Australian Government

Productivity Commission

Impacts of COAG Reforms: Business Regulation and VET

Supplement to Research Report

July 2012

Economy-wide Modelling of Impacts of COAG Reforms

This publication is available from the Productivity Commission website at www.pc.gov.au. If you require part or all of this publication in a different format, please contact Media and Publications.

Publications Inquiries:
Media and Publications
Productivity Commission
Locked Bag 2 Collins Street East
Melbourne VIC 8003

Tel: (03) 9653 2244
Fax: (03) 9653 2303
Email: maps@pc.gov.au

General Inquiries:
Tel: (03) 9653 2100 or (02) 6240 3200

An appropriate citation for this paper is:

Productivity Commission 2012, 'Economy-wide modelling of impacts of COAG reforms', Supplement to *Impacts of COAG Reforms: Business Regulation and VET*, Canberra, July.

The Productivity Commission

The Productivity Commission is the Australian Government's independent research and advisory body on a range of economic, social and environmental issues affecting the welfare of Australians. Its role, expressed most simply, is to help governments make better policies, in the long term interest of the Australian community.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Further information on the Productivity Commission can be obtained from the Commission's website (www.pc.gov.au) or by contacting Media and Publications on (03) 9653 2244 or email: maps@pc.gov.au

About this supplement

The Australian Government asked the Productivity Commission to assess the impacts of a range of reforms undertaken by the Council of Australian Governments (COAG) in the areas of business regulation and vocational education and training (VET). The Commission's final report, *Impacts of COAG Reforms: Business Regulation and VET*, was released in May 2012.

The final report consists of three volumes: an overview volume and two supporting volumes, one on the business regulation reforms and the other on the VET reforms. Copies of the final report are available from the Commission's website via the study page (www.pc.gov.au/projects/study/coag-reporting).

Among other things, the Commission reported on:

- the economy-wide impacts of reforms, including estimates of the economy-wide, regional and distributional impacts of the reforms assessed; and
- the time paths over which benefits are likely to accrue.

This modelling supplement reports on the economy-wide modelling framework used in the study. It outlines the application of economy-wide modelling in the study and describes the model — the Monash Multi-Regional Forecasting (MMRF) model — used. It specifies the key modifications that have been made to the model to enhance its usefulness for assessing the impacts of COAG reforms, and outlines a reference case used to assess the timescale over which the benefits of the reforms are likely to accrue.

The supplement has benefited from feedback received on the discussion draft modelling supplement (released in February 2012), input from participants at a modelling workshop (held in October 2011), and from consultations conducted as part of this study and the preceding framework report released in December 2010. Referee comments on the modelling of export supplies were received from Kevin Hanslow, Centre of Policy Studies (CoPS) at Monash University. The updating of the model and model database was a collaborative project between the Commission and Professor Philip Adams and colleagues from the Centre of Policy Studies at Monash University.

Contents

Part B: Modelling reference case

Boxes

Figures

Tables

Abbreviations and explanations

Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
ASFR	Age-specific fertility rate
CGE	Computable general equilibrium (model)
COAG	Council of Australian Governments
CoPS	Centre of Policy Studies
DSP	Disability support pension
EGWW	Electricity, gas, water and waste services
ERP	Estimated resident population
FDI	Foreign direct investment
GDP	Gross domestic product
GFS	Government finance statistics
GSP	Gross state product
GST	Goods and services tax
GTEM	Global trade and environment model
GVA	Gross value added
IC	Industry Commission
ICT	Information and communications technology
IEA	International Energy Agency
MFP	Multifactor productivity
MMRF	Monash Multi-Regional Forecasting (model)
NEM	National electricity market
NOM	Net overseas migration
NRA	National Reform Agenda
OECD	Organisation for Economic Co-operation and Development
PC	Productivity Commission
RBA	Reserve Bank of Australia
SITC	Standard International Trade Classification

TFP	Total factor productivity
TFR	Total fertility rate
TWI	Trade weighted index
VET	Vocational education and training

1 Introduction

The Productivity Commission released its report on *Impacts of COAG Reforms: Business Regulation and VET* on 15 May 2012. The report included assessments of reforms referred to the Commission in the letter of direction of 22 August 2011 and covered:

- aspects of the 'seamless national economy' deregulation priorities — the business regulation reforms; and
- vocational education and training (VET) reforms and initiatives that support successful transitions from school.

The approach used to assess the impacts of these reforms was outlined in the Commission's December 2010 research report *Impacts of COAG Reforms: Reporting Framework* (PC 2010a) and in the discussion draft of December 2011.

The Commission's approach involved an economy-wide assessment of the impacts of reform. It identified the direct impacts of reform, including transition and implementation costs, and their flow-on effects on wider economic activity. Within the framework, key impacts of the COAG reforms on national economic activity, employment and income were quantified. The assessment also took into account other impacts where relevant, such as social or environmental impacts.

While the reforms assessed are diverse in nature, both within the business regulation stream and between the regulation and VET streams, a similar assessment procedure was applied across the streams. This involved:

- reporting on the scope of the reform and progress in implementation;
- identifying which groups in industry and the broader community are most likely to be directly affected and how;
- assessing the direct impacts of the individual reform streams on productivity (and business and government costs) and workforce participation — so as to generate policy scenarios for the modelling of the economic and fiscal effects of the COAG reforms being assessed; and
- economy-wide modelling of the flow-on effects from these direct impacts.

Volumes 2 and 3 of *Impacts of COAG Reforms: Business Regulation and VET* detail the reforms and the Commission's assessment of the direct impacts for the business regulation and VET reforms, respectively. Each reform, or group of related reforms, is assessed individually. The overview volume draws these individual assessments together to report on the economy-wide impacts of the business regulation and VET reforms (chapters 3 and 4, respectively). The overview volume also outlines the methodology used to derive these economy-wide impacts (chapter 1 and appendix B).

This supplement provides additional detail on the economy-wide modelling undertaken by the Commission. Chapter 2 of the supplement outlines the application of economy-wide modelling in this study. It draws on more technical material presented in parts A and B of this supplement. Part A (chapters 3 to 6) details the key modifications made to the MMRF model of the Australian economy for this study, while part B (chapters 7 to 15) details the reference case used in the dynamic modelling to assess the timescale over which the benefits are likely to accrue.

This use of dynamic modelling to ascertain the timescale over which the benefits are likely to accrue is the first time that the Commission has used dynamic modelling to report on the impacts of national reform. Given this, the modelling presented should be considered as being experimental in nature.

This modelling supplement for the final report has been updated in response to feedback received on the discussion draft. The modelling reference case outlined in chapter 15 is based on an updated version of the 2005-06 MMRF database supplied by the Centre of Policy Studies.

2 Application of economy-wide modelling in this study

The economy-wide impacts of the COAG business regulation and VET reforms were assessed using the Monash Multi-Regional Forecasting (MMRF) model. The approach used to model the economy-wide impacts is outlined in chapter 1 of the overview to the final report, while appendix B of that volume provides an overview of the MMRF model and the key modifications made to the MMRF model for the purposes of this study. This chapter provides additional information on the use of the MMRF model and the changes made to it for this study.

2.1 Motivations for economy-wide modelling

The terms of reference governing this study direct the Commission to report on the economic impacts and benefits of reform — including estimates of the economy-wide, regional and distributional effects of change — and the timescale over which they are likely to accrue. They direct the Commission to develop and maintain analytical frameworks appropriate for the quantification of the impacts and benefits of the COAG reform agenda, which comprises a range of reforms much broader than the reforms covered in this inaugural study.[1]

To assess the economy-wide impacts of reform it is necessary to examine changes in resource use by different sectors and groups within the economy. These changes and their effects will depend on, among other factors, changes in the productivity of resource use, changes in relative prices and flow-on effects to Australia's trading relationships with other countries. Computable general equilibrium (CGE) models are designed to trace the economy-wide effects of the direct impacts of economic change through to aggregate activity and to the distribution of activity between industries and regions.

The Commission has used economy-wide, computable general equilibrium modelling on four previous occasions to illustrate the impacts of widely-based

[1] The terms of reference ask the Commission to report every two to three years on the impacts and benefits of COAG reforms. This study is the first of these assessments.

national reform (IC 1995; PC 1999, 2005a and 2006). The last two of these studies used the MMRF model, and the first two used predecessors of the MMRF model.

2.2 Modifications made to the MMRF model

The MMRF model of the Australian economy contains considerable detail on the economic interlinkages between industries, consumers and governments, and on government finances. It also models each state and territory economy separately. Its database is based on the ABS *Input-Output Tables* and other relevant ABS publications, such as the *Government Finance Statistics* (GFS).

The Commission previously used the MMRF model to assess the economy-wide and fiscal effects of the National Reform Agenda (PC 2006), which included reforms similar to many of those that make up the current COAG reform agenda.

Given the similarities in the nature of the reforms covered in the current reform agenda and those in the National Reform Agenda, and the impacts that the Commission has been asked to report on, the version of the MMRF model that has been used in this study is based on the version used to assess the impacts of the National Reform Agenda. However, to improve its suitability for assessing the impacts of COAG reforms, the Commission has engaged the developers of MMRF, the Centre of Policy Studies (CoPS) at Monash University, to update the model and its database. The main modifications include:

- updating the reference year of the model database to align with the 2005-06 ABS *Input-Output tables* (ABS 2009, *Australian National Accounts: Input-Output Tables — Electronic Publication,* 2005-06 Final, Cat. no. 5209.0.55.001) (discussed in chapter 3 of this supplement);
- introducing a dynamic modelling capability so that the model can now be run in two modes: *comparative-static* and *recursive-dynamic* — the comparative-static mode presents a snapshot of the economy with and without the longer-run effects of the policies being modelled, while the dynamic mode traces out the time path over which the effects are likely to occur (the dynamic modelling capability in MMRF is outlined in CoPS (2007));
- introducing explicit modelling of demographic change (chapter 4);
- introducing transformation between occupations in labour supply (chapter 5); and

- introducing transformation between supplying domestic and export markets (chapter 6).[2]

The modifications made were presented to representatives from Commonwealth, State and Territory COAG officials and modelling experts at workshops held in Melbourne on 28 October 2010 and 14 October 2011.

2.3 Application of the updated MMRF model

Each of the Commission's previous assessments of the economy-wide impacts applied a longer-run 'comparative-static' framework. The framework is *comparative* in the sense that it compares pre- and post-reform economies and assumes full adjustment to reform-induced change. It is *static* in the sense that it does not trace out the adjustment path (box 2.1).

For this study, the model was applied in the longer-run comparative-static framework to project the longer-run impacts of reforms being assessed in both the business regulation and VET streams. The fiscal analysis presented in this study follows the approach used in the 1995 and 2006 exercises. In common with those exercises, the fiscal implications of reform are reported holding real discretionary public spending constant in the policy scenario.[3]

The Commission has also applied a dynamic approach, for the first time, to report on the timescale over which benefits are likely to accrue, given current implementation plans.

A dynamic approach has the advantage over a comparative-static framework in that it traces out transition paths over time and takes into account significant changes in the structure or level of activity that may influence the ultimate impacts of reforms as well as illustrating the possible economic environment in which the impacts of reform could occur (which may be particularly important for reforms involving long gestation or implementation periods).

Under the dynamic approach, policy scenarios incorporating shocks that represent the impacts of reform are compared over time with a projected reference case, which provides the counterfactual against which the impacts of the policy scenarios are assessed. The reference case represents the economy in the absence of the policy

2 The model also includes explicit modelling of energy use (for example, Adams and Mai 2002).

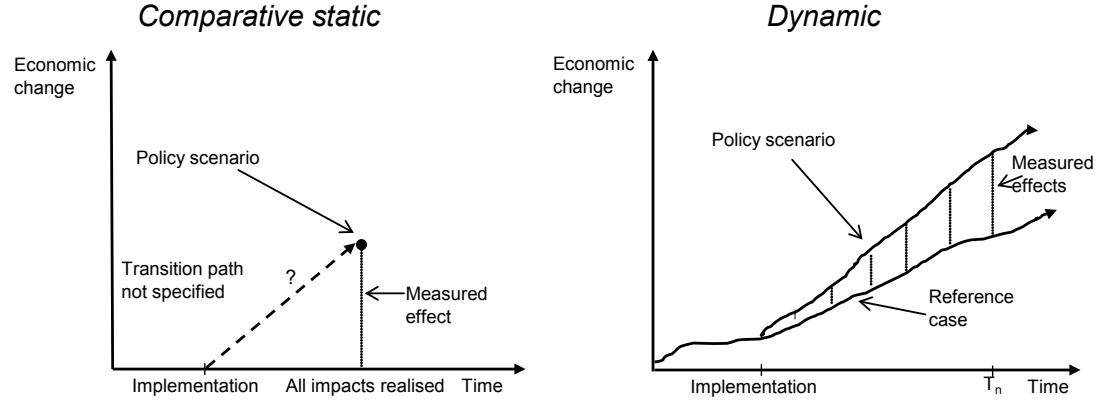
3 The 1999 and 2005 studies focused on total national expenditure rather than revenue implications for governments of reform. In those studies, budget neutrality was maintained in nominal terms, with any revenue gains being appropriated by households.

reforms being assessed. The differences between the policy scenario and the reference case represent the effects of the reform over time (box 2.1).

Box 2.1 Comparative-static and dynamic approaches to assessing economy-wide impacts

The Commission used a 'comparative-static' approach to quantify the potential economy-wide effects of National Competition Policy (IC 1995; PC 1999 and 2005a) and more recently in its assessment of the National Reform Agenda (PC 2006). Under a comparative-static approach, the impact of a policy change is measured against the representation of the economy in a benchmark period. It compares the economy pre and post full adjustment to the policy change. There is only limited scope to take into account changes in the demographic and economic structure of the economy that may affect the cost of implementation or the nature or level of benefits (left panel).

Economy-wide modelling approaches



The comparative-static approach does not trace out a transition path or take into account significant changes in the structure or level of activity that may influence the ultimate impacts of reforms or illustrate the possible economic environment in which the impacts of reform could occur (particularly for reforms involving long gestation or implementation periods).

Under the dynamic approach, policy scenarios incorporating shocks that represent the impacts of reform are compared over time with a projected reference case. The differences between the policy scenario and the reference case represent the effects of the reform over time (right panel).

The dynamic approach provides a means of taking into account possible changes in the structure of the economy and the interaction of such changes with the effects of reform. Such an approach provides a framework for assessing the impacts of reform of the economy in the period when the impacts of reform are likely to emerge.

The modelling reference case itself represents a projection of the path of the economy over time. The reference case adopted for the final report (chapter 15) is based on standard assumptions about changes in population (chapter 8), labour supply (chapter 9), productivity (chapter 10) and terms of trade (chapter 11). The reference case underlying the analysis is therefore a simplified projection of the progression of the economy. It is not a forecast of the size and composition of the economy.

As the focus of this study is on the economic impacts of the reforms being assessed, the Commission has presented comparative-static results as percentage changes from the reference case and the distribution of the changes (in proportional terms) over time.

The dynamic modelling capability and reference case for this study are set out in Part B of this supplement.

2.4 The economic environment (model closure[4])

The primary focus of this study is on the impacts of COAG business regulation and VET reforms once they have had time to work their way through the economy. More specifically, the study asks the question 'how might the Australian economy differ as a result of the introduction of the COAG reforms?'

Accordingly, a longer-term environment is used for the comparative-static modelling aspect of this study. In this environment, the estimated effects reflect those that are likely to occur once reforms have been fully implemented and there has been a complete adjustment of capital and labour between jurisdictions and industries.[5]

Comparative-static modelling environment

The comparative-static modelling undertaken in this study uses the same long-run environment as that used to assess the potential benefits of the National Reform Agenda (PC 2006). The key elements of the longer-run economic environment are as follows.

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

5 In this stream of modelling, the implementation of reforms, not the possible timescale for the realisation of benefits, is qualified for each reform in the final report.

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

Government tax rates are assumed fixed so that revenue moves in line with the various tax bases. As the Commission has been asked to report on the fiscal implications of the reforms assessed, the fiscal closure holds discretionary real government consumption fixed. Thus, nominal government expenditure on these items moves in line with induced price changes. The budget position is accordingly allowed to vary.

It is assumed that most of the reforms will not influence the national supply of labour — that is, after the full implementation of all reforms and subsequent adjustment, national labour supply will be the same as it would otherwise have been.[6] Higher national and regional output therefore depends on higher productivity of labour and the relocation of labour between regional industries. In the MMRF model, the base levels of national labour supply and employment by eight occupational groups are represented by their levels in 2005-06.

6 If the modelled changes were to increase total employment, then aggregate production gains (although not necessarily per capita gains) would be higher than the estimates presented.

Recursive-dynamic modelling environment

As it involves running the model through time in one-year steps, the modelling environment used in the 'recursive-dynamic' modelling is different from that used in the long-run comparative-static modelling discussed previously. Each step in the recursive-dynamic modelling is similar to a short-run comparative-static simulation, but with gradual adjustment in capital and labour markets. The model database is updated at each annual step.

The reference case modelling environment

The modelling environment used for the reference case assumes that:

- Population growth and the aggregate supply of labour are determined by the demographic module outlined in chapter 4 of this supplement using the demographic and labour market assumptions outlined in chapters 8 and 9.
- Investment, and with it the capital stock, in each industry gradually responds to differences between the expected and actual rates of return on capital. The base-line expected rates of return are determined by values in the MMRF database. The adjustment process is outlined in CoPS (2007).
- Nominal government expenditure (including government consumption and other outlays) moves in line with the underlying drivers of economic activity in MMRF (such as population, unemployment, aggregate economic activity and prices) (detailed in the annex to this chapter).[7]
- The budget position is held fixed as a share of GDP or gross state product (GSP) through the use of lump-sum transfers to, or from, households.

In common with the comparative-static modelling:

- Nominal household consumption is determined by post-tax household disposable income, while the balance of trade as a ratio of GDP in local currency prices is allowed to vary. Regional household consumption is determined by regional post-tax household disposable income.
- Government tax rates are assumed to remain fixed so that revenue moves in line with the various tax bases.

The specific closure changes needed to apply the reference case shocks outlined in chapters 8 to 14 are detailed in the relevant chapters.

---

7 In the current implementation of the MMRF model, real regional government investment moves in line with total real regional investment.

The policy scenario modelling environment

The modelling environment used for the policy scenario is similar to that used for the reference case, except that the fiscal closure is the same as that used in the comparative-static modelling — discretionary real government consumption is held fixed at reference-case levels, while discretionary nominal government expenditure is assumed to move in line with induced price changes. The budget deficit is allowed to vary.

Annex

Drivers of government revenue in MMRF

Source of government revenue	*Drivers*
Taxes on the provision of goods and services	
General taxes	Sales tax rates, nominal value of usage in production, investment, household consumption and exports
Goods and services tax (GST)	GST tax rates on usage in production, investment, household consumption and exports; real usage and the basic price of goods and services in production, investment, household consumption and exports
Excises and levies	Excise duty rates on other food, beverages & tobacco, petrol and other petroleum & coal products; real usage and basic price of other food, beverages & tobacco, petrol and other petroleum & coal products used in production, investment and household consumption
International trade	Import duty rates; foreign currency price of imports; nominal exchange rate; import volumes; shift term
Gambling	Commodity tax rates on hotels, cafes & accommodation and other services; real usage and basic price of hotels & cafes and other services used in production, investment and household consumption; shift term
Insurance	Commodity tax rates on financial services; real usage and basic price of financial services used in production, investment and household consumption
Use of motor vehicles	Commodity tax rates on motor vehicles & parts; real usage and basic price of motor vehicles & parts used in production, investment and household consumption
Other[a]	Consumer price index; shift term
Factor inputs	
Payroll	Payroll tax rates; employment (hours); hourly wage rate; shift term
Property	Property tax rates; capital stock; unit income on capital; shift term
Taxes on income	
Income taxes levied on individuals	Labour income tax rates; employment (hours); hourly wage rate; shift term
Income taxes levied on enterprises	Non-labour income tax rates; capital stock; unit income on capital; quantity of land; unit income on land; other costs; unit income on other costs; additional returns from exporting; shift term
Income taxes levied on non-residents	Non-labour income tax rates; real GDP; GDP price deflator; valuation effects; foreign ownership share; additional returns from exporting; shift term
Commonwealth grants to states	
Current grants	
GST-tied	GST grant expenditure by the Australian Government
Other	Other current grant expenditure by the Australian Government
Sales of goods and services[a]	Real government consumption; government consumption price deflator; shift term
Interest received	Real GDP/GSP; GDP/GSP price deflator; shift term
Other revenue	Real GDP/GSP; GDP/GSP price deflator; shift term

[a] This item comprises revenue earned through the direct provision of goods and services by general government (government departments and agencies) and public enterprises. [b] Because of the diverse nature of this item, it was not practicable to include it in the modelling. For this reason, it was assumed fixed in all policy simulations.

Drivers of government expenditure in MMRF

Type of government expenditure	*Drivers*
Gross operating expenses[a]	Real government consumption; government consumption price deflator; shift term
Personal benefit payments	
Unemployment benefits	Unemployment benefit rate; unemployment (persons); consumer price index; shift term
Disability support pension	Disability support pension rate; population; consumer price index; shift term
Age pensions	Age pension rate; population; consumer price index; shift term
Other personal benefits	Other personal benefit payment rate; population; consumer price index; shift term
Grant expenses:	
Australian Government to states: Current	
GST-tied	Nominal value of GST revenue collections
Other current grants[a]	Population; consumer price index; shift term
Australian Government to local government[a]	Real GDP/GSP; GDP/GSP price deflator; shift term
Australian Government to universities[a]	Real GDP/GSP; GDP/GSP price deflator; shift term
Australian Government and State government grants to private sector[a]	Real GDP/GSP; GDP/GSP price deflator; shift term
Property expenses[a]	Real GDP/GSP; GDP/GSP price deflator; shift term
Subsidy expenses[a]	Real GDP/GSP; GDP/GSP price deflator; shift term
Capital transfers[a]	Real GDP/GSP; GDP/GSP price deflator; shift term
Other expenditure	Real GDP/GSP; GDP/GSP price deflator; shift term

[a] Considered 'discretionary' in the fiscal modelling.

PART A

KEY MODIFICATIONS MADE TO THE MMRF MODEL FOR THIS STUDY

3 Updating the model database

This chapter provides details on the updated MMRF database used in the modelling of the economy-wide impacts of the COAG reforms.

The updated database has a reference year of 2005-06. As the database draws together data from a range of ABS publications, it is important that the industry structure is as consistent as possible across the range of publications used. The reference year 2005-06 was chosen because it was the last year that the ABS *Input-Output Tables* were compiled using the Australian and New Zealand Standard Industrial Classification (ANZSIC) 1993 industry classification and for which there was a range of industry and other data available on a similar classification basis (ABS 2009, *Australian National Accounts: Input-Output Tables — Electronic Publication*, 2005-06, Final, Cat. no. 5209.0.55.001).[1] The construction of the database is outlined in box 3.1.

The database used for the final report has been updated by the Centre of Policy Studies since the discussion draft.[2]

This chapter presents the key macroeconomic aggregates and other measures for the updated database used in the final report. The industry structure is set out in table 3.1.

1 At the time the database update commenced, the ABS was in the process of progressively implementing a new industry structure across all of its publications.

2 The main changes made to the database used for the discussion draft involve improving the alignment of state production and certain macroeconomic aggregates with available ABS statistics, refining the allocation of industry primary factor income between other costs and the three factors of production in MMRF (capital, land and labour) and reducing the number of occupations from nine to eight.

Box 3.1 **Construction of the updated database**

The Centre of Policy Studies was engaged to update the MMRF model database for this study.

The updated database has a reference year of 2005-06. It draws upon a range of ABS and other data sources. The database reflects the detailed economic structure of the Australian economy presented in ABS *Input-Output Tables* (*Australian National Accounts: Input-Output Tables — Electronic Publication*, 2005-06, Final, Cat. no. 5209.0.55.001). Supplementary sources are used to provide additional demographic, labour market and other data needed to provide a complete 'snapshot' of the economy in 2005-06. The Centre of Policy Studies disaggregates the national data to the state level on the basis of indicator information about aggregate economic activity by region and its distribution across activities.

Reconciling data from the different sources used and presenting them in a consistent way is not a straightforward task. To assist the Centre of Policy Studies in this task, the Commission supplied various state and national control targets based on published ABS data. The Centre of Policy Studies has sought to align the database with as many of these controls as possible. However, the need for internal consistency across all of the different sources used means that the resulting database may not necessarily align with the control targets supplied or with published aggregates. Differences are, however, more likely at the state rather than national level.

The demographic data used in the new demographic module has been compiled by the Commission based on various ABS demographic publications.

Table 3.1 **MMRF industries, margin services and product taxes**

1. Livestock
2. Crops
3. Dairy
4. Other agriculture
5. Forestry
6. Fishing
7. Coal mining
8. Oil mining
9. Gas mining
10. Iron ore mining
11. Other metal ore mining
12. Other mining
13. Meat products
14. Dairy products
15. Other food, beverages & tobacco
16. Textiles, clothing & footwear
17. Wood products
18. Paper products
19. Printing
20. Petrol
21. Other petroleum & coal products
22. Chemical products
23. Rubber & plastic products
24. Other non-metal mineral products
25. Cement & lime
26. Iron & steel
27. Alumina
28. Aluminium
29. Other non-ferrous metals
30. Metal products
31. Motor vehicles & parts
32. Other equipment
33. Other manufacturing
34. Electricity generation: coal
35. Electricity generation: gas
36. Electricity generation: oil
37. Electricity generation: hydro
38. Electricity generation: other
39. Electricity supply[a]
40. Gas supply
41. Water & sewerage services
42. Residential construction
43. Non-residential construction
44. Wholesale trade
45. Retail trade
46. Mechanical repairs
47. Hotels, cafes & accommodation
48. Road freight transport
49. Road passenger transport
50. Rail freight transport
51. Rail passenger transport
52. Pipeline transport
53. Water transport
54. Air transport
55. Services to transport
56. Communication services
57. Financial services
58. Ownership of dwellings
59. Business services
60. Government administration & defence
61. Education
62. Health
63. Community services
64. Other services

Transport and distribution margin services

Gas supply (part of commodity 40)
Wholesale trade (part of commodity 44)
Retail trade (part of commodity 45)
Road freight transport (part of commodity 48)
Rail freight transport (part of commodity 50)
Pipeline transport (part of commodity 52)
Water transport (part of commodity 53)
Air transport (part of commodity 54)

Product taxes

Goods and services taxes:
- Intermediate input demand
- Investment demand
- Household demand

Other non-GST taxes less subsidies:
- Australian and State government taxes on intermediate use
- Australian and State government taxes on investment use
- Australian and State government taxes on households
- Australian government taxes on exports

a Transmission, distribution and retail.

Source: MMRF database.

Table 3.2 **Components of GSP and GDP on the expenditure side in the MMRF database, 2005-06**

$ million

Component	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
Private consumption	187 216	138 748	102 179	39 437	52 270	11 291	5 735	11 112	547 988
Investment	73 989	60 753	56 988	15 615	39 360	4 729	4 391	5 040	260 865
Public consumption (State government)	33 183	25 284	20 065	8 273	10 557	2 806	2 293	1 966	104 427
Public consumption (Australian Government)	17 754	14 809	9 905	4 175	4 641	1 430	1 666	14 332	68 712
Stocks	200	100	100	50	100	30	10	22	612
NEM purchases less sales[a]	-324	-222	368	153	0	176	0	-151	0
Exports (foreign)	47 769	30 457	43 216	10 851	54 468	3 261	3 425	914	194 361
Imports (foreign)	-83 425	-59 319	-30 426	-7 678	-23 005	-728	-3 184	-1 176	-208 940
Exports (interstate)	81 488	57 096	25 836	15 450	13 238	4762	2 974	1 900	202 744
Imports (interstate)	-40 900	-32 397	-46 259	-21 786	-33 445	-9 403	-4 888	-13 667	-202 744
Gross state/domestic product	**316 950**	**235 309**	**181 971**	**64 540**	**118 184**	**18 355**	**12 423**	**20 293**	**968 025**

[a] Net purchases from the national electricity market (NEM).

Source: MMRF database based on: control targets from ABS (*Australian National Accounts: Input-Output Tables — Electronic Publication,* 2005-06 Final, Cat. no. 5209.0.55.001); ABS (*Australian National Accounts: State Accounts*, 2007-08, Cat. no. 5220.0).

Table 3.3 **Components of GSP and GDP on the income side in the MMRF database, 2005-06**

$ million

Component	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
Cost of labour	175 985	131 611	94 334	35 513	53 749	10 558	6 474	13 328	521 552
Cost of capital	112 461	81 697	70 064	22 851	54 170	6 087	4 810	5 602	357 741
Cost of agricultural land	1 390	1 534	1 662	739	1 100	155	81	0	6 660
Other costs	858	553	1 020	112	859	-1	68	-7	3 464
Commodity taxes – production	4 491	3 219	2 291	777	1 312	237	175	170	12 672
Commodity taxes – investment	1 987	1 572	1 248	395	919	138	89	146	6 495
Commodity taxes – households	5 337	4 191	3 109	1 229	1 579	351	195	269	16 260
Commodity taxes – exports	39	154	162	79	299	15	16	-8	757
Goods and services tax (GST)	13 128	9 817	7 577	2 707	3 862	800	465	769	39 125
Import duties	1 274	962	504	138	335	14	49	23	3 300
Gross state/domestic product	**316 950**	**235 309**	**181 971**	**64 540**	**118 184**	**18 355**	**12 423**	**20 293**	**968 025**

Source: MMRF database based on: control targets from ABS (*Australian National Accounts: Input-Output Tables — Electronic Publication,* 2005-06 Final, Cat. no. 5209.0.55.001); ABS (*Australian National Accounts: State Accounts*, 2007-08, Cat. no. 5220.0).

Table 3.4 **Demographic data in the MMRF database, 2005-06**[a]

Thousands of persons

Measure	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[c]
Population	6 816	5 127	4 091	1 568	2 059	490	210	334	20 695
Working-age population[b]	5 212	3 981	3 194	1 184	1 673	362	157	284	16 047
Labour force	3 440	2 628	2 108	781	1 104	239	104	187	10 591
Employment	3 261	2 491	2 007	743	1 060	223	98	181	10 064
Unemployment	179	137	101	38	44	16	6	6	527
Unemployment rate (Per cent)	5.2	5.2	4.8	4.9	4.0	6.7	5.8	3.2	5.0

[a] Data supplied by the Centre of Policy Studies to support the original demographic module. [b] Population aged 15 years and over. [c] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories).*

Source: MMRF database.

