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INDUSTRY
COMMISSION

General equilibrium models
and policy advice in Australia

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STAFF INFORMATION PAPER

CONTENTS

Abstract

Several factors have contributed to the successful use of general equilibrium models for policy advice in Australia. One is the institutional setting. The models also contain a great deal of detail about sectoral linkages and policy instruments. The models are sufficiently rigorously based and flexible to provide durable tools for policy analysis. And the modellers have endeavoured to ensure that the policy messages are relayed effectively to policy makers. The paper illustrates these points from the work of the Australian Industry Commission.

GENERAL EQUILIBRIUM MODELS AND POLICY ADVICE IN AUSTRALIA

Is economic modelling primarily for the benefit of the economic modeller? This view is not uncommon in some policy advising circles. Economic modelling is seen as an activity primarily undertaken by those with an academic persuasion for their intellectual curiosity - economic policy-making can and should be left to politicians and practical bureaucrats because it is a matter of politics and common sense.

It is certainly true that the overwhelming majority of those at the front line of economic policy formulation do not, and never will, have the time to read the Journal of Policy Modeling, nor to acquaint themselves in anything but the most cursory fashion with economic models.

Economic modelling can nevertheless offer a great deal to policy makers. But the models genuinely must have something credible to offer. And the modellers and the institutional environment in which they operate must be able to ensure that the policy messages are-relayed effectively to policy makers.

This paper illustrates how general equilibrium modelling has influenced economic policy advice in Australia. To understand the process, it is important to understand the institutional setting within which the messages from general equilibrium modelling are delivered to policy makers in Australia. That is the topic of the first section of the paper.

It is also important to understand the extent to which the general equilibrium models in use in Australia can make credible contributions to the policy debate. There have been successes and failures within the general equilibrium frameworks on offer. That is the topic of the second section of the paper.

Finally, it is important to understand the nature of the messages that are delivered. While academics are judged on the quality and quantity of their publications in scholarly journals, modellers in the bureaucracy are judged by the quality and quantity of their successful `sales' to other bureaucrats and politicians, only some of whom may be fellow economists. The nature of the policy messages sold to policy makers in Australia is the topic of the last section of the paper. The paper throughout provides illustrations from the work of the Australian Industry Commission.'

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1 Although many of the examples are drawn from the post-1985 period, 1985 is by no means a natural break in the history of the Industry Commission but merely the year in which I arrived in Australia. Examples from earlier periods are drawn primarily from the work of colleagues and associates, especially Vincent (1989) and Powell and Lawson (1989), and I have borrowed shamelessly from those sources.

I The institutional setting

The Industry Commission (hereafter Commission) is the Australian Commonwealth Government's major review and advisory body on industry matters. In an earlier manifestation, as the Industry Assistance Commission, its main focus was on industry assistance. The transition to a broader role occurred in 1990. At that time, the Australian reform agenda had moved from issues of border protection (tariffs and quotas) to a much broader range of issues affecting costs, productivity and competitiveness generally. The Industry Commission was established to be a catalyst for broad-based reform.

In both these manifestations, the Commission has operated as an independent statutory authority through the provisions of an act of parliament. The Commission does not have direct Ministerial or departmental responsibilities.

The Commission performs its review and advisory role in several ways. Principally it conducts inquiries into industries, activities and issues referred to it by the Commonwealth Government. The forward inquiry program is reviewed annually by Cabinet.

The range of issues referred. to the Commission has broadened enormously over the past decade or so (see Box 1). Eight years ago the Commission's inquiry load was dominated by inquiries into assistance issues, albeit over relatively broad sectors of industry (eg. the glass and glassware industry). More recently, the Commission's work load has required it to evaluate the appropriate role of Commonwealth and State Government business enterprises and the efficiency of their operations within the Australian economy. The Commission also undertakes inquiries into industry development that require it to identify impediments to growth, and growth opportunities, for particular industry groups.

As specific examples of the wide range of issues, the Commission has looked at the efficiency of economic infrastructure, such as railways, electricity and postal services, currently provided in Australia by Commonwealth or State Governments.[2] The Commission has also looked at the impact of proposed interventions in environmental areas such as recycling and the reduction of greenhouse gas emissions. It has looked into what in Australia is the contentious issue of labour market regulation in the context of its inquiries into regional industry adjustment and meat processing. It is currently evaluating the policy relevance of some of the arguments from the endogenous growth literature in the context of an inquiry into research and development. It is also looking into the respective roles for government and the private sector in the provision of social services through its inquiries into workers' compensation, occupational health and safety and charitable organisations.

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2 The impetus for this kind of inquiry was provided in part by the Commission's 1988 investigation into government (non-tax) charges.

Box 1: Inquiries referred to the Commission

Date Title	Assistance issue?	GE modelling used?
1986 Certain fluorescent lamps (tubes) from the Federal Republic of Germany and Canada (anti-dumping)	Yes	
Medical and scientific equipment	Yes	
Glass and glassware	Yes	Yes
Cultivation machinery	Yes	
Export concessions, manufacture in bond and the 2 per cent revenue duty	Yes	Yes
The rice industry	Yes	
Fresh fruit and fruit products industries	Yes	
Certain uncoated wood-free papers from South Africa (anti-dumping)	Yes	
The customs and excise bond systems	Yes	
The tobacco growing and manufacturing industries	Yes	
1987 The wheat industry	Yes	Yes
Precious metals, gems and jewellery	Yes	
Transport containers	Yes	
Razors and razor blades	Yes	
Mining and minerals processing plant and equipment	Yes	Yes
Coastal shipping		Yes
Ships, boats and other vessels	Yes	
1988 International trade in services		Yes
Government (non-tax) charges		Yes
Travel and tourism		Yes
The dried vine fruits industry	Yes	
Commercial tariff concessions (PVC foam blocks and DC electric motors)	Yes	
Food processing and beverages industries	Yes	Yes
1989 Disodium carbonate (soda ash)	Yes	
Apples and pears (export underwriting)	Yes	
Concessional entry of aluminised steel for use in exhaust muffler systems	Yes	
Aids and appliances for people with disabilities	Yes	
Recycling		Yes
Product liability		
Construction costs for major projects		Yes
Mining and minerals processing in Australia		Yes

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Box 1: **Inquiries referred to the Commission (continued)**

Date	Title	Assistance issue?	GE modelling used?
	Pulp and paper: bleaching and the environment		
	Interim report on paper recycling		
1990	The commercial tariff concession and by-law system	Yes	Yes
	The automotive industry	Yes	Yes
	Statutory marketing arrangements for primary products	Yes	Yes
	Rail transport		Yes
	Energy generation and distribution		Yes
	Australian dairy industry		Yes
	Costs and benefits of reducing greenhouse gas emissions		Yes
	Availability of capital		Yes
1991	Cost recovery for managed fisheries		
	Exports of health services		
	Exports of education services		
	Australian sugar industry	Yes	Yes
	Review of overseas export enhancement measures	Yes	Yes
	Raw materials pricing for domestic use	Yes	
	Commercial restrictions on exporting (including franchising)		
	Water resources and waste water disposal		Yes
	Regulation of intra-state aviation		
	Mail, courier and parcel services		
	National procurement development program	Yes	
	Taxation and financial policy impacts on urban settlement		
	Horticulture		
1992	Port authority services and activities		
	Book production	Yes	
	Environmental waste management equipment systems and services Urban transport		
	Adding further value to Australia's forest products		Yes
	Impediments to regional industry adjustment Public housing		
	Workers compensation in Australia		
1993	Petroleum industry		Yes
	Meat processing		
	The tobacco industry	Yes	
	Defence procurement		Yes
	Research and development		
	Charitable organisations		

Box 1: Inquiries referred to the Commission (continued)

Date	Title	Assistance issue?	GE modelling used?
1994	**Motor vehicle and marine insurance and repair industries**		
	New industrial materials		
	Occupational health and safety		**Yes**
	Computer hardware and software		
	Contracting out by public sector agencies (expected)		**?**
	Sustainable land management (expected)		**?**

The Commission also has a general reporting function. It has a statutory obligation to report annually on the economic performance of industry and the principal factors affecting that performance, and on the nature and impact of assistance and regulations affecting industry. It uses its annual report to government to comment on the state of industry policy, as well as the state of industry performance. Its annual reports have provided a major additional outlet for economic research and applied economic modelling, in addition to that undertaken for particular inquiries.

Finally, the Commission from time to time undertakes research for other government, business and international organisations. It provided input into the government decision-making processes that culminated in wide-ranging and unilateral reductions in industry protection in May 1988 and March 1991. It undertook a major study of the economy-wide impacts of transport reform for the Business Council, a peak industry body in Australia. It has staff members currently participating in the OECD study into indicators of government assistance, and assisted the Australian Department of Foreign Affairs and Trade in preparing the Australian Government's report to the GATT trade policy review mechanism.

1.1 The public inquiry process

A unique and extremely important aspect of the Commission's operations is its active attempts to encourage the public participation of all interested parties in its policy advisory procedures. The public inquiry process encourages public participation in policy formulation and maximises the public scrutiny of the advice provided to Government. But the process is a two-way street. It contributes to public understanding of the costs of adjustment to a more competitive and efficient economic structure, as well as the benefits likely to accrue to the

community as a whole. This is seen by the Commission as being crucial to overcoming the resistance of directly affected groups to proposed policy changes.

After receiving a request for an inquiry from the Government, the Commission advertises the inquiry in the press and notifies industry organisations, trade unions, relevant government agencies, domestic producers, importers, users, consumers, environmental groups and others likely to be interested. The Commission typically visits some participants to help identify key issues and information requirements. It then requests written submissions from all interested parties. At the same time it normally distributes an issues paper designed to focus attention on matters specified in the reference and on issues that the Commission thinks are particularly relevant. Often the Commission also conducts an initial round of public hearings, providing participants with a further opportunity to voice concerns, advance suggestions and to respond to issues raised by the Commission and other participants.

The Commission then prepares its draft report, based on its own research and analysis and the information, analysis and views presented by participants. The report usually canvasses policy options and proposes a course of action that the Commission considers to be most advisable. Interested parties are then invited, through an additional round of written submissions and public hearings, to examine the Commission's analysis and discussion and to offer comment. In their draft report submissions, participants frequently comment, both favourably and unfavourably, on aspects of the Commission's applied modelling work. They may also comment on the submissions of other participants.

After taking into account the views of participants, the Commission publishes its final report for consideration by the Government. The Commission as an institution plays no further part in the policy formation process once its final report is completed.

Unless the Commission recommends otherwise, the report must be tabled in Parliament within 25 sitting days of being received. However, there is no requirement that the report be debated in Parliament. Similarly there is no statutory or constitutional requirement for the Government to follow the Commission's advice. The Government's decision is announced following consultations within Government and the relevant departments responsible for translating the Commission's policy recommendations into actual policy. During this stage, Commission staff are sometimes asked to undertake further applied modelling analysis of possible policy options.

