69	-0.14	0.35
Air transport	-0.02	0.01	0.08	-0.07	-0.40	0.24
Services to transport	0.62	0.14	0.52	0.03	0.01	1.11
Communications	1.37	0.07	0.56	-0.02	0.51	-16.74
Finance	-0.19	-0.01	-0.38	-0.07	0.06	-0.25

(Continued on next page)

Table 5.7 **(continued)**

	Electricity	*Gas*	*Urban water*	*Urban transport*	*Ports & rail freight*	*Telecoms*
Insurance	1.14	-0.01	0.10	-0.21	-0.08	-0.29
Dwellings	0.02	-0.04	-0.27	-0.09	0.05	0.34
Public administration	-0.39	-0.03	0.11	-0.12	0.06	-0.20
Defence	-0.11	0.02	0.15	-0.04	-0.17	0.27
Health	-0.22	-0.05	-0.07	-0.13	-0.10	0.71
Education	-1.16	-0.03	0.06	-0.04	0.22	1.08
Welfare	-0.19	-0.03	-0.04	-0.12	-0.07	0.11
Entertainment	-0.35	0.00	-0.17	-0.09	-0.01	-0.14
Personal services	-0.41	-0.05	-0.13	-0.14	-0.04	0.44
Other services	-0.12	0.02	0.14	-0.04	-0.18	0.28

Source: MMRF-CR estimates.

A The MMRF-CR model

The MMRF model is a state-based version of the Monash model. This model disaggregates national production into eight State and Territory regions, and 54 industries within each region. The MMRF-CR model is a special version of the MMRF model that includes modelling of labour productivity and infrastructure industry price changes and a regional disaggregation of state results.

This appendix describes the structure and key elements of the MMRF-CR model.

A.1 The model

Because the labour productivity and service-price changes in infrastructure industries differ between jurisdictions, the MMRF model, with its state disaggregation, is particularly suited to analysing the effects of these changes. Box 1.1 provides an overview of the model.

Database

The core of the MMRF model is its database, showing how each industry in each state economy is linked to other industries within a state and in other states.

The database is based on input-output tables prepared by the Australian Bureau of Statistics (ABS) and various ABS state publications. It provides a detailed description of the structure of production and demand in each State and Territory. The database shows, for each state economy:

- the flow of industry outputs to other industries (termed 'intermediate inputs'), final demands by households (consumption), government, investment (for capital formation purposes) and exports; and
- the cost structures of industries in terms of intermediate inputs of commodities (goods and services supplied by domestic industries and by imports), primary factors of production (labour, capital and agricultural land) and commodity taxes and subsidies.

It accounts for product taxes and subsidies on all transactions and includes margin services, which represent the costs associated with transferring products from the producer or the port of entry (in the case of imports) to final consumers and other users. Transportation and distribution margin services include wholesale and retail trade, transport, storage and insurance costs. Product taxes and margin services represent the difference between the cost of providing a good or service (at the producer level) — the basic price of the good, and the price paid by the user —the purchasers' price of the good. Customs tariffs (other than excise on imported goods) are treated as a commodity tax on imports.

The database used has 54 industries each producing a single commodity (table A.1). The database has one representative consumer in each state.

The database represents the economy as it was in 1993-94. Being benchmarked to this year, the database does not reflect any important structural changes in state or regional economies since then that are unrelated to NCP or changes in the infrastructure industries considered in this study, which may have implications for the results produced. For example, the database does not fully capture the significant increase in gas exports from the North West Shelf and it pre-dates the closure of the Newcastle steelworks in the Hunter region, both of which will have national and regional implications for the changes in infrastructure industries considered.

Table A.1 **MMRF-CR industries, margin services and product taxes**

1. Agriculture
2. Mining
3. Food products
4. Beverages
5. Tobacco
6. Textiles
7. Clothing
8. Leather
9. Footwear
10. Wood products
11. Furniture
12. Paper products
13. Printing
14. Industrial chemicals
15. Other chemicals
16. Petrol
17. Rubber
18. Plastics
19. Pottery
20. Glass
21. Other non-metallic products
22. Iron and steel
23. Non-ferrous metal products
24. Metal products
25. Non-electrical machinery
26. Electrical machinery
27. Transport equipment
28. Scientific equipment
29. Other manufactured products
30. Electricity
31. Gas
32. Water
33. Construction
34. Wholesale trade
35. Retail trade
36. Repairs
37. Restaurants, hotels and clubs
38. Road transport
39. Rail transport
40. Water transport
41. Air transport
42. Services to transport
43. Communications
44. Finance
45. Insurance
46. Dwellings
47. Public administration
48. Defence
49. Health
50. Education
51. Welfare
52. Entertainment
53. Personal services
54. Other services

Transport and distribution margin services

Wholesale trade (part of commodity 34)
Retail trade (part of commodity 35)
Restaurants, hotels and clubs (part of commodity 37)
Road transport (part of commodity 38)
Rail transport (part of commodity 39)
Water transport (part of commodity 40)
Air transport (part of commodity 41)
Services to transport (part of commodity 42)
Insurance (part of commodity 45)

Product taxes

Taxes on intermediate usage (production)
Taxes on household (consumption)

Source: MMRF-CR database.

Theory and parameters

The MMRF model uses economic theory to specify how producers, household and government consumers, exporters and foreign and local investors respond to relative prices, productivity improvements and other economic changes. It also has two government sectors — state and federal — whose revenue and expenditure behaviour is modelled separately. Important elements of the theoretical structure of MMRF include the following:

- Producers and consumers respond to changes in the international competitiveness of Australian industries. Producers and final consumers are modelled as substituting between domestically produced and imported intermediate inputs and final goods in response to changes in the competitiveness of local industries.
- Export sales are sensitive to changes in the international competitiveness of local industry. The demand for Australian exports is modelled as responding to changes in the export price of Australian products.
- Producers alter their relative use of the primary factor inputs of labour, capital and agricultural land in response to changes in the relative cost of these factors in production.
- Final consumers change their consumption of particular commodities as their aggregate spending changes and as they substitute between commodities in response to changes in the relative prices of goods consumed.
- Producers are assumed to reduce the resource costs, and thereby the price, of their outputs in response to productivity improvements. Any productivity improvements may improve the efficiency of the use of all inputs (ie total factor productivity) or selected inputs (such as labour and fixed capital) (ie multifactor productivity).

In general, the theory and parameter values that are standard to MMRF have been applied to the current application. Nevertheless, enhancements enabling the disaggregation of results to a sub-state level and a more flexible treatment of export sales have been made to better meet the terms of reference of the inquiry and to align with modelling conventions adopted in the previous study (ie in PC 1999). These enhancements are discussed in turn.

Disaggregation of results to sub-state regions

The Monash Regional Equation System (MRES) has been added to the MMRF model to enable the impact of changes in infrastructure industries on rural and regional Australia to be gauged.

The MRES adopts a 'tops-down' approach to regional analysis. In its standard form, MRES is used to disaggregate national results to the state and sub-state and territory regional levels.[1] In this study, results for six states and two territories are estimated directly in MMRF-CR. The State results are then disaggregated to the regional level using the industry mix in each region. Using this approach, it has been possible to estimate the impact of economic change on output and employment in 55 sub-State regions (see chapter 1 for classification list). The regions are closely aligned with ABS statistical divisions.

In projecting state results to the regional level, a distinction is made between 'national' and 'state', and 'local' industries. National and state industries are those producing commodities that are highly tradable in inter-regional markets (eg agriculture, mining, and most manufacturing commodities). Conversely, local industries are those producing commodities that are predominantly traded in regional markets (eg many services and perishable commodities) and whose prospects are tied largely to general activity levels in the sub-state region in which they are located.

The presence of local industries whose prospects are tied to regional activity introduces regional 'multiplier' effects. If a region has a concentration of fast-growing national and state industries, then the effect on its overall regional growth is multiplied through fast growth of associated local industries.

MRES apportions the effect of economic activity into the region in which it occurs. While this approach is generally suitable for regional employment, it does not take into account that some of the benefits may flow out of the region, such as to the owners of fixed capital located in the state capitals or overseas and to persons who travel between regions for work.[2]

Treatment of exports

As far as practicable, export demand for each industry's output should be determined separately on the basis of its own export price and the assumed responsiveness of export sales to changes in price. In contrast to this ideal, in the standard MMRF model framework, export demand is derived in aggregate for 'non-traditional' export commodities and disaggregated to regional industry using a tops-down methodology.

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[1] A tops-down approach was adopted to produce state and regional results in PC (1999).

[2] The use of 'fly-in, fly-out' employment in mining industries whereby workers live in one region (eg Perth) and are routinely flown to work in another (eg Pilbara) for short periods is an example of where the approach taken in MRES may be inappropriate, as many of the consumer benefits may accrue to the region in which the worker lives.

The treatment of exports adopted in this study allows individual activities to be considered as responding directly to changes in their own competitiveness — that is, a bottoms-up approach to modelling aggregate exports. It is assumed that local producers of export commodities have little or no influence on the price of their commodities in world markets.[3] This approach avoids over specialisation in mining and non-ferrous metal processing that can occur if export possibilities are limited to these 'traditional' export sectors.

The approach adopted in the current study conforms to that adopted in PC (1999).

Treatment of changes in labour productivity

Changes in labour productivity are measured as the change in labour requirement per unit of output. As it refers to only one factor of production, labour productivity is only a partial measure of change in industry productivity. Improvements in labour productivity can arise from technological and organisational change (including reductions in manning levels to world best practice levels) or the more intensive use of other factors (such as capital).