Table 3.5 **Government revenue in the MMRF database, 2005-06**

$ million

Revenue item	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*State & local*	*Aust Govt*[a]
Taxation revenue	17 755	13 048	8 835	3 520	5 931	888	429	769	51 175	242 931
Taxes on goods & services:	4 307	3 750	2 077	826	1 017	228	108	166	12 479	66 350
General taxes	0	0	0	0	0	0	0	0	0	968
GST	0	0	0	0	0	0	0	0	0	39 118
Excises and levies	5	60	0	0	0	1	0	0	66	22 734
International trade	0	0	0	0	0	0	0	0	0	5 001
Gambling	1 522	1 460	841	400	146	79	57	47	4 552	0
Insurance	1 393	1 048	385	284	326	51	21	41	3 549	0
Use of motor vehicles	1 899	1 242	1084	384	736	121	36	90	5 592	0
Other[b]	-512	-60	-233	-242	-191	-24	-6	-12	-1 280	-1 471
Factor inputs:	13 448	9 298	6 758	2 694	4 914	660	321	603	38 696	383
Payroll	5 171	3 302	1 903	790	1 355	217	125	204	13 067	369
Property	8 277	5 996	4 855	1 904	3 559	443	196	399	25 629	14
Income taxes:	0	0	0	0	0	0	0	0	0	176 198
Individuals	0	0	0	0	0	0	0	0	0	118 418
Enterprises	0	0	0	0	0	0	0	0	0	56 394
Non-residents	0	0	0	0	0	0	0	0	0	1 386
Australian Govt grants to states:	18 672	13 932	12 787	5 463	6 971	2 131	2 255	1 119	63 330	0
GST-tied[c]	10 901	8 241	8 090	3 621	4 002	1 574	1 929	760	39 118	0
Other current	7 771	5 691	4 697	1 842	2 969	557	326	359	24 212	0
Sales of goods and services	16 581	9 813	13 055	3 666	8 780	2 303	650	597	55 445	34 674
Interest received	1 974	1 050	4 353	627	598	275	103	85	9 065	4 585
Other revenue	4 742	4 278	4 314	804	2 628	403	461	174	17 804	3 518
GFS Revenue	**59 724**	**42 121**	**43 344**	**14 080**	**24 908**	**6 000**	**3 898**	**2 744**	**196 819**	**285 708**

[a] Australian Government. [b] Taxes not elsewhere classified adjusted for the difference in total taxation revenue between the ABS *Government Finance Statistics, Australia* and *Taxation Revenue Australia*. [c] Actual GST grants scaled to match the corresponding grant expenditure. [d] Balance of current grants and subsidies.

Source: MMRF database based on: control targets from ABS (*Government Finance Statistics, Australia,* 2008-09, Cat. no. 5512.0); ABS (*Taxation Revenue, Australia*, 2008-09, Cat. no. 5506.0); Commonwealth of Australia (2005, p. 7).

Table 3.6 **Government expenditure in the MMRF database, 2005-06**

$ million

Expenditure item	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*State & local*	*Aust Govt*[a]
Gross operating expenses	48 220	35 612	31 385	11 463	18 335	4 963	3 061	2 434	155 473	89 195
Personal benefit payments:[b]	0	0	0	0	0	0	0	0	0	77 336
Unemployment benefits[c]	0	0	0	0	0	0	0	0	0	5 719
Disability support pension (DSP)[d]	0	0	0	0	0	0	0	0	0	8 257
Age pensions[e]	0	0	0	0	0	0	0	0	0	21 426
Other personal benefit payments[f]	0	0	0	0	0	0	0	0	0	41 934
Grant expenses:	4 277	2 617	3 088	1 012	1 939	380	391	403	14 107	78 739
Australian Government to the states:	0	0	0	0	0	0	0	0	0	63 330
GST-tied[g]	0	0	0	0	0	0	0	0	0	39 118
Other current	0	0	0	0	0	0	0	0	0	24 212
Local governments	0	0	0	0	0	0	0	0	0	81
Universities	0	0	0	0	0	0	0	0	0	5 556
Private sector	4 277	2 617	3 088	1 012	1 939	380	391	403	14 107	9 772
Property expenses	3 205	1 530	2 356	1 077	1 059	483	264	199	10 173	13 343
Subsidy expenses	479	36	517	396	-6	51	13	9	1 495	6 090
Capital transfers	531	683	588	66	172	22	58	33	2 153	4 730
Other expenditure	513	56	171	38	369	11	21	0	1 179	0
GFS Expenditure	**57 225**	**40 534**	**38 105**	**14 052**	**21 868**	**5 910**	**3 808**	**3 078**	**184 580**	**269 433**

[a] Australian Government. [b] Other current transfers. [c] Newstart, Mature age allowance, Widow allowance and Non-full-time students receiving youth allowance. [d] Disability support pension [e] Age pension, Age pension saving bonus, Self-funded retirees' supplementary bonus, Telephone allowance for Commonwealth seniors health card holders, Utilities allowance, Seniors concession allowance, Widow class B pension, Wife pension (partner age pension) and Wife pension (partner DSP). [f] The balance of other current transfers not accounted for by unemployment benefits, disability support pensions and age pensions. [g] Tied to GST revenue collections to remove the effect of timing differences. [h] Tax expenses plus other current transfers.

Source: MMRF database based on: control targets from ABS (*Government Finance Statistics, Australia*, 2008-09, Cat. no. 5512.0); ABS (*Year Book*, 2009-10, Cat. no. 1301.0, pp. 287–8).

Table 3.7 **Fiscal balances in the MMRF database, 2005-06**

$ million

Fiscal measure	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*State & local*	*Aust Govt*[a]
Net operating balance[b]	2 499	1 587	5 239	28	3 040	90	90	-334	12 239	16 275
Net acquisition of non-financial assets	4 484	2 519	5 115	132	2 505	241	128	-105	15 019	3 516
Net lending (+)/borrowing (-)	-1 985	-932	124	-104	535	-151	-38	-229	-2 780	12 759

[a] Australian Government. [b] GFS Revenue less GFS Expenditure.

Source: MMRF database based on: control targets from ABS (*Government Finance Statistics, Australia,* 2008-09, Cat. no. 5512.0).

Table 3.8 **Population by age and state in the MMRF database, males, 30 June 2005**

Thousands

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
0	44.3	31.9	27.2	9.0	13.1	3.1	1.8	2.1	132.6
1	43.7	31.9	26.4	9.1	13.0	3.0	1.8	2.2	131.0
2	43.8	31.8	26.3	9.0	12.8	3.0	1.9	2.1	130.6
3	43.6	31.7	26.9	9.2	13.2	3.1	1.8	2.0	131.5
4	44.9	32.1	27.7	9.1	13.4	3.2	1.8	2.0	134.4
5	45.3	32.2	27.6	9.7	13.4	3.2	1.7	2.1	135.2
6	44.9	32.7	27.6	9.7	13.9	3.3	1.7	2.1	136.0
7	44.8	33.0	27.7	9.7	13.8	3.2	1.8	2.1	136.0
8	45.5	33.4	28.0	9.8	14.1	3.4	1.7	2.1	138.1
9	45.6	33.5	28.4	10.2	14.4	3.4	1.8	2.1	139.4
10	46.4	34.4	29.2	10.4	14.5	3.6	1.8	2.2	142.7
11	46.6	34.5	29.5	10.2	14.7	3.6	1.7	2.2	143.0
12	47.0	34.3	29.7	10.4	14.6	3.5	1.7	2.2	143.5
13	47.6	34.7	29.5	10.5	14.7	3.5	1.7	2.3	144.5
14	47.5	35.1	29.6	10.7	14.9	3.6	1.7	2.3	145.5
15	47.6	35.1	29.3	10.7	15.1	3.6	1.7	2.3	145.5
16	46.5	34.6	28.1	10.8	14.9	3.5	1.6	2.3	142.3
17	45.9	34.8	27.8	10.6	14.9	3.4	1.5	2.5	141.3
18	45.8	35.2	27.8	10.6	15.1	3.4	1.5	2.7	142.2
19	46.7	35.7	28.5	11.0	15.2	3.3	1.6	2.8	144.8
20	47.2	36.2	28.8	11.1	15.2	3.3	1.6	3.0	146.3
21	46.7	36.0	29.1	11.2	15.1	3.2	1.7	3.1	146.0
22	47.3	36.5	29.9	10.8	15.1	3.1	1.7	3.1	147.6
23	47.5	36.4	29.2	10.5	14.9	3.0	1.7	3.0	146.3
24	47.5	36.3	28.4	10.3	14.4	2.8	1.8	2.8	144.3
25	46.2	35.6	27.4	10.0	13.9	2.7	1.7	2.7	140.1
26	45.8	34.9	26.4	9.7	13.8	2.7	1.7	2.7	137.7
27	45.5	34.9	26.2	9.5	13.8	2.6	1.8	2.6	136.9
28	45.7	34.8	26.5	9.7	13.4	2.6	1.8	2.6	136.9
29	46.1	34.9	26.7	9.8	13.8	2.8	1.9	2.6	138.6
30	47.5	35.6	27.4	9.9	13.8	2.8	1.8	2.6	141.4
31	48.8	36.8	28.5	10.0	14.1	2.9	1.9	2.6	145.5
32	50.6	37.6	29.4	10.4	14.7	2.9	1.8	2.6	150.0
33	52.6	39.2	30.4	11.0	15.7	3.2	1.8	2.7	156.5
34	52.7	39.8	31.0	11.5	16.1	3.4	2.0	2.7	159.1
35	49.4	38.7	29.4	11.2	15.4	3.3	1.9	2.6	151.9
36	48.6	38.4	29.0	11.1	15.4	3.3	1.7	2.4	150.0
37	47.1	37.2	28.0	11.0	14.9	3.2	1.7	2.4	145.4
38	47.2	36.3	28.0	10.7	14.8	3.0	1.7	2.4	144.3
39	47.9	36.2	28.0	11.0	15.0	3.1	1.8	2.3	145.3
40	48.6	36.8	28.6	11.2	15.0	3.3	1.6	2.4	147.5

(Continued next page)

Table 3.8 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
41	50.9	37.5	29.8	11.5	15.7	3.5	1.7	2.4	153.1
42	51.7	38.2	29.9	11.8	15.9	3.5	1.7	2.5	155.3
43	51.9	37.9	30.3	11.6	15.8	3.7	1.7	2.5	155.3
44	51.0	37.6	30.1	11.9	15.7	3.7	1.8	2.5	154.2
45	49.3	36.6	29.3	11.6	15.4	3.7	1.6	2.4	150.1
46	48.6	36.7	28.7	11.4	15.1	3.6	1.5	2.3	147.8
47	47.8	35.3	27.9	11.3	14.8	3.6	1.5	2.3	144.5
48	47.0	34.6	27.5	11.0	14.7	3.5	1.5	2.3	142.1
49	46.3	35.0	27.4	10.9	14.9	3.6	1.5	2.2	141.9
50	45.1	33.4	26.8	10.9	14.1	3.4	1.4	2.2	137.2
51	44.2	32.6	26.1	10.5	13.9	3.3	1.4	2.2	134.1
52	43.8	32.5	26.4	10.5	13.8	3.5	1.4	2.2	134.1
53	42.3	31.5	26.0	10.2	13.6	3.4	1.4	2.2	130.6
54	42.2	31.0	25.6	10.2	13.5	3.3	1.4	2.1	129.3
55	42.0	30.6	25.5	10.3	13.1	3.3	1.3	2.1	128.1
56	40.9	29.8	25.1	10.0	12.8	3.1	1.2	2.0	124.8
57	41.6	30.4	25.4	9.9	13.0	3.3	1.1	2.0	126.7
58	42.6	31.5	26.3	10.5	13.3	3.5	1.2	2.1	131.0
59	36.7	26.9	22.3	8.7	10.8	2.8	1.0	1.8	111.0
60	35.2	25.2	21.8	8.3	10.3	2.7	0.9	1.5	106.0
61	33.9	24.1	20.4	7.9	9.9	2.8	0.8	1.4	101.2
62	30.4	22.0	18.3	7.4	9.0	2.5	0.7	1.3	91.5
63	29.7	22.2	18.2	7.1	8.9	2.4	0.7	1.3	90.5
64	28.2	20.9	17.0	6.6	8.2	2.3	0.7	1.1	84.9
65	27.4	20.1	16.4	6.5	7.9	2.2	0.6	1.1	82.1
66	26.2	19.4	15.4	6.4	7.7	2.2	0.5	1.0	78.7
67	25.1	18.3	14.6	6.0	7.3	2.0	0.4	0.9	74.7
68	24.6	17.8	14.0	5.9	6.8	1.9	0.4	0.9	72.2
69	23.4	17.1	13.3	5.6	6.5	1.8	0.4	0.8	68.8
70	21.5	15.8	11.9	5.3	6.0	1.7	0.3	0.8	63.4
71	20.8	15.6	11.5	5.3	5.5	1.7	0.2	0.7	61.4
72	20.4	15.0	11.0	5.1	5.4	1.6	0.2	0.7	59.4
73	19.9	14.4	10.8	4.9	5.3	1.6	0.2	0.7	57.8
74	19.8	14.7	10.7	4.9	5.4	1.5	0.2	0.7	58.0
75	19.2	14.3	10.1	5.0	5.0	1.5	0.2	0.6	55.9
76	18.3	13.4	9.5	4.8	4.7	1.4	0.2	0.6	52.8
77	17.5	12.9	9.0	4.6	4.4	1.3	0.2	0.6	50.4
78	16.1	12.0	8.3	4.3	4.1	1.2	0.1	0.5	46.7
79	15.1	11.3	7.9	4.0	3.8	1.2	0.1	0.5	43.9
80	13.7	10.1	7.1	3.6	3.4	1.1	0.1	0.5	39.5

(Continued next page)

Table 3.8 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
81	12.2	9.1	6.3	3.3	3.1	0.9	0.1	0.4	35.2
82	11.1	8.1	5.6	3.0	2.8	0.8	0.1	0.4	31.7
83	10.0	7.4	5.1	2.6	2.4	0.8	0.1	0.3	28.6
84	8.6	6.3	4.5	2.3	2.1	0.6	…	0.3	24.8
85	7.3	5.3	3.9	2.0	1.8	0.5	…	0.2	21.2
86	5.5	3.9	2.9	1.5	1.2	0.4	…	0.1	15.5
87	4.6	3.2	2.4	1.2	1.0	0.3	…	0.1	12.9
88	3.8	2.8	2.1	1.1	1.0	0.3	…	0.1	11.1
89	3.1	2.4	1.6	0.8	0.8	0.3	…	0.1	9.1
90	2.6	1.9	1.3	0.7	0.6	0.2	…	0.1	7.4
91	2.0	1.5	1.1	0.5	0.5	0.2	…	0.1	5.8
92	1.4	1.2	0.8	0.4	0.4	0.1	…	…	4.3
93	1.1	0.8	0.6	0.3	0.3	0.1	…	…	3.1
94	0.7	0.6	0.4	0.2	0.2	0.1	…	…	2.3
95	0.5	0.4	0.3	0.2	0.2	…	…	…	1.6
96	0.3	0.3	0.2	0.1	0.1	…	…	…	1.0
97	0.2	0.2	0.1	0.1	0.1	…	…	…	0.7
98	0.1	0.1	0.1	…	0.1	…	…	…	0.5
99	0.1	0.1	0.1	…	…	…	…	…	0.3
100+[b]	0.2	0.1	0.1	…	…	…	…	…	0.5
Total	**3 347.8**	**2 494.0**	**1 992.3**	**766.7**	**1 015.8**	**239.8**	**107.1**	**163.2**	**10 126.7**

… zero or less than 500. [a] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories).* [b] 100 years and over.

Source: MMRF database based on: ABS (*Population by Age and Sex, Australian States and Territories*, June 2009, Cat. no. 3201.0).

Table 3.9 **Population by age and state in the MMRF database, females, 30 June 2005**

Thousands

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
0	41.4	30.4	25.5	8.6	12.3	2.9	1.7	2.0	124.9
1	41.3	30.4	25.1	8.5	12.1	2.8	1.7	2.0	123.9
2	41.5	30.0	24.9	8.7	12.3	2.9	1.7	1.9	123.9
3	41.4	30.3	25.5	8.8	12.3	3.0	1.7	2.0	124.9
4	42.4	30.4	26.4	9.0	12.6	3.0	1.8	2.0	127.6
5	43.2	31.3	26.0	9.1	12.9	3.1	1.6	2.0	129.2
6	42.9	31.0	26.1	9.4	13.1	3.2	1.6	2.1	129.2
7	42.9	30.8	26.5	9.3	12.9	3.0	1.6	2.0	129.1
8	43.3	31.5	26.8	9.5	13.1	3.2	1.6	2.1	131.0
9	43.5	31.7	27.2	9.7	13.2	3.2	1.6	2.1	132.1
10	44.6	32.6	27.8	9.8	13.6	3.4	1.6	2.1	135.5
11	44.4	32.6	27.6	9.8	13.7	3.3	1.6	2.1	135.1
12	44.6	32.8	27.9	9.9	13.7	3.3	1.7	2.1	136.1
13	44.7	32.7	28.5	10.1	13.9	3.4	1.6	2.2	136.9
14	45.1	33.2	28.2	9.9	14.1	3.5	1.6	2.2	137.9
15	44.8	33.4	27.7	10.1	14.2	3.3	1.6	2.2	137.2
16	44.2	33.1	27.0	9.9	14.1	3.3	1.4	2.3	135.2
17	44.0	33.6	26.5	10.1	13.8	3.3	1.4	2.3	135.0
18	44.2	33.7	26.8	10.3	14.1	3.3	1.4	2.5	136.2
19	44.6	34.6	28.0	10.7	14.5	3.3	1.5	2.7	139.7
20	45.4	35.6	28.5	10.7	14.5	3.3	1.5	2.8	142.1
21	45.3	35.1	28.5	10.7	14.2	3.1	1.6	2.8	141.2
22	46.3	35.2	28.9	10.3	13.9	3.0	1.7	2.9	142.2
23	46.0	35.5	27.7	10.1	13.7	3.0	1.7	3.0	140.6
24	45.9	35.1	27.2	9.8	13.5	2.9	1.7	2.9	139.1
25	45.0	34.6	26.4	9.3	13.2	2.7	1.7	2.8	135.7
26	45.5	34.6	25.9	9.2	13.1	2.7	1.7	2.7	135.4
27	45.5	34.2	26.2	9.2	13.0	2.7	1.8	2.6	135.2
28	46.4	34.3	26.5	9.5	13.1	2.7	1.7	2.6	136.8
29	46.6	34.8	26.9	9.4	13.4	2.8	1.8	2.5	138.2
30	48.1	36.2	27.4	9.6	13.6	2.9	1.7	2.5	142.1
31	49.7	37.6	28.6	9.9	13.9	2.9	1.8	2.6	146.9
32	51.8	38.3	29.8	10.3	14.3	3.2	1.8	2.7	152.3
33	53.5	40.5	31.1	11.0	15.4	3.4	1.9	2.7	159.5
34	53.8	41.8	31.7	11.3	15.6	3.5	1.9	2.8	162.3
35	50.2	39.3	29.9	11.1	15.1	3.3	1.8	2.6	153.3
36	49.6	39.3	29.5	10.9	15.0	3.4	1.7	2.6	152.0
37	47.9	37.9	28.6	10.7	14.6	3.3	1.7	2.5	147.2
38	47.6	37.1	28.6	10.7	14.6	3.3	1.6	2.3	145.8
39	48.0	37.4	28.7	11.0	14.8	3.2	1.6	2.5	147.3
40	49.1	37.6	29.4	11.2	15.1	3.4	1.5	2.4	149.7

(Continued next page)

Table 3.9 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
41	51.2	38.5	30.4	11.6	15.4	3.7	1.6	2.6	155.0
42	52.3	38.8	31.2	11.8	15.7	3.7	1.6	2.5	157.6
43	52.0	38.7	31.2	11.9	15.6	3.8	1.5	2.6	157.4
44	51.9	38.5	30.7	12.1	15.8	4.0	1.6	2.6	157.1
45	50.7	37.8	29.9	11.9	15.5	3.8	1.5	2.5	153.6
46	49.3	37.1	29.3	11.7	15.2	3.7	1.4	2.6	150.4
47	49.0	36.3	28.9	11.4	14.8	3.6	1.4	2.5	147.8
48	47.3	35.4	28.0	11.4	14.5	3.6	1.4	2.5	144.0
49	46.6	35.2	27.6	11.3	14.8	3.6	1.4	2.4	142.8
50	45.8	34.2	27.2	10.8	14.3	3.5	1.3	2.3	139.4
51	44.5	33.3	26.6	10.9	13.9	3.5	1.3	2.4	136.1
52	44.3	33.3	26.3	10.8	13.8	3.5	1.3	2.3	135.6
53	42.8	32.1	25.6	10.6	13.3	3.4	1.2	2.3	131.3
54	42.5	32.2	25.5	10.6	13.0	3.3	1.2	2.3	130.6
55	42.0	31.7	25.5	10.4	12.7	3.3	1.1	2.2	128.9
56	40.5	30.5	24.7	10.2	12.5	3.2	1.0	2.1	124.7
57	41.0	31.1	24.5	10.2	12.1	3.3	0.9	2.1	125.3
58	42.2	32.0	25.4	10.8	12.6	3.5	0.9	2.1	129.4
59	36.1	26.7	21.5	9.0	10.0	2.9	0.8	1.7	108.5
60	34.9	25.3	21.1	8.7	9.7	2.8	0.6	1.6	104.8
61	33.4	24.7	19.8	8.2	9.5	2.7	0.7	1.5	100.4
62	30.5	22.4	17.8	7.5	8.5	2.4	0.5	1.3	91.1
63	29.7	22.2	17.6	7.3	8.5	2.4	0.5	1.3	89.5
64	28.6	20.9	16.3	6.8	8.0	2.3	0.5	1.2	84.6
65	27.6	20.5	15.9	6.9	7.7	2.2	0.4	1.1	82.3
66	26.8	20.1	15.3	6.9	7.5	2.1	0.3	1.0	80.1
67	26.1	19.5	14.0	6.5	7.2	2.1	0.3	1.0	76.7
68	25.7	18.9	13.8	6.4	6.8	2.0	0.3	1.0	74.8
69	24.7	18.4	13.0	6.0	6.6	1.9	0.3	0.9	71.8
70	23.4	17.3	12.4	5.8	6.2	1.8	0.2	0.8	67.8
71	22.3	17.0	11.5	5.7	5.9	1.8	0.2	0.8	65.2
72	22.1	16.5	11.5	5.6	5.8	1.7	0.2	0.8	64.2
73	22.0	16.1	11.2	5.5	5.7	1.7	0.2	0.8	63.1
74	22.6	16.7	11.6	5.8	5.7	1.7	0.2	0.7	64.9
75	22.2	16.5	11.1	5.6	5.6	1.7	0.2	0.7	63.5
76	21.6	15.9	10.8	5.6	5.2	1.6	0.2	0.7	61.6
77	21.0	15.5	10.6	5.5	5.1	1.6	0.2	0.7	60.2
78	20.2	15.2	9.9	5.5	4.9	1.5	0.1	0.6	57.8
79	19.6	14.8	9.7	5.4	4.7	1.5	0.1	0.7	56.5
80	19.0	14.0	9.3	5.1	4.4	1.4	0.1	0.6	54.0

(Continued next page)

Table 3.9 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
81	17.6	13.1	8.4	4.7	4.1	1.3	0.1	0.6	49.9
82	16.5	12.2	8.1	4.5	3.8	1.3	0.1	0.6	47.0
83	15.5	11.3	7.6	4.3	3.7	1.2	0.1	0.5	44.1
84	14.2	10.6	7.1	3.9	3.4	1.1	0.1	0.4	40.8
85	12.3	9.3	6.1	3.3	3.1	1.0	0.1	0.4	35.6
86	10.0	7.2	5.0	2.7	2.3	0.7	0.1	0.3	28.2
87	8.9	6.3	4.5	2.4	2.0	0.7	…	0.3	25.1
88	8.1	5.8	4.0	2.1	1.9	0.6	…	0.2	22.8
89	7.0	5.2	3.4	1.8	1.8	0.6	…	0.2	20
90	6.2	4.6	3.0	1.7	1.6	0.5	…	0.2	17.8
91	5.0	3.8	2.5	1.4	1.3	0.4	…	0.1	14.5
92	3.9	2.9	1.9	1.2	1.0	0.3	…	0.1	11.3
93	3.1	2.4	1.5	0.9	0.8	0.2	…	0.1	9.0
94	2.4	1.9	1.1	0.7	0.6	0.2	…	0.1	6.9
95	1.8	1.4	0.9	0.5	0.5	0.1	…	0.1	5.2
96	1.3	0.9	0.6	0.3	0.3	0.1	…	…	3.6
97	0.9	0.7	0.4	0.2	0.2	0.1	…	…	2.6
98	0.6	0.5	0.3	0.2	0.1	…	…	…	1.8
99	0.4	0.3	0.2	0.1	0.1	…	…	…	1.2
100+[b]	0.6	0.5	0.3	0.2	0.2	…	…	…	2.0
Total	**3 408.6**	**2 554.6**	**2 002.5**	**785.8**	**1 001.3**	**246.6**	**99.2**	**166.9**	**10 265.6**

… zero or less than 500. [a] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories).* [b] 100 years and over.

Source: MMRF database based on: ABS (*Population by Age and Sex, Australian States and Territories*, June 2009, Cat. no. 3201.0).

Table 3.10 **Fertility rate assumptions by state in the MMRF database, 2005-06**

Mother's age	*NSW*	*VIC*	*Qld*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
Total fertility rate (births per woman)									
	1.78	1.72	1.90	1.77	1.89	2.09	2.22	1.67	1.81
Age-specific fertility rates (births per 1000 women)[a]									
15	2.2	1.6	3.5	2.9	3.3	4.4	10.6	1.5	2.6
16	5.5	4.0	8.6	7.3	8.3	11.0	26.3	3.8	6.5
17	11.8	8.6	18.6	15.7	17.9	23.8	56.8	8.3	14.0
18	18.6	13.6	29.3	24.8	28.2	37.4	89.5	13.0	22.0
19	27.8	20.3	43.8	37.0	42.1	55.9	133.6	19.4	32.9
20	36.9	28.7	47.6	39.9	43.4	59.4	73.8	24.2	38.5
21	42.2	32.9	54.4	45.7	49.7	68.0	84.5	27.7	44.1
22	48.5	37.8	62.5	52.4	57.1	78.0	97.0	31.8	50.7
23	56.1	43.7	72.4	60.7	66.1	90.3	112.3	36.8	58.5
24	64.7	50.4	83.4	69.9	76.1	104.1	129.4	42.4	67.4
25	77.3	70.7	86.9	82.0	83.2	97.8	86.3	66.6	78.7
26	89.1	81.5	100.2	94.6	95.9	112.7	99.5	76.7	90.7
27	100.4	91.8	113.0	106.6	108.1	127.0	112.1	86.5	102.3
28	112.0	102.5	126.0	118.9	120.6	141.7	125.1	96.5	114.1
29	120.9	110.6	136.0	128.4	130.2	153.0	135.0	104.2	123.2
30	124.8	130.5	121.8	119.2	127.3	126.2	107.0	130.3	125.5
31	127.0	132.8	124.0	121.3	129.5	128.4	108.9	132.6	127.7
32	122.4	127.9	119.5	116.8	124.8	123.8	104.9	127.7	123.0
33	114.3	119.5	111.6	109.1	116.5	115.6	98.0	119.3	114.9
34	102.5	107.2	100.1	97.9	104.5	103.7	87.9	107.0	103.1
35	93.0	99.4	83.0	79.4	89.8	79.2	82.5	101.2	91.1
36	78.3	83.7	69.9	66.9	75.6	66.7	69.5	85.3	76.7
37	61.8	66.0	55.1	52.8	59.7	52.7	54.8	67.3	60.5
38	47.6	50.9	42.5	40.7	46.0	40.6	42.2	51.9	46.6
39	35.0	37.4	31.2	29.9	33.8	29.8	31.0	38.1	34.3
40	24.1	25.7	20.3	18.7	22.1	18.3	22.1	27.0	23.0
41	16.0	17.0	13.5	12.4	14.7	12.1	14.7	17.9	15.3
42	9.5	10.1	8.0	7.3	8.7	7.2	8.7	10.6	9.1
43	5.4	5.8	4.6	4.2	5.0	4.1	5.0	6.1	5.2
44	2.8	3.0	2.3	2.2	2.6	2.1	2.6	3.1	2.7
45	1.4	1.4	1.2	0.9	1.2	0.7	1.3	1.3	1.3
Sex ratio (males births per 100 female births)[b]									
	105.0	104.6	105.8	105.9	103.5	106.5	104.3	103.1	105.2

a Published age-specific fertility rate for the relevant five-year age group in that state multiplied by the ratio of the age-specific fertility rate for that age for Australia to the average age-specific fertility rate for that five-year age group for Australia. The resulting age-specific fertility rates are scaled to align with the published total fertility rate for that state on a financial-year basis. **b** Average of the sex ratios for calendar years 2005 and 2006.

Source: MMRF database based on: ABS (*Australian Demographic Statistics*, June 2010, Cat. no. 3101.0); ABS (*Births, Australia*, 2009, Cat. no. 3301.0).