The public inquiry process provides extensive opportunity for the Commission to exchange views with interest parties, both potential winners and losers from a proposed policy change, before presenting its policy advice to Government. While the Commission is rarely able to gain the agreement of all interested parties to its views, it has extensive opportunity to explain its analysis and judgements to

the full range of parties likely to be affected by its recommendations, and to refine its analysis and judgements in light of their scrutiny. As a result, the Commission is respected, if not admired, by many of the participants in its inquiries.

The public inquiry process also contributes greatly to the credibility of the applied general equilibrium modelling undertaken as part of the Commission's analysis. It provides a vehicle through which the Commission obtains information about the industry and issues under consideration. It also ensures that the modelling work is subjected to stringent reality checks.

The public inquiry process provides little opportunity for the Commission to exchange views directly with the politicians making the final policy decisions, nor does the time frame of public inquiries fit political time frames. The lack of interaction is reflected in the much lower regard in which the Commission is held by some politicians, primarily because the Commission is seen as paying too little attention to the political imperatives within which the politicians must operate. A more active role in translating its advice into policy is nevertheless seen by the Commission as being likely to jeopardise its statutory independence. This independence is critical to the Commission's ability to be fearless, though well-informed, in the economic policy advice it gives to Government.

1.2 The Commission's policy guidelines

In examining the issues referred to it by Government, the Commission is required to have regard to a number of general policy guidelines enshrined in the Industry Commission Act. They require the Commission to take an economy-wide perspective and to consider, not just the problems facing directly affected sectors, but also the welfare of the community as a whole.

Specifically, the guidelines require the Commission to have regard to the desire of the Commonwealth Government:

- to encourage the development and growth of Australian industries that are efficient in their use of resources, self-reliant, enterprising, innovative and internationally competitive;
- to facilitate adjustment to structural changes in the economy and to ease social and economic hardships arising from those changes;
- to reduce regulation of industry (including regulation by the States and Territories) where this is consistent with the social and economic goals of the Commonwealth Government; and
- to recognise the interests of industries, consumers, and the community, likely to be affected by measures proposed by the Commission.

The Commission is also required to take account of the social and environmental consequences of any recommendations.

The Commission is not a pork barrel institution, in part because its overriding policy guidelines require it to take a general equilibrium view of the world. But this is precisely the area where common sense can become strained. It is often difficult to keep track mentally of the myriad of interrelationships and economywide resource constraints that determine the way in which policy changes in one part of the economy will have spillover effects in other parts of the economy. Even where the linkages are relatively clear, there is frequently a number of offsetting channels of influence so that the net result becomes an empirical issue.

Formal general equilibrium modelling has greatly assisted the Commission, the participants in its inquiries and those involved in the downstream policy-making process to take a general equilibrium view. Often, the formal modelling has helped less by resolving empirical issues than by allowing those exposed to it to hone their own general equilibrium habits of thought.

1.3 Applied general equilibrium modelling at the Commission

The Commission comprises no fewer than five and no more than nine Commissioners. Each is appointed by the Government for a period of up to 5 years. Commissioners are drawn from a spectrum of Australian society including private industry, the government sector and academia. One or two will typically be assigned to any particular inquiry. In addition, an Associate Commissioner is frequently appointed to an inquiry in order to bring specific expertise and/or balanced membership to that inquiry. While Commissioners' role is primarily to offer advice to the Government on economic issues, there is no requirement that they have a background in, nor any particular level of understanding of, economic thought. Their membership is designed to be balanced and representative of the community as a whole.

Commissioners are assisted by a staff of about 240 permanent public servants. Most staff have tertiary training in at least one area of economics, such as microeconomics, econometrics, or industrial organisation. A small but growing number have tertiary training in related disciplines such as law. Very few come to the Commission with any background in general equilibrium modelling.

Commission inquiries are generally conducted within a twelve month time frame. Typically, a team of two or three quantitative researchers has about four to six months:

   to familiarise themselves with the industries or activities under investigation, the interrelationships among these activities and with the rest of the economy, the incentives environment in which the activities operate and hence the range of policy issues likely to confront the Commission;

   in conjunction with other Commission staff, to identify what quantitative analysis, if any, is required to address policy issues or to evaluate possible policy options;

- to choose an appropriate quantitative framework, which may range from applied general equilibrium modelling, partial equilibrium modelling, econometric analysis, total factor productivity measurement or measurement of rates of industry assistance;

- to implement that framework; and

- to present the results of the quantitative analysis for internal scrutiny before they are presented to the public in the draft report.

Applied general equilibrium modelling is not an appropriate tool for every inquiry. For example, where an activity accounts for a small share of GDP and has few forward and backward linkages to the rest of the economy, the economy-wide implications of policy changes can safely be ignored.

But where general equilibrium modelling is deemed appropriate, time and resource constraints often make it virtually impossible to construct a general equilibrium model from scratch. This is where the IMPACT project has played an absolutely critical role.

The IMPACT project was conceived in 1975 as a cooperative arrangement between Australian universities and Commonwealth Government agencies to provide publicly accessible policy information systems to governments and to private and academic analysts. It has done this by developing models with associated databases, computing systems and documentation, which enable the implications of both policy-induced and naturally occurring changes to be studied systematically in an economy-wide perspective. The project's research has been carried out in academic institutions, but some funding and the focus on applicability for policy purposes have been provided by the participating Commonwealth agencies.[3]

Thus the IMPACT project has undertaken basic research to develop `investment' goods for use at the Commission, other participating agencies and universities. The investment goods have taken the form of model frameworks that are sufficiently rigorously based and flexible to provide off-the-shelf modelling shells for adaption to a range of applications. The modelling staff at the Commission have therefore been able to concentrate on providing `consumption' goods, taking off-the-shelf modelling shells and adapting them to meet a range of Commission applications.

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3 The project is convened by the Industry Commission. The participating institutions currently include Monash University, the Australian National University and La Trobe Univeristy, along with the Industry Commission, the Australian Bureau of Agricultural and Resource Economics, the Department of the Environment, Sport and Territories, the Department of Employment, Education and Training, the Bureau of Immigration and Population Research, and the Bureau of Industry Economics. Powell and Lawson (1989) give a comprehensive historical overview of the project.

By far the most successful output of the project has been the ORANI general equilibrium model of the Australian economy (Dixon et al. 1982). Within the Australian Government bureaucracy, the expertise required to modify and use the ORANI model was for many years heavily concentrated in the Commission. The Commission has also had the responsibility to maintain the economic models of the IMPACT project, particularly the ORANI model, and to ensure that all government agencies have access to these models. Keeping the ORANI model's database and computing systems up to date, and maintaining adequate in-house training of Commission staff, has involved a significant commitment of Commission staff resources.

More recently, the expertise required to use general equilibrium model frameworks has spread to a number of other government agencies and private consulting firms, in part because of on-movements of Commission staff. The development of the GEMPACK suite of modelling software by the IMPACT project has also provided a quantum leap in the ease with which existing general equilibrium models can be modified and used (Codsi and Pearson 1988). The software suite has allowed government agencies for the first time to contemplate building their own general equilibrium models from scratch.

2 The applied general equilibrium models used for policy analysis

The Industry Commission is currently making regular use of three general equilibrium model frameworks. The first is ORANI, a detailed multi-sectoral model of the Australian economy (Dixon et al. 1982, Dee 1989, McDougall and Skene 1992). The second is Monash-MR, a multi-sectoral, multi-regional model of each State and Territory economy in Australia (Centre of Policy Studies 1993). Both of these basic model frameworks were developed by staff at the IMPACT project, more recently in conjunction with the Centre of Policy Studies at Monash University. The third is Salter, a multi-sectoral, multi-country model of the global economy (Jomini et al. 1994). Salter was developed by staff at the Industry Commission at the request of the Australian Department of Foreign Affairs and Trade.[4]

These three general equilibrium frameworks have a number of features in common, primarily because these features have proved invaluable in carrying out model-based economic policy analysis:

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4 In addition, the Commission has used, and undertaken further development of, a general equilibrium model of urban land use and transport interaction for its inquiries into patterns of urban settlement and urban transport (Horridge 1991, Gabbitas and Morgan 1993). The model is a general equilibrium model of a single city, rather than the Australian economy as a whole.

• they each trace the interactions between producing and consuming activities in considerable detail;

• they each incorporate, at the individual activity and commodity level, a wide range of policy instruments; and

• they each allow analysis of the short-term adjustment pressures created by policy changes, as well as the long-term effects on resource allocation and aggregate economic efficiency.

2.1 Sectoral linkages and sectoral detail

The ORANI model contains by far the greatest degree of sectoral detail. The offthe-shelf version describes the interrelationships between 113 separate industries that produce 115 separate commodities. There are 11 industries producing 13 commodities within the rural sector (7 of the rural industries are modelled as multi-product industries), 6 industries and commodities in the mining sector, 66 industries and commodities in the manufacturing sector and 30 industries and commodities in the service sector.

The sectoral detail built into the ORANI model corresponds, except in the rural sector, to the most detailed level of sectoral detail available in the published inputoutput accounts of the Australian Bureau of Statistics. The ORANI database embodies all the input-output linkages from those input-output accounts.

The sectoral detail in the two multi-region models is, of necessity, more aggregated. Monash-MR contains sectoral detail for only 13 industries and commodities, since this is the level of aggregation at which data are available for production and value added for the Australian States and Territories. The Salter model contains sectoral detail for 37 industries and commodities, chosen to give a separate representation of the activities important in the international trade of Australia and other APEC member countries.[5]

For most academic purposes, the sectoral detail in Monash-MR would be adequate, the sectoral detail in the Salter model would be annoying and the sectoral detail in the ORANI model would seem an extreme case of `excess baggage'. But for the work of the Industry Commission, a high level of sectoral detail is an absolute necessity. Indeed, the Commission frequently finds that even the sectoral detail in the basic ORANI model is not enough.

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5 The Salter model contains sixteen countries or groups of countries centred on the Pacific Rim - Australia, New Zealand, Canada, the United States, Japan, South Korea, Indonesia, Malaysia, the Philippines, Thailand, Singapore, Hong Kong, Taiwan, China, the European Community and the Rest of the World. The model therefore contains a separate representation of each APEC member country, along with the European Community and the Rest of the World.

An extreme example to illustrate the point is provided by the Commission's inquiry into the assistance afforded the chemicals and plastics industries (IAC 1986). Vinyl chloride monomer (VCM) is a feedstock into making polyvinyl chloride (PVC), which is subsequently used to make various types of plastic products. At the time of the inquiry, domestic VCM was protected by a tariff of 2 per cent, PVC by a tariff of 30 per cent, and the local plastic products industries by tariffs of 20 to 25 per cent. Clearly, each component of the production chain had to be modelled separately to assess the effects of rationalising the tariff structure in this part of the manufacturing sector.