For this study, a new equation explaining changes in labour productivity in terms of changes in regional industry employment and output was added to the MMRF model. In this study, the change in labour productivity was treated as exogenous and data on the observed change was applied as a model shock. The corresponding endogenous variable was a MMRF labour augmenting technical change term — a measure of the changes in labour productivity not arising from the more intensive use of other factors. The model was used to solve for the redistribution of employment between regional industries and the new level of regional industry output implied by the observed changes in productivity.

The approach adopted in the current study refines the approach for the modelling of labour productivity applied in PC (1999).

[3] This is achieved by setting the export demand elasticity to -20 for each non-traditional export commodity. The exceptions are exports of public administration, defence services, ownership of dwellings, personal services and other services, which are assumed to be exogenously determined and held fixed and exports of electricity, gas, water, rail transport, road transport, water transport, service to transport and communications which are assumed to adjust to maintain export revenue at a constant level (ie the standard Cobb-Douglas assumption). The initial MMRF export demand elasticities for non-traditional export commodity groups is -10.

Treatment of changes in infrastructure industry service prices

Changes in infrastructure industry service prices are measured in terms of the producer or purchasers' price depending on the valuation basis used in the data source from which the price change was estimated. Price changes for household and non-household users are modelled separately depending on the activity under analysis. For transport activities, the price of margin services is modelled separately from the price of other transport services. For example, a change in urban rail-service productivity or prices is assumed to have no affect on margin or non-margin rail freight service prices.

Having the service price determined, a choice must be made concerning the modelling of associated changes in industry costs or productivity. If the change in service price coincidentally *exactly* accounted for the benefits of labour productivity improvements (discussed above), the modelling task is straightforward. However, because the productivity of non-labour inputs can vary (eg with changes in capital productivity or contracting out) as can the margin between service prices and industry costs (eg with increased cost recovery), the observed service-price change may be greater or less than the price change implied by labour productivity improvements. The modelling option adopted for the July workshop was to attribute all of the difference to 'non-labour input' technical change. The disadvantage of this, as highlighted at the workshop, is that it would treat unobserved increases in cost recovery as technical regression. This was considered to be a significant limitation, given the extent of price rebalancing and increased incidence of cost recovery during the 1990s. Another modelling option would be to treat the difference as a change in the rate of cost recovery by (mainly government) owners. This would have the disadvantage of treating unobserved technical advances as a decline in returns (or subsidy).

To avoid such disadvantages, unobserved factors influencing costs are subsumed into an 'other cost' shift term that has no feedback links in MMRF-CR to producers or consumers. The cost-competitiveness of state businesses would therefore depend on state prices. This approach enables the national and regional impacts of infrastructure industry price changes to be quantified. However, available information does not enable the productivity or financial implications (including through state budgets) of modelled changes in the other costs item to be assessed.

The approach adopted extends the modelling of prospective 'price-rebalancing' in PC (1999) to take account of observed price changes pertaining to state-household and other users.

The economic environment (ie model closure)[4]

This study is designed to examine the effect of changes in productivity and prices in the infrastructure industries on the level and distribution of activities once these changes have had time to work through the economy. More specifically, the study asks the question 'how would the Australian economy of the early 1990s have differed had infrastructure industries' productivity and real prices of the year 2000 prevailed?'

Accordingly, a longer-term environment is used. In this environment, the estimated effects reflect those that are likely to occur after there has been full adjustment of capital and labour between jurisdictions and industries (after a period of, say, ten years). The framework is comparative-static in the sense that it compares the economy pre- and post adjustment and does not trace out the adjustment path.

The key elements of the longer-run economic environment adopted in MMRF-CR are as follows.

- The model index of consumer prices is the numeraire. That is, all changes in domestic prices in the model can be interpreted as changes relative to the general level of prices in the economy. In all simulations, the nominal exchange rate is flexible.
- National employment is fixed (at the early 1990s level), while real pre-tax wages adjust. National employment by occupational group is also fixed while real pre-tax wages by occupational group in each state adjust, as does state employment in each occupational group. The number of households in each state and state populations are assumed to change in line with state employment.
- The economy-wide rate of return on capital is fixed, while the national stock of capital varies. Each regional industry adjusts its capital stocks in order to equilibrate its expected and actual rates of return on capital. The expected rate of return is determined by values in the MMRF database. Industries' demands for investment goods are linked by an exogenous investment/capital ratio to changes in their capital stock.
- Nominal household consumption is determined by post-tax household disposable income, while the balance of trade as a ratio of GDP in local currency prices is allowed to vary. Regional household consumption is determined by regional post-tax household disposable income.

4 The term 'model closure' is used to refer to the assignment of the model's variables between those determined outside the model (ie exogenous variables) and those determined by the model (ie endogenous variables).

- Regional government consumption in nominal terms moves in line with nominal household consumption expenditure. Real regional government investment moves in line with total real regional investment.
- Budget neutrality is maintained in nominal terms as are tax rates. After allowing income taxes and personal benefit payments to vary in proportion to activity levels and government nominal consumption spending to vary in proportion to nominal household consumption, any government surplus is returned to households as a 'lump sum'.[5]

It is assumed that the modelled productivity and price changes have no influence on the national supply of labour — that is, it is the same as it would otherwise be.[6] Higher national and regional output therefore depend on higher productivity of labour and the relocation of labour between regional industries. In MMRF, national labour supply and employment by eight occupational groups is represented by levels in the early 1990s while the stock of fixed capital is allowed to vary.

Productive capital in infrastructure industries has been assumed fixed. This treatment has been adopted mainly because of incomplete information on factors influencing industry and regional capital stocks — including changes in the price-cost margins that may affect returns to capital and investment decisions. Higher output in infrastructure industries therefore comes from higher labour productivity in those industries and the use of additional non-capital inputs.[7]

5 That is, it is assumed that all changes are contemporaneous and do not affect households across time (ie other than through modelled changes in the level of household disposable income and consumer spending).

6 If the modelled changes in infrastructure industries increase total employment, then the production gains would be higher than the estimates presented here.

7 Higher labour productivity would be expected to lower the requirement for fixed capital in the infrastructure industries and be accompanied by a relocation of capital between regional industries. In the absence of full information on factors influencing the level of capital in infrastructure industries, the effects of relocating capital from those industries is not modelled in the current study.

B A framework for assessing the welfare effects of infrastructure industry change

Improvements in the productivity of infrastructure industries would be expected to increase national output and flow through to higher living standards. To assess the benefits arising from infrastructure industry change on living standards, a direct measure of welfare change is needed. The measurement of welfare received attention at the workshop both in the context of interpreting the results of the MMRF-CR model and in the context of prospective analysis of the distributional impacts of infrastructure industry changes. This appendix outlines a framework for assessing the welfare impacts of change. Given the scope of current modelling, the measures, when applied, abstract from adjustment and administrative costs.

How infrastructure industry and other economic change effects the wellbeing of Australians depends on:

- what the change does to the disposable income of Australians (in nominal terms);
- the effect of changes in prices, and hence the purchasing power of income (in real terms); and
- how the community values the benefits of additional real expenditure.

Real national disposable income provides a monetary measure of these influences and is the central economy-wide measure of economic welfare. National disposable income encompasses community benefits from current consumption and from current net saving (since saving increases future consumption). Finally, current government expenditure represents the community benefits from the government's provision of public goods and services.[1]

[1] The top-level utility function in MMRF-CR is assumed to be homothetic, meaning that successive increases in real expenditures are assumed to generate equi-proportional increases in economic wellbeing. This is likely to be a reasonable assumption for relatively small changes in prices and/or quanties.

To obtain a measure of change in real national disposable income, changes induced by infrastructure industries are reported in inflation-adjusted terms.[2] So adjusted, the measures provide an indication of what real changes in activity levels mean for the purchasing power associated with a policy or other economic change.

How the community assesses the 'real' changes in disposable income depends on the benchmark or reference prices used to evaluate the changes. The benchmark price can be evaluated against 'old' (pre reform) or 'new' (post reform) prices. In MMRF-CR, real inflation adjusted change is evaluated against old prices. In doing so, the analyst asks the question 'What is the income required to ensure that the new level of utility is maintained with the old set of prices'. The equivalent variation of income provides an upper bound measure of 'true' welfare change.[3]

Data in the MMRF-CR model do not provide a direct measure of national disposable income or changes in that aggregate. However, the model does provide partial measures, which in practice are closely correlated over time with national disposable income. Gross domestic product (GDP) is one such measure. Apart from its output focus, a significant limitation of this measure is that it does not take into account the effects of changes in the terms of trade. This is an important concern in welfare calculations, because higher export volumes achieved through lower, more competitive export prices are a significant source of output growth.

To overcome this limitation, this study adopts gross national expenditure (GNE) as a more appropriate, partial measure of economic welfare. GNE measures the total expenditure within a given period by Australian residents on final goods and services. It is equivalent to gross domestic product plus imports of goods and services less exports of goods and services evaluated in Australian dollars. Changes in GNE reflect changes in purchasing power of income due to changes in productive efficiency and the terms of trade.

A limitation of both partial measures — GDP and GNE — is that they do not take into account investment income accruing to overseas residents that would occur

[2] A change in real national disposable income is an equivalent to the sum of changes in consumer and producer surplus. Specifically, McCloskey (1985, pp. 217–21) shows that the change in consumer and producer surplus arising from an economic change lies between the Paasche and Laspeyres measures of the 'true' change in national income.