Table 3.11 **Mortality rates by age and state in the MMRF database, males, 2005-06**[a,b]

Probability of dying in the next year on an age-at-last-birthday basis

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
Newborns	0.00460	0.00427	0.00528	0.00364	0.00381	0.00400	0.00931	0.00446
0	0.00084	0.00073	0.00096	0.00077	0.00074	0.00088	0.00174	0.00080
1	0.00031	0.00022	0.00037	0.00037	0.00033	0.00042	0.00070	0.00030
2	0.00022	0.00014	0.00028	0.00020	0.00023	0.00019	0.00048	0.00019
3	0.00018	0.00012	0.00022	0.00015	0.00018	0.00015	0.00032	0.00015
4	0.00016	0.00011	0.00018	0.00012	0.00016	0.00014	0.00024	0.00012
5	0.00014	0.00010	0.00014	0.00010	0.00014	0.00013	0.00019	0.00010
6	0.00012	0.00010	0.00013	0.00008	0.00013	0.00012	0.00016	0.00009
7	0.00010	0.00010	0.00011	0.00007	0.00012	0.00013	0.00016	0.00008
8	0.00010	0.00010	0.00010	0.00006	0.00012	0.00013	0.00016	0.00007
9	0.00010	0.00010	0.00010	0.00006	0.00012	0.00015	0.00021	0.00008
10	0.00010	0.00011	0.00011	0.00007	0.00012	0.00016	0.00025	0.00007
11	0.00011	0.00011	0.00012	0.00008	0.00013	0.00019	0.00033	0.00009
12	0.00012	0.00012	0.00014	0.00010	0.00014	0.00023	0.00043	0.00010
13	0.00013	0.00014	0.00017	0.00011	0.00015	0.00025	0.00053	0.00013
14	0.00017	0.00018	0.00022	0.00015	0.00022	0.00032	0.00067	0.00016
15	0.00025	0.00025	0.00030	0.00021	0.00032	0.00042	0.00085	0.00024
16	0.00038	0.00038	0.00045	0.00038	0.00047	0.00057	0.00111	0.00038
17	0.00054	0.00053	0.00062	0.00058	0.00064	0.00076	0.00138	0.00054
18	0.00065	0.00064	0.00074	0.00070	0.00078	0.00089	0.00161	0.00066
19	0.00072	0.00071	0.00081	0.00078	0.00084	0.00097	0.00180	0.00073
20	0.00074	0.00072	0.00084	0.00082	0.00086	0.00102	0.00195	0.00075
21	0.00075	0.00073	0.00086	0.00083	0.00086	0.00104	0.00208	0.00075
22	0.00074	0.00072	0.00087	0.00085	0.00088	0.00105	0.00219	0.00075
23	0.00074	0.00072	0.00087	0.00086	0.00087	0.00107	0.00231	0.00075
24	0.00075	0.00071	0.00088	0.00088	0.00089	0.00109	0.00243	0.00075
25	0.00076	0.00073	0.00090	0.00091	0.00091	0.00112	0.00256	0.00077
26	0.00080	0.00076	0.00093	0.00096	0.00094	0.00116	0.00270	0.00079
27	0.00083	0.00079	0.00096	0.00100	0.00098	0.00121	0.00283	0.00082
28	0.00085	0.00082	0.00100	0.00105	0.00101	0.00124	0.00296	0.00085
29	0.00089	0.00085	0.00102	0.00109	0.00105	0.00128	0.00308	0.00086
30	0.00091	0.00087	0.00105	0.00114	0.00108	0.00132	0.00319	0.00089
31	0.00094	0.00090	0.00107	0.00118	0.00111	0.00135	0.00330	0.00090
32	0.00097	0.00093	0.00110	0.00122	0.00113	0.00138	0.00340	0.00092
33	0.00101	0.00096	0.00112	0.00126	0.00116	0.00141	0.00350	0.00094
34	0.00104	0.00098	0.00115	0.00130	0.00119	0.00145	0.00359	0.00095
35	0.00107	0.00102	0.00118	0.00134	0.00122	0.00147	0.00368	0.00097
36	0.00111	0.00105	0.00121	0.00140	0.00126	0.00151	0.00378	0.00098
37	0.00117	0.00110	0.00126	0.00145	0.00130	0.00157	0.00388	0.00101
38	0.00124	0.00116	0.00132	0.00153	0.00136	0.00162	0.00399	0.00106
39	0.00131	0.00124	0.00139	0.00161	0.00143	0.00170	0.00410	0.00111
40	0.00140	0.00133	0.00147	0.00171	0.00151	0.00178	0.00424	0.00117

(Continued next page)

Table 3.11 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
41	0.00151	0.00142	0.00157	0.00182	0.00161	0.00189	0.00439	0.00125
42	0.00165	0.00155	0.00169	0.00195	0.00172	0.00201	0.00454	0.00133
43	0.00178	0.00167	0.00182	0.00209	0.00184	0.00214	0.00472	0.00144
44	0.00194	0.00181	0.00197	0.00224	0.00197	0.00229	0.00492	0.00155
45	0.00212	0.00197	0.00213	0.00241	0.00213	0.00245	0.00514	0.00168
46	0.00229	0.00214	0.00231	0.00259	0.00229	0.00264	0.00537	0.00181
47	0.00250	0.00232	0.00250	0.00278	0.00246	0.00282	0.00562	0.00196
48	0.00272	0.00252	0.00271	0.00298	0.00266	0.00305	0.00590	0.00212
49	0.00294	0.00272	0.00294	0.00320	0.00285	0.00328	0.00620	0.00229
50	0.00318	0.00294	0.00317	0.00342	0.00306	0.00352	0.00653	0.00248
51	0.00345	0.00317	0.00342	0.00367	0.00330	0.00380	0.00688	0.00267
52	0.00374	0.00345	0.00372	0.00394	0.00355	0.00411	0.00729	0.00289
53	0.00408	0.00374	0.00405	0.00425	0.00385	0.00445	0.00773	0.00314
54	0.00444	0.00407	0.00442	0.00459	0.00417	0.00485	0.00824	0.00344
55	0.00486	0.00445	0.00482	0.00499	0.00454	0.00529	0.00881	0.00377
56	0.00533	0.00488	0.00529	0.00542	0.00496	0.00580	0.00946	0.00414
57	0.00585	0.00537	0.00582	0.00592	0.00545	0.00637	0.01018	0.00459
58	0.00645	0.00592	0.00641	0.00649	0.00599	0.00702	0.01099	0.00508
59	0.00711	0.00653	0.00708	0.00711	0.00660	0.00775	0.01190	0.00564
60	0.00785	0.00725	0.00782	0.00783	0.00729	0.00857	0.01290	0.00629
61	0.00868	0.00802	0.00866	0.00863	0.00806	0.00949	0.01403	0.00700
62	0.00961	0.00890	0.00958	0.00950	0.00893	0.01051	0.01526	0.00781
63	0.01063	0.00986	0.01059	0.01050	0.00987	0.01165	0.01663	0.00872
64	0.01174	0.01093	0.01172	0.01158	0.01093	0.01289	0.01812	0.00970
65	0.01297	0.01210	0.01294	0.01276	0.01210	0.01427	0.01974	0.01081
66	0.01432	0.01340	0.01429	0.01407	0.01337	0.01577	0.02152	0.01202
67	0.01576	0.01478	0.01572	0.01547	0.01474	0.01740	0.02341	0.01333
68	0.01732	0.01628	0.01728	0.01700	0.01622	0.01915	0.02544	0.01474
69	0.01906	0.01797	0.01900	0.01869	0.01788	0.02111	0.02770	0.01632
70	0.02104	0.01990	0.02097	0.02064	0.01978	0.02334	0.03021	0.01816
71	0.02331	0.02211	0.02322	0.02287	0.02197	0.02587	0.03303	0.02027
72	0.02589	0.02465	0.02579	0.02542	0.02447	0.02874	0.03620	0.02269
73	0.02883	0.02754	0.02870	0.02834	0.02733	0.03199	0.03973	0.02547
74	0.03217	0.03082	0.03198	0.03164	0.03057	0.03566	0.04366	0.02862
75	0.03591	0.03452	0.03571	0.03535	0.03423	0.03978	0.04803	0.03220
76	0.04012	0.03870	0.03986	0.03955	0.03835	0.04437	0.05288	0.03623
77	0.04481	0.04335	0.04450	0.04422	0.04295	0.04948	0.05820	0.04074
78	0.05001	0.04853	0.04965	0.04942	0.04806	0.05513	0.06403	0.04577
79	0.05578	0.05426	0.05532	0.05517	0.05374	0.06137	0.07044	0.05134
80	0.06220	0.06068	0.06168	0.06160	0.06006	0.06831	0.07747	0.05760

(Continued next page)

Table 3.11 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
81	0.06952	0.06797	0.06888	0.06892	0.06729	0.07613	0.08536	0.06471
82	0.07777	0.07625	0.07704	0.07721	0.07546	0.08496	0.09420	0.07281
83	0.08640	0.08487	0.08555	0.08584	0.08400	0.09415	0.10333	0.08123
84	0.09512	0.09361	0.09413	0.09460	0.09262	0.10348	0.11257	0.08977
85	0.10485	0.10336	0.10372	0.10438	0.10227	0.11386	0.12275	0.09935
86	0.11608	0.11466	0.11479	0.11568	0.11343	0.12575	0.13438	0.11040
87	0.12891	0.12750	0.12744	0.12852	0.12614	0.13918	0.14746	0.12304
88	0.14345	0.14210	0.14179	0.14316	0.14063	0.15439	0.16222	0.13744
89	0.15937	0.15814	0.15756	0.15920	0.15653	0.17101	0.17820	0.15328
90	0.17594	0.17476	0.17386	0.17583	0.17300	0.18820	0.19484	0.16967
91	0.19215	0.19110	0.18992	0.19216	0.18920	0.20510	0.21089	0.18579
92	0.20764	0.20675	0.20514	0.20776	0.20464	0.22128	0.22626	0.20121
93	0.22227	0.22136	0.21954	0.22245	0.21916	0.23654	0.24072	0.21564
94	0.23373	0.23449	0.23142	0.23758	0.23243	0.24763	0.26575	0.22833
95	0.24794	0.24895	0.24535	0.25227	0.24663	0.26246	0.28069	0.24233
96	0.26212	0.26303	0.25902	0.26647	0.26059	0.27687	0.29633	0.25643
97	0.27586	0.27715	0.27259	0.28095	0.27464	0.29180	0.31063	0.27013
98	0.28941	0.29118	0.28577	0.29532	0.28830	0.30624	0.32661	0.28385
99	0.30362	0.30592	0.29959	0.31042	0.30263	0.32139	0.34342	0.29827
100+[c]	0.32701	0.32646	0.32057	0.32776	0.32275	0.34755	0.33745	0.31997

a The convention of reporting mortality rates to five decimal places is used here. **b** Based on average of the mortality rates implied by *ABS Life Tables* for 2004–2006 and 2005–2007 converted from an 'exact age' 'basis to an 'age-at-last-birthday' basis using the methodology outlined in PC(2005b). **c** 100 years and over.

Source: MMRF database based on: ABS (*Life Tables, Australia,* 2004–2006 and 2005–2007, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.12 **Mortality rates by age and state in the MMRF database, females, 2005-06**[a,b]

Probability of dying in the next year on an age-at-last-birthday basis

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
Newborns	0.00377	0.00390	0.00415	0.00334	0.00403	0.00267	0.00647	0.00528
0	0.00069	0.00066	0.00076	0.00061	0.00072	0.00053	0.00128	0.00090
1	0.00028	0.00020	0.00030	0.00023	0.00027	0.00028	0.00067	0.00029
2	0.00018	0.00014	0.00019	0.00016	0.00016	0.00021	0.00056	0.00022
3	0.00015	0.00012	0.00015	0.00013	0.00012	0.00018	0.00048	0.00018
4	0.00012	0.00010	0.00013	0.00010	0.00011	0.00016	0.00044	0.00014
5	0.00010	0.00009	0.00011	0.00009	0.00009	0.00014	0.00041	0.00013
6	0.00009	0.00007	0.00010	0.00008	0.00007	0.00012	0.00038	0.00011
7	0.00007	0.00006	0.00009	0.00007	0.00007	0.00011	0.00037	0.00010
8	0.00006	0.00006	0.00008	0.00007	0.00006	0.00010	0.00035	0.00009
9	0.00006	0.00006	0.00008	0.00007	0.00006	0.00010	0.00035	0.00008
10	0.00006	0.00007	0.00008	0.00007	0.00007	0.00011	0.00035	0.00008
11	0.00007	0.00007	0.00009	0.00008	0.00008	0.00012	0.00036	0.00009
12	0.00008	0.00009	0.00010	0.00010	0.00010	0.00013	0.00037	0.00010
13	0.00010	0.00011	0.00013	0.00013	0.00013	0.00016	0.00041	0.00012
14	0.00014	0.00015	0.00016	0.00017	0.00019	0.00020	0.00046	0.00014
15	0.00018	0.00019	0.00021	0.00021	0.00023	0.00025	0.00052	0.00018
16	0.00022	0.00023	0.00025	0.00025	0.00028	0.00029	0.00057	0.00020
17	0.00025	0.00026	0.00028	0.00028	0.00031	0.00032	0.00062	0.00023
18	0.00026	0.00027	0.00030	0.00030	0.00034	0.00034	0.00067	0.00024
19	0.00026	0.00027	0.00030	0.00030	0.00035	0.00035	0.00068	0.00024
20	0.00026	0.00027	0.00030	0.00030	0.00036	0.00036	0.00072	0.00023
21	0.00026	0.00027	0.00030	0.00030	0.00036	0.00036	0.00074	0.00023
22	0.00026	0.00027	0.00030	0.00030	0.00037	0.00037	0.00077	0.00022
23	0.00026	0.00027	0.00030	0.00030	0.00038	0.00037	0.00081	0.00022
24	0.00026	0.00027	0.00031	0.00031	0.00039	0.00039	0.00085	0.00022
25	0.00027	0.00029	0.00032	0.00032	0.00040	0.00040	0.00089	0.00022
26	0.00028	0.00029	0.00033	0.00032	0.00042	0.00042	0.00095	0.00024
27	0.00029	0.00031	0.00034	0.00034	0.00045	0.00044	0.00101	0.00024
28	0.00030	0.00032	0.00036	0.00036	0.00046	0.00047	0.00106	0.00026
29	0.00032	0.00034	0.00038	0.00038	0.00048	0.00049	0.00113	0.00027
30	0.00033	0.00035	0.00039	0.00039	0.00050	0.00052	0.00119	0.00028
31	0.00036	0.00038	0.00042	0.00042	0.00053	0.00055	0.00126	0.00030
32	0.00038	0.00040	0.00044	0.00045	0.00055	0.00058	0.00134	0.00032
33	0.00041	0.00043	0.00048	0.00048	0.00058	0.00062	0.00142	0.00034
34	0.00045	0.00047	0.00051	0.00052	0.00061	0.00067	0.00150	0.00038
35	0.00049	0.00050	0.00055	0.00056	0.00065	0.00072	0.00161	0.00042
36	0.00054	0.00056	0.00060	0.00062	0.00070	0.00078	0.00171	0.00046
37	0.00059	0.00061	0.00066	0.00067	0.00075	0.00084	0.00182	0.00050
38	0.00065	0.00067	0.00072	0.00074	0.00080	0.00090	0.00194	0.00056
39	0.00072	0.00072	0.00077	0.00080	0.00086	0.00098	0.00207	0.00061
40	0.00079	0.00080	0.00085	0.00088	0.00093	0.00107	0.00220	0.00068

(Continued next page)

Table 3.12 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
41	0.00087	0.00087	0.00093	0.00096	0.00099	0.00116	0.00235	0.00075
42	0.00096	0.00096	0.00101	0.00105	0.00107	0.00125	0.00251	0.00082
43	0.00106	0.00104	0.00110	0.00114	0.00115	0.00135	0.00267	0.00090
44	0.00114	0.00113	0.00120	0.00124	0.00124	0.00146	0.00285	0.00099
45	0.00126	0.00124	0.00130	0.00135	0.00133	0.00158	0.00303	0.00107
46	0.00138	0.00134	0.00142	0.00147	0.00144	0.00171	0.00324	0.00118
47	0.00149	0.00146	0.00153	0.00158	0.00154	0.00184	0.00344	0.00127
48	0.00163	0.00158	0.00166	0.00172	0.00166	0.00199	0.00366	0.00139
49	0.00177	0.00171	0.00179	0.00185	0.00178	0.00214	0.00390	0.00151
50	0.00193	0.00185	0.00195	0.00200	0.00191	0.00232	0.00416	0.00163
51	0.00210	0.00201	0.00211	0.00216	0.00206	0.00249	0.00443	0.00178
52	0.00227	0.00217	0.00228	0.00232	0.00221	0.00270	0.00472	0.00192
53	0.00246	0.00235	0.00246	0.00250	0.00237	0.00291	0.00503	0.00208
54	0.00267	0.00255	0.00267	0.00269	0.00256	0.00315	0.00538	0.00226
55	0.00293	0.00278	0.00290	0.00292	0.00278	0.00342	0.00577	0.00248
56	0.00320	0.00303	0.00317	0.00318	0.00302	0.00373	0.00620	0.00272
57	0.00351	0.00334	0.00348	0.00348	0.00331	0.00409	0.00668	0.00300
58	0.00387	0.00368	0.00382	0.00380	0.00363	0.00450	0.00721	0.00332
59	0.00427	0.00406	0.00421	0.00417	0.00399	0.00494	0.00781	0.00368
60	0.00470	0.00447	0.00463	0.00457	0.00438	0.00543	0.00844	0.00407
61	0.00517	0.00491	0.00509	0.00499	0.00480	0.00595	0.00913	0.00450
62	0.00564	0.00538	0.00556	0.00544	0.00523	0.00652	0.00985	0.00495
63	0.00618	0.00588	0.00608	0.00593	0.00571	0.00713	0.01064	0.00544
64	0.00675	0.00644	0.00664	0.00646	0.00624	0.00781	0.01150	0.00597
65	0.00739	0.00706	0.00727	0.00705	0.00681	0.00855	0.01244	0.00659
66	0.00811	0.00776	0.00798	0.00772	0.00747	0.00940	0.01350	0.00727
67	0.00893	0.00856	0.00879	0.00849	0.00821	0.01036	0.01466	0.00807
68	0.00986	0.00948	0.00971	0.00937	0.00907	0.01145	0.01598	0.00897
69	0.01093	0.01054	0.01078	0.01038	0.01006	0.01268	0.01746	0.01003
70	0.01214	0.01173	0.01198	0.01154	0.01118	0.01410	0.01912	0.01123
71	0.01353	0.01311	0.01336	0.01287	0.01247	0.01570	0.02098	0.01262
72	0.01510	0.01468	0.01493	0.01439	0.01393	0.01751	0.02307	0.01420
73	0.01689	0.01645	0.01671	0.01611	0.01560	0.01956	0.02541	0.01599
74	0.01894	0.01850	0.01876	0.01810	0.01752	0.02191	0.02804	0.01808
75	0.02130	0.02087	0.02112	0.02042	0.01975	0.02460	0.03104	0.02048
76	0.02405	0.02361	0.02387	0.02310	0.02234	0.02769	0.03445	0.02327
77	0.02723	0.02679	0.02704	0.02623	0.02535	0.03125	0.03834	0.02651
78	0.03088	0.03047	0.03072	0.02984	0.02883	0.03532	0.04277	0.03026
79	0.03509	0.03470	0.03493	0.03401	0.03284	0.03999	0.04776	0.03457
80	0.03989	0.03952	0.03975	0.03877	0.03743	0.04527	0.05341	0.03949

(Continued next page)

Table 3.12 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
81	0.04536	0.04501	0.04522	0.04421	0.04267	0.05127	0.05976	0.04510
82	0.05156	0.05125	0.05144	0.05039	0.04862	0.05803	0.06689	0.05145
83	0.05856	0.05829	0.05847	0.05738	0.05537	0.06563	0.07486	0.05865
84	0.06647	0.06625	0.06640	0.06528	0.06299	0.07418	0.08377	0.06678
85	0.07545	0.07528	0.07542	0.07428	0.07168	0.08385	0.09380	0.07600
86	0.08568	0.08558	0.08566	0.08453	0.08158	0.09478	0.10508	0.08648
87	0.09713	0.09710	0.09716	0.09603	0.09271	0.10697	0.11760	0.09823
88	0.10978	0.10984	0.10987	0.10874	0.10501	0.12042	0.13138	0.11122
89	0.12362	0.12377	0.12374	0.12265	0.11848	0.13502	0.14630	0.12538
90	0.13857	0.13881	0.13875	0.13771	0.13306	0.15080	0.16238	0.14070
91	0.15455	0.15490	0.15476	0.15379	0.14864	0.16762	0.17942	0.15707
92	0.17081	0.17127	0.17111	0.17019	0.16449	0.18480	0.19684	0.17378
93	0.18694	0.18747	0.18727	0.18642	0.18016	0.20177	0.21410	0.19032
94	0.20173	0.20272	0.20286	0.19999	0.19596	0.21473	0.22646	0.21079
95	0.21779	0.21878	0.21897	0.21601	0.21162	0.23138	0.24333	0.22773
96	0.23439	0.23555	0.23558	0.23247	0.22788	0.24848	0.26072	0.24540
97	0.25071	0.25200	0.25211	0.24893	0.24370	0.26542	0.27805	0.26273
98	0.26702	0.26832	0.26848	0.26512	0.25969	0.28243	0.29510	0.28003
99	0.28440	0.28571	0.28591	0.28236	0.27673	0.30053	0.31320	0.29847
100+[c]	0.32013	0.32182	0.32122	0.32180	0.30958	0.34271	0.35468	0.32727

[a] The convention of reporting mortality rates to five decimal places is used here. [b] Based on average of the mortality rates implied by *ABS Life Tables* for 2004–2006 and 2005–2007 converted from an 'exact age' 'basis to an 'age-at-last-birthday' basis using the methodology outlined in PC(2005b). [c] 100 years and over.

Source: MMRF database based on: ABS (*Life Tables, Australia,* 2004–2006 and 2005–2007, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.13 **Annual change in mortality rates by age and state in the MMRF database, males, 2005-06**[a]

Per cent per year

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
Newborns	-3.93	-3.93	-3.93	-3.93	-3.93	-3.93	-5.90	-3.93
0	-3.94	-3.94	-3.94	-3.94	-3.94	-3.94	-5.91	-3.94
1	-3.95	-3.95	-3.95	-3.95	-3.95	-3.95	-5.92	-3.95
2	-3.95	-3.95	-3.95	-3.95	-3.95	-3.95	-5.93	-3.95
3	-3.95	-3.95	-3.95	-3.95	-3.95	-3.95	-5.93	-3.95
4	-3.94	-3.94	-3.94	-3.94	-3.94	-3.94	-5.91	-3.94
5	-3.92	-3.92	-3.92	-3.92	-3.92	-3.92	-5.88	-3.92
6	-3.89	-3.89	-3.89	-3.89	-3.89	-3.89	-5.83	-3.89
7	-3.84	-3.84	-3.84	-3.84	-3.84	-3.84	-5.76	-3.84
8	-3.79	-3.79	-3.79	-3.79	-3.79	-3.79	-5.68	-3.79
9	-3.73	-3.73	-3.73	-3.73	-3.73	-3.73	-5.59	-3.73
10	-3.66	-3.66	-3.66	-3.66	-3.66	-3.66	-5.49	-3.66
11	-3.59	-3.59	-3.59	-3.59	-3.59	-3.59	-5.39	-3.59
12	-3.52	-3.52	-3.52	-3.52	-3.52	-3.52	-5.28	-3.52
13	-3.45	-3.45	-3.45	-3.45	-3.45	-3.45	-5.17	-3.45
14	-3.38	-3.38	-3.38	-3.38	-3.38	-3.38	-5.07	-3.38
15	-3.31	-3.31	-3.31	-3.31	-3.31	-3.31	-4.96	-3.31
16	-3.23	-3.23	-3.23	-3.23	-3.23	-3.23	-4.85	-3.23
17	-3.14	-3.14	-3.14	-3.14	-3.14	-3.14	-4.71	-3.14
18	-3.04	-3.04	-3.04	-3.04	-3.04	-3.04	-4.55	-3.04
19	-2.90	-2.90	-2.90	-2.90	-2.90	-2.90	-4.36	-2.90
20	-2.75	-2.75	-2.75	-2.75	-2.75	-2.75	-4.12	-2.75
21	-2.57	-2.57	-2.57	-2.57	-2.57	-2.57	-3.85	-2.57
22	-2.37	-2.37	-2.37	-2.37	-2.37	-2.37	-3.56	-2.37
23	-2.17	-2.17	-2.17	-2.17	-2.17	-2.17	-3.25	-2.17
24	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-2.95	-1.96
25	-1.77	-1.77	-1.77	-1.77	-1.77	-1.77	-2.66	-1.77
26	-1.60	-1.60	-1.60	-1.60	-1.60	-1.60	-2.40	-1.60
27	-1.45	-1.45	-1.45	-1.45	-1.45	-1.45	-2.17	-1.45
28	-1.33	-1.33	-1.33	-1.33	-1.33	-1.33	-2.00	-1.33
29	-1.24	-1.24	-1.24	-1.24	-1.24	-1.24	-1.86	-1.24
30	-1.19	-1.19	-1.19	-1.19	-1.19	-1.19	-1.78	-1.19
31	-1.16	-1.16	-1.16	-1.16	-1.16	-1.16	-1.74	-1.16
32	-1.17	-1.17	-1.17	-1.17	-1.17	-1.17	-1.75	-1.17
33	-1.20	-1.20	-1.20	-1.20	-1.20	-1.20	-1.80	-1.20
34	-1.26	-1.26	-1.26	-1.26	-1.26	-1.26	-1.89	-1.26
35	-1.33	-1.33	-1.33	-1.33	-1.33	-1.33	-2.00	-1.33
36	-1.43	-1.43	-1.43	-1.43	-1.43	-1.43	-2.14	-1.43
37	-1.53	-1.53	-1.53	-1.53	-1.53	-1.53	-2.29	-1.53
38	-1.63	-1.63	-1.63	-1.63	-1.63	-1.63	-2.45	-1.63
39	-1.74	-1.74	-1.74	-1.74	-1.74	-1.74	-2.61	-1.74
40	-1.85	-1.85	-1.85	-1.85	-1.85	-1.85	-2.78	-1.85

(Continued next page)

Table 3.13 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
41	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-2.94	-1.96
42	-2.07	-2.07	-2.07	-2.07	-2.07	-2.07	-3.10	-2.07
43	-2.16	-2.16	-2.16	-2.16	-2.16	-2.16	-3.24	-2.16
44	-2.26	-2.26	-2.26	-2.26	-2.26	-2.26	-3.38	-2.26
45	-2.34	-2.34	-2.34	-2.34	-2.34	-2.34	-3.51	-2.34
46	-2.42	-2.42	-2.42	-2.42	-2.42	-2.42	-3.63	-2.42
47	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-3.74	-2.49
48	-2.56	-2.56	-2.56	-2.56	-2.56	-2.56	-3.84	-2.56
49	-2.63	-2.63	-2.63	-2.63	-2.63	-2.63	-3.94	-2.63
50	-2.69	-2.69	-2.69	-2.69	-2.69	-2.69	-4.03	-2.69
51	-2.75	-2.75	-2.75	-2.75	-2.75	-2.75	-4.12	-2.75
52	-2.80	-2.80	-2.80	-2.80	-2.80	-2.80	-4.21	-2.80
53	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-4.29	-2.86
54	-2.91	-2.91	-2.91	-2.91	-2.91	-2.91	-4.36	-2.91
55	-2.95	-2.95	-2.95	-2.95	-2.95	-2.95	-4.43	-2.95
56	-2.99	-2.99	-2.99	-2.99	-2.99	-2.99	-4.49	-2.99
57	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-4.53	-3.02
58	-3.05	-3.05	-3.05	-3.05	-3.05	-3.05	-4.57	-3.05
59	-3.06	-3.06	-3.06	-3.06	-3.06	-3.06	-4.59	-3.06
60	-3.07	-3.07	-3.07	-3.07	-3.07	-3.07	-4.61	-3.07
61	-3.07	-3.07	-3.07	-3.07	-3.07	-3.07	-4.61	-3.07
62	-3.07	-3.07	-3.07	-3.07	-3.07	-3.07	-4.60	-3.07
63	-3.05	-3.05	-3.05	-3.05	-3.05	-3.05	-4.58	-3.05
64	-3.04	-3.04	-3.04	-3.04	-3.04	-3.04	-4.55	-3.04
65	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-4.52	-3.01
66	-2.99	-2.99	-2.99	-2.99	-2.99	-2.99	-4.48	-2.99
67	-2.96	-2.96	-2.96	-2.96	-2.96	-2.96	-4.43	-2.96
68	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92	-4.38	-2.92
69	-2.88	-2.88	-2.88	-2.88	-2.88	-2.88	-4.32	-2.88
70	-2.84	-2.84	-2.84	-2.84	-2.84	-2.84	-4.26	-2.84
71	-2.79	-2.79	-2.79	-2.79	-2.79	-2.79	-4.18	-2.79
72	-2.73	-2.73	-2.73	-2.73	-2.73	-2.73	-4.10	-2.73
73	-2.67	-2.67	-2.67	-2.67	-2.67	-2.67	-4.00	-2.67
74	-2.60	-2.60	-2.60	-2.60	-2.60	-2.60	-3.89	-2.60
75	-2.51	-2.51	-2.51	-2.51	-2.51	-2.51	-3.77	-2.51
76	-2.43	-2.43	-2.43	-2.43	-2.43	-2.43	-3.64	-2.43
77	-2.33	-2.33	-2.33	-2.33	-2.33	-2.33	-3.50	-2.33
78	-2.23	-2.23	-2.23	-2.23	-2.23	-2.23	-3.35	-2.23
79	-2.13	-2.13	-2.13	-2.13	-2.13	-2.13	-3.20	-2.13
80	-2.03	-2.03	-2.03	-2.03	-2.03	-2.03	-3.04	-2.03

(Continued next page)

Table 3.13 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
81	-1.92	-1.92	-1.92	-1.92	-1.92	-1.92	-2.88	-1.92
82	-1.81	-1.81	-1.81	-1.81	-1.81	-1.81	-2.72	-1.81
83	-1.71	-1.71	-1.71	-1.71	-1.71	-1.71	-2.56	-1.71
84	-1.60	-1.60	-1.60	-1.60	-1.60	-1.60	-2.40	-1.60
85	-1.49	-1.49	-1.49	-1.49	-1.49	-1.49	-2.24	-1.49
86	-1.39	-1.39	-1.39	-1.39	-1.39	-1.39	-2.08	-1.39
87	-1.28	-1.28	-1.28	-1.28	-1.28	-1.28	-1.92	-1.28
88	-1.18	-1.18	-1.18	-1.18	-1.18	-1.18	-1.77	-1.18
89	-1.07	-1.07	-1.07	-1.07	-1.07	-1.07	-1.61	-1.07
90	-0.98	-0.98	-0.98	-0.98	-0.98	-0.98	-1.46	-0.98
91	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-1.32	-0.88
92	-0.80	-0.80	-0.80	-0.80	-0.80	-0.80	-1.20	-0.80
93	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-1.10	-0.73
94	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-1.02	-0.68
95	-0.65	-0.65	-0.65	-0.65	-0.65	-0.65	-0.97	-0.65
96	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.96	-0.64
97	-0.65	-0.65	-0.65	-0.65	-0.65	-0.65	-0.97	-0.65
98	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-1.02	-0.68
99	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-1.09	-0.73
100+[c]	-0.79	-0.79	-0.79	-0.79	-0.79	-0.79	-1.18	-0.79

a Owing to the limited time series of ABS *Life Tables* by state, the annual average reduction in age-specific mortality rates for Australia between 1970–1972 and 2007–2009 are used. Improvement factors are estimated using the methodology outlined in Australian Government Actuary (2009, p. 35) and are smoothed using a Hodrick-Prescott filter. **b** Assumed to improve at a 50 per cent faster rate than the rest of Australia. **c** 100 years and over.