A further example is provided by the Commission's inquiry into rail transport in Australia (IC 1991a). Major problems in the productivity, pricing and quality of Australian railway services have manifest themselves in poor financial performance, with railway operations losing $4 billion or more each year. Clearly the scope for reform was enormous, but the problems differed in different parts of the railway network. Studies showed that some rail charges for bulk mineral freight were excessive, while bulk grain freight and non-bulk freight charges did not cover current costs. The rail transport of iron ore on privately operated, dedicated rail lines was already at or near international best practice. The deficits were largest for urban passenger services. To model the economy-wide impacts of proposed reforms it was necessary to model each component of the rail network separately.

The Commission is often required to modify the database of the off-the-shelf version of ORANI to incorporate additional sectoral detail. Staff at the Commission have developed software routinely to disaggregate the model's database, either using unpublished input-output data at the approximately 1400 commodity level available from the Australian Bureau of Statistics, or using data from participants in the Commission's inquiries.

In many cases, the required level of sectoral detail and sectoral linkage can be obtained simply by disaggregating a general equilibrium model's database, leaving its theoretical structure intact. Nevertheless, given that the theoretical structure specifies which commodities and primary factors are mobile between industries and which are not, which are perfectly substitutable or transformable and which are not, the user can engineer subtle theoretical changes in the way in which an individual activity is treated, according to whether it is aggregated with other activities. Particularly in earlier times when it was extremely difficult to change the computer code of a model quickly, staff at the Commission became particularly adept at exploiting the theoretical changes they could engineer by way of model disaggregation.

Since the development of the GEMPACK suite of software, it has become possible to implement major changes in the theoretical structure of an existing model within the time frame of a Commission inquiry. The best example is provided by the changes to existing model structures that were implemented for

the Commission's inquiry into the costs and benefits of reducing greenhouse gas emissions (IC 1991 b).

All the off-the-shelf versions of the general equilibrium models used by the Commission maintain the Leontief assumption that each intermediate input is used in fixed proportions with output, although users are able to substitute between domestic and various imported sources of each intermediate input. Primary factors as a group are also used in fixed proportions with output, although within the primary factor group, users can substitute between labour, capital or agricultural land.

For an inquiry into the possible effects of carbon taxes and other measures to reduce greenhouse gas emissions, this treatment was clearly inadequate. Carbon taxes would generate significant changes in the relative prices of fossil and non-fossil fuels. This would be expected to generate significant substitution between these types of fuel. However, the different fuels were treated as distinct intermediate inputs to production and consumption in the standard versions of our models, and therefore not capable of substitution.

Carbon taxes could also be expected to generate significant conversions towards more fuel-efficient technologies, leading to a reduction in fuel usage and increase in capital usage. However, fuel-capital substitution was also ruled out in the standard versions of our models.

Drawing on the work of the OECD (1991), the Commission amended the theoretical structures of both the ORANI and the Salter models to allow for interfuel and fuel-capital substitution. The substitution possibilities in production allowed for in ORANI-Greenhouse are shown in Figure 1. Similar amendments were made to the Salter model.

The amendments to the ORANI model went further. Unlike Salter, ORANI has a detailed treatment of domestic transport `margins' - the road, rail, air and sea freight services, insurance, wholesale and retail trade associated with the transportation of goods and services from their place of production to their place of consumption or use.[6] This detailed treatment is important in many applications because for some bulk, low unit value commodities of importance to Australia, such as wheat and coal, internal transport costs can equal or exceed the farm- or mine-gate value of the commodity.

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6 Salter has a detailed treatment of the transport margins required for the international shipment of goods and services between regions, but not of the transport margins required to ship goods and services within each region.

Figure 1: **Structure of production in ORANI-Greenhouse**
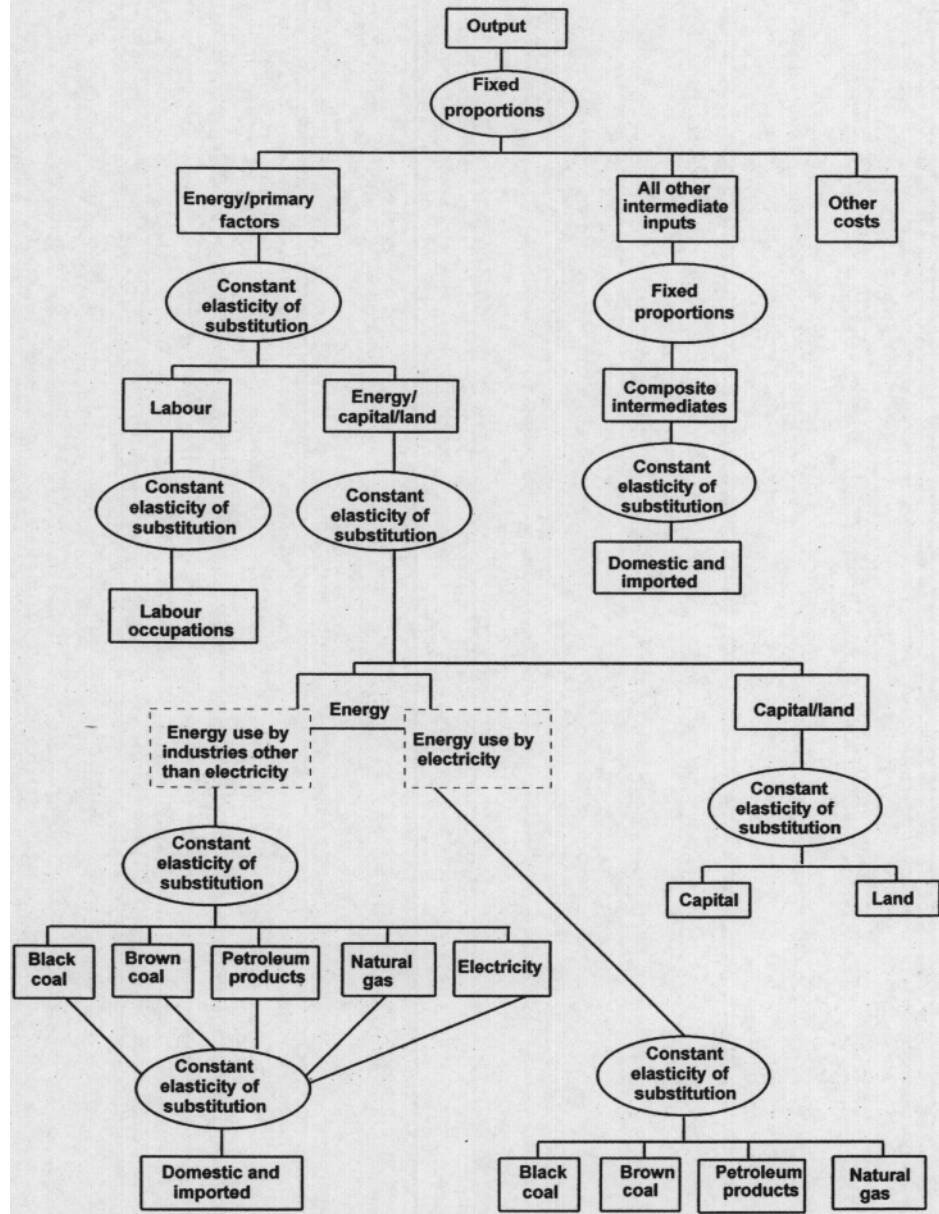
Normally, it is assumed that the usage of each mode of transport to convey a particular commodity moves in strict proportion with the volume being shipped - there is no provision for substitutionn between transport modes. Since transportation is a significant source of carbon dioxide emissions, and since

carbon taxes could be expected to change the relative prices of transport modes significantly, ORANI-Greenhouse also made provision for inter-modal substitution in the use of transport margins to allow for substitution between `clean' and `dirty' transport modes.

Finally, both Salter and ORANI were amended by the addition of carbon dioxide emissions coefficients, measuring the weight of carbon dioxide emitted per unit of energy obtained from the use of each fossil fuel. Accounting equations were then used to keep track of the changes in total carbon dioxide emissions resulting from projected changes in the level and composition of economic activity. Since methane is the second most important greenhouse gas, and since significant amounts of methane are emitted during coal mining and by grazing animals, methane emissions coefficients were also added to ORANI-Greenhouse so that the model could be used to compare the impact of carbon dioxide and methane taxes (the severe practical difficulties of implementing a methane tax notwithstanding).

The OECD had developed its GREEN model to analyse international policies directed towards reducing carbon dioxide emissions. However, the GREEN model did not have a separate representation of Australia. The Commission used ORANI-Greenhouse to measure the costs to Australia of unilateral action to reduce greenhouse gas emissions, and to give detailed sectoral projections of the impact of such measures. It used its amended version of the Salter model to assess the economy-wide impact on Australia of international consensus or plurilateral agreements to reduce carbon dioxide emissions, and to examine the nature of the tradeoffs between wider consensus or deeper cuts from a narrower group of countries. Both applications made use of the facility within the GEMPACK software suite to correct the model solutions for linearisation error.

The Industry Commission finds that it can hardly ever use the off-the-shelf versions of its general equilibrium models as they are. In order to address the policy issues directed to it by government, the Commission frequently fmds it needs to amend the off-the-shelf modelling shells in a number of ways, and often the amendments require significant further model development work.

The Commission has also found that for its off-the-shelf modelling tools to be durable, so that they remain a suitable basis from which to start, they need to be of higher quality than models built for a single purpose. Since database preparation is often the most time consuming part of building a model from scratch, and since database inadequacies can be difficult to rectify ex post, the Commission fmds it worthwhile to invest considerable time in ensuring that its databases are accurate in as many dimensions as possible right from the start. The Commission has also followed the lead of the IMPACT project in ensuring that both its basic models, and the more important special purpose versions, are thoroughly documented so that they can survive beyond the time span at the Commission of their individual developers.

2.2 Policy instruments

Many general equilibrium frameworks are built to deal with a specialised set of policy problems. The survey by Shoven and Whalley (1984), for example, partitions models into those designed for trade policy analysis and those designed for tax policy analysis. The policy instruments built into the off-the-shelf models at use in the Commission allow them to be used for both purposes, and more.