[3] The changes can also be evaluated against the 'new' set of prices. If it is evaluated against new prices, the analysis asks the question 'what is the income required to ensure the existing level of utility is maintained but with the new set of prices' (termed the compensating variation). A limitation of the compensating variation measure is that it uses a different set of 'hypothetical' base prices for the evaluation of different economic changes. While, in principle, the compensating measure provides a lower-bound estimate of change in true welfare, in practice, the equivalent and compensating measures are similar for small changes.

with any increase in foreign ownership of capital associated with additional investment spending.[4] The impact of changes in investment income accruing to foreigners on the welfare of Australian residents currently cannot be calculated in MMRF-CR.

Partial measures can also be calculated to disaggregate national income and quantify the distributional effects of change. One such measure is net household disposable income, which when expressed in real or price adjusted terms is equal to projected changes in real household consumption in the MMRF-CR model. While real consumption is not a measure of national welfare, as it ignores the benefit that would accrue from additional investment (ie net savings), the change in real consumption provides a relevant partial indicator of the contemporaneous impact of economic change on the purchasing power of households. This measure has been used to indicate the distributional effects of infrastructure industry change across income groups (chapter 5 and appendix C).

With the assumption of no-change in aggregate employment, achieving higher labour productivity involves some relocation of jobs between industries and regions. MMRF-CR produces two key measures of the regional implications of economic change — gross regional product and employment. From these two measures a third measure can be inferred — change in income per person employed. Each of these measures indicate different aspects of a region's output and income generating potential and hence contribution to national disposable income. However, while they are useful regional activity measures, they do not take into account terms of trade or income distributional (or transfer) effects. Hence, they are qualified measures of the regional dimension of changes in national wellbeing.

Measures of the welfare implications of infrastructure industry change, as quantified by changes in real GNE, are reported in chapter 3.

[4] This would be improved by deducting changes in allowance for consumption of capital and net borrowings from foreigners. The MMRF-CR model estimate of the change in the balance of trade in local current prices provides an approximate measure of this aggregate.

C The income distribution model

An income distribution (ID) model based on the 1993-94 Household Expenditure Survey (HES) has been linked to the MMRF-CR model to enable the impact of changes in infrastructure industries on the distribution of household income to be gauged.

This appendix describes the structure and key elements of the MMRF-CR and ID models used to estimate the distributional effects of productivity and price changes in infrastructure industries on household incomes. It first outlines the model framework then details a procedure for reconciling the ID model results based on HES data with benchmark estimates from the MMRF-CR model. It also outlines reporting conventions applied to households with negative income and a decomposition analysis of changes in real household disposable income. The benchmark MMRF-CR model is described in appendix A.

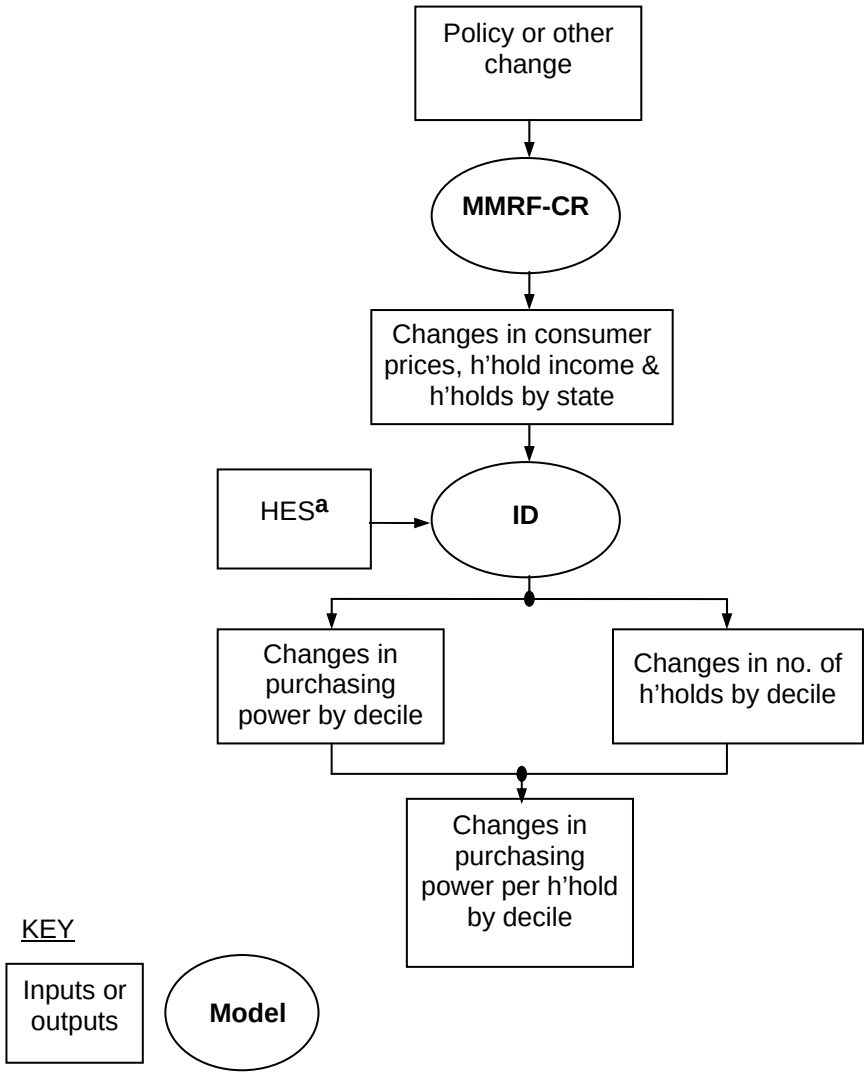
C.1 The model

This study uses a 'tops-down' approach to distributional analysis (figure C.1). Household income results for each state are estimated, in aggregate, directly in MMRF-CR. The state results are then disaggregated down to the household level using unit record household income and expenditure information from the HES and concordances between income and expenditure items in the two frameworks. The unit record information is then re-aggregated to household income deciles estimated on the basis of gross household income as reported in the HES.

While the MMRF-CR model is suited to assessing the aggregate effects of change on households in each state, the ID model with its detailed unit record information on household income and expenditure is particularly suited to evaluating the effects of those changes across household income groups. Through its use of unit record data to extrapolate how household incomes change in response to external economic and demographic conditions, the ID model falls within the genre of models termed 'microsimulation models'.[1]

[1] Outlines of microsimulation modelling are provided in Harding (1996) and Gupta and Kapur (2000).

Figure C.1 **Illustration of the 'tops-down' MMRF-ID framework**



a Household Expenditure Survey 1993-94 (ABS, Cat. no. 6527.0).

To the Commission's knowledge, this is the first application simulating the impact of changes in infrastructure industries on households using benchmark projections of economic and demographic change from a multi-regional computable general equilibrium model such as MMRF.[2] The current study also goes beyond earlier

[2] Meagher and Agrawal (1986) analysed the distributional impacts of taxation reform using a prototype microsimulation/applied computable general equilibrium framework. Later, Dixon, Malakellis and Meagher (1996) developed an integrated framework and applied it to provide an illustrative analysis of the impacts of labour productivity improvements across national industries on the incomes of 9 family types whose income characteristics were drawn from the 1989-90 ABS Survey of Income and Housing.

Commission studies which focused on the initial price effects of change on households (sometimes referred to as the 'morning-after' effect).[3]

Database

The HES provides unit record data on incomes and expenditure for a sample of 8389 households in 1993-94. The larger states had significantly larger samples than the less populous states and territories.[4] Each household was assigned a household population survey weight that measures the inverse of the probability of the household being selected in the survey. Survey units with a relatively high weight represent a relatively large number of households within the nation while units with relatively low weights represent a relatively small number of households. The HES sample weights provide a basis for estimating aggregate changes in household income and expenditure across Australia. In aggregate, these 8389 households represented a population of 6.6 million households across Australia.

This detailed unit record information forms the core of the ID model.

To link projections of changes estimated in MMRF-CR to HES income and expenditure data, concordances were developed between the 13 MMRF-CR items of household income with the 34 HES items of income and 54 MMRF-CR items of household expenditure and 423 HES items of expenditure. The concordance between items of income in the two frameworks and the indicators of change provided by the MMRF-CR model are listed in table C.1.

[3] See, for example, Industry Commission (1990), which examined the price effects of tariff reductions, and Industry Commission (1996), which examined the price effects of average changes in a selection of infrastructure service prices.

[4] The sample size in each state in the 1993-94 HES was: 2226 in New South Wales, 1782 in Victoria, 1148 in Queensland, 719 in South Australia, 684 in Western Australia, 791 in Tasmania, 602 in the Northern Territory and 437 in the Australian Capital Territory. About three quarters of these households were located in capital cities (ABS, Cat. no. 6527.0. p. 15).