Source: MMRF database based on: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Life Tables, Australia,* 2007–2009, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.14 **Annual change in mortality rates by age and state in the MMRF database, females, 2005-06**[a]

Per cent per year

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
Newborns	-3.96	-3.96	-3.96	-3.96	-3.96	-3.96	-5.94	-3.96
0	-3.95	-3.95	-3.95	-3.95	-3.95	-3.95	-5.93	-3.95
1	-3.94	-3.94	-3.94	-3.94	-3.94	-3.94	-5.91	-3.94
2	-3.91	-3.91	-3.91	-3.91	-3.91	-3.91	-5.87	-3.91
3	-3.87	-3.87	-3.87	-3.87	-3.87	-3.87	-5.81	-3.87
4	-3.82	-3.82	-3.82	-3.82	-3.82	-3.82	-5.73	-3.82
5	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-5.62	-3.75
6	-3.66	-3.66	-3.66	-3.66	-3.66	-3.66	-5.49	-3.66
7	-3.56	-3.56	-3.56	-3.56	-3.56	-3.56	-5.34	-3.56
8	-3.45	-3.45	-3.45	-3.45	-3.45	-3.45	-5.18	-3.45
9	-3.34	-3.34	-3.34	-3.34	-3.34	-3.34	-5.01	-3.34
10	-3.22	-3.22	-3.22	-3.22	-3.22	-3.22	-4.83	-3.22
11	-3.11	-3.11	-3.11	-3.11	-3.11	-3.11	-4.67	-3.11
12	-3.01	-3.01	-3.01	-3.01	-3.01	-3.01	-4.52	-3.01
13	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92	-4.38	-2.92
14	-2.84	-2.84	-2.84	-2.84	-2.84	-2.84	-4.26	-2.84
15	-2.76	-2.76	-2.76	-2.76	-2.76	-2.76	-4.14	-2.76
16	-2.69	-2.69	-2.69	-2.69	-2.69	-2.69	-4.04	-2.69
17	-2.62	-2.62	-2.62	-2.62	-2.62	-2.62	-3.93	-2.62
18	-2.54	-2.54	-2.54	-2.54	-2.54	-2.54	-3.81	-2.54
19	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-3.69	-2.46
20	-2.37	-2.37	-2.37	-2.37	-2.37	-2.37	-3.56	-2.37
21	-2.29	-2.29	-2.29	-2.29	-2.29	-2.29	-3.43	-2.29
22	-2.20	-2.20	-2.20	-2.20	-2.20	-2.20	-3.31	-2.20
23	-2.12	-2.12	-2.12	-2.12	-2.12	-2.12	-3.19	-2.12
24	-2.05	-2.05	-2.05	-2.05	-2.05	-2.05	-3.08	-2.05
25	-1.99	-1.99	-1.99	-1.99	-1.99	-1.99	-2.99	-1.99
26	-1.94	-1.94	-1.94	-1.94	-1.94	-1.94	-2.91	-1.94
27	-1.91	-1.91	-1.91	-1.91	-1.91	-1.91	-2.87	-1.91
28	-1.89	-1.89	-1.89	-1.89	-1.89	-1.89	-2.84	-1.89
29	-1.90	-1.90	-1.90	-1.90	-1.90	-1.90	-2.84	-1.90
30	-1.91	-1.91	-1.91	-1.91	-1.91	-1.91	-2.87	-1.91
31	-1.94	-1.94	-1.94	-1.94	-1.94	-1.94	-2.91	-1.94
32	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-2.96	-1.97
33	-2.02	-2.02	-2.02	-2.02	-2.02	-2.02	-3.03	-2.02
34	-2.06	-2.06	-2.06	-2.06	-2.06	-2.06	-3.10	-2.06
35	-2.11	-2.11	-2.11	-2.11	-2.11	-2.11	-3.17	-2.11
36	-2.16	-2.16	-2.16	-2.16	-2.16	-2.16	-3.24	-2.16
37	-2.20	-2.20	-2.20	-2.20	-2.20	-2.20	-3.31	-2.20
38	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24	-3.37	-2.24
39	-2.28	-2.28	-2.28	-2.28	-2.28	-2.28	-3.42	-2.28
40	-2.31	-2.31	-2.31	-2.31	-2.31	-2.31	-3.46	-2.31

(Continued next page)

Table 3.14 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
41	-2.33	-2.33	-2.33	-2.33	-2.33	-2.33	-3.50	-2.33
42	-2.35	-2.35	-2.35	-2.35	-2.35	-2.35	-3.53	-2.35
43	-2.37	-2.37	-2.37	-2.37	-2.37	-2.37	-3.56	-2.37
44	-2.39	-2.39	-2.39	-2.39	-2.39	-2.39	-3.58	-2.39
45	-2.40	-2.40	-2.40	-2.40	-2.40	-2.40	-3.61	-2.40
46	-2.42	-2.42	-2.42	-2.42	-2.42	-2.42	-3.63	-2.42
47	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-3.65	-2.44
48	-2.45	-2.45	-2.45	-2.45	-2.45	-2.45	-3.68	-2.45
49	-2.47	-2.47	-2.47	-2.47	-2.47	-2.47	-3.70	-2.47
50	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-3.73	-2.49
51	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-3.75	-2.50
52	-2.52	-2.52	-2.52	-2.52	-2.52	-2.52	-3.78	-2.52
53	-2.53	-2.53	-2.53	-2.53	-2.53	-2.53	-3.80	-2.53
54	-2.54	-2.54	-2.54	-2.54	-2.54	-2.54	-3.81	-2.54
55	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.82	-2.55
56	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.83	-2.55
57	-2.56	-2.56	-2.56	-2.56	-2.56	-2.56	-3.83	-2.56
58	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.83	-2.55
59	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.83	-2.55
60	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.82	-2.55
61	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.82	-2.55
62	-2.54	-2.54	-2.54	-2.54	-2.54	-2.54	-3.82	-2.54
63	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.82	-2.55
64	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.82	-2.55
65	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.83	-2.55
66	-2.56	-2.56	-2.56	-2.56	-2.56	-2.56	-3.84	-2.56
67	-2.57	-2.57	-2.57	-2.57	-2.57	-2.57	-3.86	-2.57
68	-2.58	-2.58	-2.58	-2.58	-2.58	-2.58	-3.87	-2.58
69	-2.59	-2.59	-2.59	-2.59	-2.59	-2.59	-3.89	-2.59
70	-2.60	-2.60	-2.60	-2.60	-2.60	-2.60	-3.90	-2.60
71	-2.60	-2.60	-2.60	-2.60	-2.60	-2.60	-3.90	-2.60
72	-2.60	-2.60	-2.60	-2.60	-2.60	-2.60	-3.89	-2.60
73	-2.58	-2.58	-2.58	-2.58	-2.58	-2.58	-3.87	-2.58
74	-2.56	-2.56	-2.56	-2.56	-2.56	-2.56	-3.84	-2.56
75	-2.53	-2.53	-2.53	-2.53	-2.53	-2.53	-3.79	-2.53
76	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-3.73	-2.49
77	-2.43	-2.43	-2.43	-2.43	-2.43	-2.43	-3.65	-2.43
78	-2.36	-2.36	-2.36	-2.36	-2.36	-2.36	-3.54	-2.36
79	-2.28	-2.28	-2.28	-2.28	-2.28	-2.28	-3.42	-2.28
80	-2.19	-2.19	-2.19	-2.19	-2.19	-2.19	-3.29	-2.19

(Continued next page)

Table 3.14 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
81	-2.09	-2.09	-2.09	-2.09	-2.09	-2.09	-3.13	-2.09
82	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-2.96	-1.97
83	-1.84	-1.84	-1.84	-1.84	-1.84	-1.84	-2.76	-1.84
84	-1.70	-1.70	-1.70	-1.70	-1.70	-1.70	-2.55	-1.70
85	-1.55	-1.55	-1.55	-1.55	-1.55	-1.55	-2.32	-1.55
86	-1.39	-1.39	-1.39	-1.39	-1.39	-1.39	-2.08	-1.39
87	-1.23	-1.23	-1.23	-1.23	-1.23	-1.23	-1.84	-1.23
88	-1.07	-1.07	-1.07	-1.07	-1.07	-1.07	-1.61	-1.07
89	-0.93	-0.93	-0.93	-0.93	-0.93	-0.93	-1.39	-0.93
90	-0.81	-0.81	-0.81	-0.81	-0.81	-0.81	-1.21	-0.81
91	-0.73	-0.73	-0.73	-0.73	-0.73	-0.73	-1.09	-0.73
92	-0.70	-0.70	-0.70	-0.70	-0.70	-0.70	-1.05	-0.70
93	-0.74	-0.74	-0.74	-0.74	-0.74	-0.74	-1.12	-0.74
94	-0.87	-0.87	-0.87	-0.87	-0.87	-0.87	-1.31	-0.87
95	-1.11	-1.11	-1.11	-1.11	-1.11	-1.11	-1.66	-1.11
96	-1.46	-1.46	-1.46	-1.46	-1.46	-1.46	-2.18	-1.46
97	-1.93	-1.93	-1.93	-1.93	-1.93	-1.93	-2.89	-1.93
98	-2.52	-2.52	-2.52	-2.52	-2.52	-2.52	-3.78	-2.52
99	-3.21	-3.21	-3.21	-3.21	-3.21	-3.21	-4.82	-3.21
100+[c]	-3.97	-3.97	-3.97	-3.97	-3.97	-3.97	-5.95	-3.97

a Owing to the limited time series of ABS *Life Tables* by state, the annual average reduction in age-specific mortality rates for Australia between 1970–1972 and 2007–2009 are used. Improvement factors are estimated using the methodology outlined in Australian Government Actuary (2009, p. 35) and are smoothed using a Hodrick-Prescott filter. **b** Assumed to improve at a 50 per cent faster rate than the rest of Australia. **c** 100 years and over.

Source: MMRF database based on: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Life Tables, Australia,* 2007–2009, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.15 **Net overseas migration by age and state in the MMRF database, males, 2005-06**[a]

Thousand

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
0	0.2	0.3	0.3	0.1	0.2	…	…	…	1.0
1	0.2	0.3	0.3	0.1	0.2	…	…	…	1.0
2	0.2	0.3	0.3	0.1	0.2	…	…	…	1.0
3	0.2	0.3	0.3	0.1	0.2	…	…	…	1.0
4	0.2	0.3	0.3	0.1	0.2	…	…	…	1.0
5	0.3	0.3	0.3	0.1	0.2	…	…	…	1.1
6	0.3	0.3	0.3	0.1	0.2	…	…	…	1.1
7	0.3	0.3	0.3	0.1	0.2	…	…	…	1.1
8	0.3	0.3	0.3	0.1	0.2	…	…	…	1.1
9	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
10	0.2	0.2	0.3	0.1	0.2	…	…	…	1.0
11	0.2	0.2	0.3	0.1	0.2	…	…	…	1.0
12	0.2	0.2	0.3	0.1	0.2	…	…	…	1.0
13	0.2	0.2	0.3	0.1	0.2	…	…	…	1.0
14	0.2	0.2	0.3	0.1	0.2	…	…	…	1.1
15	0.7	0.8	0.4	0.1	0.3	…	…	…	2.2
16	0.7	0.8	0.4	0.1	0.3	…	…	…	2.2
17	0.7	0.8	0.4	0.1	0.3	…	…	…	2.2
18	0.6	0.8	0.4	0.1	0.3	…	…	…	2.2
19	0.7	0.8	0.4	0.1	0.3	…	…	…	2.2
20	0.9	0.9	0.5	0.1	0.2	…	…	…	2.6
21	0.9	0.9	0.5	0.1	0.2	…	…	…	2.6
22	0.9	0.9	0.5	0.1	0.2	…	…	…	2.6
23	0.9	0.9	0.5	0.1	0.2	…	…	…	2.6
24	0.9	0.9	0.5	0.1	0.2	…	…	…	2.6
25	0.6	0.5	0.4	0.1	0.2	…	0.1	…	1.9
26	0.6	0.4	0.4	0.1	0.2	…	0.1	…	1.8
27	0.6	0.4	0.4	0.1	0.2	…	0.1	…	1.8
28	0.6	0.4	0.4	0.1	0.2	…	0.1	…	1.8
29	0.6	0.4	0.4	0.1	0.2	…	0.1	…	1.8
30	0.4	0.4	0.4	0.1	0.3	…	…	…	1.6
31	0.4	0.4	0.4	0.1	0.3	…	…	…	1.7
32	0.4	0.4	0.4	0.1	0.3	…	…	…	1.7
33	0.4	0.4	0.4	0.1	0.3	…	…	…	1.8
34	0.4	0.5	0.4	0.1	0.3	…	…	…	1.8
35	0.2	0.3	0.3	0.1	0.3	…	…	…	1.4
36	0.2	0.3	0.3	0.1	0.3	…	…	…	1.3
37	0.2	0.3	0.3	0.1	0.3	…	…	…	1.3
38	0.2	0.3	0.3	0.1	0.3	…	…	…	1.3
39	0.2	0.3	0.3	0.1	0.3	…	…	…	1.3
40	0.1	0.2	0.2	0.1	0.2	…	…	…	0.8

(Continued next page)

Table 3.15 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
41	0.1	0.2	0.2	0.1	0.2	…	…	…	0.9
42	0.1	0.2	0.2	0.1	0.2	…	…	…	0.9
43	0.1	0.2	0.2	0.1	0.2	…	…	…	0.9
44	0.1	0.2	0.2	0.1	0.2	…	…	…	0.9
45	…	0.1	0.1	…	0.1	…	…	…	0.4
46	…	0.1	0.1	…	0.1	…	…	…	0.4
47	…	0.1	0.1	…	0.1	…	…	…	0.4
48	…	0.1	0.1	…	0.1	…	…	…	0.4
49	…	0.1	0.1	…	0.1	…	…	…	0.4
50	…	…	0.1	…	…	…	…	…	0.1
51	…	…	0.1	…	…	…	…	…	0.1
52	…	…	0.1	…	…	…	…	…	0.1
53	…	…	0.1	…	…	…	…	…	0.1
54	…	…	0.1	…	…	…	…	…	0.1
55	…	…	…	…	…	…	…	…	0.1
56	…	…	…	…	…	…	…	…	0.1
57	…	…	…	…	…	…	…	…	0.1
58	…	…	…	…	…	…	…	…	0.1
59	…	…	…	…	…	…	…	…	0.1
60	…	…	…	…	…	…	…	…	0.1
61	…	…	…	…	…	…	…	…	0.1
62	…	…	…	…	…	…	…	…	0.1
63	…	…	…	…	…	…	…	…	0.1
64	…	…	…	…	…	…	…	…	0.1
65	…	…	…	…	…	…	…	…	…
66	…	…	…	…	…	…	…	…	…
67	…	…	…	…	…	…	…	…	…
68	…	…	…	…	…	…	…	…	…
69	…	…	…	…	…	…	…	…	…
70	…	…	…	…	…	…	…	…	…
71	…	…	…	…	…	…	…	…	…
72	…	…	…	…	…	…	…	…	…
73	…	…	…	…	…	…	…	…	…
74	…	…	…	…	…	…	…	…	…
75	…	…	…	…	…	…	…	…	…
76	…	…	…	…	…	…	…	…	…
77	…	…	…	…	…	…	…	…	…
78	…	…	…	…	…	…	…	…	…
79	…	…	…	…	…	…	…	…	…
80	…	…	…	…	…	…	…	…	…

(Continued next page)

Table 3.15 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
81	…	…	…	…	…	…	…	…	…
82	…	…	…	…	…	…	…	…	…
83	…	…	…	…	…	…	…	…	…
84	…	…	…	…	…	…	…	…	…
85	…	…	…	…	…	…	…	…	…
86	…	…	…	…	…	…	…	…	…
87	…	…	…	…	…	…	…	…	…
88	…	…	…	…	…	…	…	…	…
89	…	…	…	…	…	…	…	…	…
90	…	…	…	…	…	…	…	…	…
91	…	…	…	…	…	…	…	…	…
92	…	…	…	…	…	…	…	…	…
93	…	…	…	…	…	…	…	…	…
94	…	…	…	…	…	…	…	…	…
95	…	…	…	…	…	…	…	…	…
96	…	…	…	…	…	…	…	…	…
97	…	…	…	…	…	…	…	…	…
98	…	…	…	…	…	…	…	…	…
99	…	…	…	…	…	…	…	…	…
100+[c]	…	…	…	…	…	…	…	…	…
Total	**18.0**	**20.5**	**16.1**	**4.7**	**11.3**	**0.5**	**0.7**	**0.2**	**72.1**

… zero or less than 500. [a] Net overseas migration by state published by five-year age groups scaled to align with the latest revised total net overseas migration published for that state. This approach assumes that 'category jumping' is distributed in proportion to *NOM arrivals* less *NOM departures*. The resulting measure of net overseas migration for each age group is allocated to individual years of age using the age and gender distribution of the existing population in that state. [b] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories)*. [c] 100 years and over.

Source: MMRF database based on: ABS (NOM (*improved method) Arrivals and Departures by State/territory, Age and sex, Calendar and financial years*, 2010); ABS (*Migration, Australia*, 2008-09, Cat. no. 3412.0); ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001).

Table 3.16 **Net overseas migration by age and state in the MMRF database, females, 2005-06**[a]

Thousand

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
0	0.2	0.2	0.3	0.1	0.2	…	…	…	1.0
1	0.2	0.2	0.2	0.1	0.2	…	…	…	1.0
2	0.2	0.2	0.2	0.1	0.2	…	…	…	1.0
3	0.2	0.2	0.2	0.1	0.2	…	…	…	1.0
4	0.2	0.2	0.3	0.1	0.2	…	…	…	1.0
5	0.2	0.2	0.3	0.1	0.2	…	…	…	1.1
6	0.2	0.2	0.3	0.1	0.2	…	…	…	1.1
7	0.2	0.2	0.3	0.1	0.2	…	…	…	1.1
8	0.2	0.2	0.3	0.1	0.2	…	…	…	1.1
9	0.2	0.2	0.3	0.1	0.2	…	…	…	1.1
10	0.2	0.2	0.2	0.1	0.2	…	…	…	1.0
11	0.2	0.2	0.2	0.1	0.2	…	…	…	1.0
12	0.2	0.2	0.2	0.1	0.2	…	…	…	1.0
13	0.2	0.2	0.2	0.1	0.2	…	…	…	1.0
14	0.2	0.2	0.3	0.1	0.2	…	…	…	1.0
15	0.6	0.6	0.4	0.1	0.2	…	…	…	2.0
16	0.6	0.6	0.4	0.1	0.2	…	…	…	2.0
17	0.6	0.6	0.4	0.1	0.2	…	…	…	2.0
18	0.6	0.6	0.4	0.1	0.2	…	…	…	2.0
19	0.6	0.7	0.4	0.1	0.2	…	…	…	2.0
20	0.9	0.5	0.4	0.1	0.2	…	…	…	2.2
21	0.9	0.5	0.4	0.1	0.2	…	…	…	2.2
22	0.9	0.5	0.4	0.1	0.2	…	…	…	2.2
23	0.9	0.5	0.4	0.1	0.2	…	…	…	2.2
24	0.9	0.5	0.4	0.1	0.2	…	…	…	2.2
25	0.8	0.6	0.5	0.1	0.3	…	0.1	…	2.5
26	0.8	0.6	0.5	0.1	0.3	…	0.1	…	2.5
27	0.8	0.6	0.5	0.1	0.3	…	0.1	…	2.4
28	0.8	0.6	0.5	0.1	0.3	…	0.1	…	2.5
29	0.8	0.6	0.5	0.1	0.3	…	0.1	…	2.5
30	0.5	0.5	0.4	0.1	0.3	…	…	…	1.8
31	0.5	0.5	0.4	0.1	0.3	…	…	…	1.9
32	0.5	0.5	0.5	0.1	0.3	…	…	…	1.9
33	0.5	0.5	0.5	0.1	0.3	…	…	…	2.0
34	0.5	0.5	0.5	0.2	0.3	…	…	…	2.1
35	0.3	0.3	0.4	0.1	0.3	…	…	…	1.4
36	0.3	0.3	0.4	0.1	0.3	…	…	…	1.4
37	0.3	0.3	0.3	0.1	0.3	…	…	…	1.4
38	0.3	0.3	0.3	0.1	0.3	…	…	…	1.3
39	0.3	0.3	0.3	0.1	0.3	…	…	…	1.3
40	0.2	0.2	0.2	0.1	0.2	…	…	…	0.9

(Continued next page)

Table 3.16 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
41	0.2	0.2	0.2	0.1	0.2	…	…	…	0.9
42	0.2	0.2	0.2	0.1	0.2	…	…	…	0.9
43	0.2	0.2	0.2	0.1	0.2	…	…	…	0.9
44	0.2	0.2	0.2	0.1	0.2	…	…	…	0.9
45	0.1	0.1	0.1	…	0.1	…	…	…	0.4
46	0.1	0.1	0.1	…	0.1	…	…	…	0.4
47	0.1	0.1	0.1	…	0.1	…	…	…	0.4
48	0.1	0.1	0.1	…	0.1	…	…	…	0.4
49	0.1	0.1	0.1	…	0.1	…	…	…	0.4
50	0.1	0.1	0.1	…	…	…	…	…	0.2
51	0.1	0.1	0.1	…	…	…	…	…	0.2
52	…	0.1	0.1	…	…	…	…	…	0.2
53	…	0.1	0.1	…	…	…	…	…	0.2
54	…	0.1	0.1	…	…	…	…	…	0.2
55	…	…	…	…	…	…	…	…	0.2
56	…	…	…	…	…	…	…	…	0.2
57	…	…	…	…	…	…	…	…	0.2
58	…	…	…	…	…	…	…	…	0.2
59	…	…	…	…	…	…	…	…	0.2
60	…	…	…	…	…	…	…	…	0.1
61	…	…	…	…	…	…	…	…	0.1
62	…	…	…	…	…	…	…	…	0.1
63	…	…	…	…	…	…	…	…	0.1
64	…	…	…	…	…	…	…	…	0.1
65	…	…	…	…	…	…	…	…	…
66	…	…	…	…	…	…	…	…	…
67	…	…	…	…	…	…	…	…	…
68	…	…	…	…	…	…	…	…	…
69	…	…	…	…	…	…	…	…	…
70	…	…	…	…	…	…	…	…	…
71	…	…	…	…	…	…	…	…	…
72	…	…	…	…	…	…	…	…	…
73	…	…	…	…	…	…	…	…	…
74	…	…	…	…	…	…	…	…	…
75	…	…	…	…	…	…	…	…	…
76	…	…	…	…	…	…	…	…	…
77	…	…	…	…	…	…	…	…	…
78	…	…	…	…	…	…	…	…	…
79	…	…	…	…	…	…	…	…	…
80	…	…	…	…	…	…	…	…	…

(Continued next page)

Table 3.16 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
81	…	…	…	…	…	…	…	…	…
82	…	…	…	…	…	…	…	…	…
83	…	…	…	…	…	…	…	…	…
84	…	…	…	…	…	…	…	…	…
85	…	…	…	…	…	…	…	…	…
86	…	…	…	…	…	…	…	…	…
87	…	…	…	…	…	…	…	…	…
88	…	…	…	…	…	…	…	…	…
89	…	…	…	…	…	…	…	…	…
90	…	…	…	…	…	…	…	…	…
91	…	…	…	…	…	…	…	…	…
92	…	…	…	…	…	…	…	…	…
93	…	…	…	…	…	…	…	…	…
94	…	…	…	…	…	…	…	…	…
95	…	…	…	…	…	…	…	…	…
96	…	…	…	…	…	…	…	…	…
97	…	…	…	…	…	…	…	…	…
98	…	…	…	…	…	…	…	…	…
99	…	…	…	…	…	…	…	…	…
100+[c]	…	…	…	…	…	…	…	…	…
Total	**20.5**	**19.0**	**16.8**	**5.1**	**11.0**	**0.6**	**1.2**	**0.3**	**74.6**

… zero or less than 500. [a] Net overseas migration by state published by five-year age groups scaled to align with the latest revised total net overseas migration published for that state. This approach assumes that 'Category jumping' is distributed in proportion to *NOM arrivals* less *NOM departures*. The resulting measure of net overseas migration for each age group is allocated to individual years of age using the age and gender distribution of the existing population in that state. [b] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories).* [c] 100 years and over.

Source: MMRF database based on: ABS (NOM (*improved method) Arrivals and Departures by State/territory, Age and sex, Calendar and financial years*, 2010); ABS (*Migration, Australia*, 2008-09, Cat. no. 3412.0); ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001).

Table 3.17 **Net interstate migration by age and state in the MMRF database, males, 2005-06**[a]

Thousand

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
0	-0.3	…	0.2	…	0.1	…	…	…	…
1	-0.3	…	0.2	…	…	…	…	…	…
2	-0.2	…	0.2	…	…	…	…	…	…
3	-0.3	…	0.2	…	…	…	…	…	…
4	-0.3	…	0.2	…	0.1	…	…	…	…
5	-0.2	…	0.2	…	…	…	…	…	…
6	-0.2	…	0.2	…	…	…	…	…	…
7	-0.2	…	0.2	…	…	…	…	…	…
8	-0.2	…	0.2	…	…	…	…	…	…
9	-0.2	…	0.2	…	…	…	…	…	…
10	-0.1	…	0.2	…	…	…	…	…	…
11	-0.2	…	0.2	…	…	…	…	…	…
12	-0.2	…	0.2	…	…	…	…	…	…
13	-0.2	…	0.2	…	…	…	…	…	…
14	-0.2	…	0.2	…	…	…	…	…	…
15	-0.3	…	0.2	…	…	…	…	0.1	…
16	-0.3	…	0.2	…	…	…	…	0.1	…
17	-0.3	…	0.2	…	…	…	…	0.1	…
18	-0.3	…	0.2	…	…	…	…	0.1	…
19	-0.3	…	0.2	…	…	…	…	0.1	…
20	-0.3	-0.1	0.3	…	0.1	-0.1	0.1	…	…
21	-0.3	-0.1	0.3	…	0.1	-0.1	0.1	…	…
22	-0.4	-0.1	0.4	…	0.1	-0.1	0.1	…	…
23	-0.4	-0.1	0.4	…	0.1	…	0.1	…	…
24	-0.4	-0.1	0.3	…	0.1	…	0.1	…	…
25	-0.2	-0.1	0.3	-0.1	0.1	…	…	…	…
26	-0.2	-0.1	0.3	-0.1	0.1	…	…	…	…
27	-0.2	-0.1	0.3	-0.1	0.1	…	…	…	…
28	-0.2	-0.1	0.3	-0.1	0.1	…	…	…	…
29	-0.2	-0.1	0.3	-0.1	0.1	…	…	…	…
30	-0.3	-0.1	0.3	…	0.1	…	…	…	…
31	-0.3	-0.1	0.3	…	0.1	…	…	…	…
32	-0.3	-0.1	0.3	…	0.1	…	…	…	…
33	-0.3	-0.1	0.3	…	0.1	…	…	…	…
34	-0.3	-0.1	0.3	…	0.1	…	…	…	…
35	-0.3	-0.1	0.3	…	0.1	…	…	…	…
36	-0.3	-0.1	0.3	…	0.1	…	…	…	…
37	-0.3	-0.1	0.3	…	0.1	…	…	…	…
38	-0.2	-0.1	0.3	…	0.1	…	…	…	…
39	-0.2	-0.1	0.2	…	0.1	…	…	…	…
40	-0.2	-0.1	0.2	…	…	…	…	…	…

(Continued next page)

Table 3.17 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
41	-0.2	-0.1	0.2	…	…	…	…	…	…
42	-0.2	-0.1	0.2	…	…	…	…	…	…
43	-0.2	-0.1	0.2	…	…	…	…	…	…
44	-0.2	-0.1	0.2	…	…	…	…	…	…
45	-0.2	-0.1	0.2	…	…	…	…	…	…
46	-0.2	-0.1	0.2	…	…	…	…	…	…
47	-0.1	-0.1	0.2	…	…	…	…	…	…
48	-0.1	-0.1	0.2	…	…	…	…	…	…
49	-0.1	-0.1	0.2	…	…	…	…	…	…
50	-0.1	…	0.1	…	…	…	…	…	…
51	-0.1	…	0.1	…	…	…	…	…	…
52	-0.1	…	0.1	…	…	…	…	…	…
53	-0.1	…	0.1	…	…	…	…	…	…
54	-0.1	…	0.1	…	…	…	…	…	…
55	-0.1	…	0.1	…	…	…	…	…	…
56	-0.1	…	0.1	…	…	…	…	…	…
57	-0.1	…	0.1	…	…	…	…	…	…
58	-0.1	…	0.1	…	…	…	…	…	…
59	-0.1	…	0.1	…	…	…	…	…	…
60	-0.1	…	0.1	…	…	…	…	…	…
61	-0.1	…	0.1	…	…	…	…	…	…
62	-0.1	…	0.1	…	…	…	…	…	…
63	-0.1	…	0.1	…	…	…	…	…	…
64	-0.1	…	0.1	…	…	…	…	…	…
65	…	…	…	…	…	…	…	…	…
66	…	…	…	…	…	…	…	…	…
67	…	…	…	…	…	…	…	…	…
68	…	…	…	…	…	…	…	…	…
69	…	…	…	…	…	…	…	…	…
70	…	…	…	…	…	…	…	…	…
71	…	…	…	…	…	…	…	…	…
72	…	…	…	…	…	…	…	…	…
73	…	…	…	…	…	…	…	…	…
74	…	…	…	…	…	…	…	…	…
75	…	…	…	…	…	…	…	…	…
76	…	…	…	…	…	…	…	…	…
77	…	…	…	…	…	…	…	…	…
78	…	…	…	…	…	…	…	…	…
79	…	…	…	…	…	…	…	…	…
80	…	…	…	…	…	…	…	…	…

(Continued next page)

Table 3.17 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
81	…	…	…	…	…	…	…	…	…
82	…	…	…	…	…	…	…	…	…
83	…	…	…	…	…	…	…	…	…
84	…	…	…	…	…	…	…	…	…
85	…	…	…	…	…	…	…	…	…
86	…	…	…	…	…	…	…	…	…
87	…	…	…	…	…	…	…	…	…
88	…	…	…	…	…	…	…	…	…
89	…	…	…	…	…	…	…	…	…
90	…	…	…	…	…	…	…	…	…
91	…	…	…	…	…	…	…	…	…
92	…	…	…	…	…	…	…	…	…
93	…	…	…	…	…	…	…	…	…
94	…	…	…	…	…	…	…	…	…
95	…	…	…	…	…	…	…	…	…
96	…	…	…	…	…	…	…	…	…
97	…	…	…	…	…	…	…	…	…
98	…	…	…	…	…	…	…	…	…
99	…	…	…	…	…	…	…	…	…
100+[c]	…	…	…	…	…	…	…	…	…
Total	**-13.3**	**-2.2**	**14.2**	**-1.3**	**2.3**	**-0.1**	**0.1**	**0.2**	**…**

… zero or less than 500. [a] Net interstate migration by state published by five-year age groups scaled to align with the latest revised total net interstate migration published for that state. The resulting measure of net interstate migration for each age group is allocated to individual years of age using the age and gender distribution of the existing population in that state. [b] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories)*. [c] 100 years and over.

Source: MMRF database based on: ABS (*Interstate Migration, Arrivals, departures and net, State/territory, age and sex, Calendar and financial years*, 2009); ABS (*Migration, Australia*, 2008-09, Cat. no. 3412.0); ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001).