The model databases and theoretical structures incorporate a full range of assistance instruments, including tariffs and quantitative restrictions on imports, taxes and subsidies on exports, taxes and subsidies on production and sales, and set combinations of these such as would be required to model the impact of domestic price support measures for agricultural products. In the 1970s and 1980s when the Commission's role was primarily to review assistance arrangements before changes could be made, these policy instruments were clearly of prime importance. With a growing recognition of the importance of being able to report on the fiscal implications of its industry policy recommendations, the Commission has subsequently ensured that its model frameworks also incorporate the full range of fiscal policy instruments, and give a full accounting of the relevant government budgets. This development was spurred by internal debates within the Commission about the relative merits of delivering assistance through tariffs or production subsidies. The argument was put that subsidies were preferable because they only distorted production decisions, while tariffs distorted both production and consumption decisions. However, this argument ignored the welfare costs associated with raising taxes to fund the production subsidies. The Commission therefore extended the ORANI model so that it accounted fully for direct as well as indirect taxation, and for all categories of government spending and transfers. Its other model frameworks similarly include a full set of fiscal accounts. They can therefore be used to evaluate the merits of policy measures in a revenue- or deficit-neutral fashion.

The Commission has not used its general equilibrium frameworks to contribute in a major way to tax debates in Australia. In particular, the Commission did not contribute in a major way to the debates of the mid-1980s and early 1990s about the merits of introducing a consumption tax (or VAT). In large part this reflects the accepted division of labour between the Industry Commission and the Australian Treasury - the former deals with industry policy while the latter deals with tax policy. It also reflects the political sensitivity of the debates, and the consequent reluctance of the Australian Treasury to risk advertising its interest in an issue at an inconvenient time by inviting the involvement of an outside organisation.[7]

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7 In 1991 the Australian Treasury built its own model, Prismod, to analyse the impact of various tax changes including a consumption tax. Prismod is an input-output model linked to

Nevertheless, Monash-MR was recently used by the Centre of Policy Studies to analyse the impact of abolishing fiscal equalisation - the allocation of Commonwealth Government grants to the Australian States and Territories according to a principle of horizontal equity rather than, say, on a strict per capita basis.[8] Indeed, Monash-MR was originally developed for this purpose.

The Commission has used its general equilibrium frameworks, in particular their very detailed treatment of commodity taxes, to analyse tax policy issues having a direct bearing on industry policy. An example is provided in the Commission's recent inquiry into the petroleum industry (IC 1994). Some petroleum products are subject to heavy excise taxation, affecting both final and intermediate input use. Current arrangements allow some remission of the burden on intermediate input use by providing rebates of the excise paid on diesel for specified off-road uses (primarily in agriculture and mining). The Commission used a special purpose version of the ORANI model to assess the desirability of extending the diesel fuel rebate scheme in several deficit-neutral ways. The analysis made extensive use of a standard feature of ORANI, namely, its provision for commodity taxes on intermediate usage to vary by industry of end use.

The general equilibrium models used at the Commission therefore contain a detailed treatment of government spending, transfers and taxes on goods and income flows, but because they abstract from the processes of household portfolio allocation and financial intermediation, do not distinguish the differing tax treatments of different real and financial assets. This, however, was a major issue in the Commission's inquiry into the availability of capital (IC 1991c). To address issues in that inquiry, the Commission needed to build a small general equilibrium model from scratch that incorporated household portfolio allocation decisions between houses, non-housing equity, bonds, and overseas property, as well as capturing goods and income flows. The model was used to assess the impact on economic activity of reducing tax disparities that currently favour owner

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an income distribution module. As such it is able to tell detailed stories about the impact of policy changes on income distribution, but makes no allowance that consumers or users might substitute between commodities as relative prices change. The input-output table on which it is based was obtained by updating the Australian Bureau of Statistics 1986-87 table to 1990-91, and is still more up to date than any input-output table published by the ABS. To date the Australian Treasury has

notmade Prismod or the underlying input-output data generally available.

8 Commonwealth grants to the States and Territories are designed to redress vertical imbalance, since under current taxing and spending arrangements the Commmonwealth raises about two-thirds of all public sector revenue but the States and Territories account for almost 60 per cent of total public sector final demand. Under fiscal equalisation, the allocation of Commonwealth grants takes account of State disability factors arising from age/sex and socio-economic composition, geographic dispersion, urbanisation, input costs, and the inability to take advantage of economies of scale in administration and service delivery.

occupiers so as to redirect domestic savings towards financing business investment.[9]
In addition to a detailed menu of fiscal and trade policy instruments, the Commission's general equilibrium models contain a detailed set of instruments with which to model the effects of productivity improvements. At the time of its original development, the ORANI model contained by far the most detailed treatment of technological change of any general equilibrium model in the world. The Commission has ensured that an equally detailed treatment has been incorporated into Salter and Monash-MR, because these instruments have been

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crucial in assessing the economy-wide impacts of microeconomic reforms.

The endogenous growth literature stresses that technological change is not exogenously given. The literature highlights the potential links between the rate of technological change and the rates of investment in public infrastructure (Aschauer 1989), the rates of investment in plant and equipment (de Long and Summers 1991), and the rates of investment in human capital and knowledge capital (Lucas 1988, Romer 1990).

The policy agenda, and hence the research agenda, of the Industry Commission has been slightly different. It has focused on identifying (possibly) once-off but permanent productivity improvements that can be brought about changing the institutional and regulatory environment in which industries operate. And the research has been conducted on a case-by-case basis at the grubby empirical end of the spectrum, in the course of the Commission's public inquiries.

The Commission's general equilibrium models do not incorporate formal links between productivity improvements and the institutional and regulatory environment - technological change is still an exogenous variable in our general equilibrium models. The most important empirical analysis needs to be done outside the general equilibrium model framework. It involves a careful and detailed assessment of the circumstances of a particular industry or activity so as to identify the scope for improvement and the ways in which this might be brought about.

The circumstances vary from industry to industry. In the case of the rail industry, the size of the annual losses incurred was a clear indicator that something was wrong. In the case of the electricity industry, politically-driven investment programs meant that generation plants operated at a capacity well below that achieved in many overseas countries, while pricing policies lead to rates of return that were low or negative. In coastal shipping, where regulation prevents the use of foreign flagged vessels, crewing levels and crew per berth ratios were found to be higher than in Western Europe.

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9 Mortgage interest payments on a principal residence are not tax deductible in Australia, but the proceeds from the sale of a principal residence are not subject to capital gains tax.

The Commission is increasingly using comparisons of total factor productivity, rates of return and other indicators against national or international best practice to identify the scope for reform, if not the policy changes to encourage it.[10] The Commission also makes use of engineering studies, typically undertaken by consultants, to identify the cost characteristics of national or international best practice.

The fact that such important empirical analysis needs to be done outside of the general equilibrium framework has been, and should be, seen as a failing of general equilibrium modelling in assessing -the scope for microeconomic reform. On the other hand, it should come as no surprise. The comparative advantage of general equilibrium models is in assessing the nature of the linkages *between* industries, whereas identifying the scope for reform requires detailed analysis of the circumstances *within* an industry.

Once the scope for productivity or pricing improvements has been identified, however, general equilibrium modelling can be used to evaluate the economywide impacts of achieving those improvements. Since microeconomic reform typically involves a great deal of pain for some agents within the industry, an ability to identify winners and losers beyond the industry in question is critical to being able to built a coalition in favour of the microeconomic reform.

In most respects, the Commission's general equilibrium models are well equipped to evaluate the impacts of productivity improvements in public and private enterprises, and pricing improvements in Australia's public enterprises." However, a recent example highlights their limitation in evaluating some types of pricing reform. The demand equations in our general equilibrium models reflect the first order conditions from cost minimisation problems or utility maximisation problems on the assumption that pricing schedules are linear. For some types of public infrastructure, however, non-linear pricing would clearly be a better option. In the Commission's inquiry into water reticulation and sewerage disposal (IC 1992), the Commission canvassed the option of a two-part pricing schedule for urban water use comprising separate access and usage charges.[12] While the Commission's general equilibrium models could have been used to evaluate the impact on the rest of the economy of some single water usage charge equivalent,

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10 The Commission has gained the participation of Australia's government business enterprises (elsewhere called public or state-owned enterprises) in an ongoing annual benchmarking exercise

of this sort, and is in the process of organising participative performance measurement among service providers more generally (eg. in health and education).

11 Pricing reforms in public sector enterprises are typically modelled through tax changes because of the essential equivalence between tax policy and public sector pricing policy.

12 Under current arrangements, households in some parts of Australia receive a `free' water allowance in return for paying an access charge related to property values, while some irrigators pay for a fixed allocation of water irrespective of whether they use it. In areas where users are now charged for every litre of water they use, substantial reductions in water consumption were observed and costly system augmentations were able to be deferred.

in dollar terms, to the proposed two-part tariff, the analysis would not have captured the impact of the two-part tariff on the separate access and usage components of household choice. 13

The Commission has recently been asked to look at activities or issues where externalities emphasised by the endogenous growth literature are thought to be large, and where methods of dealing with those externalities are the main policy focus. The Commission's current inquiry into research and development is the best example. A forthcoming inquiry into sustainable land management may be another. For these inquiries, the first step in the empirical research agenda will not be to reach for a general equilibrium model, but rather to use econometric analysis to assess the strength of the spillover effects. Once a convincing *empirical* case can be made for the nature and strength of these spillovers, they can be built into subsequent general equilibrium frameworks by endogenising the relevant technical change variables.

2.3 Macroeconomic closures

To date the Commission has not felt compelled to adopt a fully dynamic framework in its general equilibrium modelling, but has remained in the slightly old-fashioned world of comparative static analysis. The reasons are primarily institutional. The Commission has little need for a forecasting tool because it does not see its role as `picking winners'. Its role is the analysis of policy counterfactuals in a `deviation from control' framework. But neither has the Commission felt the need to spell out explicitly the control path from which these deviations occur. The reason is that the Commission endeavours to give industry policy advice to government that is relatively robust to where Australia is in the business cycle.

This approach sometimes sits rather uncomfortably with politicians' intense interest in the adjustment pressures created on various vested interest groups. The approach at the Commission has therefore been two-pronged.

The early strategy was to use general equilibrium models to provide two alternative snapshot pictures of the impacts of policy changes, one giving a shortterm view of the adjustment pressures likely to confront industries and occupations, and another giving a long-term view of the eventual effects on resource allocation and aggregate economic efficiency. But to the extent that the real pain of adjustment is associated with resource movements rather than price pressures, the long-term projections that assume a high degree of flexibility in the way in which resources can be reallocated often give a clearer picture of potential pain (and gain) from adjustment than the short-term projections in which much of

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13 The sectoral impact of pricing reform has also been difficult to evaluate convincingly in industries such as electricity where under current arrangements, prices to large users are negotiated on a case-by-case basis and are subject to commercial confidentiality.

the pressure is absorbed through prices. For this reason, the Commission in more recent times has concentrated on providing long-term projections.' [4] However, the short-term projections have been useful in identifying the immediate impact of proposed policy changes, particularly on aggregate employment and the current account. This was especially true during the early tariff debates.