Table C.1 **Concordance between MMRF-CR and HES items of income**

MMRF-CR model	*HES-based classification adopted in the income distribution model*	*MMRF-CR indicator of*	
		Price change	*Quantum change*
Wage income for eight occupations *plus* one implicit category for households with no occupation (same as those in MMRF-ID)	Managers & administrators Professionals Para-Professionals Tradespersons Clerks Sales & personal service workers Plant & machinery operators and drivers Laborers & related workers Households with no occupation in the HES (eg retired persons, welfare recipients)	Wage rate by state occupational group	Employment by state occupational group
Non-wage primary factor income (capital, land, 'other costs' and imputed wages of owner operators)	Business income or self employment Property rent	Average household return on non-labour factors by state[a]	Average household employment of non-labour factors by state[a]
Unemployment benefit payments	Unemployment benefits	National consumer prices (assumed zero change)	Number of unemployed persons by state[b]
Other government benefit receipts (State, Territory and Australian Government)	Sickness benefits Family allowance Veterans pensions Age pensions Widows pensions Disabled pensions Supporting parenting benefits Wives pensions Other Australian government benefits AUSTUDY support Carers' pensions Other overseas government benefits	National consumer prices (assumed zero change)	Population by state[b]
Other income	*Property income* Interest (financial institutions) Investments *Secondary income* Workers compensation Accident compensation Maintenance Other regular sources Private scholarship Government scholarship Overseas pensions	National consumer prices (assumed zero change)	Value of gross state product
Direct taxes	Income tax	Tax rate (assumed constant)	Value of gross household income

(Continued next page)

Table C.1 **(continued)**

MMRF-CR model	*HES-based classification adopted in the income distribution model*	*MMRF-CR indicator of*	
		Price change	*Quantum change*
Government fiscal balancing item	Estimated item allocated to households in proportion to net HES income	na	Financial flow expressed as cents per dollar of net income[c]
Out of scope	Superannuation receipts		

na not applicable. [a] Estimated as the weighted sum of returns (or quantum employed) to fixed capital, land, 'other' value adding costs of business and imputed wages of unincorporated enterprises. [b] Following MMRF, these aggregates are estimated indirectly by deducting the projected changes in the benefit rate from the benefits paid. With no change assumed in the benefit rate, the measures approximate change in the number of households (persons) receiving the benefit. [c] Defined in terms of net household disposable income so that the measure does not have distributional consequences in terms of net income (ie household purchasing power).

Sources: MMRF-CR and ID model databases.

In MMRF-CR, household disposable income includes income from labour and property income, government benefit payments and net other transfers as defined in the Australian National Accounts. It excludes proceeds from the sale of businesses and realisation of household investments. Items of household income broadly align between the MMRF-CR and HES-based ID models. The main differences between the two frameworks are:

- The HES includes income tax payments as a 'selected other payment'. The MMRF-ID framework includes income taxes (or direct taxes) as a deduction in deriving disposable income.
- The HES includes superannuation receipts as an item of income. The MMRF-ID models treat these payments as withdrawals from household wealth.
- The MMRF-CR model includes a 'government fiscal balancing item' as a shift term used to implement the assumption of no-change in government fiscal balances resulting from infrastructure industry change (appendix A). Changes in the fiscal balance are treated as government benefit payments in MMRF-CR. To preserve distributional neutrality, these balances are distributed in the ID model to households in proportion to household income net of any income tax payable.

Household expenditure in MMRF-CR refers to consumption spending as defined in the Australian National Accounts. This spending includes durable (eg electrical appliances, motor vehicles) and non-durable (eg food) goods and services but excludes expenditure on fixed assets (including dwellings), valuables (works of art) and debt repayments.

In addition to these expenditure items, the HES includes outlays on non-current items such as mortgage repayments, asset purchases and superannuation

contributions (table C.2). The HES also includes transfer payments between households such as alimony, pocket money and donations. Because household outlays on non-current payments and transfer payments are not modelled in MMRF-CR and because it has not been practicable to link changes in infrastructure industry productivity and prices to the 'user cost' of these items, the current study does not include estimated effects of changes in these items on aggregate household purchasing power.

For consistency with the aggregate analysis in MMRF-CR, the expenditure totals and associated shares estimated from HES data used in the analysis do not include household transfers and non-current outlays. The services of private non-profit organisations serving households are also included in MMRF-CR. Although the HES did not collect expenditure data directly from such organisations, it did collect expenditures on club subscriptions paid by households and explicit service charges and event expenditures (such as entry fees and accommodation expenses).

Table C.2 **Items of household outlays in the HES with no corresponding items in the MMRF-CR model**

Alimony or maintenance payments
Cash gifts, donations to charity
Pocket money or allowance
State deficit levy (Victoria only)
Mortgage payments - principal (selected dwelling)
Principal component of mortgage repayment for other property
Purchase of selected dwelling or other property (excluding mortgage payments)
Additions/extensions
Internal renovations
Insulation
In-ground swimming pool
Outside building
Landscape contractor
Outside improvements, n.e.c.
Other capital housing costs, n.e.c.
Superannuation and annuities
Life insurance

n.e.c. not elsewhere classified.

Sources: MMRF-CR and ID model databases.

Theoretical structure of the ID model

The MMRF-CR model uses economic theory to specify how households in each state respond to changes in household disposable income and consumer prices (appendix A). In general, the theory and parameter values that are standard in

MMRF-CR have been applied in the current application. Nevertheless, an enhancement has been made to disaggregate indicators of the mobility of households between states to better align the MMRF-CR and HES-based ID models. The basic accounting of household income and expenditure and changes in household purchasing power in MMRF-CR is outlined first below. This is followed by an outline of the 'tops-down' methodology applied in the ID framework for estimating the distributional effects of change, including a discussion of MMRF-CR indicators of household mobility.

Estimation of aggregate changes in overall household income and expenditure

MMRF-CR contains a detailed accounting of household disposable income and consumption flows for households in aggregate for each state. In MMRF-CR, aggregate household disposable income (*Y*) is broadly defined as:

$$Y = wL + rK + B + O - T \qquad \text{C.1}$$

where *w* and *r* represent the wage rates for occupational labour and the rental price of household capital, respectively. *B* represents unemployment and other personal benefit receipts, while *O* represents (net) other income such as from workers compensation (see table C.1 for details). *T* represents direct taxes on income paid by households.

Aggregate household consumption expenditure in each state over 54 consumption items is defined as:

$$C = P_1 X_1 + P_2 X_2 + ... + P_{54} X_{54} \qquad \text{C.2}$$

where the *X*s are the respective items of household consumption spending and the *P*s are the consumer prices (see table A.1 for item list).

Based on these accounting relationships, the percentage change in real household disposable income in each state household (or real purchasing power) — *yR* — can be expressed in aggregate terms as:

$$yR = y - p = cR \qquad \text{C.3}$$

where *y* and *p* are the percentage changes in nominal income of all households from all sources and consumer prices faced by those households, respectively. As the average propensity to consume by households is assumed unchanged with changes in real household disposable income in MMRF-CR, the change in real household consumption spending — *cR* — is defined to be equal to the change in real household disposable income.

The longer-run closure adopted in MMRF-CR has a number of important implications for projections of change in household disposable income and therefore real household consumption, and the interpretation of those projections. First, the closure adopted treats capital as mobile between regions — activities adjust their capital stocks to equilibrate expected and actual rates of return. Although this treatment was relaxed for infrastructure industries, where capital stocks were assumed fixed (chapter 1), its application, in general, means that projections of change in disposable income will reflect estimated changes in the deployment of capital in the region and changes in the national stock of capital.

Second, the assumption of fixed national employment by occupational group allows labour and associated households to relocate from slower to faster growing regions. The application of this treatment means that projections of change in disposable income will reflect estimated changes in employment and changes in the wage rate for each occupation. The MMRF-CR price and quantum items measuring change in household disposable income, change in labour and capital income and other items of household disposable income are listed in table C.1, together with links to items of income in the ID model.

Estimation of the distributional effects of change

The HES unit record database used contains detailed income and expenditure information for each household. The distribution effects are estimated in the ID model in a two stage process. Broadly, in the first stage, the respective state results for each item of household consumption, wages by occupational group, business and investment income, government benefit payments and direct taxation estimated in MMRF-CR were disaggregated using a tops-down methodology to each surveyed household using their income and expenditure levels. In the second stage, the estimates were re-aggregated to household income groups.

Tops-down disaggregation of aggregate results

The tops-down disaggregation of state results to individual households within a state assumes that the percentage change in each item of income and expenditure is uniform across households within any one state. The percentage change in factor earnings for a surveyed household (g) within a state was therefore estimated in the ID model as the weighted sum of the percentage change in earnings from its income sources:

$$y_g = \sum_f \phi_{g.f}\, y_f \qquad \text{C.4}$$

where $\phi_{g,f}$ is the value share of an item of income (*f)* in the household *g*'s total income and y_f is the estimated percentage change in the value of income by item in the state in which household *g* resides. (A regional subscript to y_f is implicit in this equation.)

Similarly, the percentage change in the consumer price for a surveyed household within a state is equal to the sum of the percentage changes in the prices paid for goods and services in that state, p_i, weighted by their household expenditure shares, $\theta_{g,i}$, that is:

$$p_g = \sum_i \theta_{g,i} p_i \qquad \text{C.5}$$

Projections of the *y's* and *p's* were obtained from MMRF-CR. The income and price measures estimated in MMRF-CR for each state are assigned to each HES household in that state — the tops-down approach to modelling change at the household level. The income and expenditure shares, ϕ's and θ's, were calculated for each household from information drawn from the 1993-94 HES.