Table 3.18 **Net interstate migration by age and state in the MMRF database, females, 2005-06**[a]

Thousand

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
0	-0.3	…	0.2	…	0.1	…	…	…	…
1	-0.2	…	0.2	…	0.1	…	…	…	…
2	-0.2	…	0.2	…	0.1	…	…	…	…
3	-0.2	…	0.2	…	0.1	…	…	…	…
4	-0.3	…	0.2	…	0.1	…	…	…	…
5	-0.2	…	0.2	…	…	…	…	…	…
6	-0.2	…	0.2	…	…	…	…	…	…
7	-0.2	…	0.2	…	…	…	…	…	…
8	-0.2	…	0.2	…	…	…	…	…	…
9	-0.2	…	0.2	…	…	…	…	…	…
10	-0.1	…	0.2	…	…	…	…	…	…
11	-0.1	…	0.2	…	…	…	…	…	…
12	-0.1	…	0.2	…	…	…	…	…	…
13	-0.1	…	0.2	…	…	…	…	…	…
14	-0.1	…	0.2	…	…	…	…	…	…
15	-0.3	…	0.3	…	…	…	…	0.1	…
16	-0.3	…	0.3	…	…	…	…	0.1	…
17	-0.3	…	0.2	…	…	…	…	0.1	…
18	-0.3	…	0.2	…	…	…	…	0.1	…
19	-0.3	…	0.3	…	…	…	…	0.1	…
20	-0.2	0.1	0.2	-0.1	…	-0.1	…	…	…
21	-0.2	0.1	0.2	-0.1	…	-0.1	…	…	…
22	-0.2	0.1	0.2	-0.1	…	-0.1	…	…	…
23	-0.2	0.1	0.2	-0.1	…	-0.1	…	…	…
24	-0.2	0.1	0.2	-0.1	…	-0.1	…	…	…
25	-0.2	0.1	0.2	-0.1	0.1	…	…	…	…
26	-0.2	0.1	0.2	-0.1	0.1	…	…	…	…
27	-0.2	0.1	0.2	-0.1	0.1	…	…	…	…
28	-0.2	0.1	0.2	-0.1	0.1	…	…	…	…
29	-0.2	0.1	0.2	-0.1	0.1	…	…	…	…
30	-0.2	…	0.3	…	…	…	…	…	…
31	-0.3	…	0.3	…	…	…	…	…	…
32	-0.3	…	0.3	…	…	…	…	…	…
33	-0.3	…	0.3	…	…	…	…	…	…
34	-0.3	…	0.3	…	…	…	…	…	…
35	-0.2	-0.1	0.3	…	0.1	…	…	…	…
36	-0.2	…	0.3	…	0.1	…	…	…	…
37	-0.2	…	0.3	…	0.1	…	…	…	…
38	-0.2	…	0.3	…	0.1	…	…	…	…
39	-0.2	…	0.3	…	0.1	…	…	…	…
40	-0.2	…	0.2	…	…	…	…	…	…

(Continued next page)

Table 3.18 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
41	-0.2	…	0.2	…	…	…	…	…	…
42	-0.2	…	0.2	…	…	…	…	…	…
43	-0.2	…	0.2	…	…	…	…	…	…
44	-0.2	…	0.2	…	…	…	…	…	…
45	-0.1	…	0.2	…	…	…	…	…	…
46	-0.1	…	0.2	…	…	…	…	…	…
47	-0.1	…	0.2	…	…	…	…	…	…
48	-0.1	…	0.2	…	…	…	…	…	…
49	-0.1	…	0.2	…	…	…	…	…	…
50	-0.1	…	0.1	…	…	…	…	…	…
51	-0.1	…	0.1	…	…	…	…	…	…
52	-0.1	…	0.1	…	…	…	…	…	…
53	-0.1	…	0.1	…	…	…	…	…	…
54	-0.1	…	0.1	…	…	…	…	…	…
55	-0.1	…	0.1	…	…	…	…	…	…
56	-0.1	…	0.1	…	…	…	…	…	…
57	-0.1	…	0.1	…	…	…	…	…	…
58	-0.1	…	0.1	…	…	…	…	…	…
59	-0.1	…	0.1	…	…	…	…	…	…
60	…	…	0.1	…	…	…	…	…	…
61	…	…	…	…	…	…	…	…	…
62	…	…	…	…	…	…	…	…	…
63	…	…	…	…	…	…	…	…	…
64	…	…	…	…	…	…	…	…	…
65	…	…	…	…	…	…	…	…	…
66	…	…	…	…	…	…	…	…	…
67	…	…	…	…	…	…	…	…	…
68	…	…	…	…	…	…	…	…	…
69	…	…	…	…	…	…	…	…	…
70	…	…	…	…	…	…	…	…	…
71	…	…	…	…	…	…	…	…	…
72	…	…	…	…	…	…	…	…	…
73	…	…	…	…	…	…	…	…	…
74	…	…	…	…	…	…	…	…	…
75	…	…	…	…	…	…	…	…	…
76	…	…	…	…	…	…	…	…	…
77	…	…	…	…	…	…	…	…	…
78	…	…	…	…	…	…	…	…	…
79	…	…	…	…	…	…	…	…	…
80	…	…	…	…	…	…	…	…	…

(Continued next page)

Table 3.18 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
81	…	…	…	…	…	…	…	…	…
82	…	…	…	…	…	…	…	…	…
83	…	…	…	…	…	…	…	…	…
84	…	…	…	…	…	…	…	…	…
85	…	…	…	…	…	…	…	…	…
86	…	…	…	…	…	…	…	…	…
87	…	…	…	…	…	…	…	…	…
88	…	…	…	…	…	…	…	…	…
89	…	…	…	…	…	…	…	…	…
90	…	…	…	…	…	…	…	…	…
91	…	…	…	…	…	…	…	…	…
92	…	…	…	…	…	…	…	…	…
93	…	…	…	…	…	…	…	…	…
94	…	…	…	…	…	…	…	…	…
95	…	…	…	…	…	…	…	…	…
96	…	…	…	…	…	…	…	…	…
97	…	…	…	…	…	…	…	…	…
98	…	…	…	…	…	…	…	…	…
99	…	…	…	…	…	…	…	…	…
100+[c]	…	…	…	…	…	…	…	…	…
Total	**-12.3**	**0.4**	**12.4**	**-1.5**	**1.6**	**…**	**-0.6**	**…**	**…**

… zero or less than 500. [a] Net interstate migration by state published by five-year age groups scaled to align with the latest revised total net interstate migration published for that state. The resulting measure of net interstate migration for each age group is allocated to individual years of age using the age and gender distribution of the existing population in that state. [b] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories).* [c] 100 years and over.

Source: MMRF database based on: ABS (*Interstate Migration, Arrivals, departures and net, State/territory, age and sex, Calendar and financial years*, 2009); ABS (*Migration, Australia*, 2008-09, Cat. no. 3412.0); ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001).

4 Explicit modelling of demographic change

This chapter outlines the new demographic module that has been added to the Monash Multi-Regional Forecasting (MMRF) model for the study. The new demographic module will improve MMRF's suitability for assessing policies with a longer-term focus where:

- changes in the level and/or composition of the population may be important; or
- the policies under consideration impact on fertility or mortality rates.

The new module is a demographic model of the effect of population change for subsets of the population (called cohorts). It uses a 'stock–flow' approach to calculate the population in each state by age and gender. The results for Australia are derived from the corresponding state measures.

Section 4.1 outlines the background to the new module, and links this development to earlier demographic modelling by the Commission. Section 4.2 provides an overview of the new demographic module, while sections 4.3 to 4.6, respectively, outline the modelling of births, overseas migration, interstate migration and deaths. Section 4.7 describes how the new demographic module has been integrated into the MMRF model.

4.1 Background

The MMRF model of the Australian economy, in its basic form, contains a rudimentary demographic module that stylistically models the three main sources of demographic change:

- net natural population increase (that is, births less deaths);
- net foreign migration (that is, immigration less emigration); and
- net interstate migration (that is, interstate arrivals less departures).

It does not contain a cohort-based demographic model.

In the basic model, these changes are read in from the model database during each simulation year and are updated using any shocks applied in the preceding simulation year.[1] Unless shocks are applied during the simulation year, this reading in of the changes in population from the model database each simulation year gives the basic model a quasi 'steady state' nature, albeit one in which the annual changes in the demographic components are specified in persons rather than growth rates.

Modelling demographic change in this way limits the capability of MMRF to model policies with a long-term focus where the level and composition of the population differs from that specified or implied in the model database, or where policies under consideration affect fertility rates, mortality rates or foreign migration.

This weakness could be partly overcome by deriving demographic projections from an external demographic model, such as the *MoDEM*, a spreadsheet demographic model (Cuxon et al. 2008), and applying these projections as shocks to the corresponding demographic aggregates in the MMRF model.

Linking MMRF to an external demographic model improves the long-term capability of the model, but with two potential drawbacks. First, linking the two models in this way does not allow for feedback effects between the models. For example, demographic change may affect the supply and demand for labour, which, in turn, may flow through into wages, prices and incomes. Changes in economic conditions between states or industries may potentially affect the incentives for interstate or overseas migration. Second, as the demographic aggregates in the MMRF demographic module are coarser than their counterparts in a standalone demographic model, much of the richer demographic information is omitted from the MMRF demographic accounting framework.

Another way of improving the suitability of the MMRF model for longer-term policy analysis is to incorporate a fully operational demographic model with age, gender and state cohorts *within* the MMRF model. This would allow for the possibility of feedback effects between demographic and economic variables, resulting in richer demographic information and providing complete demographic accounting within MMRF.

The version of MMRF used for the Commission's final report includes a fully operational cohort-based demographic model. Births and deaths are modelled endogenously for individual cohorts of the population based on age, gender and state-of-residence. The conceptual approach used to model fertility and mortality is based on two earlier spreadsheet-based models developed by the Productivity

[1] As the model database is based on the ABS *Input-Output Tables* for the financial year 2005-06, a simulation year effectively corresponds to a financial year.

Commission. However, their implementation in the new demographic module differs somewhat from the earlier models, in part because the MMRF programming language (called TABLO) does not have the same functionality as *Microsoft Excel*, which was used for the spreadsheet models, and partly to provide additional functionality in the modelling of demographic change (and, in particular, the endogenous modelling of population movements between jurisdictions).

Links to earlier demographic modelling

The new demographic module is based on a series of demographic modelling tools that were initially developed by the Productivity Commission for its study into the *Economic Implications of an Ageing Australia* (PC 2005b). These tools have subsequently given rise to:

- a spreadsheet demographic module *MoDEM* (Cuxon et al. 2008) that was used in modelling the *Potential Benefits of the National Reform Agenda* (PC 2006);[2] and
- a spreadsheet model of fertility called *FERTMOD* (Lattimore 2008) that was used in *Recent Trends in Australian Fertility* (Lattimore and Pobke 2008).

The new demographic module extends the national demographic relationships in *MoDEM* to the eight states and territories (hereafter referred to as states).[3] It also adopts many of the assumptions used in *FERTMOD* and *MoDEM*. These assumptions are similar to those made by the ABS in its demographic projections of the national population. For example, demographic change is modelled as a discrete rather than continuous process and is consistent with the discrete nature of recursive-dynamic CGE modelling.

4.2 Overview of the new demographic module

The new demographic module models the effect of demographic change on subsets of the population (called cohorts) based on age, gender and state. This makes it a 'cohort component' model. It uses a 'stock–flow' approach to calculate state population by age and gender. The 2005-06 database consists of the estimated resident population (ERP) for 1616 cohorts as at 30 June 2005. Each cohort represents a unique combination of:

2 The version of *MoDEM* referred to in this chapter is version 2.0.

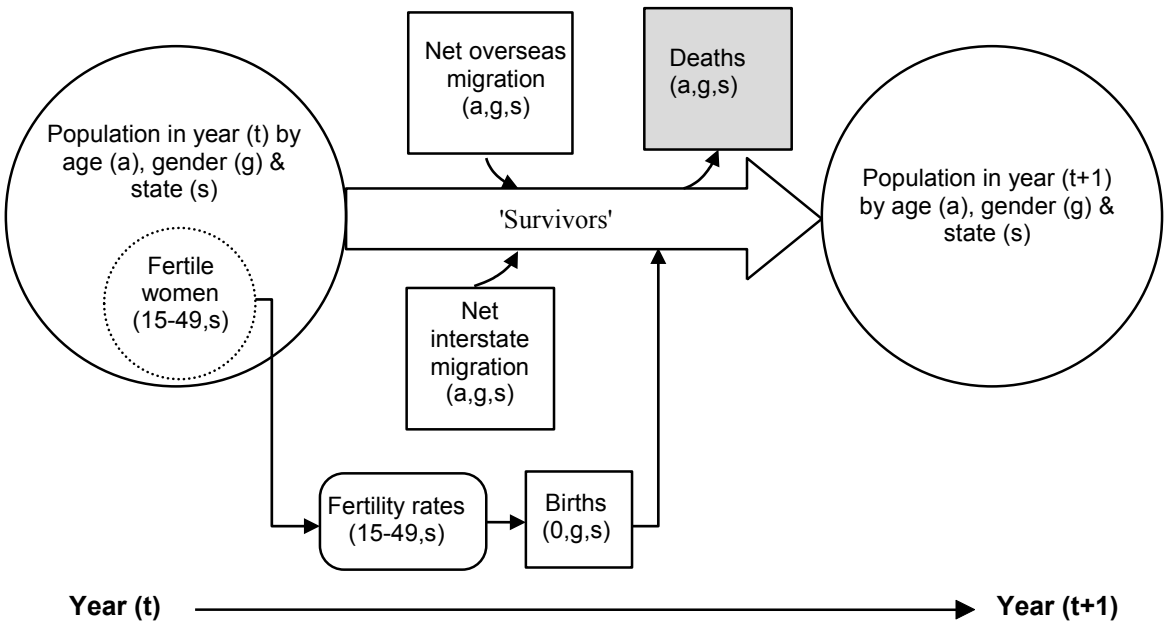
3 In the new demographic module, state refers to state-of-residence unless otherwise stated.

- 101 age groups: 100 single year age cohorts — *0 years old* to *99 years old* — and an open ended *100 years and over* cohort;
- two genders: male and female; and
- eight 'states': New South Wales, Victoria, Queensland, Western Australia, South Australia, Tasmania, the Australian Capital Territory and the Northern Territory.[4]

In each simulation year, age, gender and state cohorts change size according to:

- the net inflow through overseas migration (that is, immigration less emigration);
- the net inflow through interstate migration (that is, interstate arrivals less departures);
- deaths;
- births for the *0 year old* cohort; and
- the effects of ageing (figure 4.1).

Figure 4.1 **Population projection module**



a: age; g: gender; and s: state.

Source: Adapted from Cuxon et al. (2008).

4 The model database does not include Australians that reside in Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories*). Consequently, the total population in the demographic module database is slightly less than the official ERP for Australia.

People who do not die or leave the state are one year older by the end of the simulation year and join the next age cohort. The TABLO implementation adopts an approach similar to that outlined by Penec (2009).

The new demographic module is linked into the MMRF model core to determine population, working-age population and labour supply. The linking into the labour supply in the model core is discussed in chapter 5. The module is expressed in level terms and it adopts the practice in MMRF of reporting all population and labour market variables in thousands of people.

4.3 The modelling of births

Births at the state level are modelled in the new demographic module using the same approach as that used nationally in the PC's report *Economic Implications of an Ageing Australia* (2005c, 2005d). This approach is also used in MoDEM (Cuxon et al. 2008). Births are calculated using a two-step process:

- total births in each state are calculated; and
- total births are split into male and female births.

First, the number of births in each state is calculated by multiplying age and state-specific fertility rates (ASFR) by the average number of women of that age in that state during the simulation year and aggregating across all childbearing ages (aged 15 to 49 years).[5] The average number of women is defined as the initial population of each age and state cohort for women plus half of the estimated change in population for that cohort during the simulation year. The ASFR used are for the financial year 2005-06 and are estimated as the average of published ABS ASFR for the calendar years 2005 and 2006 (sourced from ABS *Births, Australia,* 2009, Cat. no. 3301.0).

Second, the number of male births in each state is calculated by applying the share of total births in that state that are male (a state-specific sex ratio) to the total number of births (ABS *Births, Australia,* 2009, Cat. no. 3301.0). Female births are calculated as total births less male births.

Births increase the *0 year old* cohort only.[6]

---

5 The ABS publishes age-specific fertility rates for women aged 15 to 49 grouped in 5 year intervals. The ABS assigns births to women below 15 years of age to the 15–19 year old age group and births to women over 49 to the 45–49 year old age group.

6 To make the demographic accounting in TABLO easier for the other age cohorts, the births variable is defined over all age groups. Births in the remaining 100 age groups are set to zero.

In keeping with the practice used by the ABS in compiling its demographic statistics, any subsequent deaths of newborn babies are recorded as deaths. This means that births are recorded on a gross basis and not the net basis used in MoDEM.

A similar 'gross demographic accounting' approach is used to record net overseas and net interstate migration (discussed in sections 4.4 and 4.5).

The new demographic module allows the ASFR to change over time to allow for timing and tempo effects that enable the total fertility rate and the distribution of ASFR to vary independently. The methodology used is more complicated than that used to estimate births and is outlined in detail in Lattimore (2008).

4.4 The modelling of overseas migration

The new demographic module models the *net* flow of migrants that enter each cohort from overseas during a simulation year (or leave to go overseas). Unlike *MoDEM*, it does not separately model immigration and emigration.

Net overseas migration (NOM) can be modelled in a number of alternative ways. It can be specified exogenously, by specifying either:

- aggregate migration, which is allocated to individual cohorts using the age, gender and state shares of net overseas migration in the database; or
- net migration for each age, gender and state cohort.

NOM can also be modelled endogenously as a specified share of the population (initially set at 0.6 per cent of the population, see chapter 8), which is the approach used in this study where actual overseas migration data are not available. The age, gender and state-of-residence of these migrants are determined by the actual distribution of *NOM Arrivals* less *NOM Departures*, as recorded by the ABS.[7]

Like *MoDEM*, the new demographic module adopts the same assumption that net overseas migration occurs uniformly throughout the year. This is equivalent to assuming that all net overseas migration occurs on 31 December of the simulation year. This means that, on average, immigrants are only in the destination state for

[7] Net overseas migration by age, gender and state is estimated from actual ABS data published for five-year age groups scaled to align with the latest revised total net overseas migration published for that state. This approach assumes that 'category jumping' is distributed in proportion to *NOM arrivals* less *NOM departures*. The resulting measure of net overseas migration for each age group is allocated to individual years of age using the age and gender distribution of the existing population in that state.

half of each simulation year. It is assumed that half of all immigrants have a birthday in the intervening six months before the end of the simulation year and their age is increased by one year accordingly. This implies that, for example, half of the 15 year olds that arrive turn 16 before the end of the simulation year.

The net overseas migration data used in the new demographic module database are sourced from ABS (NOM (*improved method) Arrivals and Departures by State/territory, Age and sex, Calendar and financial years*, 2010; *Migration, Australia*, 2008-09, Cat. no. 3412.0; and *Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001).

Deaths of overseas migrants

In keeping with the practice used by the ABS in compiling its demographic statistics, any subsequent deaths of overseas migrants are recorded separately as deaths (discussed in section 4.6).

4.5 The modelling of interstate migration

Interstate migration is also modelled in net terms in the new demographic module (that is, arrivals less departures) and is assumed to occur at the start of each the simulation year.

Changes in the relative economic conditions between states affect the incentives for businesses and workers to locate in particular states.

As many of the reforms assessed in *Potential Benefits of the National Reform* (PC 2006) had a distinct longer-term focus, the benchmark MMRF model developed for that study allowed the supply of labour by occupation in each state to vary in response to differences in occupation-specific changes in real wages that would emerge between states over the longer term.[8]

This endogenous modelling of labour supply was linked to interstate migration by assuming that those not in the labour force and children aged less than 15 years of age (that is, those not of working age) moved in proportion with those in the labour

[8] This does not assume that the level of real wages is the same across states for a given occupation, just that the percentage changes are the same.

force (akin to assuming that all members of a household move together when a worker moves interstate).[9]

A consequence of this approach is that interstate migrants implicitly take on the characteristics of workers and/or residents in their destination state (and not those prevailing in the state where they move from). Thus, for example, a worker moving interstate takes on the labour productivity of a worker with the same occupation in the destination state regardless of their pre-move labour productivity.

This modelling of interstate migration for the *Potential Benefits of the National Reform Agenda* meant that changes in labour supply implied changes in, first, the working-age population in each state and, then, the population in each state.

This approach to modelling interstate migration has been adopted in the new demographic module.

Interstate migration in the new demographic module is determined by the interstate migration of labour supply in the core of the MMRF model, which responds, as in the National Reform Agenda (NRA) benchmark model, to differences in occupation-specific changes in real wages between states.

The resulting aggregate changes in labour supply by each state from the model core are mapped into the age, gender and state cohorts in the new demographic module using the initial population shares in the model database.

Interstate migration across age and gender cohorts are modelled as adding to zero across states to ensure that there is no net change in population nationally from interstate migration.

4.6 The modelling of deaths

To align with published ABS statistics, deaths are calculated separately for four distinct sub-groups of the population:

- those initially in each cohort;

[9] This approach assumes that the government policies being modelled do not affect the level of non-economic interstate migration. The longer term policies examined when the NRA benchmark model was being developed, and which are similar to many of the longer term reforms that make up the COAG Reform Agenda for which the model has been developed, were considered unlikely to have a material effect on non-economic migration. If a suitable theory existed to explain non-economic migration, it might be possible to add a non-economic component to interstate migration in MMRF.

- those joining each cohort from overseas;
- those joining each cohort from interstate; and
- newborn babies.

The total number of deaths is the sum of deaths for these four sub-groups.

The basic approach to calculating the number of deaths for each cohort in these four sub-groups is similar. The number of deaths is calculated by applying age, gender and state-specific mortality rates to particular population sub-groups and summing across sub-groups. However, the calculation varies between sub-groups as:

- the mortality rate applied to migrants covers half a year (as migration is assumed to occur half way through the simulation year);
- the *0 year old* age cohort includes newborn babies; and
- the *100 years and over* age cohort covers all ages over 99 years of age.

The remainder of each cohort at the beginning of the simulation year that does not migrate interstate or move overseas remains within the state for the full simulation year. The number of deaths for this group is estimated by applying the full-year mortality rate for that age, gender and state cohort to the beginning-of-year population for that cohort less the number of people that leave the state.

In keeping with the approach used in PC (2005b) and MoDEM, the mortality rates in the new demographic module have been converted from an 'exact age' basis to an 'age-at-last-birthday' basis to align with the ERP in the model database. The methodology for doing this is set out in PC (2005c). The 'exact age' mortality rate by age, gender and state used is the average of those implied by the ABS *Life Tables* for 2004-2006 and 2005-2007 (Cat. no. 3302.0.55.001) and state equivalents.

The result indicates the number of deaths that occur, not the age at which those deaths occur (as death may occur at the 'beginning of year' age in the database or after their birthday at the next age). It is assumed that ageing occurs uniformly; the number of deaths calculated using the methodology described above is divided equally between the initial age and the next age group for all age groups except the *0 year olds* and the *100 years and over* groups. The number of deaths in the new demographic module for all of the cohorts other than these two exceptions consists of half of the deaths from the cohort below and half from its own age cohort. As people do not leave the *100 years and over* cohort through ageing, the number of deaths for this cohort is half of those for the 99 year olds and all of those for the *100 years and over* cohort. Deaths for *0 year olds* is the gender and state-specific mortality rate for newborn babies multiplied by the number of newborn babies plus

half of the deaths of those initially aged *0 years* at the beginning of the simulation year.

Deaths of interstate migrants are modelled in the same way as those people that remain in the state, except that the mortality rates in the destination rather than source state are used.

A similar approach is used to estimate the number of deaths of immigrants, except that only half the age, gender and state-specific mortality rates are used, as, on average, these groups are only in the destination state for half a year.

To make the demographic accounting tractable in TABLO, all deaths in the new demographic module are recorded as a negative increase in population.

The age, gender and state-specific mortality rates can vary through time. The approach used in the final report is to specify annual percentage change improvement factors in the mortality rates based on the methodology used by the Australian Government Actuary (2009, p. 35). These improvement factors are on an 'age-at-last-birthday' basis and have been derived from the *Life Tables* in ABS *Australian Historical Population Statistics* (Cat. no. 3105.0.65.001) for 1970–1972 and 2007–2009 and smoothed across ages using a Hodrick-Prescott filter.

4.7 Integration into MMRF

The new demographic module can be activated to replace the existing demographic module or turned off using a control variable.[10]

The new cohort-based demographic module, however, involves some relatively minor changes to the way in which the demographic module is linked into the core of MMRF. This primarily involves:

- determining the value of certain coefficients in the model core from the levels in the new demographic module rather than from the database (for example, state population, state working-age population and labour supply by state and occupation); and
- calculating the corresponding changes for the accompanying variables from the changes in the demographic module.

10 The new demographic module may be de-activated to use the old demographic module or to operate the model in comparative-static mode.

The population and working-age population by state in the core of MMRF are determined by the changes in the new demographic module. The labour supply is also determined by applying age, gender and state-specific participation rates to the number of people in each cohort (discussed in chapter 5). The occupational distribution of this labour supply is initially assumed to remain unchanged.[11] The participation rates are sourced from ABS (*Labour Force, Australia, Detailed – Electronic Delivery*, May 2010, Cat. no. 6291.0.55.001, Data cube LM8).

The endogenous modelling of interstate migration means that the working-age population and population in each state can vary and is not known *a priori*.

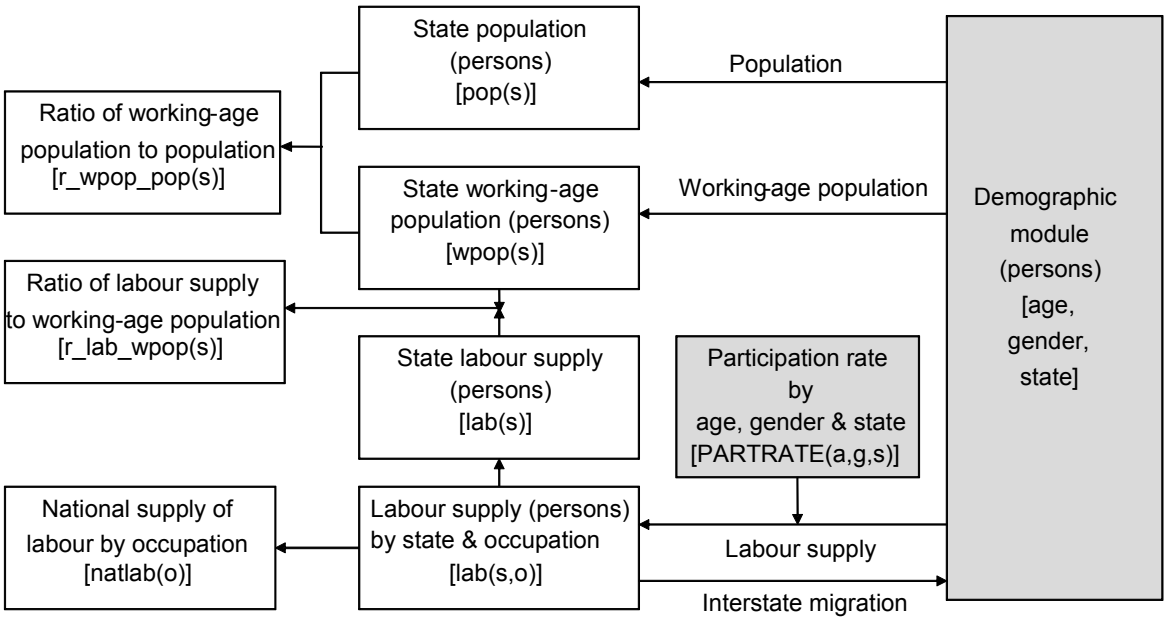
As a result, the state-specific participation rates are now calculated within the model from the changes in labour supply and working-age population in the model core rather than being exogenously specified.

Similarly, the ratio of working-age population to population in each state, which was previously exogenous, is now calculated from the changes in working-age population and population in the model core.

The integration of the new demographic module into the MMRF core is illustrated diagrammatically in figure 4.2.

[11] As outlined in chapter 5, the initial labour supply in each occupation nationally can gradually adjust to differences in real wage rate changes across occupations that arise during each simulation year.

Figure 4.2 **Integration of the new demographic module into MMRF**



a: age; g: gender; s: state; and o: occupation.

5 Labour market modifications

This chapter outlines the labour market-related modifications made to the MMRF model for this study, namely:

- integration of the new cohort-based demographic module into the existing labour markets; and
- the introduction of occupational transformation — the ability for the supply of labour by occupation to adjust in response to changes in real wage differentials across occupations.

5.1 Background

The new cohort-based demographic module added to MMRF (chapter 4) has been linked into the labour market in the core of MMRF. The supply of labour by state and occupation is now calculated within the model from changes in the working-age population by age, gender and state using exogenously specified participation rates by age, gender and state. As a result, the participation rates for each state are now calculated within the model from the changes in labour supply and working-age population rather than being exogenously specified as in previous versions of MMRF.

The percentage change in the supply of labour nationally is assumed to change in line with the percentage change in the national working-age population (those aged 15 years and over) in the new demographic module and any changes made to the age, gender and state-specific participation rates. Those not in the labour force implicitly change by a similar percentage.

Age, gender and state-specific participation rates are applied to the number of people in each cohort to determine the initial level of labour supply in each simulation year. The initial participation rates are read from the database (tables 5.1 and 5.2) and are sourced from the ABS. These participation rates can be updated during simulations through exogenous shocks.