The Commission's second strategy has been to use its general equilibrium frameworks to demonstrate that if reforms are sufficiently broadly based, then not only will the pain of adjustment be spread around but so too will the gains. Few sectors need lose in absolute terms. This strategy has proved useful in the debates on microeconomic reform. This theme is taken up again in the next section.

The short- and long-term snapshot pictures provided by the Commission's general equilibrium models are distinguished primarily by their macroecononic closures. In the academic literature, various general equilibrium modelling families have been distinguished by their definition of microeconomic equilibrium and by their macroeconomic closures. The approach at the Industry Commission has been entirely pragmatic - we close our models in a way that reflects Australian conditions rather than purist notions, and we (for better or worse) still call it general equilibrium modelling.

The short- and long-run closures are distinguished according to their treatment of labour markets, capital markets and the government's fiscal balance.

In short-term projections, the labour market is typically not assumed to clear. Instead, wages are modelled as behaving according to the prevailing government policy. For much of the 1980s, Australia's centralised system of wage bargaining delivered wage increases that fully reflected increases in the consumer price index.[1]5 During this period, the Commission's short-run closure of its general equilibrium models held real wages fixed, while aggregate employment was allowed to vary in response to the policy changes under consideration.

Australia is now in the process of moving to a system of enterprise bargaining, under which nominal wage increases will be granted in return for improvements in productivity. In its inquiry into defence procurement (an inquiry in which policy

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14 The short-term projections may also give a misleading picture of the short-term impacts in some circumstances because they abstract from the short-term influence that monetary policy and portfolio reallocation can have on real variables in the economy. From an institutional perspective, this criticism can be discounted on the grounds that the Industry Commission's role is not to advise on monetary policy. The Commission's long-term projections are less vulnerable to this criticism if one believes in the long-run neutrality of money. Increasingly, the macroeconomic models in use in Australia have the characteristic of converging to the same long-run steady state as would a general equilibrium model (see Parsell, Powell and Wilcoxen 1989).

15 An important exception occurred during the 1987 collapse in world commodity prices. The government negotiated a round of wage discounting (wage increases less than the increase in the consumer price index) to ensure that the sharp nominal depreciation in the currency at the time was translated into a real exchange rate depreciation.

induced productivity improvements are not a major issue), the Commission is modelling the short-term impact of various defence procurement policies in an environment in which nominal rather than real wages are assumed to be fixed.

In its long-run projections, the Commission normally allows real and nominal wages to vary so as to keep the number of unemployed fixed.[16] The rationale given is that in the long term, unemployment is fixed at some `natural' rate. In periods of recession when the unemployment rate is felt to be well above its natural rate, the Commission is often criticised for its long-term labour market treatment. Recent econometric work undertaken by the Commission in the context of its inquiry into regional industry adjustment (IC 1993a) suggests that Australian labour markets are characterised by strong unemployment hysteresis, though not wage hysteresis (Blanchard and Summers 1986, Layard, Nickell and Jackman 1991). Short-term increases in unemployment tend to persist for a very long time, although such variation in real and relative wages as has been allowed by Australia's system of wage setting does assist in reallocating labour and bringing the unemployed back to work. This finding adds some credence to the Commission's current long-run treatment of unemployment in its general equilibrium models, though not necessarily its long-run treatment of wages. An unresolved empirical question is the extent to which unemployment hysteresis would continue to characterise Australia's labour market under the more flexible wage regime allowed for in the Commission's long-run closure.

By far the most important characteristic distinguishing the Commission's short-and long-term projections has been the treatment of physical capital. The short term is defined to be a period shorter than the gestation lag of new investment. Generally, this period is thought to be about two years. In short-run closures, physical capital stocks are held fixed in each industry, while policy-induced changes in economic conditions manifest themselves in changes in industry profitability.

In the long term, physical capital is assumed to be perfectly mobile, not just within Australia but also internationally. Arbitrage ensures that abnormal returns to capital are eliminated in all activities. In all its general equilibrium models, including the Salter model of the world economy, the supply curve of physical capital to each activity is horizontal at the going world real rate of return.[17] In

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16 Early versions of ORANI did not model the labour supply process, so could give projections for employment but not unemployment. Early versions similarly did not include an aggregate consumption function. The Commission has added labour supply and aggregate consumption functions to all its general equilibrium models. In the case of ORANI, the additions were motivated by the requirement to model the behaviour of unemployment benefits, and drew heavily on the empirical work undertaken by the IMPACT project for Bachuroo, its (now defunct) demographic model (Powell 1983).

17 Empirical work undertaken for the Commission's inquiry into the availability of capital suggested that while the supply of debt financing may be perfectly elastic, the supply of

ORANI and Monash-MR, this rate of return is taken to be exogenously given on the grounds that unilateral policy action taken in Australia is unlikely to affect world real interest rates. In Salter, the world real interest rate is determined endogenously by the requirement that global savings equal global investment.

International capital mobility is a feature of general equilibrium modelling in Australia that may distinguish it from general equilibrium modelling in other countries. The assumption that mobility is perfect is extreme. But particularly since the major financial reforms of the mid-1980s, Australians are acutely aware that international capital mobility is a real feature of the world in which they operate.

Recognition that capital is internationally mobile has a critical influence on the nature of the long-term projections from the Commission's general equilibrium models. It is a prime reason why the extent of resource reallocation in the longterm projections typically exceeds that in short-term projections. But international capital mobility also has implications for the way in which welfare needs to be measured. If not all capital accumulation is financed from domestic savings, Australia incurs more debt service obligations to foreigners. The income generated in Australia may increase, but not necessarily the income accruing to Australians.

The Commission's versions of the ORANI and Salter models therefore distinguish GDP, the income generated in a region, from GNP, the income accruing to the residents of that region. Although the models are comparative static rather than dynamic, they cannot ignore entirely the intrinsic dynamics of wealth accumulation out of savings. The dynamics of wealth accumulation over time govern the amount of debt accumulated by the long run, and therefore the debt service obligations accrued in the long run.

The intrinsic dynamics embedded into the Commission's version of the ORANI model were developed by the IMPACT project (Horridge 1985). The intrinsic dynamics embedded into the Salter model were developed by the Commission, drawing on its experience of building a model of income flows and asset stocks for its inquiry into the availability of capital. The Salter model's intrinsic dynamics are based on an explicit treatment of intertemporal choice, and the model gives projections for foreign debt accumulation by both households and governments (McDougall 1993).

A final feature of the Commission's short- and long-term projections is the way in which government budgets are treated. In the short term, it is typically assumed that fiscal policy is passive - there are no adjustments to government spending, transfers or tax rates to offset the impact that induced changes in economic

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equity financing is less than perfectly elastic. Ideally, this should be reflected in a less than perfectly elastic supply of physical capital to Australia as a whole.

activity have on government deficits. This is consistent with the Commonwealth Government's current policy stance. [18]

In the long term, governments are typically assumed to adopt an active policy to hold its fiscal deficit constant in real terms.[19] This is not done by adjusting lumpsum taxes, for the pragmatic reason that no such things exist. At the Commonwealth Government level, the deficit is normally held fixed by equiproportional adjustments to personal and corporate tax rates. These taxes are the most broadly based taxes in Australia, so that adjustments tend to have the most neutral effect and do not mask the impact of the industry policy change under consideration. At the State Government level in Monash-MR, deficits have been held fixed by variations in State government spending.[20]

The treatment of labour markets, capital markets and government budget deficits normally distinguish the short- and long-run projections from the Commission's general equilibrium models. The IMPACT project's choice of a Johansen framework for its initial modelling efforts has meant that such closure changes could always be implemented routinely without the need to modify the models' solution algorithm. The ability to adjust model closures has been an enormous asset to the Commission, and not just because it allows the Commission to provide both short- and long-term snapshot pictures from the same theoretical structure and computer implementation. This feature also allows the Commission to investigate a wide range of 'target-instrument' policy problems simply by swapping the closures of the target and instrument variables.

3 Policy messages from general equilibrium models

The level of detail in the Commission's general equilibrium models has allowed it to model proposed policy changes with a considerable degree of specificity. But the most influential policy messages have typically not been obtained by very detailed examination of the model results. They have been much broader messages. This is only in part because broader messages are easier to sell to policy-makers with little or no familiarity with economics or economic models. It is also because the Commission recognises that broad messages are likely to be the most robust to credible variations in model specification.

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18 The Commonwealth Government has allowed its fiscal deficit to deteriorate in the face of the current recession, but plans to reduce it to I per cent of GDP by 1996.

19 In Salter, nominal deficits are normally held constant as a proportion of total nominal government receipts.

20 The treatment of State government budgets broadly mirrors current conditions. At the Commonwealth level, the government has managed its budget in practice by a combination of tax rate changes, improved tax collections, closer targeting of transfer payments through income and assets tests and reductions in government spending.

The Commission nevertheless ensures that the detailed results from its models are subject to internal and external scrutiny. It also undertakes formal sensitivity testing of its results in some instances. The results are presented in a reasonable amount of detail to the participants in its inquiries. Model results are exposed in even more detail to academic audiences in papers written by Commission staff for academic conferences.

The process of exposing the detailed results of its models, and being able to explain the key mechanisms leading to those results, is seen by the Commission as being critically important in establishing the credibility of those results and the broad messages they illustrate. Policy-makers may be loathe to invest the effort to understand the results themselves, but are even more deeply suspicious of results that appear to come from a `black box' that no-one else understands - except, at times, when the black box comes up with the `right' answer. The Commission's commitment to transparency in its processes and analysis is less important when it is confirming than when it is challenging the conventional wisdom.

The Commission's general equilibrium modelling has been used in Australia to inform a number of issues. Several influential applications of the ORANI model have been the recent contributions to the tariff debate and the microeconomic reform debate. The Commission has also used an application of the Salter model in its response to the recent recession.

3.1 Analysis of reductions in protection

In its 1987-88 annual report, the Commission published its analysis of the impact of the reductions in protection that had been announced in May 1988 (IAC 1988). Those results had earlier been provided to the Australian Treasury on request in the inter-departmental process leading up to the policy announcement.

The general reductions in protection announced in May 1988 represented an important break with the piecemeal approach of the past. An earlier Commission report had argued the dangers of the piecemeal approach by pointing out that the
welfare costs of protection are a function of both levels and disparities in assistance to different industries (IAC 1982). A piecemeal reduction in one industry, sometimes the outcome of a recommendation by the Commission after an inquiry into a particular industry, might reduce the level of assistance to that industry but not necessarily the disparities in assistance between industries.[21] A further strategic reason for general rather than piecemeal reductions was that

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21 The 1982 report also included an early application of the ORANI model which showed that the second-best concerns in their strongest form were not necessarily warranted. All of the proposed options for phased reductions were projected to benefit the economy as a whole, although a 'tops-down' approach to tariff reduction yielded bigger gains than equiproportional reductions.

general reductions could spread the gain as well as the pain, and mitigate the adverse effects on at least some industries.