Following the definition of change in aggregate real disposable income of households, the change in household *g*'s real disposable income or purchasing power is defined as:

$$yR_g = y_g - p_g \qquad \text{C.6}$$

The longer run modelling of change implies, as indicated above, household disposable income can increase from the ownership of additional capital as well as other changes in labour income, investment income, benefits receipts after allowing for changes in income taxation. However, with the assumption of fixed aggregate employment by occupational group and the additional modelling assumption that the occupational characteristic of households is not influenced by infrastructure industry change, projections of change in labour income of household *g* are only influenced by changes in regional occupational wage rates.

Re-aggregation of household results

In the second stage, the results for each surveyed household were aggregated in the ID model using sample survey population weights to form national aggregates and decompositions of national aggregates into household income groups according to household gross income before infrastructure industry change. In the basic implementation of the model households were classified into 10 income groups or deciles — the basic model has thus been specified in terms of deciles. In

summarising the results of the income distribution analysis, households were also classified into 5 income groups or quintiles using a parallel methodology to that outlined for the 10 income groups or deciles.

The weighted changes in real household income and real consumption expenditure at the national level are defined as:

$$yR = \sum_g w_g yR_g = \sum_g w_g \left(y_g - p_g \right) \qquad \text{C.7}$$

where the weight for household g is defined as $w_g = \frac{W_g^{HES}}{\sum_g W_g^{HES}}$. Where W_g^{HES} is the weight for household g in the HES. The weight represents the inverse probability of selection while the sum of the survey weights estimates the total number of households, about 6.6 million, in 1993-94. In this aggregative case, with the assumption of no change in the number of households at the national level, the estimated change in real disposable income per household would be equal to the weighted sum of estimated changes at the household level. The change estimated in the ID model by aggregating changes across households would, in principle, align with that estimated in MMRF-CR. In practice, data differences between the two frameworks mean that the estimates are not identical and some scaling, detailed below, was made in the detailed processing to improve the alignment of estimates.

Household deciles were formed in ID by ranking all households in terms of gross income before the effects of infrastructure industry change and then dividing the households into ten groups — each containing approximately 10 per cent of all households in the population.[5] The decile indicator for each household was used to re-aggregate the impact of changes on household income to deciles — observed before the change — to indicate the distributional effects of change. The re-aggregation, using household survey weights from the HES, is defined as:

$$yR_d = \sum_{g \in d} wd_g yR_g = \sum_{g \in d} wd_g \left(y_g - p_g \right) \qquad \text{C.8}$$

where the household weights for estimating the change in real income for each decile d are defined as $wd_g = \frac{W_{g \in d}^{HES}}{\sum_{g \in d} W_g^{HES}}$. In this framework, therefore, calculation of aggregate measures of changes in household purchasing power depend on the importance of items of income or expenditure within households' budgets and the

[5] Because the HES is a sample survey, it is not possible to divide the population of households into groups with exactly one tenth of households.

respective contribution of households surveyed to the 'national household' as indicated by their population weight.

With the assumption of no change in national employment by occupational group, attaining higher output from labour productivity improvements requires some relocation of labour between regional activities. Aggregate changes in real disposable income for households characteristic of each decile group, observed before the change, would therefore be influenced by:

- changes in purchasing power per household; and
- re-location of households between deciles.

For households characteristic of each decile group observed before the change, the projected average percentage change in purchasing power per household (*yRph*) was estimated by subtracting the change in number of households characteristic of that group (*h*) from the real income growth for the group, that is:

$$yRph_d = yR_d - h_d \qquad \text{C.9}$$

Because MMRF-CR is not based on unit record data, projections of changes in the number of households by income decile (as observed before the change) cannot be read directly from MMRF-CR results. Thus, following the tops-down approach being adopted in this study, the projections of changes in the number of households in C.9 must be made within the ID model using HES data on household characteristics and aggregate projections from MMRF-CR.

In this study, each household was attributed a 'characteristic' occupational group based on the occupation of the household 'reference person'. The number of individual households identified by characteristic occupation, in each state, were then modelled as varying in proportion with MMRF-CR projections of change in state employment by occupational group. The approach elaborates the standard approach in MMRF-style models where only a single 'representative household' in each state is considered. The original and modified treatments are outlined in box C.1.

Box C.1 **Estimation of changes in purchasing power per household**

In the MMRF-CR *Regional Population and Labour Market Settings* module, the change in the number of households in each state was assumed to alter in line with state total employment changes. State populations were also assumed to alter in line with state employment. That is:

$$h_q = e_q = p_q$$

where *e*, *h* and *p* represent the percentage change in employment, number of households and resident population in each state *q*.[6] To take account of differences in the relocation of labour in the eight occupational groups modelled in MMRF-CR, it was assumed that changes in the number of households by occupational group in each state alter in line with employment by occupational group in that state. Moreover, it was assumed that the occupation of the reference person of each household was the 'characteristic' occupation of the household. For households for which the reference person is not an employee (such as persons mainly earning 'business income' or retired-persons), the household was assigned an 'unspecified' occupation and the change in the number of households in each state was assumed to alter in line with the state population.[7] That is,

$$h_{q,m^*} = \begin{cases} e_{q,o} \text{ for } m^* = m = 1 \text{ to } 8 \\ p_q \text{ for } m^* = 9 \end{cases}$$

Because projected changes in state populations and households are assumed to alter in line with state employment, the share weighted sum of the change of households across state occupational groups (*m**) is also equal to those aggregate changes. Using this more detailed stratification of the relocation of households between regions, the percentage change in the number of households by decile is defined as

$$h_d = \sum_{g \in d} wd^{HES}_{g \in (d,q),m} \times h_{q,m}$$

where $wd^{HES}_{g \in (d,q),m} = \dfrac{W^{HES}_{g \in (d,q),m}}{\sum_{g \in d} W^{HES}_{g}}$

6 As the number of persons and workers in each household differs, so may the projected change of national population and households based on HES data. Nevertheless, such differences are small and do not affect the broad results. More refined modelling could enforce the assumption of no change in the national population and households.

7 Ideally, modelling the relocation of workers and households would be based on a transition table that links each household's location and income by source before and after the change. Such a transition table would enable the analyst to ask the question "What is the change in income of a household in its new activity and location relative to its initial location?"

The approach adopted takes account of occupational differences between households. However, the approach — being based on the characteristic occupation of households — does not assess the impact of the incidence of multi-occupation households that draw a significant share of income from other sources.

While the approach indicates the extent of *net* relocations of households across income groups, there is insufficient information to link measures of income of households before the change with that of the same households after the change. To establish such a link would require a household transition matrix of change. It was not practicable to establish such a transition table in the current project. Nevertheless, a decomposition analysis of the sources of change across income groups has been possible. Details of this analysis are provided below.

C.2 Model reconciliation and reporting conventions

Reconciliation

Data comparisons indicated that the HES-based share of non-wage factor income in total household income is significantly less than the comparable share in the Australian National Accounts for 1993-94.[8] Reported income from government benefits and other sources also appear less in HES than in the national accounts.[9] The HES-based income and expenditure shares also differ from the shares implied by the national accounts based MMRF-CR model database.

In a broad ranging assessment of the consistency of the data in various household surveys with external aggregates, Siminski, Saunders and Bradbury (2003) suggested that income from cash wages and salaries appears to have been generally well reported (p. 346). They also suggested that income from own-business or partnership appears to have been 'reasonably well' reported across household surveys (p. 345). However, they noted the omission of imputed interest from financial institutions (such as superannuation funds) from survey-based measures of

[8] Reasons for this difference include: the inclusion of income from dwellings (including imputed earnings from owner-occupied dwellings) in the national accounts but not in business income in the HES; and the inclusion of imputed interest arising from investment income of insurance companies, superannuation funds and imputed returns on unfunded government superannuation arrangements in the national accounts but not in investment income in the HES.

[9] Reasons for the observed difference include: the fact that the HES does not cover the whole population — it excludes many recipients of direct benefits in special dwellings (such as residents of nursing homes); it does not fully capture some cash benefits (such as irregular or one-off cash payments) through the income questions in the HES; and there is likely under-reporting of government benefit and pension payments (ABS, HIES Working Paper 96/1, p. 13).

income as being of importance (p. 347) and there was likely under-reporting of income from government pensions and allowances and/or under-estimation of the number of recipients.

In addition to these aggregate differences, more detailed classificatory differences exist. For example, the classification of labour income by the characteristic occupation of households differs from that in the MMRF-CR database. With household 'occupation' determined by the occupation of the household reference person, the main source of difference is the existence of multi-occupation households.

Because of these aggregate and detailed classificatory differences, estimates of percentage changes in real household disposable income made in MMRF-CR cannot be replicated in the ID model using HES household data without adjustment. In particular, the estimates would not fully reflect the contribution of changes in non-wage primary factor income (including income from family businesses and ownership of dwellings) and other income. In the distributional analysis, changes in the purchasing power of households relatively more dependent on such income would be understated relative to households dependent on labour income.

Different approaches can be taken to handle these differences. One approach would be to ignore the differences and allow a wedge between the benchmark and distribution model results. Another approach would be to attempt to integrate HES household unit record data with the MMRF-CR aggregate data. In practice, such an integration would be a major undertaking involving both a review of the MMRF-CR database and the sources on which it was based and a comparative review of HES unit record information. Such an exercise is beyond the scope of this study. Nevertheless, some steps were taken to re-calibrate the links between the HES-based ID model and MMRF-CR to ameliorate the effects of data inconsistencies particularly as they related to the coverage of non-labour income and the representation of labour income by occupational group (box C.2).

While the adjustments made to reconcile the two models impact on the estimated *magnitude* of change in each household income group, they do not materially impact on the distributional effects of change (table C.3).