Table 5.1 **Labour force participation rates in the MMRF database, males, 2005-06**

Per cent

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
15	25.6	26.8	44.1	29.9	43.3	28.4	32.8	35.9
16	44.4	42.8	57.4	44.1	54.7	43.9	41.1	47.7
17	51.7	52.6	68.1	58.3	67.0	65.0	64.6	55.8
18	69.4	70.0	79.7	78.8	85.7	77.2	75.2	70.4
19	74.4	78.6	87.5	87.2	86.9	84.0	75.0	84.1
20	80.6	79.7	84.6	84.4	85.6	79.8	76.5	84.0
21	83.5	79.8	89.9	84.4	85.8	84.6	80.3	84.7
22	84.6	81.5	90.7	83.5	86.7	87.4	80.7	90.9
23	86.6	85.3	90.1	86.0	85.9	88.0	77.8	87.0
24	87.5	88.3	88.7	87.2	89.2	90.2	66.0	93.8
25	90.6	90.8	91.8	91.0	90.7	88.2	81.7	89.6
26	90.6	90.8	91.8	91.0	90.7	88.2	81.7	89.6
27	90.6	90.8	91.8	91.0	90.7	88.2	81.7	89.6
28	90.6	90.8	91.8	91.0	90.7	88.2	81.7	89.6
29	90.6	90.8	91.8	91.0	90.7	88.2	81.7	89.6
30	91.5	92.8	92.2	91.3	93.2	85.8	78.3	93.2
31	91.5	92.8	92.2	91.3	93.2	85.8	78.3	93.2
32	91.5	92.8	92.2	91.3	93.2	85.8	78.3	93.2
33	91.5	92.8	92.2	91.3	93.2	85.8	78.3	93.2
34	91.5	92.8	92.2	91.3	93.2	85.8	78.3	93.2
35	90.7	93.1	91.7	90.4	93.6	92.6	83.8	94.3
36	90.7	93.1	91.7	90.4	93.6	92.6	83.8	94.3
37	90.7	93.1	91.7	90.4	93.6	92.6	83.8	94.3
38	90.7	93.1	91.7	90.4	93.6	92.6	83.8	94.3
39	90.7	93.1	91.7	90.4	93.6	92.6	83.8	94.3
40	90.7	91.8	90.0	90.8	93.1	87.1	82.6	95.9
41	90.7	91.8	90.0	90.8	93.1	87.1	82.6	95.9
42	90.7	91.8	90.0	90.8	93.1	87.1	82.6	95.9
43	90.7	91.8	90.0	90.8	93.1	87.1	82.6	95.9
44	90.7	91.8	90.0	90.8	93.1	87.1	82.6	95.9
45	88.8	90.6	89.8	87.5	92.2	88.5	77.4	91.7
46	88.8	90.6	89.8	87.5	92.2	88.5	77.4	91.7
47	88.8	90.6	89.8	87.5	92.2	88.5	77.4	91.7
48	88.8	90.6	89.8	87.5	92.2	88.5	77.4	91.7
49	88.8	90.6	89.8	87.5	92.2	88.5	77.4	91.7
50	85.9	85.2	86.9	84.9	90.0	80.0	88.1	92.0
51	85.9	85.2	86.9	84.9	90.0	80.0	88.1	92.0
52	85.9	85.2	86.9	84.9	90.0	80.0	88.1	92.0
53	85.9	85.2	86.9	84.9	90.0	80.0	88.1	92.0
54	85.9	85.2	86.9	84.9	90.0	80.0	88.1	92.0
55	72.9	78.5	75.7	71.8	81.8	70.6	78.9	82.5
56	72.9	78.5	75.7	71.8	81.8	70.6	78.9	82.5

(Continued next page)

Table 5.1 **(continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
57	72.9	78.5	75.7	71.8	81.8	70.6	78.9	82.5
58	72.9	78.5	75.7	71.8	81.8	70.6	78.9	82.5
59	72.9	78.5	75.7	71.8	81.8	70.6	78.9	82.5
60	53.1	58.5	54.5	50.8	60.6	49.0	58.8	60.9
61	53.1	58.5	54.5	50.8	60.6	49.0	58.8	60.9
62	53.1	58.5	54.5	50.8	60.6	49.0	58.8	60.9
63	53.1	58.5	54.5	50.8	60.6	49.0	58.8	60.9
64	53.1	58.5	54.5	50.8	60.6	49.0	58.8	60.9
65	22.4	27.0	24.9	19.3	29.8	25.5	36.2	20.4
66	22.4	27.0	24.9	19.3	29.8	25.5	36.2	20.4
67	22.4	27.0	24.9	19.3	29.8	25.5	36.2	20.4
68	22.4	27.0	24.9	19.3	29.8	25.5	36.2	20.4
69	22.4	27.0	24.9	19.3	29.8	25.5	36.2	20.4
70	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
71	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
72	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
73	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
74	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
75	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
76	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
77	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
78	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
79	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
80	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
81	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
82	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
83	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
84	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
85	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
86	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
87	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
88	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
89	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
90	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
91	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
92	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
93	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
94	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
95	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
96	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
97	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
98	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
99	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5
100+	6.3	5.1	4.9	4.9	8.3	6.8	9.9	5.5

Source: MMRF database based on ABS (*Labour Force, Australia, Detailed – Electronic Delivery*, May 2010, Cat. no. 6291.0.55.001, Data cube LM8).

Table 5.2 **Labour force participation rates in the MMRF database, females, 2005-06**

Per cent

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
15	36.1	36.4	45.4	35.1	46.8	36.6	36.6	40.5
16	48.4	54.1	57.8	59.1	54.8	48.9	42.0	48.5
17	54.7	53.8	73.7	68.7	74.1	60.5	62.1	65.9
18	66.1	70.8	78.6	76.9	82.2	73.3	61.2	73.1
19	76.3	76.6	81.4	79.1	84.9	71.9	64.7	81.7
20	72.3	75.0	76.0	77.6	78.1	71.4	80.7	83.7
21	78.6	77.4	77.8	78.1	81.1	72.2	64.7	84.9
22	76.8	75.9	81.7	77.6	74.0	69.5	65.4	79.9
23	76.2	81.5	77.9	79.5	80.6	76.5	65.3	90.3
24	77.0	80.7	80.4	80.8	77.5	77.1	66.0	82.3
25	74.7	77.0	75.9	72.9	73.5	67.4	63.0	82.4
26	74.7	77.0	75.9	72.9	73.5	67.4	63.0	82.4
27	74.7	77.0	75.9	72.9	73.5	67.4	63.0	82.4
28	74.7	77.0	75.9	72.9	73.5	67.4	63.0	82.4
29	74.7	77.0	75.9	72.9	73.5	67.4	63.0	82.4
30	71.0	70.4	71.5	69.1	66.3	69.3	64.8	79.6
31	71.0	70.4	71.5	69.1	66.3	69.3	64.8	79.6
32	71.0	70.4	71.5	69.1	66.3	69.3	64.8	79.6
33	71.0	70.4	71.5	69.1	66.3	69.3	64.8	79.6
34	71.0	70.4	71.5	69.1	66.3	69.3	64.8	79.6
35	68.8	68.6	72.9	71.1	70.2	71.4	76.3	82.1
36	68.8	68.6	72.9	71.1	70.2	71.4	76.3	82.1
37	68.8	68.6	72.9	71.1	70.2	71.4	76.3	82.1
38	68.8	68.6	72.9	71.1	70.2	71.4	76.3	82.1
39	68.8	68.6	72.9	71.1	70.2	71.4	76.3	82.1
40	74.8	76.2	78.9	78.0	75.9	79.8	81.7	83.1
41	74.8	76.2	78.9	78.0	75.9	79.8	81.7	83.1
42	74.8	76.2	78.9	78.0	75.9	79.8	81.7	83.1
43	74.8	76.2	78.9	78.0	75.9	79.8	81.7	83.1
44	74.8	76.2	78.9	78.0	75.9	79.8	81.7	83.1
45	77.1	77.3	79.0	80.0	80.0	79.7	82.3	86.7
46	77.1	77.3	79.0	80.0	80.0	79.7	82.3	86.7
47	77.1	77.3	79.0	80.0	80.0	79.7	82.3	86.7
48	77.1	77.3	79.0	80.0	80.0	79.7	82.3	86.7
49	77.1	77.3	79.0	80.0	80.0	79.7	82.3	86.7
50	72.8	73.3	71.1	73.6	74.9	72.1	74.6	81.0
51	72.8	73.3	71.1	73.6	74.9	72.1	74.6	81.0
52	72.8	73.3	71.1	73.6	74.9	72.1	74.6	81.0
53	72.8	73.3	71.1	73.6	74.9	72.1	74.6	81.0
54	72.8	73.3	71.1	73.6	74.9	72.1	74.6	81.0
55	54.5	56.5	56.5	55.8	59.7	56.6	65.2	64.9
56	54.5	56.5	56.5	55.8	59.7	56.6	65.2	64.9

(Continued next page)

Table 5.2 **(Continued)**

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
57	54.5	56.5	56.5	55.8	59.7	56.6	65.2	64.9
58	54.5	56.5	56.5	55.8	59.7	56.6	65.2	64.9
59	54.5	56.5	56.5	55.8	59.7	56.6	65.2	64.9
60	32.1	31.5	32.1	29.2	36.1	25.0	53.6	39.7
61	32.1	31.5	32.1	29.2	36.1	25.0	53.6	39.7
62	32.1	31.5	32.1	29.2	36.1	25.0	53.6	39.7
63	32.1	31.5	32.1	29.2	36.1	25.0	53.6	39.7
64	32.1	31.5	32.1	29.2	36.1	25.0	53.6	39.7
65	10.7	10.1	13.2	9.2	14.2	12.2	33.9	12.3
66	10.7	10.1	13.2	9.2	14.2	12.2	33.9	12.3
67	10.7	10.1	13.2	9.2	14.2	12.2	33.9	12.3
68	10.7	10.1	13.2	9.2	14.2	12.2	33.9	12.3
69	10.7	10.1	13.2	9.2	14.2	12.2	33.9	12.3
70	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
71	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
72	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
73	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
74	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
75	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
76	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
77	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
78	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
79	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
80	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
81	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
82	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
83	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
84	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
85	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
86	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
87	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
88	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
89	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
90	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
91	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
92	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
93	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
94	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
95	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
96	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
97	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
98	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
99	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1
100+	1.8	1.3	1.6	1.3	2.2	1.4	3.9	3.1

Source: MMRF database based on ABS (*Labour Force, Australia, Detailed – Electronic Delivery*, May 2010, Cat. no. 6291.0.55.001, Data cube LM8).

As noted in chapter 4, endogenous interstate migration was added to the previous version of MMRF. Interstate migration of labour supply continues to operate in response to changes in real wage differentials by occupation. Interstate migration in the demographic module is linked to interstate migration of labour supply in the core of the model. This endogenous modelling of interstate migration means that the labour supply, the working-age population and the population in each state can vary and is not known *a priori*. This means that:

- the change in the ratio of working-age population to population in each state, which was previously exogenous, is now calculated from changes in both the working-age population and population in the demographic module; and
- the change in the ratio of labour supply to working-age population (the state participation rate) is similarly calculated from the changes in state labour supply in the model core and from the change in the working-age population in each state from the demographic module.

The integration of the new demographic module into the labour market in MMRF is shown schematically in figure 4.2 in chapter 4.

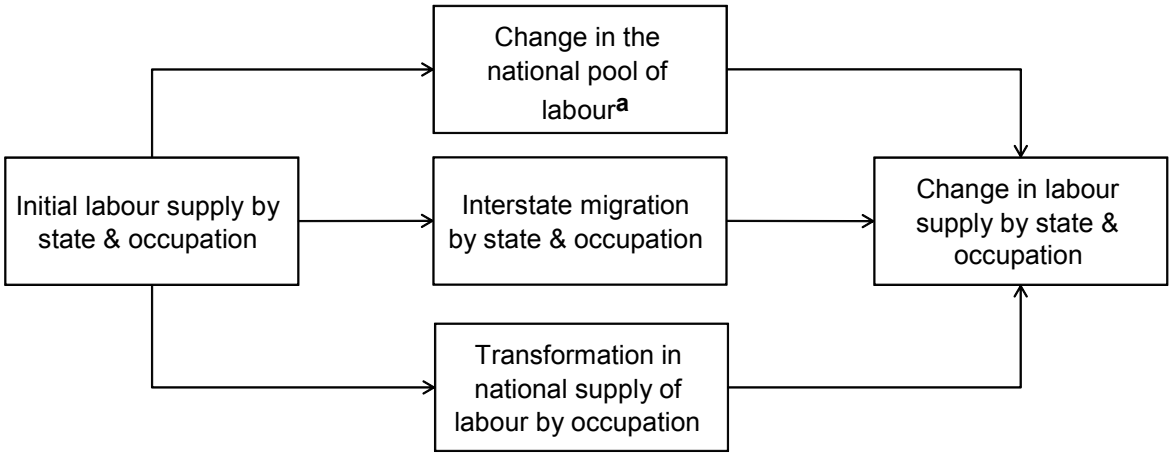
5.2 Explicit modelling of occupational transformation

Changes in wage relativities provide existing workers with an incentive to reskill and may influence the career choices of those leaving school or entering the labour market. Over time, changes in these differentials may give rise to 'occupational transformations' in which the occupational composition of the labour force changes (for example, reducing the supply of labourers and increasing the supply of professionals).

Occupational transformation has been added to MMRF to enable changes in the supply of labour by occupation through time. The supply of labour in each occupation responds positively to changes in wage relativities between occupations. This adjustment is based on a constant elasticity of transformation with the transformation parameter set to 0.1 (implying that the occupational structure is assumed to change gradually, in the absence of an exogenous 'shock' to the labour market or economy). The resource costs associated with this transformation are assumed to be embodied in the cost structure of the economy and are not explicitly modelled.

Changes in the supply of labour by state and occupation in the updated model used in the final report are shown schematically in figure 5.1.

Figure 5.1 **Schematic representation of labour market arrangements**



a Change in the national working-age population arising through demographic change (mortality, overseas migration and ageing of the population).

6 Explicit modelling of export supplies

This chapter outlines the explicit modelling of export supplies added to the MMRF model. The workshop paper on which this chapter is based was refereed by Kevin Hanslow from the Centre of Policy Studies at Monash University, whose comments and suggestions were most valuable.[1,2]

6.1 Background

The theory in the standard MMRF model allows for sales to adjust instantaneously to ensure that the basic price received by producers (that is, the ex-farm, mine or factory price) is the same across all categories of demand — that is, production, investment, household consumption, exports, State and Australian government consumption, inventories and the national electricity market. This adjustment ensures that there are no 'pure' profits in production.

Yet the presence of existing contractual arrangements, availability of infrastructure and other factors may impede the rate at which producers can switch sales between categories of demand in response to changes in demand conditions and associated price changes that may arise in the real world. Such less-than-instantaneous adjustments may give rise to 'price wedges' between markets, particularly between export and domestic markets, that result in additional returns (either profits or losses) from exporting relative to supplying domestic sources of demand.[3] As contracts are re-negotiated and other adjustments occur (including infrastructure service provision and changes in productive capacity), producers would be able to vary their sales mix over time to reduce or eliminate any price differential between market segments.

To allow for less-than-instantaneous adjustment in supply between categories of demand, export transformation, or the explicit modelling of export supplies, has been added to precursors of the MMRF model. Gretton (1988) introduced transformation possibilities across all categories of demand in the ORANI model.

1 References in this chapter to exports relate to foreign exports and not to interstate trade.

2 Detailed technical paper available on request.

3 Recent examples of this involve changes in Australian commodity export prices not fully flowing through, as yet, into domestic commodity prices.

The export component of the ORANI transformation was added to the Monash model for use in replicating structural and other economic change over time (PC 2000). Similarly, Horridge (2003) introduced export transformation as an option into the ORANI-G model.

In a similar vein to these earlier developments, changes have been made to the MMRF model to allow for the possibility of gradual switching (or transformation) by producers between sales to the domestic and export markets in response to any price difference (termed 'export transformation' in this chapter).

6.2 Explicit modelling of transformation between markets

Pricing of product supplies in the standard model

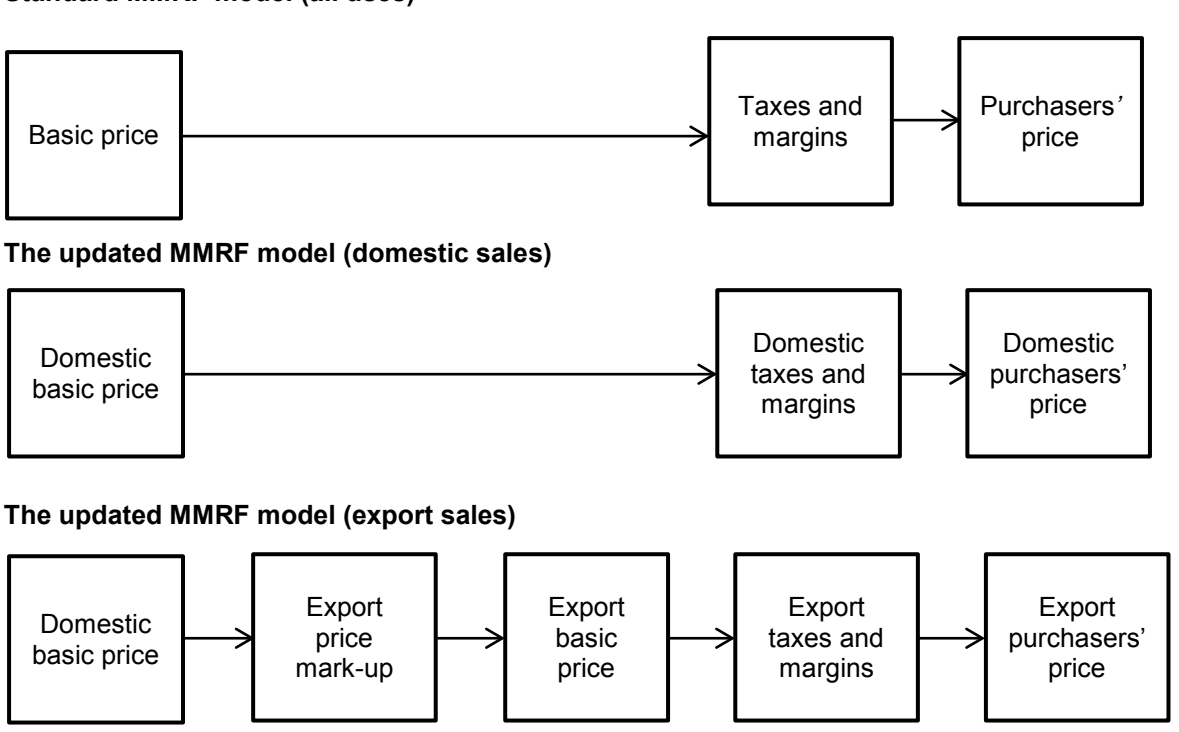
In the standard version of MMRF, the basic price is the price received by producers (often called the ex-farm/mine/factory price) and reflects the cost of production, including a normal rate of return on capital. Zero pure profits in production ensure that the basic price equals the cost of producing that output. Taxes and margins that differ across categories of demand are then added to the basic price to give the purchasers' price for each category of demand (upper panel of figure 6.1).

Breaking the assumed nexus between export and domestic market supplies

The introduction of transformation between supplying the domestic and export markets allows for the possibility of a wedge between the return to the producer from domestic sales (termed 'the domestic basic price' in this chapter) (middle panel of figure 6.1) and that received from export sales (termed 'the basic price of exports' in this chapter) (lower panel of figure 6.1). As depicted in the middle panel, it is assumed that producers continue to earn a normal rate of return (or zero pure profits) on all *domestic* sales. However, the wedge means that producers can earn an *additional* return (either positive or negative) from exporting.[4] This wedge alters the basic price of exports, while leaving the basic price of domestic sales unchanged.

4 Earlier implementations of export transformation implicitly assumed that a normal rate of return continues to be earned across *all* sales, including exports.

Figure 6.1 **Schematic representation of the key price relationships in MMRF**



In keeping with the earlier transformation models, the price wedge added to the MMRF model only applies to exports of non-margin commodities (which account for most Australian exports). The basic price of exports of margin commodities, such as air transport, wholesale trade and retail trade, is assumed to remain unchanged and is the same as that from domestic sales. To make the application of the export transformation theory tractable in the current version of MMRF, the export price of 'non-traditional' exports such as health services is assumed to move in line with the domestic price. For those commodities where exports are modelled separately (such as communications services and water transport), the export supply price is also aligned with the domestic supply price, by convention.

Implications for returns on capital and investment

The introduction of a price wedge associated with export sales means that capital income now consists of two implicit components:

- a normal return from all sales; and
- an additional return or mark-up (or mark-down) received on export sales.

Under this approach, the standard MMRF transmission mechanisms are assumed to apply to the normal returns from all sales.

The additional return (that is, the mark-up on export sales) provides owners of capital an additional after-tax income stream that affects the overall rate of return to the exporting industry and provides producers in that industry with an incentive to:

- switch sales of existing production between domestic and export markets on the basis of relative price differences;
- vary the level of total production; and
- undertake new investment (or disinvestment) to meet overall demand for industry outputs.

With less than perfect transformation, producers are modelled as gradually switching sales between the domestic and export markets in response to differences between the basic prices in these markets.

The rate of this transformation is controlled by a transformation parameter. A parameter value of 0 ensures that no substitution is possible and that export sales volumes move with domestic sales. Sensitivity testing by Gretton (1988) indicated that a value of 300 approximates the perfect transformation of the standard model. In keeping with the earlier implementations of the theory, the assumption of gradual adjustment is implemented by setting the export transformation parameter in the updated MMRF model to a value of 0.5 for all commodities.

Under the expanded theory, changes in the overall rate of return from exporting would progressively affect capital used in production, as industry investment is modelled as gradually responding to changes in the expected equilibrium rate of return.

However, to ensure no pure profits (or losses) on sales to the domestic market, the use of capital in current-period production is modelled under the expanded theory as continuing to be determined by the normal rate of return on capital used in supplying *domestic* sales.[5]

5 If the additional returns from exporting also entered into the production decision, the price of capital would change relative to those of other primary factors (labour and land) and the model would respond by substituting away from (or towards) the use of capital in production and towards (away from) the other primary factors. This change in the mix of factors used in production would alter the cost of sales to the domestic market. The treatment adopted ensures that the additional returns from exporting are not passed through to domestic prices in the short run.

The main changes to the model theory

The changes made to explicitly model export supplies involve numerous changes to the model theory. The main changes include:

- introducing a price wedge between the basic price of domestic and export sales;
- linking the purchasers' price of Australian exports to the new export basic price;
- re-defining the value of export sales and taxes on exports in terms of the new export basic price;
- re-specifying a number of existing price variables as the weighted-average of the domestic and export basic prices;
- re-specifying the returns to owners of capital to include any additional returns from exporting;
- re-specifying household non-labour factor income to include any additional returns from exporting;
- re-specifying net inflow of foreign income to include any additional returns from exporting;
- re-specifying taxes on income received by enterprises and non-residents to include any additional returns from exporting; and
- re-specifying gross state product (GSP) to include any additional returns from exporting.

These changes involve adjustments to the coefficients in the model database (or their updating) and changes to variables in the model.

The explicit modelling of export supplies can be activated (or de-activated) as required through closure changes or by altering the value of the transformation parameter.

PART B

MODELLING REFERENCE CASE

7 Developing the reference case

As noted in chapter 2, the Commission has used a 'dynamic' modelling framework to assess the timescale over which the benefits of the COAG reforms assessed in this study are likely to accrue. The modelling framework is based on an updated version of the MMRF model (outlined in part A of this supplement) and is supported by a modelling 'reference case' that reflects possible demographic, economic and other changes affecting the level and distribution of economic activity over time.

This chapter outlines the role of a reference case in the Commission's assessment of the impacts of the COAG reforms and the development of the reference case used in this study.

7.1 About the reference case

The reference case in a dynamic model represents a projection of the path of the economy over time. It reflects assumptions about the impacts of existing policy settings and the other factors influencing the evolution of the economy.

It is used to help assess the likely effects of a 'shock' of particular interest — in this case, the COAG reforms that the Commission has assessed — on the development and/or composition of the economy and the timescale over which such changes are likely to occur. Given long timeframes in both the implementation of some COAG reforms and over which some impacts are expected to occur, there are likely to be interactions between the COAG reforms assessed and other influences on the economy, environment and society more generally. For example, the magnitude of the impacts of human capital reforms (in this case, the VET reforms) will be affected by changes in the targeted population groups, which are likely to change over time. By abstracting from the impacts of COAG reforms, the reference case provides a point of comparison (see box 2.1, chapter 2, for further explanation).

The modelling reference case for this study extends from 2010 to 2050. This timescale provides a basis for quantifying the economy-wide impacts of many of the COAG reforms in train with longer implementation and gestation periods — including some regulatory reforms. It should also allow sufficient time to have

elapsed for their full effects to have worked through the economy, and to provide a longer-term focus to the assessment of the timescale of impacts.

Given the longer-term focus of the Commission's analysis, the projections for key economic variables abstract from short-term macro-economic fluctuations. However, broad medium- to longer-term sectoral trends in productivity and changes in international market conditions (including possible changes in the terms of trade) are taken into account.

Establishing a reference case suitable for modelling the timescale over which benefits are likely to accrue is complicated in a number of ways.

First, past trends in productivity, prices and sectoral changes may not always provide the most appropriate indicators of future ones. Any reference case will therefore represent assumptions about how these may evolve over time.

Second, past trends embody the results of policy reforms over the period on which they are based. In making projections based on these trends, there is an implicit assumption that past levels of 'reform' will continue. Such assumptions are termed 'business as usual'. For this study, the reference case developed unavoidably embodies such business-as-usual assumptions. There is a risk, however, that where COAG reforms take place in areas of ongoing policy evolution, the impacts of reform could implicitly be included in the reference case.

A suitably constructed reference case should enable assessment of the impacts of COAG reforms and the broad context in which they are being implemented. This is done through highlighting the mechanisms by which COAG reforms will increase or decrease overall economic activity.

Any reference case projected to 2050 will inevitably diverge from reality as it unfolds. Indeed, because of uncertainties surrounding policy changes, exogenous shocks and economic policy developments more generally, it is not possible to meaningfully depict *with* and *without* COAG reform growth paths. Importantly though, as the reference case is used in this study only as a basis for assessing *changes* in the future growth path and composition of the economy due to the COAG reforms, divergences between the reference case and the actual trajectory of the economy need not significantly affect the robustness of the modelling results or broad conclusions that may be drawn from them about the timescale over which the benefits are likely to accrue.

The reference case adopted for this study takes the detailed structure of the Australian economy represented in the model database and, using key exogenous changes, projects the economy through time. Reference cases applied in future

Commission studies may need to be updated to take into account new information about key developments in the economy, including relevant national reform activity. The assumptions underpinning the reference case for any future study will be reported and, where appropriate, tests will be undertaken to illustrate the sensitivity of results to these assumptions.

7.2 Factors influencing the reference case

The modelled path of the economy over time will be conditioned by a range of assumptions about Australia's broad economic policy settings, its place in the global economy, domestic factors that contribute to economic growth and the evolution of these factors over time.

Broad economic policy settings and global position

In order to establish a reference case for estimating the economic impacts of COAG reforms, it is assumed that Australia:

- is a small open economy which has no influence on world prices;
- has a stable political, economic and judicial system such that there is no change in the sovereign risk of Australia that affect the required rates of return by industry;
- maintains its current approach to monetary policy and inflation targeting and that the nominal exchange rate is flexible (that is, Australia maintains a floating exchange rate regime); and
- maintains a budget balance fixed as a share of nominal GDP through lump-sum transfers on households, with aggregate government consumption expenditures varying with nominal household consumption and no change in taxation rates.

The reference case also assumes no major changes in geopolitical conditions that may engender large population movements or demographic change.

Factors contributing to economic growth

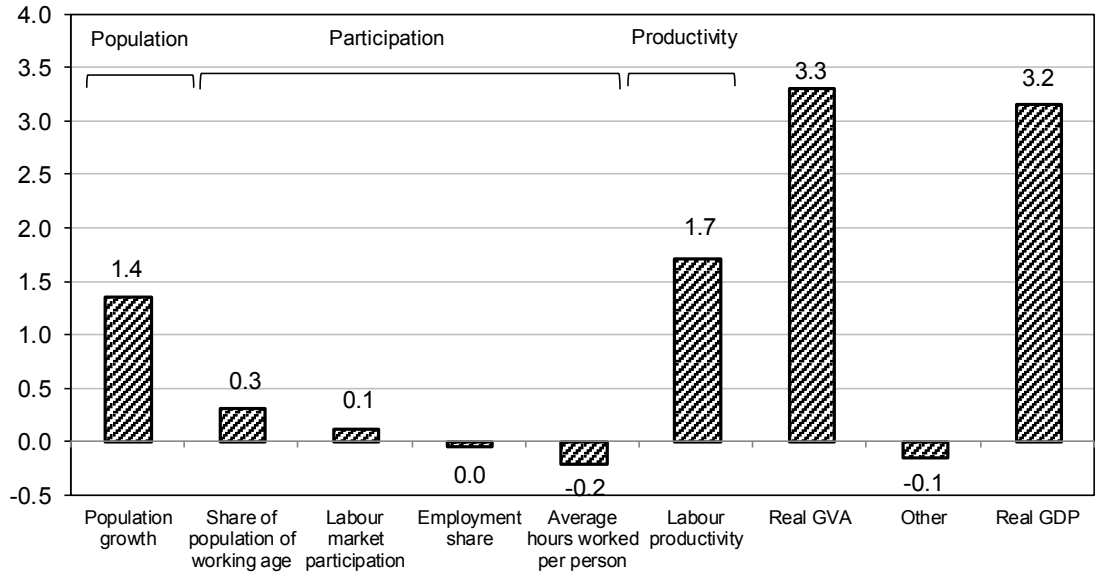
Economic growth can be considered in terms of population growth, participation of the population in employment and the productivity of employed persons. Over the 35 years from 1974-75 to 2009-10, Australia's population increased annually by around 1.4 per cent (figure 7.1). After account is taken of the increase in the working-age population and changes in the participation in employment, labour

inputs (measured in hours worked) increased by an average of 1.6 per cent per year.[1] This represents about half the growth in the level of national output (real gross value added), which grew by 3.3 per cent per year.

Increases in labour productivity added a further 1.7 percentage points per year to growth. In any one year, changes in labour productivity may reflect changes in the use of capital per unit of labour input (capital deepening or shallowing) and changes in the productivity of labour and capital — termed multifactor productivity (MFP) — through technological change and the better organisation of production.

Figure 7.1 **Contributions to the growth in real gross domestic product, 1974-75 to 2009-10**[a]

Per cent per year



a Other consists of changes in taxes less subsidies on products and in the ABS statistical discrepancy.

Sources: Commission estimates based on ABS (*Labour Force, Australia*, Cat no. 6202.0); ABS (*Population by Age and Sex, Australian States and Territories*, Cat. no. 3201.0); ABS (*Australian National Accounts: National Income, Expenditure and Product*, Cat. no. 5206.0); ABS (*Labour Force Historical Timeseries, Australia*, 1966 to 1984, Cat. no. 6204.0.55.001).

1 The sum of the contributions made by population growth, the share of population of working age, labour market participation, employment share and average hours worked per person.