The May 1988 program involved general reductions in protection, with tariffs above 15 per cent being reduced in annual steps to 15 per cent and those between 10 and 15 per cent being reduced to 10 per cent. There were associated changes to existing plans for phased reductions in assistance to the textiles, clothing and footwear (TCF) industries and to passenger motor vehicles. By the end of the reduction program, the average nominal and effective rates of assistance for the manufacturing sector were estimated by the Commission to fall to 8 and 13 per cent, respectively, compared with 11 and 19 per cent at the end of 1987. Disparities in assistance were also estimated to decline by one-third, although assistance to the TCF and motor vehicle industries would still be four to eight times above the average for the manufacturing sector as a whole.

The Commission's analysis of the long-term macroeconomic implications focused on the impact on the trade balance and aggregate employment. Its analysis of the long-term impact on sectoral activity highlighted how reductions in assistance in one sector could benefit others, even within manufacturing.

As indicated in Table 1, the reductions in assistance were projected to lead to lower prices, higher employment, greater productive capacity (as measured by the aggregate capital stock) and higher real GDP by the mid-1990s than would otherwise have been the case.

The analysis noted that reductions in assistance would reduce prices through several channels. Lower import prices would place downward pressure on the prices of domestic competing products and reduce costs to domestic using industries. These reductions would improve the international competitiveness of export industries and help to mitigate the effects of reduced assistance for some import-competing industries.

The overall effect was projected to be a gain in exports and real GDP. The effects on the trade balance were more complicated because imports were also projected to increase. Where assistance was reduced, imports would tend to gain market share at the expense of domestically produced goods. As some of the gains in national income were spent, the size of the market would also increase, for imports as well as for locally made products. Finally, investment would need to grow to maintain a higher stock of capital, and investment spending tended to be import intensive.

The net effect was projected to be a decline in the trade balance at the end of the adjustment period, although only a slight one.

As productive capacity and activity levels grew, the demand for labour was projected to increase. This was projected to put upward pressure on real pre-tax wage costs and lead to some increase in employment.

Table 1: Projected long-run effects of announced changes in assistancea

Variable	Projected change in response to assistance reductions	Variable	Projected change in response to assistance reductions
Macroeconomic aggregates	0.48	**Sectoral outputs** (contd)	
Real GDP			
Real private consumption	0.07	Food, beverages, tobacco	0.67
Real investment	2.00	Textiles, clothing, footwear	-4.50
Real government spendingb	0.00	Wood, wood products	0.33
Exports (volume index)	2.56	Paper, paper products	-0.06
Imports (volume index)	2.78	Chemical, petroleum products	-1.70
		Non-metallic minerals	1.28
Trade balance/GDP ratio	-0.13	Basic, fabricated metals	1.06
		Transport equipment	-6.81
Aggregate employment (persons)	0.05	Other machinery, equipment	0.12
Aggregate capital stock	0.89	Miscellaneous manufacturing	-1.85
		Electricity, gas, water	0.23
Consumer price index	-0.82	Construction	1.74
Real pre-tax wage rate	0.85	Wholesale, retail trade	0.42
Aggregate real disposable		Transport, communication	0.63
non-wage income	0.26	Finance, property, business services	0.23
		Public administration, defence	0.01
Sectoral outputs		Community services	-0.07
Agriculture	0.52	Recreational, personal services	-0.05
Mining	5.02		

a All projections, with the exception of the balance of trade, are percentage deviations from the value the variable in question would have taken in the mid-1990s in the absence of the shock. The balance of trade, while also a deviation from control, is expressed as a share of base-period GDP.
b Held fixed by assumption.
Source: IAC (1988).

Overall, the announced changes were projected to generate 0.5 per cent more real GDP in the longer term than would otherwise have been the case. In 1986-87 prices, that amounted to around $1.2 billion a year, a sizeable gain from assistance reductions that initially lowered the average price of manufactured imports by less than 3 per cent.[22]

The tariff program produced relatively large reductions in nominal rates of assistance for some TCF industries and for paper and paper products, chemicals and plastics, while changes to the passenger motor vehicle plan produced relatively large reductions in assistance for that sector. The sectoral model

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22 The fact that the GNP gain was less than the GDP gain was not highlighted in this application, in part because Commissioners were not yet comfortable with the distinction. The Commission's subsequent analysis of the effects of the March 1991 program of reductions in assistance discussed the implications for GNP.

projections tended to show reductions in activity for these sectors commensurate with their reductions in assistance.

Of greater significance, the program also provided relatively large reductions in nominal rates of assistance for sheet and other metal products, construction machinery and other machinery and plant. These industries were only about two-thirds as large as the TCF and motor vehicle industries combined, but made more sales of intermediate and investment goods to other using industries.

Reductions in assistance to these metal products and machinery industries were therefore projected to have pervasive effects, encouraging activity, investment and a build-up of capital stocks in using industries. This is shown in Table 1 by the relatively large boost to investment and by the relatively good performance of using industries in the relatively capital-intensive mining sector. As a result, the metal products and machinery industries were projected to gain, despite their initial reductions in protection. Elsewhere, there were projected gains in activity for export-oriented industries such as agriculture and for import-competing industries not directly affected by the assistance reductions.

The Commission, like economists generally, will never be able to convincingly distinguish correlation from causation. Nevertheless, the two major programs of assistance reduction in Australia announced in May 1988 and March 1991 probably owe at least a little to the work of the Commission over the years, as well as to the contribution of its general equilibrium modelling.

3.2 Analysis of microeconomic reforms

In its 1988-89 and 1989-90 annual reports, the Commission packaged together the results from a number of its inquiries, together with additional analysis, to demonstrate the economy-wide impacts of a broad-ranging program of microeconomic reform. The results from the original 1988-89 analysis are shown in Table 2 (IAC 1989).

The results suggested annual gains in real GDP of almost 5 per cent, equivalent to $16 billion a year in 1988-89 dollars. Of this, just over $9.5 billion accrued in the form of higher household and government consumption spending. This amounted to over $1600 a year for each household. The employment gains were equivalent to about 35 000 extra jobs.[23]

Many of the reforms were of the sort that would lead to improved productivity, either through better work and management practices or by promoting domestic competition. A large portion of the cost saving in domestic water transport was

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23 Once again, the Commission failed to report the implications for real GNP, and has subsequently been criticised for this omission.

Table 2: Projected long-run effects of microeconomic reform[a]

	Domestic water transport	International liner shipping	Bulk commodity handling	Rail transport	Domestic aviation	International aviation	Road transport	Post and telecom-munications	Electricity supply	Rural and manufacturing assistance	Total
Macroeconomic aggregates											
Real GDP	0.4	0.2	0.6	0.7	0.1	0.2	0.5	0.5	0.4	1.1	4.7
Real consumption	0.2	0.3	0.7	0.6	0.1	0.2	0.9	0.5	0.4	0.4	4.3
Real investment	0.4	0.5	1.3	1.3	0.1	0.2	-0.5	0.4	0.1	2.4	6.2
Real government spending	0.2	0.3	0.7	0.6	0.1	0.2	..		0.4	..	2.5
Export volume	1.9	-0.2	0.2	0.7		-0.6	1.2	0.7	0.4	8.6	12.9
Import volume	0.8	0.9	1.4	0.9	..	-0.3	0.5	0.3	0.2	6.2	10.9
Balance of trade		..	-0.1	-0.1		..	0.1	..	..	..	-0.1
CPI	0.1	0.4	1.2	0.2	..	-0.3	-3.8	-0.3	..	-3.8	-6.3
Real pre-tax wage rate	0.3	0.4	0.8	0.7	0.1	0.3	2.6	0.6	0.5	1.6	7.9
Aggregate employment (persons)	0.1		0.1				0.2		..	0.1	0.5
Aggregate capital stock	0.4	0.5	1.3	1.3	0.1	0.2	-0.5	0.4	0.1	2.4	6.2
Shift in direct tax rates	-0.5	-0.1	-0.8	-0.8	-0.1	-0.3	3.2	-1.2	-1.3	2.4	0.5
Sectoral outputs											
Agriculture	0.4	..	-0.3	0.3	..	0.1	0.2	0.1	-0.1	1.3	2.0
Mining	1.8	-0.3	3.8	1.1	0.1	2.3	1.8	1.2	1.0	11.5	24.3
Manufacturing	0.6	..	-0.8	0.8	..	0.3	1.4	0.5	0.2	-1.0	2.0
Services	0.3	0.2	0.6	0.7	0.1	-0.1	-0.4	0.4	0.4	0.9	3.1

a All results are expressed in percentage changes, except for the balance of trade which is expressed in percentage points worth of base-period GDP.
Source: IAC (1989).

modelled this way, as was the grain handling portion of the bulk commodity scenario, the rail transport, domestic aviation and postal and telecommunications reforms and the improvements in the electricity supply industry.

Such productivity improvements would essentially expand Australia's `effective' resource base. With more resources, Australia would tend to be better off. The model projections abstracted from any costs incurred in making the necessary adjustments to achieve the productivity gains. Nevertheless, in scenarios where the gains accrued through productivity improvements, Australia was projected to achieve greater income, more consumption and higher wages, while still maintaining its international competitiveness (as demonstrated through export expansion).

In other reforms, the gains accrued from foreign competition which gave greater access to cheaper imports. Reforms of international liner shipping (including Trans-Tasman shipping) and in international aviation, and the removal of all remaining rural and manufacturing assistance fell into this category.

Such reforms would benefit the domestic industries (particularly those in the traded sector) that used cheaper imported goods and services, but could harm those that directly faced stronger competition. Overall, however, these reforms were projected to produce income, consumption and real wage gains.

Yet other reforms involved changes in domestic pricing policies. The road transport scenario and the coal freight portion of the bulk commodity scenario fell into this category. There was also a pricing policy aspect to rate of return increases that were enforced in the postal and electricity supply industries.

Here the pattern of macroeconomic effects tended to be more case-specific, although real income, consumption and real wage gains still resulted. The removal of the excess rail freight on coal directly benefited an important export activity and overall exports were projected to expand. The move to a user-pays basis for road charging disadvantaged some investment activities, particularly construction activity reliant on road transport of cement and concrete products, and investment was projected to contract.[24] Offsetting this, households were projected to benefit from lower road charges, and household consumption was projected to expand.