Box C.2 **MMRF-CR and ID model reconciliation**

Without adjustment, the aggregate increase in real household disposable income per person estimated in the ID model is 1.04 per cent compared to the benchmark estimate of 1.28 per cent.

From this initial situation, ID model estimates were reconciled with counterpart MMRF-CR benchmark estimates in a three stage process. In the first stage, aggregate measures of the value of each item of non-wage income implied by the HES and MMRF-CR databases were indexed to the value of wages and salaries, in the respective databases, for each state. The index numbers were compared and state-wide 'data-adjustment factors' needed to align HES income shares (but not levels) with benchmark MMRF-CR shares were calculated.

These data-adjustment factors were used to scale the HES data simultaneously with the application of the model shock. From equation C.4 (with the addition of *q* subscripts for states), the adjusted change in aggregate household income is defined as:

$$y = \sum_{g} w_{g \in q} \sum_{f} \phi_{g \in q.f}\, y_{q,f}\, \psi_{q,f} \qquad q = 1 \text{to} 8$$

where the last term (Ψ) is an adjustment factor uniform across households in each state (q) for income item (f). This process does not alter the population survey weight or the ranking of households by income group derived from HES data. The latter convention could be considered at odds with the adjustments undertaken — a point raised at the February income distribution modelling workshop. However, while data differences may be observed in aggregate, it is far from clear how unit record data should be adjusted on a case by case basis. Without such detailed information, the shorthand method of improving the reconciliation would appear reasonable. This adjustment eliminates around two thirds of the aggregate difference. It also raised the share of non-wage income in total income relative to that reported in the HES.

In the second stage, occupational wage and salary income relativities in the HES were aligned with benchmark relativities in MMRF-CR. For this, each household was treated as specialising in the occupation of the reference person — the occupation assumed to be 'characteristic' of the household (see text). The HES-based labour income shares were compared with those in MMRF-CR and state-wide occupational adjustment factors needed to align occupational shares in the two databases were calculated. These occupational-share adjustment factors were used to modify the household survey population weight while preserving total labour income information on each household unit record. From above, the revised measure of the change in aggregate household income is defined as:

$$y = \sum_{g} w_{g \in q,m} * \zeta_{q,m} \sum_{f} \phi_{g \in q.f}\, y_{q,f}\, \psi_{q,f} \qquad q = 1 \text{to} 8;\ m = 1 \text{ to } 9$$

where ζ is the weight adjustment across occupations (m) by state (q).

(Continued next page)

Box C.2 **(continued)**

Households for which no occupation was reported for the representative member (eg those on pensions) were not adjusted (ie $\zeta_9 = 1$). Moreover, the factors were calculated so as not to impact on the total number of households estimated from the HES data. This adjustment raised the share of wage income from the clerical and labouring work relative to income from other sources but had little impact on aggregate changes.[10]

To fully align the estimates at the state level, a further round of simulation-specific scaling was undertaken.[11] This scaling accounted for all remaining data differences at the state level. The main difference relates to variation in commodity expenditure shares between HES and MMRF-CR data. It was assumed that this third round of scaling was neutral with respect to the distribution effects of change.[12]

Table C.3 **Sensitivity of estimates to MMRF-HES data reconciliation by household income group**

Per cent

Scenario	*Lowest*	*Second*	*Third*	*Fourth*	*Highest*	*Correlation with estimates without adjustment*
Estimates without adjustment	0.50	0.87	0.81	0.72	1.26	1.00
Estimates with income and occupational share adjustments[a]	0.77	1.10	1.11	1.01	1.51	0.99

a As outlined in Box C.2. Adopted as the 'reference case' in the body of this report.

Source: ID model estimates.

10 Another approach to reconciling ID and MMRF-CR occupational shares would be to draw on income and occupation information for each person within HES households. While extending the analysis in this way may be considered worthwhile on conceptual grounds, sensitivity testing indicated that results would not differ materially from the 'household' approach adopted.

11 The classification of households by income group in this study was based on gross income as reported in the HES. This classification conforms with the classification adopted by the ABS in its release of 1993-94 HES data.

12 This was achieved by applying a simple balancing adjustment in proportion to net disposable household income.

Treatment of households with negative business income

A small minority of households — estimated to be less than 1 per cent of households represented in the 1993-94 HES — reported zero or negative income (mainly due to losses in business and property ownership). By definition, these households are concentrated at the lowest end of scales based on gross income. However, they often have substantial expenditure relative to income and pose problems for estimating the impact of changes in business and property income on the purchasing power of such households and for the presentation of results.

It was evident from the February modelling workshop that there is no standard method of modelling these households or data presentation. Possible treatments noted were the omission of households with negative income from the analysis and dropping the first decile altogether (or even the second decile as well). On the other hand, it was also pointed out that households with negative income, being part of the observed economy, should not be excluded from the analysis.

The following conventions have been adopted in this study to deal with these households:

- the direction of change in negative business or property income reported by a household is modelled as conforming to the direction of change for the state in which the household is located and the size of the change is in proportion to the state average; and
- households with zero and negative gross income (table C.6 at the end of this appendix) are 'censored' from the results presented so as not to draw attention away from results for other households, particularly in the low-income groups, which typically draw the majority of their income from lower paid jobs or government benefit payments and for which expenditure is more closely aligned with income received.[13]

C.3 Decomposition analysis of changes in real purchasing power of households

As noted, changes in the real purchasing power of households at the economy-wide level can arise from relocation of households from slower growing activities to faster growing activities, changes in resource use per household and changes in relative prices. The ID analysis provides projections of (net) changes in households

[13] The changes in capital incomes were adjusted to ensure that the aggregate change in capital income in each state in the ID model was consistent with the MMRF-CR benchmark.

across income groups. This analysis looks at change from the perspective of income groups before the change. This section examines the contribution of individual factors to changes in national household disposable income or household purchasing power.

Recalling from equation C.8, the change in household income for group *d* can be defined in terms of its broad components as $yR_d = \sum_{g \in d} wd_g \left(y_g - p_g \right)$. The change in nominal income can be further decomposed into that attributable to the change in rental prices (*r*), quanta (*x*) and the distribution of additional government revenue to ensure fiscal balance (*b*) (see table C.1) gives:

$$yR_d = \sum_{g \in d} wd_g \left(\left[\sum_f \phi_{g.f} \left(r_f + x_f \right) + b_g \right] - p_g \right) \qquad \text{C.10}$$

Adding and subtracting the change in the number of households by income group (box C.1) and rearranging the resulting expression to identify the impact of changes in resource use per household, real price effects and household relocation, gives:

$$yR_d = \sum_{g \in d} wd_g \left(\sum_f \phi_{g.f} \left(q_f - h_d \right) + b_g \right) + \sum_{g \in d} wd_g \left(\sum_f \phi_{g.f} r_f - p_g \right) + h_d \qquad \text{C.11}$$

The first expression measures the impact of changes in the occupational composition of state workforces,[14] changes in the availability of business capital per household, and changes in the quantum of investment income, government benefit and other receipts per household and the distribution to ensure government fiscal balance. The second term measures the net price effect of change. The assumption that the relocation of households is proportional to the relocation of labour by occupational group (box C.1) means that the last expression on the right hand side measures the impact of worker (and household without occupation) relocation between states.

This decomposition identifies the sources of change in total real income in each income category (inclusive of the first term on the right hand side) and per household (after excluding the last term on the right hand side). The decomposition of the change in real disposable income per household (*yRph*) adopted in the current study is outlined in table C.4.

[14] Changes are measured at the *margin* for income groups and weighted according to benchmark HES data. The modelling, however, does not measure possible 'level' effects that may arise from households relocating between regions with differing levels of *average* income.

Table C.4 **Decomposition of changes in real disposable income per household by income group**

Variable	*Component*	*Description*
$yRph_g =$	$\sum_{g \in d} wd_g \left(\sum_{f \in W,NW} \phi_{g.f} \left(x_f - h_d \right) \right)$ where *W* is the labour income from occupation group and *NW* is non-wage primary factor income.	Change in the employment of primary factors of labour and capital per household. (Influenced mainly by changes in the availability of fixed capital but also by changes in the occupational composition of regional workforces.)
	$+ \sum_{g \in d} wd_g \left(\sum_{f \in U,OGB} \phi_{g.f} \left(x_f - h_d \right) \right)$ where *U* is unemployment benefits, and *OGB* is other government benefits.	Changes in the quantum of unemployment benefits and other government benefits per household.
	$+ \sum_{g \in d} wd_g \left(\sum_{f \in OY} \phi_{g.f} \left(x_f - h_d \right) \right)$ where *OY* is other income.	Changes in the quantum of other income (mainly dividends and other investment income) per household.
	$+ \sum_{g \in d} wd_g \left(\sum_{f \in DT} \phi_{g.f} \left(x_f - h_d \right) \right)$ where *DT* is direct taxes	Changes in the quantum of other direct tax payments per household.
	$+ \sum_{g \in d} wd_g * b_g$	Distributionally-neutral allocation to households of the government fiscal balancing item.
	$+ \sum_{g \in d} wd_g \left(\sum_{f} \phi_{g.f} r_f \right)$	Changes in returns per unit of primary factor. (Influenced mainly by changes in occupational wages.)
	$- \sum_{g \in d} wd_g * p_g$ **a**	Changes in consumer prices (Influenced by changes in relative prices of consumer goods. See also statistical discrepancy below.)
	$+ \psi_d$ **a**	Statistical discrepancy between MMRF-CR projections of household disposable income and estimates from the ID model. It was allocated across deciles in a distributionally neutral fashion. (Influenced mainly by differences in aggregate consumption patterns implied by HES and those measured in the benchmark MMRF-CR database.)

a For presentation of results, the categories were aggregated into a publication item termed ‘consumer prices (net)’ (see chapter 5, figure 5.4).