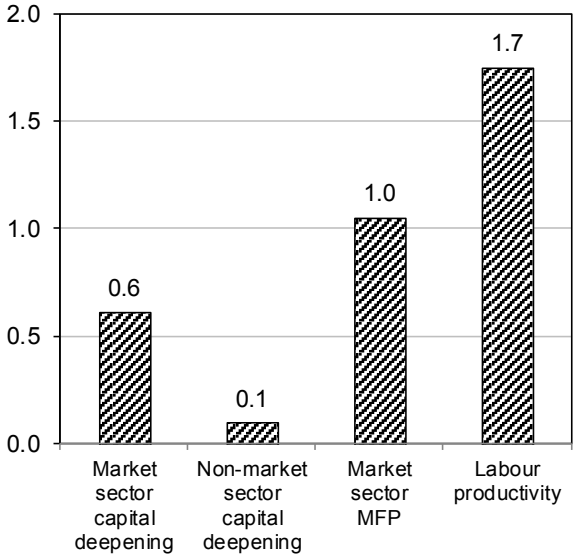
Because the impact of technological and organisational change on GDP cannot be directly measured, the contribution of these effects to output is estimated as the difference between growth in outputs and growth in labour and capital inputs. This methodology is used by the Australian Bureau of Statistics to derive its MFP growth for the 'market sector', a grouping of industries which comprises just over 60 per cent of aggregate economic activity.[2]

Available estimates indicate that market sector MFP growth contributed over half of estimated national labour productivity growth with capital deepening contributing the remainder (figure 7.2).

In order to establish a reference case, assumptions need to be made about possible future changes in the population of Australia, participation in the workforce, employment and labour productivity. To complete the reference case, assumptions also need to be made about other changes that might influence incomes and the distribution of output and employment between activities and regions, including changes in the terms of trade and the composition of household and government demand.

Figure 7.2 **Sources of labour productivity growth, 1974-75 to 2009-10**

Per cent per year



Source: Commission estimates.

2 The application of this methodology requires independent estimates of changes in industry inputs and outputs. The ABS publishes estimates for industries that are predominantly commercially orientated (such as agriculture, mining, manufacturing and a range of services), which are collectively referred to as the 'market sector'. For the non-market sector, growth in output is estimated on the basis of growth in inputs. The non-market sector predominantly comprises public-sector industries (public administration & safety, education & training, health care & social assistance) and ownership of dwellings.

For each of these areas, the approach adopted in this study has been to:

- review past trends in aggregate and by component;
- outline the implications of a simple continuation of past trends into the projection period, as well as longer-term projections and assumptions adopted in official modelling of the implications of carbon emission reduction policies, the *Intergenerational Report* and other relevant studies; and
- state the assumptions that have been adopted for this reference case.

Chapter 8 reports on *population* trends in Australia and key factors affecting population growth including fertility, mortality, and overseas migration. It also reports on available projections of Australia's population along with the accompanying key assumptions which underpin those projections. A suitable demographic reference case for modelling the economic impacts of COAG reforms is also presented.

Chapter 9 reports on national developments in *participation* in the workforce by people of working age. It presents trends in labour market participation rates for men and women of different age groups, employment (and unemployment) rates, average hours worked per person employed and changes in the occupational composition of the workforce. It then reports on possible projections of future trends in workforce participation, and presents an approach for the modelling of future trends and changes in the occupational composition of the workforce in the reference case.

National developments in *labour productivity* are reported in chapter 10. The chapter distinguishes between contributions to labour productivity growth due to capital deepening and, for the market sector, multifactor productivity growth. The chapter also reports labour productivity growth by broad industry category along with projections of future trends in productivity growth. Options for modelling technical and organisational changes (including the use of energy by industry) underpinning multifactor productivity growth in the reference case are also considered.

Chapters 11 to 14 report on factors that may influence national income, and the distribution of activity between industries and regions.

- Chapter 11 reports on historical trends in Australia's terms of trade, available longer-term projections of real import and export prices and possible scenarios for the reference case.
- Chapter 12 provides an overview of developments in foreign investment in Australia and investment income remitted overseas, places these changes in the

context of Australia's balance of payments with the rest of the world and outlines an approach for modelling overseas remittances in the reference case.

- Chapter 13 reports on changes in the composition of household expenditures and identifies approaches to modelling compositional changes associated with demographic change (in particular, the impact of ageing on household demand for health services).
- Chapter 14 reports on historical trends in government finances and the composition of government final consumption expenditure. The chapter outlines a reference case methodology to implement the assumption that the budget would be balanced over the longer term and that government aggregate final consumption expenditures would remain fixed as a percentage of GDP. Under the approach, any deviation from the assumed environment would be modelled as a 'policy change'. The implications of demographic change on the pattern of demand for government services are also considered.

Chapter 15 concludes this study by reporting exploratory projections of the level and distribution of economic activity in Australia conditional on assumptions for the reference case developed in the preceding chapters.

8 Demography

The level and nature of economic activity in Australia over the next 40 years will be strongly influenced by demographic change, particularly the size and age structure of the population. It is therefore necessary to make some assumptions about the key sources of demographic change in developing a modelling reference case.

However, identifying future demographic trends is a difficult task, especially over the medium to longer term, as many key variables will be affected by a wide range of economic and social factors. For example, changing social conditions and norms affect decisions about whether, and at what age, to have children. Such factors are not normally included in stylised modelling reference cases and are outside the scope of this chapter. Rather, the projections developed in this chapter are guided by broad historical patterns. As such, the projections developed imply a continuation of such trends over the projection period. The resulting projections do not represent forecasts of the future.

This chapter identifies the stylised demographic reference case used in assessing the impacts of COAG reforms. The chapter is organised into sections that focus on the key sources of national demographic change — fertility, mortality and net overseas migration.[1] Each section commences by providing a historical perspective focusing on relevant national and, where appropriate, state trends. Each section then details the key assumptions employed by the ABS and the latest *Intergenerational Report* in their population projections. Each section concludes by detailing the key demographic assumptions that the Commission adopted in the modelling reference case that was used to assess the impacts of COAG reforms. As MMRF models the economy of each state separately, many of the demographic assumptions in the modelling reference case are expressed at the state level. The historical timeframes analysed generally reflect the longest period over which comparable ABS demographic data are available.

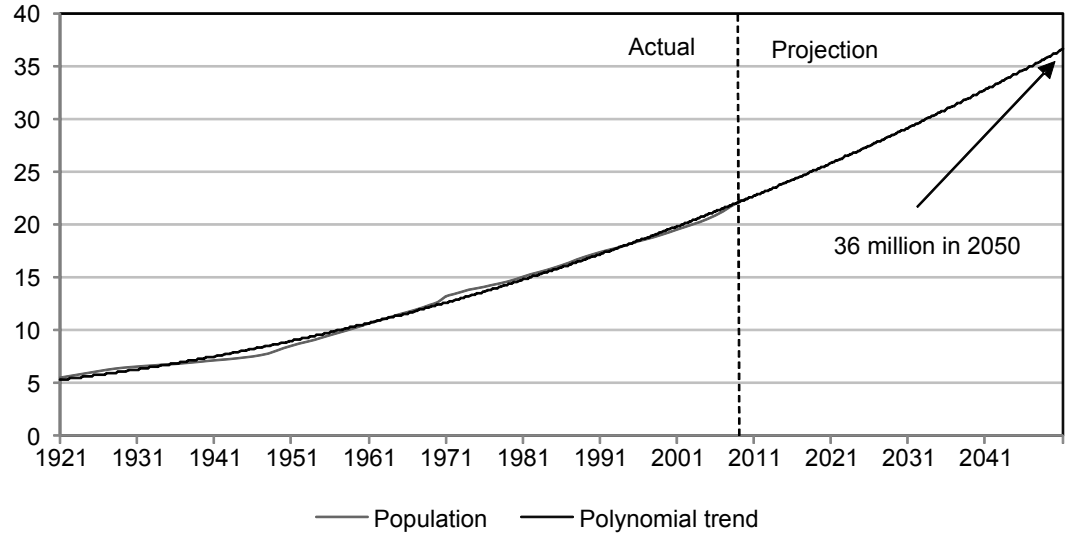
[1] As outlined in chapter 4, net interstate migration in the version of MMRF model used to assess the impacts of COAG reforms is linked to the movement in the labour market, which responds to differences in real wages by occupation across states.

8.1 Overview of demographic change in Australia

Historical perspective

The population of Australia has grown at a reasonably steady rate of 1.6 per cent per year over the last 90 years, reaching an estimated resident population of 22.7 million in September 2011 (figure 8.1). This growth has closely followed a polynomial trend.

Figure 8.1 **Australian population, December 1921 to December 2050**[a,b]
Millions of persons



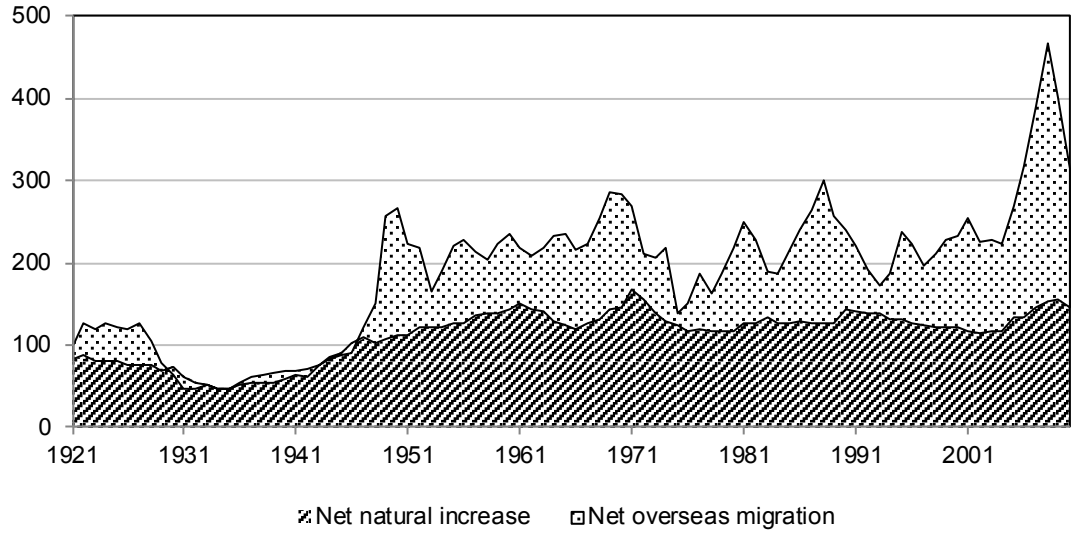
a Includes Christmas and Cocos (Keeling) Islands since September 1993. **b** Actual data to 2010. Projection to 2050.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, September 2011, Cat. no. 3101.0); Commission estimates.

The rate of population growth is determined by the net of births over deaths (net natural increase) and net of immigration over emigration (net overseas migration, NOM).[2] Natural increase has been the main source of population change over the last 90 years (PC 2010b and figure 8.2). However, since 2005, NOM has greatly exceeded the rate of natural increase. Historically, net overseas migration has been more variable than net natural increase.

2 The definition of net overseas migration has changed over time (see Philips, Klapdor and Simon-Davies 2010). Immigration and emigration are loosely used here to denote the measures of long-term arrivals and departures, respectively, in net overseas migration.

Figure 8.2 **Components of Australian population change, 1921 to 2010**[a]
Thousands of persons



[a] Net natural increase: births less deaths. Net overseas migration: immigration less emigration.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, September 2011, Cat. no. 3101.0); Phillips, Klapdor and Simon–Davies (2010).

Not only has the population of Australia increased over the last 90 years, its average age has increased too. Mortality rates have declined since 1921, resulting in a steady increase in life expectancy. Combined with periods of decreasing fertility rates, this has resulted in an ageing population structure (PC 2010b). That is, the proportion of the Australian population in older age groups has increased relative to younger age groups (figure 8.3). For example, the share of Australians aged 65 years and older has increased from 4.5 per cent in 1921 to 13.7 per cent in 2011.

Comparison of recent projections

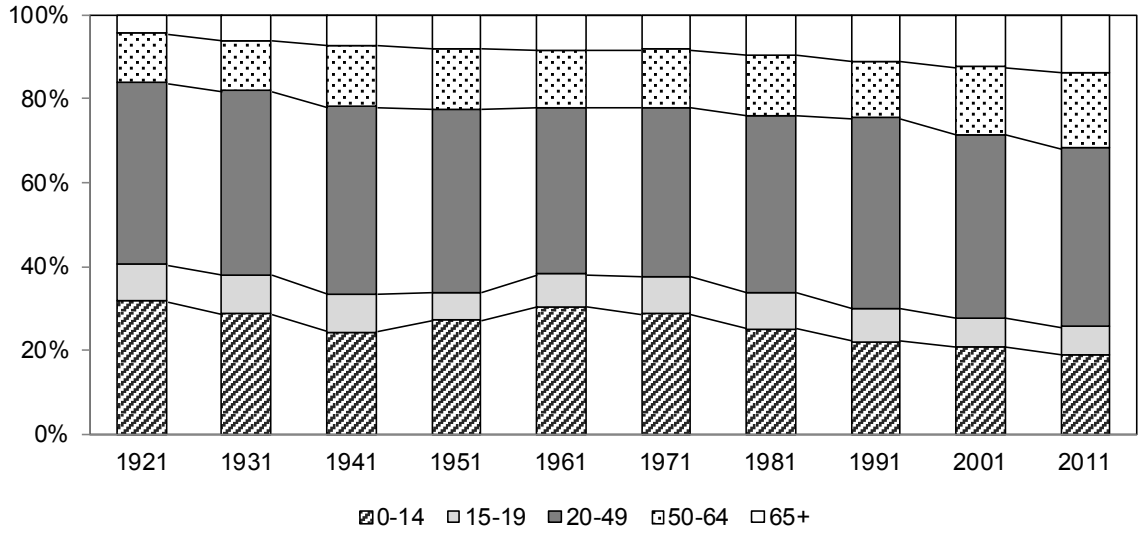
The *Intergenerational Report 2010* (Australian Government 2010, p. 5) projects that the Australian population will reach approximately 36 million by 2050.

In comparison, the ABS (*Population Projections, 2006 to 2101*, 2008, Cat. no. 3222.0) presents three projections of Australia's potential population by 2050:

- 'Series A' projects a population of around 39 million;
- 'Series B' projects a population of around 34 million; and
- 'Series C' projects a population of around 30 million.

The *Intergenerational Report 2010* and ABS Series B projections roughly align with a continuation of the historical polynomial trend in population growth (which would yield a population of 36 million by 2050) (table 8.1).

Figure 8.3 **Share of the Australian population by age, 1921 to 2011**[a,b]
Per cent



a As at 30 June. **b** Data for 2011 are preliminary.

Source: Estimates based on ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, September 2011, Cat. no. 3101.0).

Table 8.1 **Survey of Australian population projections to 2050**
Millions of persons

Projection	*2020*	*2030*	*2040*	*2050*
ABS (series B)	25.2	28.4	31.3	33.9
Intergenerational Report 2010	25.7	29.2	32.6	35.9
Continuation of historical trend since 1921 (polynomial trend)	25.5	28.5	32.0	36.0

Sources: ABS (*Population Projections, 2006 to 2101*, 2008, Cat. no. 3222.0); Australian Government (2010, p. 5); Commission estimates.

8.2 Fertility

Historical perspective

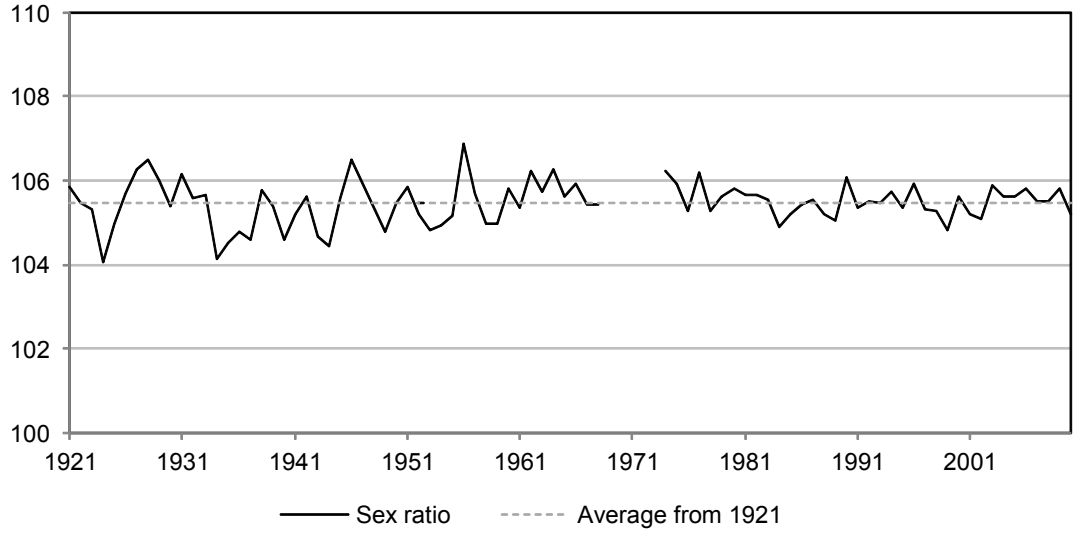
National trends

The number of births in Australia has important implications for not only the growth rate of the population, but also for its future age structure. The number of births depends on:

- the number of women of childbearing age (typically between 15 and 49 years);
- their age profile; and
- the fertility rate at each age (termed 'age-specific fertility rate').

The 'sex ratio' reflects the number of male births per 100 female births and is used in the demographic module added to MMRF to determine the gender of births. The sex ratio in Australia has fluctuated around its long-run average of 105.5 since 1921, varying from between 104 and 107 male births per 100 female births in any one year (figure 8.4).

Figure 8.4 **Sex ratio of Australian births, 1921 to 2010**[a]
Male births per 100 female births



[a] No data available for 1969 to 1973.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); *ABS (Births, Australia*, 2010, Cat. no. 3301.0).

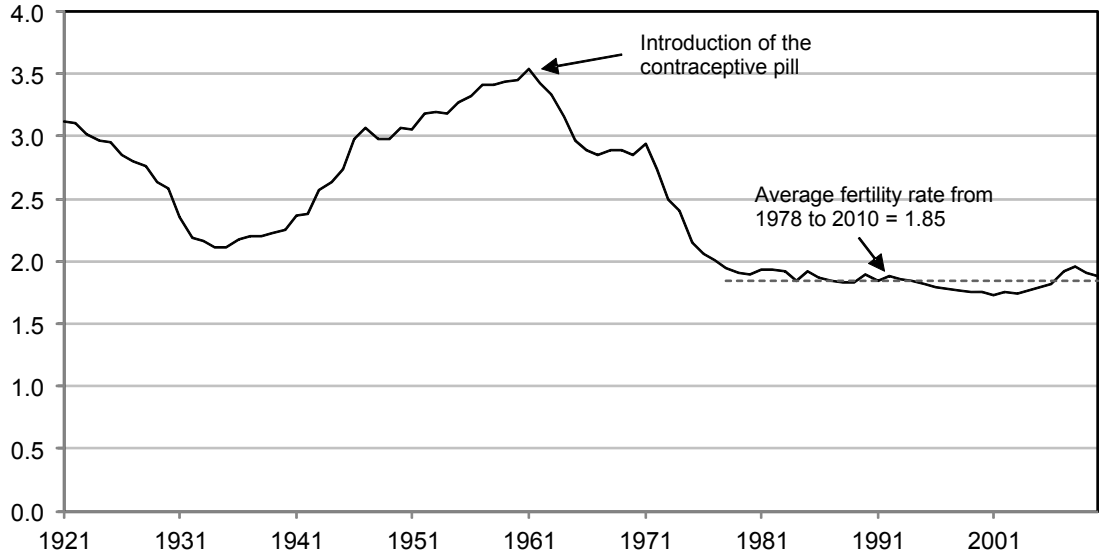
The total fertility rate (TFR) is the headline fertility figure. It measures the average number of babies each woman would have if they experienced current age-specific fertility rates (discussed below) over their life.

In the last 90 years, the TFR in Australia has varied considerably, reflecting changes in the macroeconomic environment, external shocks such as World War II, the degree of access to effective birth control, changing social norms and the patterns of education and workforce engagement. Trends in the TFR can be divided into five distinct periods (figure 8.5):

- The 1920s and 1930s — The TFR dropped from 3.1 in 1921 to a low of 2.1 in 1934. While fertility rates were already declining prior to the Great Depression, the subsequent decline in per capita income and lack of financial security appears to have exacerbated the decline (Lattimore and Pobke 2008, p. 43).
- 1939 to 1945 (World War II) — The TFR trended sharply upwards during World War II (there had been a gentle upward trend in the years immediately preceding this).
- 1946 to 1961 ('Baby Boomer' period) — fertility rates continued to rise after the end of World War II, reaching a high of 3.5 in 1961. This period coincided with a prolonged economic expansion and low levels of unemployment. Increases in fertility rates were concentrated around women aged between 20 and 30 years (figure 8.6), although teenage pregnancy also rose over this period (that is, on average, women starting having children earlier than they had in previous decades). In part, the increase in the TFR reflects 'tempo' effects — recuperation of previously foregone childbearing, and bringing forward childbearing. However, the increases in the fertility rate demonstrate significant overall change in reproductive behaviour during this period.
- 1961 to 1977 — Over this period, the TFR dropped steeply and the age at which women began having children steadily increased. Fertility rates declined most sharply for women in their twenties, but decreased in all age groups except 15-19 year olds (this group's fertility rate declined from the mid-1970s onwards). This shift in fertility trends was driven by a number of complex and interacting factors. These include:

Figure 8.5 **Australian total fertility rate, 1921 to 2010**[a]

Births per woman

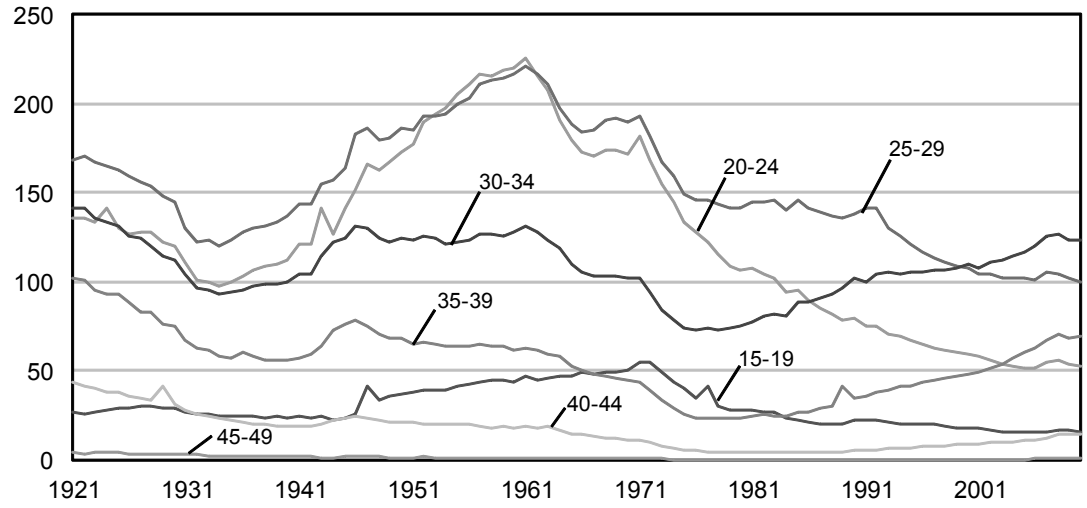


a The total fertility rate is defined as the sum of the age-specific fertility rates (live births at each age of mother per female population of that age) divided by 1000 and represents the number of children that a female would bear during her lifetime if she experienced current age-specific fertility rates at each age of her reproductive life.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat no. 3105.0.65.001); ABS (*Births, Australia*, 2010, Cat. no. 3301.0).

Figure 8.6 **Australian age-specific fertility rates by age of mother, 1921 to 2010**

Births per 1000 women



Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Births, Australia*, 2010, Cat. no. 3301.0).

- *Greater control over fertility decisions*. The oral contraceptive pill became available in Australia in 1961. While access (particularly for unmarried women) was initially constrained[3], use of the oral contraceptive pill progressively increased amongst women (ABS, *Australian Social Trends*, 1998, Cat. no. 4102.0). In addition, women were granted greater access to abortion following the reinterpretation of abortion laws in South Australia (1969), Victoria (1969) and New South Wales (1971) (Cica 1998). Carmichael (1998) argued that the most important of these was the ruling in New South Wales in 1971, in which Justice Levine declared that economic and social stresses were sufficient to establish danger to a woman's mental health.
- *Increased participation by women in higher and vocational education*.
- *Increased participation by women in the workforce*. Female labour participation increased significantly, from 42 per cent in 1966 to 52.6 per cent in 1981 (continuing to increase to 71.5 per cent in 2010 — OECD Stat, accessed 25 May 2012).[4] This reflected greater numbers of women entering the workforce, and a greater ability to re-enter following the birth of a child. For example, the Commonwealth Public Service first permitted married women to be appointed or remain as permanent officers in the Commonwealth Service and to return to their jobs after the birth of their children in 1966 (Weston et al. 2001).

- 1978 to 2009 — The TFR has been relatively stable over the last 30 years, averaging 1.85, notwithstanding a slight increase recently. Many demographers have attributed this recent increase in fertility as a 'tempo' effect arising from a delay in the age at which women start bearing children. Despite the total fertility rate remaining relatively stable, age-specific fertility rates have continued to change since 1978, with fertility rates for under 30 year olds declining and fertility rates for 30 year olds and over rising (figures 8.6 and 8.7). Heard (2010) commented that:

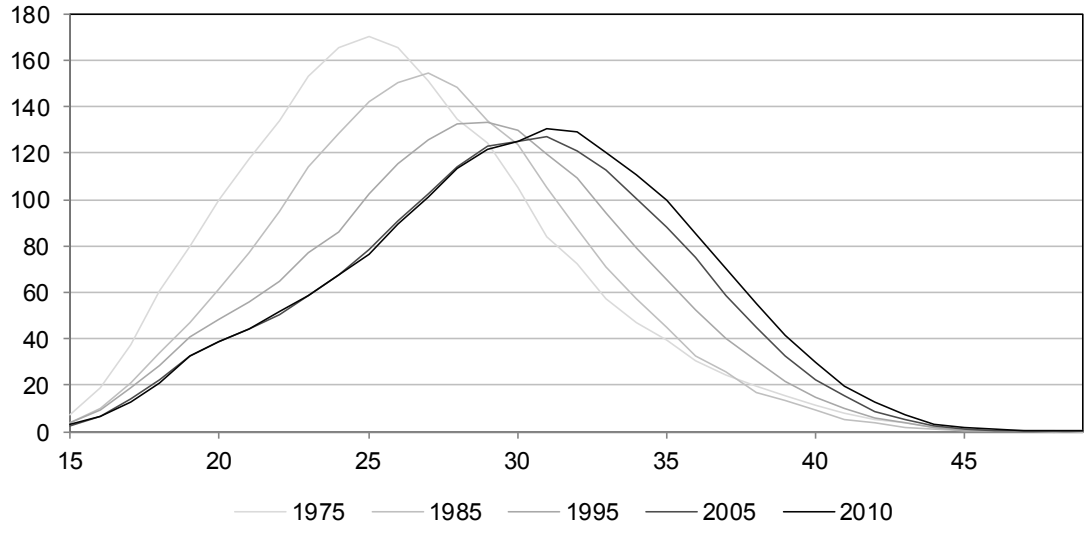
> During a shift to older ages at childbearing, fertility declines among younger women before any increase in fertility becomes evident among older women. Therefore, delayed childbearing temporarily depresses the TFR, whether or not it has any impact on completed fertility (ultimate family size).

3 Access was dependent on prescription by doctors who may have been reluctant to prescribe to unmarried women. Conversely, unmarried women may have been reluctant to approach doctors in order to access the pill (Siedlecky and Wyndham 1990).

4 The OECD participation rates are defined as a share of the population aged 15 to 65 years.

Figure 8.7 **Australian age-specific fertility rates by age of mother, 1975 to 2010**

Births per 1000 women



Source: ABS (*Births, Australia*, 2010, Cat. no. 3301.0).

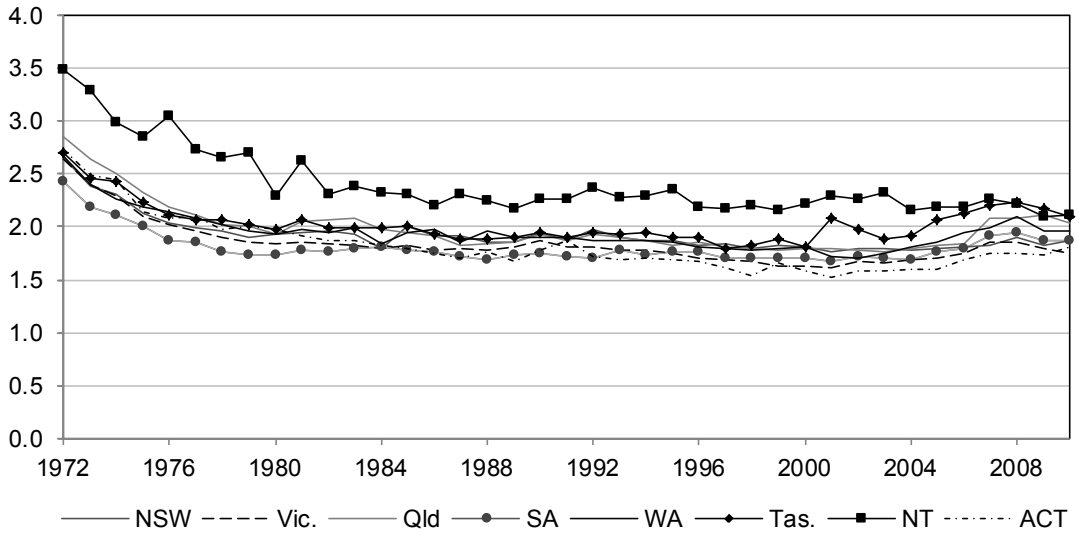
State trends

In general, state fertility rates have exhibited a similar trend to the national figures, with fertility rates declining at a decreasing rate over most of the last 30 years, but experiencing moderate increases from 2001 onwards (with the exception of the Northern Territory).

Similarly, TFRs have not varied widely between jurisdictions, with the exception of the Northern Territory, which has traditionally been considerably higher. From 2001, there has been some moderate divergence between jurisdictions (excluding the Northern Territory). In 2010, the TFR varied from 1.75 births per woman in Victoria to 2.11 births per woman in the Northern Territory (figure 8.8).