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24 Luck and Martin (1988) had shown that Australia's existing fuel excise regime resulted in overrecovery of pavement damage costs, and involved a cross-subsidy from households to heavy vehicle operators. The road transport scenario eliminated both the overrecovery and the cross-subsidisation. Given the long-run closure, the overall shortfall in general revenues was assumed to be made up by equiproportional increases in personal and corporate income tax rates.

At the sectoral level, where the gains accrued primarily through productivity improvements, they tended to be spread fairly evenly through the economy. This could be seen in the sectoral projections for reforms of domestic water transport, rail transport, domestic aviation, communications and electricity supply.

At a more disaggregated industry level, however, exceptions could arise. A few industries failed to receive sufficient spillover benefits from cheaper material inputs to offset the effects of higher wages allowed by the productivity improvements. Productivity improvements could also allow industries to economise on capital, adversely affecting their capital suppliers. Finally, primary producers were projected to expand grain at the expense of non-grain production under grain handling reform, thus reducing non-grain processing.

Other reforms involved increases in foreign competition. The sectors which tended to contract were those which directly faced foreign competition, or were closely dependent on those that did. Thus the highly protected parts of the manufacturing sector were projected to contract when manufacturing assistance was removed and the service sector (through aviation services) contracted under reform of international aviation. International aviation reform was also projected to reduce aircraft imports by Australia's international carrier.

Other industries gained from access to cheaper imported goods or services. This explained the gains to the mining sector from removal of rural and manufacturing assistance. However, cheaper liner shipping reduced the net cost of importing non-bulk cargoes, leading to a decline of some domestic manufacturing industries such as textiles, clothing and footwear. Elsewhere, industries tended to decline when they were unable to gain sufficiently from cheaper imported inputs to offset higher labour costs.

As to the reform of domestic pricing arrangements, some sectors benefited directly: the mining sector from the removal of the excess rail freight charge on coal; and the motor vehicle, oil and petroleum industries from the reductions in household road user charges. Other industries declined following reform of road pricing, a direct result of the higher road user charges applying on the transport of grains, coal, timber, iron and steel, sand, gravel and cement. Elsewhere, the pattern of gains and losses was mixed, reflecting a complex combination of conflicting, indirect price and cost pressures.

Overall, the sectoral results tended to be positive for reforms which lead to productivity gains, but mixed for reforms which increased foreign competition or involved domestic pricing policies. Where sectoral results were mixed, it was still possible for gains from one type of reform to offset the losses from

others. The boost to agriculture from removing manufacturing assistance, for example, was projected to more than offset the loss of rural assistance.

The mining sector was projected to receive by far the greatest benefit from the package of reforms. Few of the reforms imposed direct costs on this sector, while it would be well-placed to take advantage of cheaper input costs since it was less constrained than agriculture by available supplies of resources such as arable land.[25]

The other broad sectors were also projected to gain overall. At a disaggregated level, the only industries to suffer significant long-term declines were those particularly susceptible to foreign competition - the textile, clothing and footwear, motor vehicle and miscellaneous manufacturing industries - which were adversely affected by reductions in manufacturing assistance, and the international aviation industry which would face significant foreign competition under a more open international aviation regime.

The progress in implementing microeconomic reform in Australia has been substantial. When the Commission assessed the scorecard in 1991-92, it was able to point to examples of the reform dividend that included the following:

- domestic air fares on major routes had fallen an average by 23 per cent from the beginning of deregulation to the end of March 1992, and passenger traffic had increased 30 per cent in the year to April 1992;

- turnaround time for grain ships at Australian ports had dropped from an average of 4.5 days to 2.4 days by November 1991. The direct cost saving to farmers was estimated to be at least $10 million a year.

- in gearing up to meet competition from a second carrier, the Australian and Overseas Telecommunications Corporation had already reduced many

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25 The ORANI model has been criticised for its possible implication that subsidising mining activity would be good for the economy as a whole. The tendency toward this type of result is not, as one critic would have it, because of common right-wing tendencies of Commissioners and mining magnates (Quiggan 1993). Although the ORANI model does not have an explicit policy optimisation facility, it is clear that given linear pricing/taxing schedules and a government budget constraint, the model's optimal tax regime would be a Ramsey tax regime. Many commentators are willing to accept the model's characterisation of Australian mining activity as having a relatively elastic supply response (proven reserves are extensive and many operations are opencut). Somewhat more open to debate is the model's characterisation of mining activity as facing relatively elastic export demands (for example, black coal is exported under long-term contracts). Under conditions of elastic supply and demand responses, mining activity could attract low taxes or even subsidies under an optimal Ramsey tax regime. Quiggan is nevertheless accurate in highlighting the tension between the Ramsey flavour of the Commission's models and the `level playing field' nature of some of its rhetoric. For further research on the topic of the behaviour of the mining sector, see Horridge, Powell and Wilcoxen (1990) and Wilcoxen **(1993).**

charges for long-distance daytime calls - a call from Melbourne to Sydney was 13 per cent below the rate a year earlier; and

in the electricity supply industry, labour productivity had risen by more than 46 per cent and real electricity prices had fallen on average by around 12 per cent between 1987 and 1991.

The Commission also pointed to examples of slippage in the reform effort, including the introduction without prior public review of a $12 000 per unit duty on volume imports of second-hand vehicles (essentially from Japan) to protect already highly assisted Australian vehicle producers.

While by no means all reform initiatives have been in direct response to Commission recommendations, Australian Governments have drawn on Commission reports in considering their microeconomic reform agendas and in evaluating structural reforms.

3.3 Response to recent recession

By mid-1993 Australia's unemployment rate stood at over 10 per cent, the result of a recession induced by a fall in commodity prices and weakening investment after a sustained period of high interest rates. The Commission's 1992-93 annual report noted that sustained rapid growth was essential if Australia was to improve its standard of living and tackle such urgent problems (IC 1993b). It then evaluated overseas prospects and new growth theories as quick-fix options for Australia.

Its analysis of overseas prospects drew on an application of the Salter model of the world economy, which decomposed Australia's overall growth into that arising from developments at home and developments in other countries. In a growth accounting exercise, it separated Australia's *trend* growth in real GDP into the component arising from Australia's own trend labour force and total factor productivity growth, and that arising from labour force and total factor productivity growth in other countries, while taking account of the implications of this breakdown for growth in each economy's capital stock.[26]

The exercise highlighted that supply-side growth in other countries posed both a promise and a challenge to Australia. The promise was in terms of additional demand for Australia's exports as other economies grew. The challenge came from their increased competitiveness, especially through productivity improvements.

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26 The model in this instance was used to measure deviations from a base case involving no growth in population and technology, with the deviations measured as average annual growth rates.

As shown in Table 3, domestic productivity and labour force growth were projected to improve Australia's competitive position. With labour and productivity growth here not matched by growth overseas, costs and prices would tend to fall relative to those overseas. Strong export growth would contribute to a balance of trade surplus, although at the cost of a decline in Australia's terms of trade. This decline was projected mainly through declines in the export prices for wool and coal, with smaller price declines for wheat, meat products and non-ferrous metals. These are commodities for which Australia has a significant share in at least some segments of the world market.

An improved competitive position would also make Australia an attractive place in which to invest. The investment was projected to add to Australia's productive base. Not all the investment would be financed internally. An increase in net capital inflows explained the projected rise in net interest payments overseas as Australia would incur more debt service payments to foreigners. Overall, domestic labour and productivity growth was projected to contribute to a net capital inflow and a current account deficit.

The productivity improvements and induced capital inflow would allow employment growth to be accompanied by an increase in real wages. But the overall growth in real national income would be smaller than the growth in real GDP, reflecting the increased debt service payments to foreigners.

At the sectoral level, output growth from the model would be stronger in mining and manufacturing than in agriculture and services. Agricultural expansion would be somewhat constrained by the assumed fixed supply of agricultural land, but would also be discouraged by the decline in export prices, particularly for wool. However, this terms of trade decline was projected - to encourage further domestic downstream processing of agricultural products into manufactured goods, since Australia would have the potential to increase its share of the world market for these goods more easily. A similar increase was projected to occur in downstream processing of mineral products, although less at the expense of exports and output of the unprocessed products.

These factors in turn explained why the growth of agricultural exports was projected to be lower than the growth of agricultural output. They also helped to explain the relatively more favourable growth projection for the manufacturing sector, where the downstream processing of the agricultural and mineral commodities would take place.

Table 3: Impact on Australia of productivity and labour force growth here and internationallya

	Productivity and labour force growth in Australia	Productivity and labour force growth elsewhere	Total
National accounts			
Real national incomeb	1.86	0.26	2.12
Real GDP	2.38	-0.19	2.19
Real national consumption	1.86	0.27	2.13
Real investment	2.14	-0.39	1.75
Export volume	3.51	-0.28	3.22
Import volume	0.90	1.29	2.19
External account			
Balance of trade (% of GDP)	0.29	-0.08	0.21
Net interest income from abroad (% of GDP)	-0.31	0.11	-0.20
Net capital inflow from abroad (% of GDP)	0.02	-0.04	-0.01
Primary factors			
Labour employment (by assumption)	1.86		1.86
Capital stock	2.14	-0.67	1.47
Prices			
GDP deflatorc	-1.07	-0.01	-1.08
Consumer price index°	-0.92	-0.14	-1.06
Export price indexc	-0.90	-0.05	-0.94
Import price indexc	..	-1.20	-1.20
Terms of trade	-0.89	1.15	0.26
World real bond rate	..	0.06	0.06
Real wage	0.34	-0.10	0.24
Sectoral output			
Agriculture	1.99	0.50	2.49
Mining and other primary	3.75	0.08	3.84
Manufacturing	3.09	-1.05	2.04
Services	2.25	-0.16	2.09
Sectoral exports			
Agriculture	1.52	1.46	2.97
Mining and other primary	4.45	0.89	5.34
Manufacturing	4.06	-1.13	2.93
Services	3.80	-0.90	2.89

.. Less than + or - 0.005.

a All variables are measured as percentage changes, except for the external account variables which are measured in percentage points worth of GDP and the world real bond rate which is measured in percentage points.

b Defined as net national product (gross national product net of depreciation) deflated by the national (household plus government) consumption price index.

c Prices measured relative to the world average factor price index, the numeraire chosen for the model. *Source:* IC (1993b).

Overall service sector output growth would be constrained because of the importance of government services and ownership of dwellings, industries whose fortunes are tied to the growth of national consumption spending. Nevertheless, service export growth was projected to exceed service output growth, largely because of a projected increase in exports of trade and transport services and of private services such as advertising, consulting and data processing.[27]

By contrast, productivity and labour force growth elsewhere in the world was projected to be detrimental to activity levels and GDP in Australia, though not to national income. Productivity and labour force growth elsewhere unmatched by increases at home would certainly yield Australia a terms of trade gain and significantly raise Australia's exports of agricultural and mining products to particular destinations. This accounted for the projected overall growth in agricultural and mining output.