Table C.5 **Concordance between MMRF-CR and HES occupational group and Australian Standard Classification of Occupations (ASCO) minor group[ab]**

	MMRF-CR group	*ASCO sub-major group*
1	Managers and administrators	Legislators and government appointed officials; General managers, Specialist managers; Farmers and farm managers; Managing supervisors
2	Professionals	Natural scientists; Building and professional engineers; Health diagnosis and treatment practitioners; School teachers; Other teachers and instructors; Social professionals; Artists and related professionals; Miscellaneous professionals
3	Para-professionals	Medical and science technical officers and building associates; Air and sea transport technical workers; Registered nurses; Police; Miscellaneous para-professionals
4	Tradespersons	Metal fitting and machining tradespersons; Other metal tradespersons; Electrical and electronic tradespersons; Building tradespersons; Printing tradespersons; Vehicle tradespersons; Food tradespersons; Amenity horticultural tradespersons; Miscellaneous tradespersons
5	Clerks	Stenographers, and typists; Data processing and business machine operators; Numerical clerks; Filing, sorting and copying clerks; Material recording and dispatching clerks; Receptionists, telephonists and messengers; Miscellaneous clerks
6	Sales and personal service workers	Investment, insurance and real estate salespersons; Sales representatives; Sales assistants; Tellers, cashiers and ticket salespersons; Miscellaneous salespersons; Personal service workers
7	Plant and machinery operators and drivers	Road and rail transport drivers; Mobile plant operators; Stationary plant operators; Machine operators
8	Labourers and related workers	Trades assistants and factory hands; Agricultural workers and related workers; Cleaners; Construction and mining labourers; Miscellaneous labourers and related workers

a The eight occupational groups correspond to the one-digit major group level of the ASCO (1st Edition). **b** The ASCO was revised by the ABS in a second edition of the classification released in 1997. There is a close alignment between the two editions at the level shown in this table, although the later edition is comprised of 9 rather than 8 major groups.

Source: ABS (*Australian Standard Classification of Occupations (ASCO)*, Cat. no. 1222.0).

Table C.6 **Labour income and household income of households with zero or negative gross income[a]**

	Unweighted	*HES weighted*[b]	
	$000	$m	%
Labour income by occupation of household reference person			
Managers & administrators	51.1	137.4	30.1
Professionals	80.2	52.7	11.5
Para-professionals	0.0	0.0	0.0
Tradespersons	0.0	0.0	0.0
Clerks	116.6	110.8	24.3
Sales & personal service workers	76.0	111.1	24.3
Plant & machinery operators; drivers	0.8	0.7	0.2
Labourers & related workers	8.4	6.6	1.5
No applicable occupation stated for household reference person	31.2	37.2	8.1
Total labour income	**364.3**	**456.5**	**100.0**
Household income			
Labour income	364.3	456.5	-35.3
Business & investment income	-1613.5	-1855.6	143.5
Government benefit receipts	111.2	129.3	-10.0
Income tax payments	-29.8	-23.7	1.8
Disposable income	**-1167.8**	**-1293.5**	**100.0**
Share of total HES disposable income	*-0.4%*	*-0.6%*	

a 83 households surveyed in the HES reported zero or negative gross income. These represented around 1 per cent of the population of households in the 1993-94 HES. **b** Based on HES population weights.

Source: Estimates based on 1993-94 HES (ABS, Cat. no. 6527.0).

D Data sources for labour productivity and prices

There is no single data source that documents the level of output, employment and prices for the infrastructure activities under investigation. To bring available information about activity levels and service prices together, the Commission has compiled a database from various published and unpublished sources (Verikios and Zhang (forthcoming)). This information has been used to estimate changes in labour productivity and service prices for the period 1989-90 and 1999-00. Where information is only available for a sub-period, information for that sub-period has been used to calculate the changes.

The data sources for the basic activity and price information are documented in this appendix, along with the method used to derive change variables from the levels information, the estimated changes and a summary of the instruments used in modelling the economy-wide and regional impacts using MMRF-CR. In some cases, the infrastructure activity under investigation forms a part of an MMRF-CR industry. These cases are identified in this appendix, along with the weighting factors used to scale the activity information to an MMRF-CR industry basis.

Although the changes modelled (ie the model shocks) are based on the period 1989-90 and 1999-00 (or a sub-period therein), where possible, data series have been extended beyond 1999-00 to provide additional context to the changes analysed in chapter 3.

D.1 Data sources

Table D.1 lists the activities modelled, their definition based on the Australian and New Zealand Standard Industry Classification (ANZSIC), the coverage of the activity modelled in MMRF-CR, the derivation of variables created, the estimated changes (or model shocks), their units of measurement and the data sources used. As noted, some scaling and targeting of the changes in infrastructure industries was undertaken to align the shock better with the sector definitions in MMRF and to link the changes with industries and consumers affected. Details of the scaling and targeting are also provided in table D.1.

In this study, all changes in productivity and prices were assessed on a 'state-wide' basis. To the extent that actual changes vary between industries and regions, there would be flow on consequences for industry and regional results. For example, large-scale industrial users of electricity that were initially on long-term contracts may have gained less from price changes than commercial and industrial users that were not. Available data do not support accounting for such sectoral differences. Rather than make assumptions concerning the apportionment of change between users on the basis of partial information, all non-residential users of electricity in each jurisdiction were modelled as receiving lower electricity prices in proportion to the state-average change in non-residential prices.

Nevertheless, other changes related to specific users or groups of users (eg freight transport dealt with transporting goods and urban passenger transport with transporting people in urban areas). As far as practicable within the classification structure of MMRF-CR, the shocks have been targeted to confine the shocks to relevant user groups.

Table D.1 **Summary of productivity and service-price changes in infrastructure industries considered over the 1990s**
Percentage points

Sector	*Definition and coverage*	*Shock*[a]	*Units*	*Derivation*	*Sources*	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*
Electricity	Units mainly engaged in the generation, transmission or distribution of electricity. MMRF industry: Electricity Modelling includes full sector.	Employment per unit of output	Persons employed at 30 June per million kWh	Establishment employment/ Total consumption	ABS (8208.0) ESAA (1992, 2001)	-65.11	-79.98	-46.82	-69.51	-59.33	-59.42	-54.08	-45.29
		Real residential prices	Cents per kWh	None	ESAA (2000, 2004)	-9.99	8.67	-16.80	6.47	-12.42	6.77	-6.87	-2.27
		Real non-residential prices	Cents per kWh	(Total revenue – Residential revenue)/ Non-residential consumption	ESAA (2004); estimates based on ESAA (2000)	-31.69	-20.92	-10.93	-29.26	-23.33	2.18	-19.71	-23.39
Gas	Units mainly engaged in the manufacture of town gas from coal, petroleum or in the transmission (high pressured) and distribution (low pressured) of natural gas or LPG through a system of mains, including pipelines. MMRF industry: Gas Modelling includes full sector.	Employment per unit of output	Persons employed at 30 June per TJ	Establishment employment/ Total sales	ABS (8208.0) AGA (2001)	-76.74	-88.72	-86.31	-44.45	-42.69	na	-39.41	-85.37
		Real residential prices	Index	ABS CPI Expenditure Class: Gas	ABS (6401.0)	3.35	-1.85	-8.48	12.35	-10.33	na[b]	na[b]	4.35
		Real non-residential prices	$ per GJ	Weighted average of commercial and industrial prices	Estimates based on AGA (1991, 2001)	-13.49	-1.73	-1.17	0.68	-5.70	na	1.71	-4.74

(Continued next page)

Table D.1 **(continued)**

Sector	*Definition and coverage*	*Shock*[a]	*Units*	*Derivation*	*Sources*	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*
Urban water and sewerage	Units mainly engaged in the storage, purification or distribution of water. It includes the operation of irrigation systems concerned with the supply of water to the farm, and the supply of steam or hot water. MMRF industry: Water (part) Modelling of labour productivity applied to whole water sector. Modelling of price changes applied to commercial and household consumers (agriculture, mining, manufacturing, utilities & government services excluded).	Employment per unit of output	Full-time persons employed per ML	Employment/ Volume of water supplied	Agency annual reports (various*)	-59.03	-78.95	-39.07	-72.75	-60.78	1.82	-62.04	-32.56
		Real residential prices	$ per kilolitre	Average revenue per kilolitre	SCNPMGTE (1995) PC (2001)	-8.93	-18.65	22.70	4.33	14.83	-3.36	34.40	24.97
		Real non-residential prices	$ per kilolitre	Average revenue per kilolitre	SCNPMGTE (1995) PC (2001)	-39.41	-45.08	-29.93	-5.99	3.78	-23.74	29.62	24.97

- ACTEW (various); Barwon Water (various); Brisbane City Council (various); City West Water (various); Hobart Water (various); Melbourne Water Corporation (various); Power and Water Authority (various); South Australian Water Corporation (various); South East Water (various); Sydney Catchment Authority (2000); Water Authority of Western Australia (various); Water Corporation (various); WSAA (various); Yarra Valley Water (various).

(Continued next page)

Table D.1 **(continued)**

Sector	*Definition and coverage*	*Shock*[a]	*Units*	*Derivation*	*Sources*	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*
Urban passenger transport — rail	Units mainly engaged in operating railways (except tramways) for the transportation of freight or passengers, in operating railway terminal or depot facilities for receiving, despatching or transferring rail freight or cargo. MMRF industry: Rail transport (part) Modelling includes only urban rail passenger transport.	Employment per unit of output (1989-90 to 1996-97, basic data)	Persons employed per million boardings	Inverse of Boardings per employee	SCNPMGTE (1995, 1998)	-37.10	-49.77	-1.12	-46.30	-80.51	na	na	na
		MMRF sector weighted[c]				-16.14 (43.5)	-19.97 (40.1)	-0.14 (12.5)	-9.00 (19.4)	-8.43 (10.5)	na	na	na
		Real residential prices[d]	Index	Real price index updated using PC (2002)	SCNPMGTE (1995, 1996, 1998) PC (2002)	23.16 (100.0)	10.83 (100.0)	11.22 (100.0)	21.61 (100.0)	47.10 (100.0)	na	na	na
Urban passenger transport — road	Units mainly engaged in operating urban buses or tramways for the transportation of passengers. MMRF industry: Road transport (part) Modelling includes only urban road passenger transport.	Employment per unit of output (1989-90 to 1996-97, basic data)	Persons employed per million boardings	Inverse of Boardings per employee	SCNPMGTE (1995, 1998)	-24.31	-45.28	-16.54	-19.63	-24.70	2.76	na	9.95
		MMRF sector weighted[c]				-1.40 (5.8)	-3.90 (8.6)	-0.53 (3.2)	-2.52 (12.8)	-2.14 (8.7)	0.28 (10.3)	na	3.74 (37.6)
		Real residential prices[d]	Index	Real price index updated using PC (2002)	SCNPMGTE (1995, 1996, 1998) PC (2002)	14.63	16.91	79.52	21.61	47.10	22.24	25.48	45.61
		MMRF sector weighted[c]				4.58 (31.3)	2.99 (17.7)	11.73 (14.7)	9.62 (44.5)	15.81 (33.6)	4.89 (22.0)	5.79 (22.7)	25.70 (56.4)

(Continued next page)

Table D.1 **(continued)**

Sector	*Definition and coverage*	*Shock*[a]	*Units*	*Derivation*	*Sources*	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*
Urban passenger transport — water	Units mainly engaged in the operation of vessels for the transportation of freight or passengers in harbours or inland waters (except tug boats or lighters).	Employment per unit of output (1989-90 to 1996-97, basic data)	Persons employed per million boardings	Inverse of Boardings per employee	SCNPMGTE (1995, 1998)	18.90	na	-16.54	na	20.43	na	na	na
	MMRF industry: Water transport (part)	MMRF sector weighted[c]				1.00 (5.3)	na	-2.17 (13.1)	na	0.21 (1.0)	na	na	na
	Modelling includes only urban passenger ferry operations.	Real residential prices[d]	Index	Real price index updated using PC (2002)	SCNPMGTE (1995, 1996, 1998) PC (2002)	14.52	na	79.52	na	47.10	na	na	na
		MMRF sector weighted[c]				10.57 (72.8)	na	11.73 (14.7)	na	15.81 (33.6)	na	na	na
Ports	Units mainly engaged in the maintenance and leasing of port facilities to facilitate the land-sea transition of goods and passengers — port operation; wharf facility leasing and wharf provision.	Employment per unit of output (1989-90 to 1996-97, basic data)	Persons employed per '000 Mass tonnes of cargo handled	Employment/ Cargo handled (all cargo)	SCNPMGTE (1995, 1998)	-83.90	-62.86	-19.67	-61.29	-78.46	-46.73	-61.84	na
	MMRF industry: Services to transport (part)	MMRF sector weighted[c]				-9.74 (11.6)	-7.30 (11.6)	-2.28 (11.6)	-7.11 (11.6)	-9.11 (11.6)	-5.42 (11.6)	-7.18 (11.6)	na
	Modelling includes only the ports component.	Real basic price	Index	Combined container ship index and bulk ships index (weighted by total gross tonnage)	PC (2002)	-35.85	-54.96	-18.98	-29.89	-16.04	-11.60	0.53	na
		MMRF sector weighted[c]				-4.51 (11.6)	-6.38 (11.6)	-2.20 (11.6)	-3.47 (11.6)	-1.86 (11.6)	-1.35 (11.6)	0.06 (11.6)	na

(Continued next page)

Table D.1 **(continued)**

Sector	*Definition and coverage*	*Shock*[a]	*Units*	*Derivation*	*Sources*	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*
Rail freight transport	Units mainly engaged in operating railways (except tramways) for the transportation of freight or passengers, in operating railway terminal or depot facilities for receiving, despatching or transferring rail freight or cargo. MMRF industry: Rail transport Modelling includes only rail freight transport.	Employment per unit of output (1989-90 to various)	Persons employed per million NFTkm	Employment/ Net freight tonne kilometres	SCNPMGTE (1995, 1998)	-84.76	-49.61	-62.96	-47.88	-85.62	-47.72	na	na
		MMRF sector weighted[c]				-43.81 (51.7)	-16.41 (33.1)	-51.12 (81.2)	-38.57 (80.6)	-72.42 (84.6)	-47.72 (100.0)	na	na
		Real non-residential basic prices (1989-90 to various)	$ per 000 NFTkm	Freight revenue/Net freight tonne kilometres	SCNPMGTE (1995) Annual reports (various**)	-29.04	-4.90	-34.84	-18.04	-48.12	-34.43	na	na
		MMRF sector weighted[c]				-17.48 (60.2)	-2.95 (60.2)	-20.96 (60.2)	-10.86 (60.2)	-28.96 (60.2)	-33.15 (96.3)	na	na
Telecommunications	Units mainly engaged in the provision of postal, courier and telecommunication services. MMRF industry: Communications (part) Modelling includes only telecommunications.	Employment per unit of output, basic data	Persons employed per million $ of constant price value added	Employment/ Constant price value-added (derived from revenue series)	Estimates based on ABS (6203.0) PC (2001) SCNPMGTE (1995) ACA (2004)	-64.31	-67.91	-71.82	-70.73	-72.26	-63.22	-71.10	-66.70
		MMRF sector weighted[c]				-37.54 (58.4)	-.39.65 (58.4)	-41.93 (58.4)	-41.29 (58.4)	-42.19 (58.4)	-36.91 (58.4)	-41.51 (58.4)	-38.94 (58.4)
		Real basic price	Index	ABS CPI Expenditure Class: Telecommunication	ABS (6401.0)	-22.64	-22.15	-20.24	-23.83	-22.85	-21.71	-27.69	-22.70
		MMRF sector weighted[c]				-18.92 (83.6)	-18.51 (83.6)	-16.91 (83.6)	-19.91 (83.6)	-19.09 (83.6)	-18.14 (83.6)	-23.13 (83.6)	-18.96 (83.6)

** ANRC (various); FreightCorp (various); Metro Tasmania (2001); Westrail (various).

a Real prices obtained by deflating nominal price by the All Groups Consumer Price Index for each state capital (ABS, *Consumer Price Index*, Cat. no. 6401.0). **b** The ABS 'gas' price index is a weighted-average of mains and bottled gas, firewood, heating oil, natural gas and LPG. In regions where LPG and non-gas fuels dominate the category, such as Tasmania and the Northern Territory, the gas price index would reflect changes in the price of LPG and other fuels rather than mains gas. Because the focus of this study is on mains gas, residential prices for these two jurisdictions were not modelled in this study. **c** The number in brackets indicates the scaling factor used to convert the change in labour productivity or price into an equivalent measure for the corresponding MMRF-CR industry. **d** The household consumption price shocks in urban transport are confined to *intrastate* transport services consumed by households. Interstate passenger transport services are excluded. To further ensure that MMRF estimates the effects of changes in urban transport exclusively, the intra-domestic elasticity of substitution for household consumption of Water transport is set to zero from an initial value of 10. Thus, households cannot substitute urban transport (intra-regional transport) with non-urban transport (inter-regional transport) in response to any price changes. Similarly, the domestic-composite/import elasticity of substitution for household consumption of Water transport is also set to zero. The equivalent elasticities for Road transport and Rail transport do not require adjustment as they are already zero in MMRF.

Sources: Various authority and statistical publications listed in the table; Verikios and Zhang (forthcoming).

D.2 Instruments in modelling

A summary of instruments used in modelling labour productivity and service-price changes is provided in table D.2.

Table D.2 **Summary of instruments used in modelling labour productivity and service price changes**

Exogenous variable	*Associated endogenous variable*	*Assumed association between exogenous and endogenous variables*
Change in labour requirements per unit of output[a]	Labour saving organisational and technical change	Improvements in labour productivity due to organisational and technical change in the use of labour rather than substitution for other factors (eg capital depending)
Change in infrastructure industry service price	State-specific financial reserve	Changes in services prices not attributable to changes in labour use per unit of output, including due to improved efficiency in the use of other factors (eg capital, business services), contracting out and changes in price-cost margins and returns to owners.

[a] An employment per unit of output variable was introduced into MMRF to enable these shocks to be implemented.

Source: Theoretical structure of the MMRF-CR model.

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