However, productivity and labour force growth elsewhere would also pose a competitive challenge to Australia. Part of the challenge would occur in product markets. The forces for growth elsewhere would tend to lower costs and prices overseas, particularly for manufactured goods and services, relative to those in Australia. Where the growth created additional export opportunities in these areas, Australia would not share in the export growth if it had not matched the competitive gains elsewhere. Hence overall Australian manufacturing and service activity was projected to decline. To the extent that Australia did share in the export growth, it would tend to be in areas where productive capacity in all other countries was particularly weak. Hence productivity and labour force growth elsewhere was projected to benefit Australian agriculture more than mining, because Australia tends to face less global competition in wool than in coal, and less in wheat than in iron ore.

Productivity and labour force growth in other countries would generally tend to increase export opportunities. As other countries grew their imports would rise. But the effect was projected to be stronger in the more open and/or more specialised economies. While Australia was projected to be unable to share in growth elsewhere if it could not remain competitive on price, it was also projected to be unable to rely on strong income effects in some of its traditional markets. In large, diversified economies such as the United States and Japan, much of the additional demand induced by internally generated growth could be met internally because their production and consumption structures are relatively closely matched. In these economies, the induced import expansion was projected to be particularly weak. In the European

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27 The model does not capture any increases in expenditure on domestic services such as accommodation brought about by an increase in tourism.

Community the induced import growth was projected to be stronger, but much of it could be met from intra-EC trade.[28]

Productivity and labour force growth elsewhere would pose a competitive challenge for Australia not just in product markets, but also in the global market for capital. In the longer term when capital is mobile, this would be at least as important a challenge. Productivity and labour force growth in the rest of the world was projected to make Australia a relatively less attractive destination for investment. Indeed, the model results suggested that in the absence of increases in savings rates around the world, productivity and labour force growth elsewhere would in fact reduce the investment channelled into Australia and hollow out its productive base. The increased demand for investment funds elsewhere was also projected to bid up world interest rates and increase the cost of operating capital in Australia. In the absence of matching productivity improvements at home, part of the loss in competitiveness from this source would be cushioned by the projected decline in real wages. Indeed, without such a decline, the reduction in overall activity would be greater and employment in Australia would be projected to fall.

While the higher required return on capital would increase its cost of operation, it was also projected to add to national income because most of Australia's capital is owned by Australians. Higher capital income was projected to offset lower wage income, so that total factor income would be kept roughly constant in nominal terms. The projected growth in *real* national income came about from two main sources. The first arose because Australians were projected to contribute to financing the investment overseas. In the longer term, Australia's net debt to the rest of the world would be reduced, with a consequent reduction in debt service payments despite higher world interest rates. The second source of real income growth was a projected reduction in the consumer price index, driven in part by cheaper prices for imported manufactures.

Supply-side growth in the rest of the world was therefore projected to make Australia richer, but not necessarily busier. The model results were used to suggest that Australia could not necessarily look to growth in the rest of the world to accommodate real wage increases at home in the longer term, nor to cure unemployment in the shorter term. Productivity and labour force growth elsewhere would also pose a competitive challenge to Australia. Since capital tends to be more internationally mobile than labour, Australian workers would in some way or another bear the brunt of any additional challenge from overseas. In a world in which capital was mobile internationally, it would be the internally generated forces for growth that would attract the investment to put people back to work.

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28 The projections held constant the major interventions affecting world trade.

4 Conclusion

General equilibrium modelling has been an invaluable tool to the Industry Commission in framing its policy advice because of the insights it provides to the wide interactions in the economy. Understanding such interactions supports the Commission's requirement to take an economy-wide view. The ways in which general equilibrium modelling has contributed in a positive way have been illustrated in this paper. Formal modelling has often helped in sifting *through* potential policy recommendations that on the surface looked sensible. The prime role of general equilibrium modelling has been to provide discipline on intuition, and this has often been just as important a contribution. But the most influential policy messages have typically not been obtained by very detailed examination of model results. They have been much broader messages.

There is nothing in the Industry Commission's charter, however, that requires the government to act on the policy advice it receives. The Commission plays an important role even when its advice is ignored. But its advice is most readily accepted when it is congruent with political imperatives. The Commission and its general equilibrium modelling have been influential in demonstrating that tariffs on manufactured goods could act as a tax on Australia's efficient exporters in the agricultural and mining sectors. In this way it supported the building of a coalition in favour of protection reform. The Commission and its general equilibrium modelling have also been influential in identifying pathways by which broadly-based microeconomic reform could lead to a true Pareto improvement - one in which at least some sections of the economy could be made better off but in which no (or few) sections were made worse off. In this way it has supported a consensus approach to reform.

References

Aschauer, D.A. 1989, `Is public expenditure productive?', *Journal of Monetary Economics* 23(2), pp. 177-200.

Blanchard, O.J. and Summers, L.H. 1986, 'Hysteresis and the European unemployment problem', in Fischer, S. (ed), *NBER macroeconomics annual 1986,* MIT Press, pp. 15-78.

Centre of Policy Studies 1993, *Monash-MR: a multiregional model of Australia: theory, data and applications,* a report to the New South Wales and Victorian State Treasuries by the Centre of Policy Studies, Monash University.

Codsi, G. and Pearson, K.R. 1988, 'GEMPACK: general-purpose software for applied general equilibrium and other economic modellers', *Computer Science in Economics and Management 1,* pp. 189-207.

Dee, P.S. 1989, *FH-ORANI: a fiscal ORANI with Horridge extension,* IMPACT Preliminary Working Paper No. OP-66, University of Melbourne.

de Long, J.B. and Summers, L. 1991, `Equipment investment and economic growth', *Quarterly Journal of Economics* 61(2), pp. 445-502.

Dixon, P.B., Parmenter, B.R., Sutton, J. and Vincent, D.P. 1982, *ORANI: a multisectoral model of the Australian economy,* North-Holland, Amsterdam.

Gabbitas, O. and Morgan, A. 1993, *MULTI: a general equilibrium model of urban land use and transport interaction,* Research Memorandum MR-84, Industry Commission, Canberra.

Horridge, M. 1985, *Long-run closure of ORANI: first implementation,* IMPACT Preliminary Working Paper No. OP-50, University of Melbourne.

—— 1991, *A general equilibrium model of Australia's premier city,* paper presented to the Australian Conference in Applied General Equilibrium Modelling, University of Melbourne (available from Centre of Policy Studies, Monash University).

Horridge, M., Powell, A.A. and Wilcoxen, P.J. 1990, *Constraining output responses in long-run closures of ORANI: some suggestions,* IMPACT Preliminary Working Paper No. OP-70, University of Melbourne.

IAC (Industries Assistance Commission) 1982, *Approaches to general reductions in protection,* Report No. 301, Australian Government Publishing Service, Canberra.

—— 1986, *The chemicals and plastics industries,* Report No. 390, Australian Government Publishing Service, Canberra.

1988, *Annual report 1987-88,* Australian Government Publishing Service, Canberra.

IAC 1989, *Annual report 1988-89,* Australian Government Publishing Service, Canberra.

IC (Industry Commission) 1991a, *Rail transport,* Report No. 13, Australian Government Publishing Service, Canberra.

1991b, *Costs and benefits of reducing greenhouse gas emissions,* Report No. 15, Australian Government Publishing Service, Canberra.

1991c, Availability of capital, Report No. 18, Australian Government Publishing Service, Canberra.

1992, *Water resources and waste water disposal,* Report No. 26, Australian Government Publishing Service, Canberra.

1993a, *Impediments to regional industry adjustment,* Report No. 35, Australian Government Publishing Service, Canberra.

1993b, *Annual report 1992-93,* Australian Government Publishing Service, Canberra.

1994, *Petroleum products,* Draft report, Industry Commission, Melbourne.

Jomini, P., McDougall, R., Watts, G. and Dee, P.S. 1994, *The Salter model of the world economy: model structure, database and parameters,* Industry Commission, Canberra.

Layard, R., Nickell, S. and Jackman, R. 1991, *Unemployment: macroeconomic performance and the labour market,* Oxford University Press, Oxford.

Lucas, R.E. 1988, `On the mechanics of economic development', *Journal of Monetary Economics* 22(1), pp. 3-42.

Luck, D.P. and Martin, I.J. 1988, *Review of road cost recovery,* Bureau of Transport and Communications Economics Occasional Paper No. 90, Australian Government Publishing Service, Canberra.

McDougall, R. 1993, *Incorporating international capital mobility into Salter,* Salter Working Paper No. 21, Industry Commission, Canberra.

McDougall, R. and Skene, J. 1992, *ORANI-IC92: a restandardised version of FH-ORANI,* Research Memorandum OA-579, Industry Commission, Canberra.

OECD (Organisation for Economic Co-operation and Development) 1991, *The costs of policies to reduce global emissions of CO_2: initial simulation*

results with GREEN, Note by the Secretariat, Department of Economics and Statistics, Paris.

Parsell, B.F., Powell, A.A. and Wilcoxen, P.J. 1989, *The reconciliation of applied general equilibrium and macroeconomics: grounds for hope?,* IMPACT Preliminary Working Paper No. IP-44, University of Melbourne.

Powell, A.A. 1983, `Aspects of the design of Bachuroo, an economicdemographic model of labour', in Kelley, A.C., Sanderson, W.C. and Williamson, J.G. (eds), *Modelling growing economies in equilibrium and disequilibrium,* Duke Press Policy Studies, Durham N.C., pp. 277-300.

Powell, A.A. and Lawson, T. 1989, `A decade of applied general equilibrium modelling for policy work', in Bergman, L., Jorgenson, D.W. and Zalai, E. (eds), *General equilibrium modelling and economic policy analysis,* Basil Blackwell, Oxford, pp. 241-90.

Quiggan, J. 1993, *The Industry Commission approach to public sector reform,* paper prepared for the Public Sector Working Party of the Australian Council of Trade Unions, Evatt Foundation, Sydney.

Romer, P.M. 1990, `Endogenous technical change', *Journal of Political Economy 98(5),* pp. S71-102.

Shoven, J.B. and Whalley, J. 1984, `Applied general equilibrium models of taxation and international trade: an introduction and survey', *Journal of Economic Literature* 22, pp. 1007-51.

Vincent, D.P. 1989, `Applied general equilibrium modelling in the Australian Industries Assistance Commission: perspectives of a policy analyst', in Bergman, L., Jorgenson, D.W. and Zalai, E. **(eds),** *General equilibrium modelling and economic policy analysis,* Basil Blackwell, Oxford.

Wilcoxen, P.J. 1993, `Supply elasticities in the presence of adjustment costs', *Journal of Policy Modeling* 15(1), pp. 91-97.

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