Figure 8.8 **Total fertility rates by state, 1972 to 2010**[a]

Births per woman



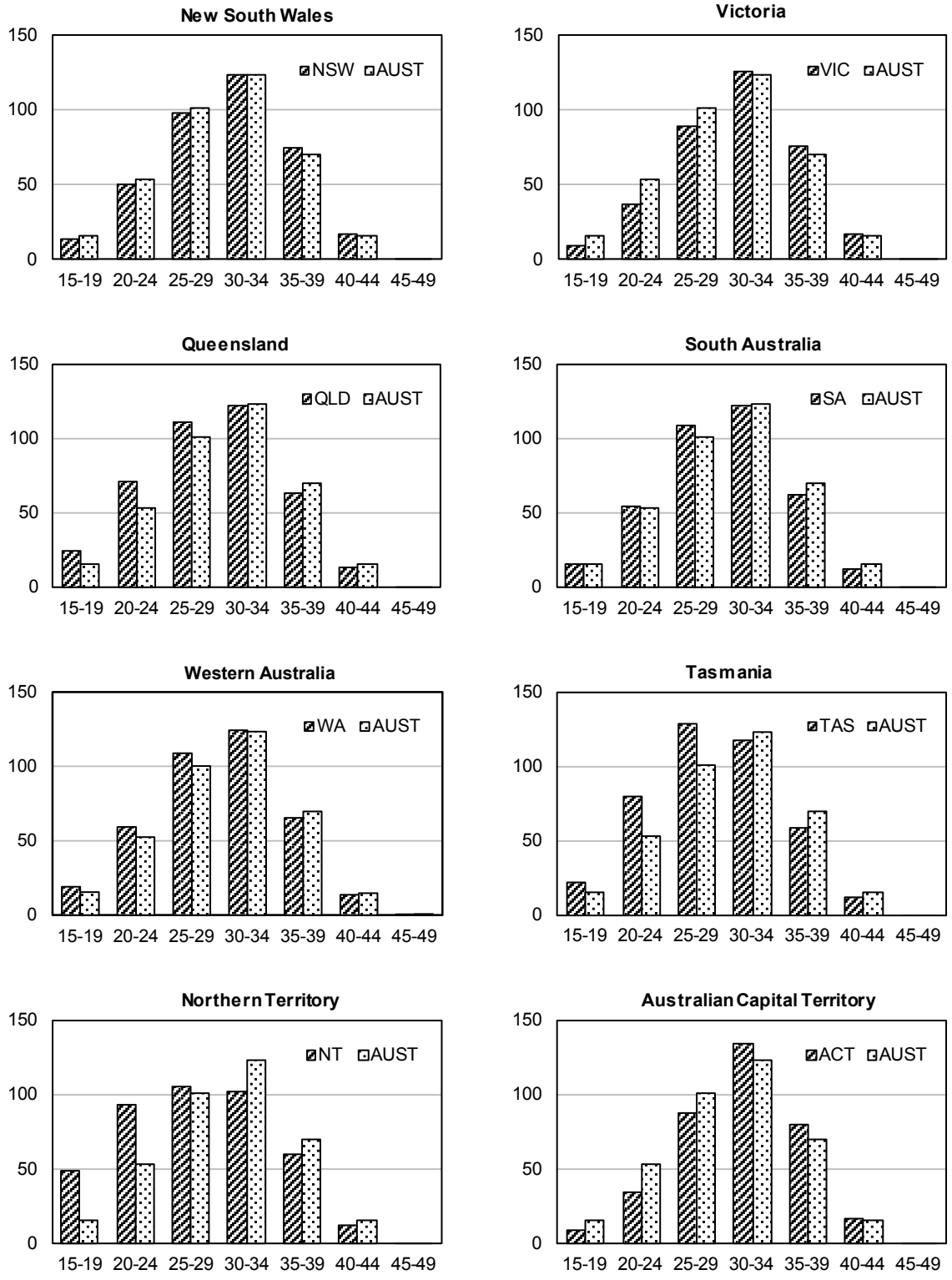
a The total fertility rate is defined as the sum of the age-specific fertility rates (live births at each age of mother per female population of that age) divided by 1000 and represents the number of children that a female would bear during her lifetime if she experienced current age-specific fertility rates at each age of her reproductive life.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Births Australia*, 2010, Cat. no. 3301.0).

In 2010 (figure 8.9):

- Variability in fertility rates between states decreased in older age groups. For 20 to 24 year olds, the lowest fertility rate was 34.3 births per 1000 women in the Australian Capital Territory compared to 92.5 births per 1000 women in the Northern Territory. For 40 to 44 year olds, the lowest fertility rate was 11.6 births per 1000 women in Tasmania and the highest was 16.7 births per 1000 women in the Australian Capital Territory.
- The Northern Territory had a much higher fertility rate for 15 to 24 year olds than the national average, and a lower fertility rate for 30 to 39 year olds.
- Queensland, Tasmania and Western Australia had above average fertility rates for women aged less than 30.
- Women in the Australian Capital Territory and Victoria delayed childbearing to older ages than other states, with fertility rates for under 30s below the national average, while fertility rates for over 30s were slightly above the national average.

Figure 8.9 **Age-specific fertility rates by state, 2010**
Births per 1000 women



Source: ABS (*Births Australia*, 2010, Cat. no. 3301.0).

Comparison of recent projections

Projections of future fertility rates have tended to assume a continuation of the recent period of relative stability (table 8.2):

- The *Intergenerational Report 2010* (Australian Government 2010, p. 6) assumed that the national TFR will decline slightly to 1.9 births per woman by 2013 and will stay at that level to 2050.
- The ABS series B population projections are based on the national TFR declining to 1.8 births per woman by 2021 and remaining at that level to 2101. Series A projections are based on fertility rates rising to 2.0 births per woman by 2021 and remaining at that level. Series C projections are based on the TFR declining to 1.6 births per woman by 2021 and remaining at that level (ABS *Population Projections, 2006 to 2101*, 2008, Cat. no. 3222.0).

If it were assumed that the national TFR were to follow the 30-year average to 2010, the future TFR would be 1.85 births per woman by 2050, the mid-point between the Treasury and ABS series B projections.

Table 8.2 **Survey of Australian total fertility rate projections to 2050**

Projection	*2020*	*2030*	*2040*	*2050*
ABS (series B)	1.81	1.80	1.80	1.80
Intergenerational Report 2010	1.90	1.90	1.90	1.90
Continuation of historical average from 1978 to 2010	1.85	1.85	1.85	1.85

Sources: ABS (*Population Projections, 2006 to 2101*, 2008, Cat. no. 3222.0); Australian Government (2010, p. 6); Commission estimates.

Towards a modelling reference case

Australia's TFR has varied considerably over the last 90 years, and it is not possible to rule out further shifts in the future. Nevertheless, based on available evidence, it appears that the long downward trend in fertility since the 1960s has abated, and there are reasonable prospects that the fertility rate will persist within the range observed in recent years (Lattimore and Pobke 2008).

The modelling reference case reflects this assessment. It uses the actual TFR in each state from 2005-06 to 2009-10, before assuming that the TFR in each state gradually transitions to the long-run national average (over the period 1978 to 2010) of 1.85 births per woman by 2050 (figure 8.10 and table 8.3).[5] The state age-

[5] The long-run TFR of 1.85 births per woman is also the midpoint between the TFRs in the *Intergenerational Report 2010* and ABS series B.

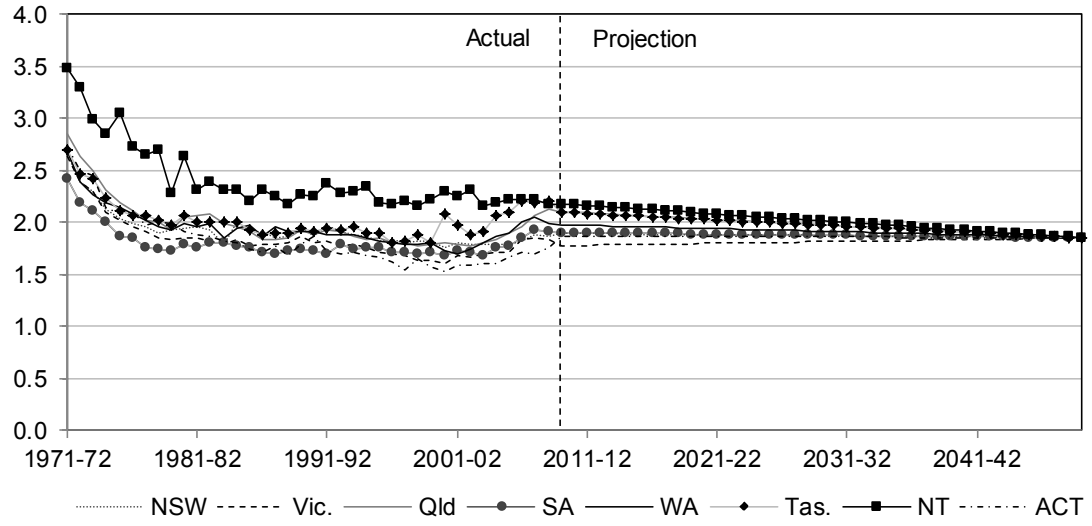
specific fertility rates in each simulation year are scaled to align with the target TFR in that year. The initial total and age-specific fertility rates in the model database are set out in chapter 3 (table 3.10).

These assumptions imply that the national TFR declines from 1.92 births per woman in 2009-10 to 1.85 births per woman in 2049-50.

The modelling reference case assumes that the sex ratio in each state — male births per 100 female births — remains at its average rate over the period 2001-02 to 2008-09 (table 8.3).[6]

Figure 8.10 **Total fertility rates by state in the modelling reference case to 2049-50**[a]

Births per woman



a Actual data to 2009-10. Projection to 2049-50. Data for 1971-72 to 2004-05 are the average of calendar year TFRs. Data for 2005-06 to 2009-10 are the financial year TFRs.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Births Australia*, 2010, Cat. no. 3301.0); ABS (*Australian Demographic Statistics*, June 2010, Cat. no. 3101.0); Commission estimates.

6 The national sex ratio over this period is 105.6 male births per 100 female births.

Table 8.3 **Fertility projections in the modelling reference case by state to 2049-50**[a]

State	*2019-20*	*2029-30*	*2039-40*	*2049-50*
Total fertility rate (births per woman)				
New South Wales	1.88	1.87	1.86	1.85
Victoria	1.80	1.82	1.83	1.85
Queensland	2.04	1.98	1.92	1.86
South Australia	1.89	1.88	1.86	1.85
Western Australia	1.95	1.92	1.89	1.85
Tasmania	2.05	1.99	1.92	1.86
Northern Territory	2.10	2.02	1.94	1.86
Australian Capital Territory	1.85	1.85	1.85	1.85
Sex ratio (male births per 100 female births)				
New South Wales	105.8	105.8	105.8	105.8
Victoria	105.3	105.3	105.3	105.3
Queensland	106.0	106.0	106.0	106.0
South Australia	104.7	104.7	104.7	104.7
Western Australia	105.2	105.2	105.2	105.2
Tasmania	105.6	105.6	105.6	105.6
Northern Territory	105.9	105.9	105.9	105.9
Australian Capital Territory	105.2	105.2	105.2	105.2

[a] In the MMRF model, the fertility rate shocks by age of mother and the sex ratio shocks are applied in the year before they take effect. The existing age-specific fertility rates are scaled to align with the target TFR in each state.

Source: Commission estimates.

8.3 Mortality

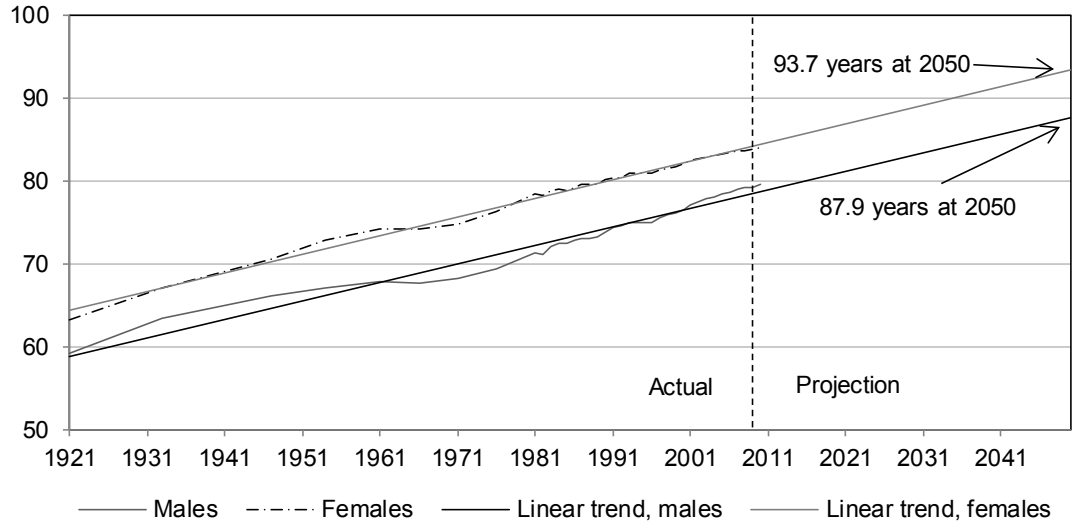
Historical perspective

National trends

Life expectancy at birth was 79.5 years for males and 84.0 years for females in 2009 (figure 8.11).

Since the 1920s, life expectancy at birth for both males and females has increased at a more-or-less linear rate. Over this period, life expectancy for females has been consistently higher than for males — although the gap widened after World War II before narrowing slightly more recently (figure 8.11). Increases in average life expectancy have in large part been driven by declines in mortality rates for those aged 0–5 and those aged 60 years and over (figure 8.12).

Figure 8.11 **Australian life expectancy at birth, 1921 to 2050**[a]
Years



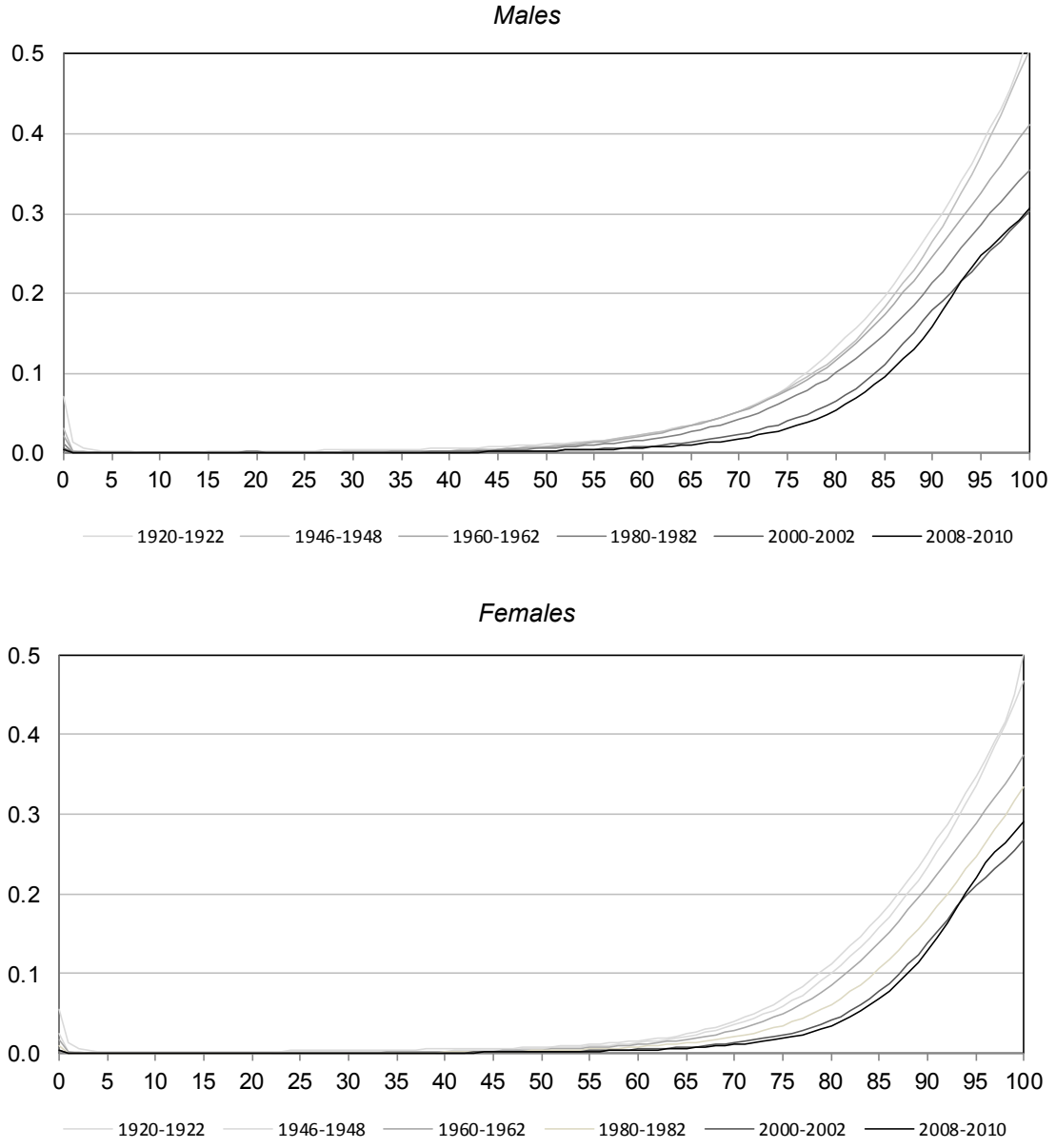
a Actual data to 2010. Projection to 2050. Data from 1995 has been calculated using data for the three years ending in the reference year.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Deaths, Australia*, 2010, Cat. no. 3302.0); Commission estimates.

State trends

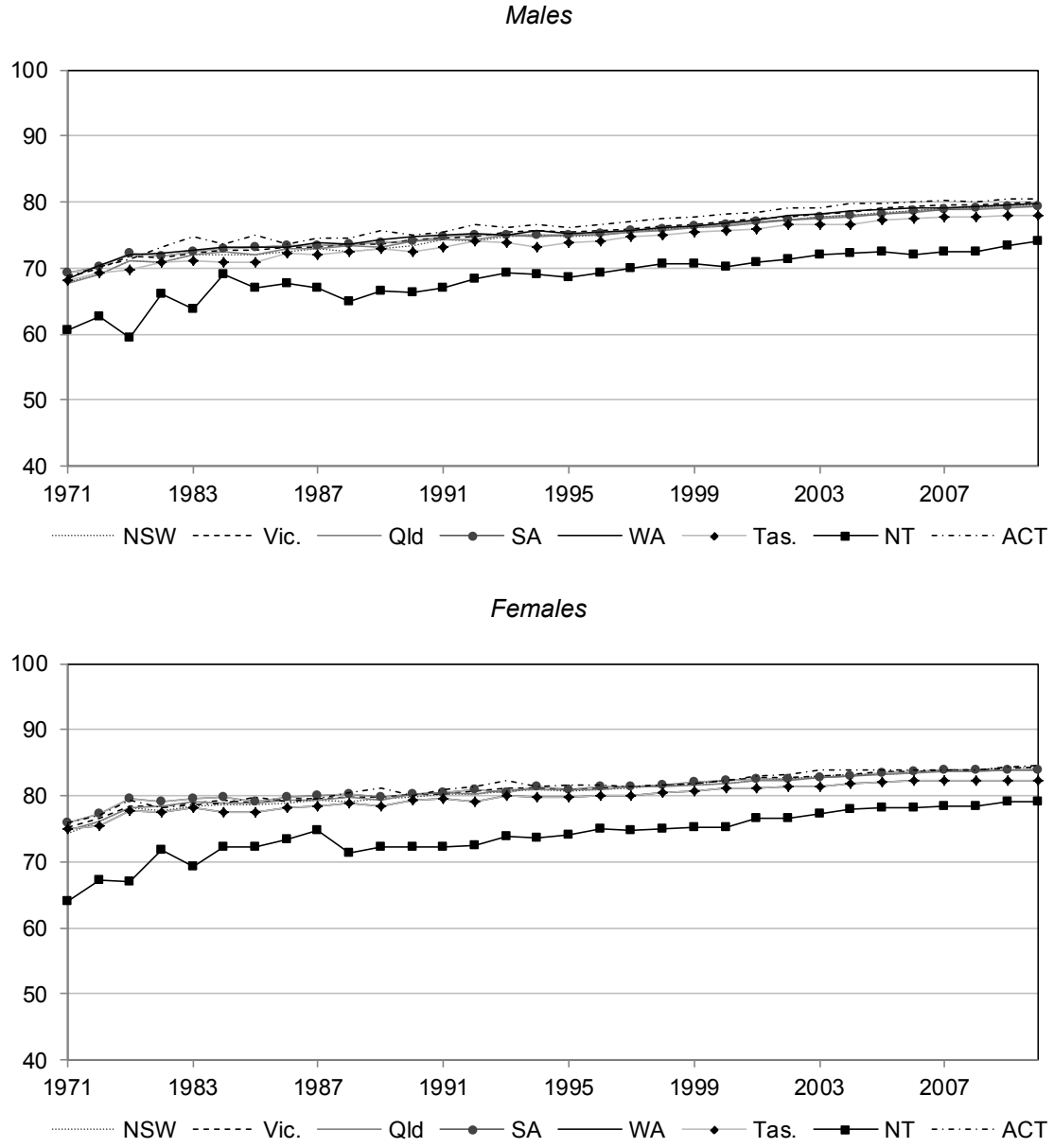
Since 1971, trends in life expectancy at birth in most states have not varied substantially from the national average (figure 8.13). The Northern Territory is the exception to this, where mortality rates have been consistently higher than the national average (and consequently life expectancy at birth has been lower) for both males and females.

Figure 8.12 **Australian mortality rates by gender, 1921 to 2010**
Probability of dying



Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Life Tables, Australia*, 2008-2010, Cat. no. 3302.0.55.001).

Figure 8.13 **Life expectancy at birth by state, 1971 to 2010**[a]
Years



a Data from 1995 has been calculated using data for the three years ending in the reference year.

Sources: ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Deaths, Australia*, 2010, Cat. no. 3302.0).

Comparison of recent projections

Both the *Intergenerational Report 2010* and the ABS project continued increases in life expectancy (table 8.4).

The ABS (*Population Projections, 2006 to 2101*, 2008, Cat. no. 3222.0) provides two possible projections:

- *High scenario* — male and female life expectancy at birth will increase from 2004–2006 levels by 0.30 and 0.25 years per year, respectively, until 2056. Based on this assumption, male life expectancy at birth would reach 93.9 years and female life expectancy at birth would reach 96.1 years in 2056.
- *Medium scenario* — from a base annual increase in life expectancy of 0.30 for males and 0.25 for females, mortality improvement is projected to gradually decline. In this scenario, life expectancy at birth will reach 85 years for males and 88 years for females by 2056.

Similarly to the ABS *Medium scenario*, the *Intergenerational Report 2010* (Australian Government 2010, p. 7) assumed that the rate of increase will diminish over time, projecting that, by 2050, life expectancy at birth will reach 87.7 years for males and 90.5 years for females.

The ABS and *Intergenerational Report 2010* project that life expectancies for males and females will gradually converge by 2050.

Table 8.4 **Survey of Australian life expectancy at birth projections to 2050**
Years

Projection	*2020*		*2030*		*2040*		*2050*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
ABS (series B)	82.1	86.1	83.1	86.9	84.0	87.5	84.6	87.8
Intergenerational Report 2010	82.5	86.2	84.5	87.8	86.1	89.2	87.7	90.5
Continuation of historical trend from 1921 to 2009 (linear)	81.0	86.9	83.3	89.2	85.5	91.4	87.8	93.7

Sources: ABS (*Population Projections, 2006 to 2101*, 2008, Cat. no. 3222.0); Australian Government (2010, p. 7); Commission estimates.

Towards a modelling reference case

While genetic limitations may mean that life expectancy cannot increase indefinitely, there has, nonetheless, been a more-or-less linear increase in life expectancy over the last 90 years (rather than the rate of increase diminishing over time).

However, adjusting the age-specific mortality rates published in life tables to achieve a target life expectancy as implied by extrapolating past trends is neither a straightforward process, nor one that is conducive to modelling in the demographic module in MMRF. Given this, the mortality rates in the model database (detailed in tables 3.11 and 3.12 in chapter 3) are updated using age, gender and state-specific growth rates (detailed in tables 3.13 and 3.14 in chapter 3). These growth rates are derived from the *ABS Life Tables* using the methodology outlined by the Australian Government Actuary (2009, p. 35). The resulting life expectancies at birth implied by these updated mortality rates (table 8.5) are generally close to those obtained by linearly extrapolating historical trends (figure 8.11).[7]

Table 8.5 **Life expectancy at birth by state implied by the annual changes in mortality rates used in the modelling reference case to 2049-50**

Years

	2019-20	*2029-30*	*2039-40*	*2049-50*
Males				
New South Wales	82.0	84.1	86.0	87.7
Victoria	82.4	84.5	86.3	87.9
Queensland	81.9	84.1	86.0	87.7
South Australia	81.9	84.0	85.9	87.6
Western Australia	82.2	84.3	86.2	87.9
Tasmania	80.8	83.0	85.0	86.8
Northern Territory	78.3	82.2	85.3	88.0
Australian Capital Territory	83.1	85.1	86.8	88.4
Females				
New South Wales	86.3	88.3	90.6	93.3
Victoria	86.4	88.4	90.6	93.4
Queensland	86.2	88.3	90.5	93.3
South Australia	86.4	88.4	90.7	93.5
Western Australia	86.6	88.7	91.0	93.9
Tasmania	85.1	87.1	89.3	91.9
Northern Territory	83.4	87.2	91.7	99.0
Australian Capital Territory	86.5	88.5	90.6	93.3

Source: Commission estimates.

7 The one exception where applying recent improvements in mortality rates results in a higher life expectancy at birth than would be expected from extrapolating historical trends in life expectancy is for females in the Northern Territory. The resulting higher life expectancy does not materially affect the results presented in this supplement or in the final report.

8.4 Overseas migration

Historical trends

National trends

The level, age and gender composition of net overseas migration affect the rate of population growth. The effect of net overseas migration on population growth can be amplified by increasing the proportion of migrants from the high fertility rate age groups (20 to 39 years old) and/or the proportion of females.

Since 1921, the number of net overseas migrants as a proportion of the Australian population has fluctuated substantially between -0.19 per cent (1931) and 1.89 per cent (1949) (figure 8.14). However, despite the year-to-year variations, the long-run average has remained fairly stable at around 0.6 per cent of the Australian population over sub-periods to 2010 (table 8.6).

The overall number of migrants entering Australia has historically been determined by Australian Government policy (table 8.7). Over time, immigration policies have become more flexible, enabling the system to be more responsive to changes in the demand for labour.

Table 8.6 **Average net overseas migration to Australia as a share of the population, 1921 to 2010**

Per cent

Time period	*Share of population*
1921-2010	0.58
1955-2010	0.68
1975-2010	0.59
1990-2010	0.62

Source: Estimates based on Phillips, Klapdor and Simon−Davies (2010); ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, September 2011, Cat. no. 3101.0).

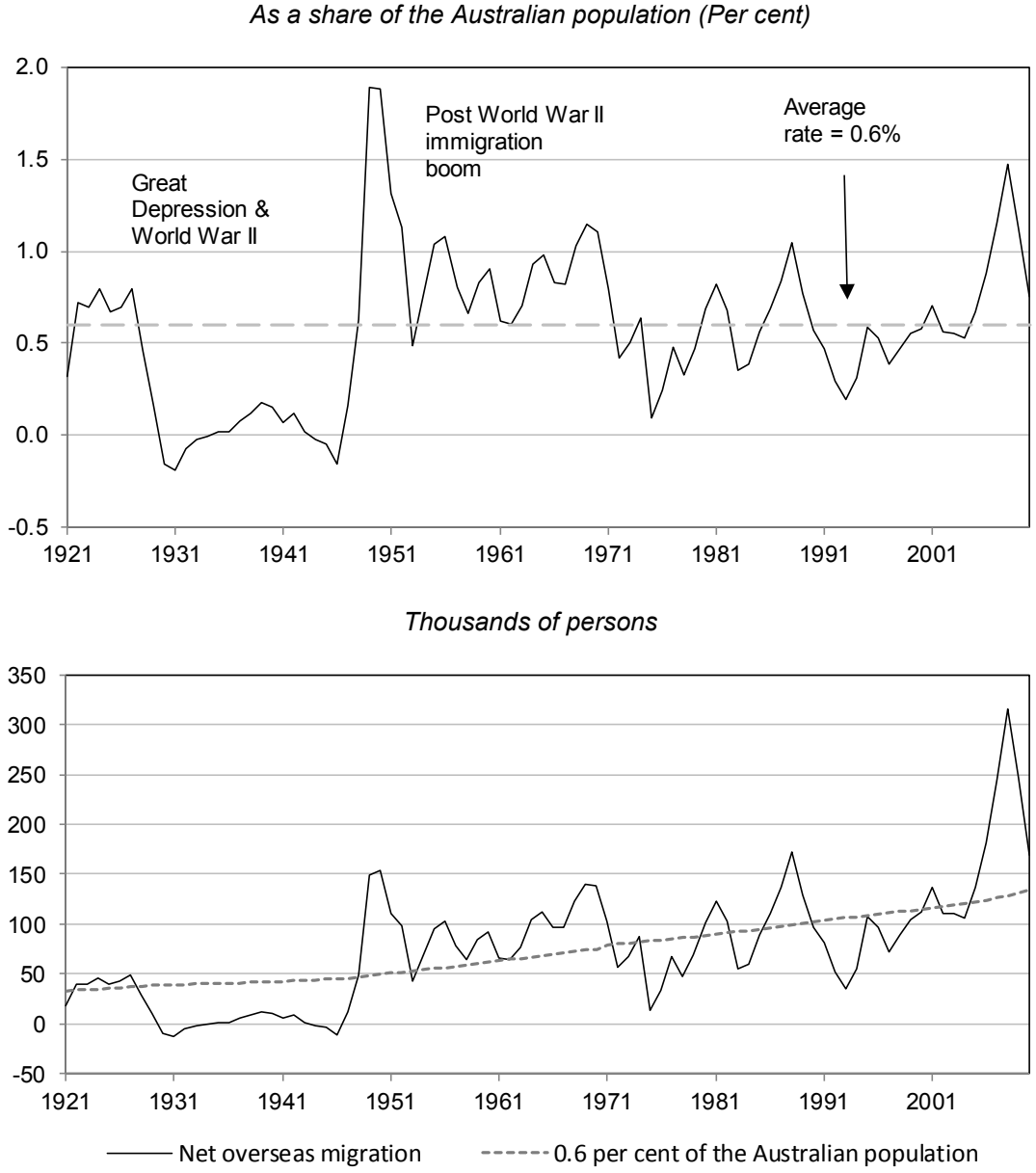
There have also been significant changes in the level and composition of migration over the last seven years. Between 2004 and 2008, annual net overseas migration rose from just over 100 000 to over 300 000 (figure 8.14). In large part, this was driven by large net increases in the number of long-term temporary visitors coming to Australia (especially international students and long-stay business visas), rather than reductions in the number of departures (figures 8.15 and 8.16).

Table 8.7 **Selected changes to Australia's immigration program, 1973 to 2010**

Year	*Change*
1973	Introduction of the unrestricted Trans-Tasman Travel Arrangement between Australia and New Zealand
1977	Commencement of the first tailored humanitarian program
1996	Introduction of the uncapped temporary business (long stay) visa (subclass 457)
1999	Introduction of a 'migration occupations in demand list', containing occupations considered to be in 'shortage'
	Additional points granted to migrants educated at an Australian institution
2001	Removal of the requirement for overseas students educated at an Australian institution with certain skills (especially information and communications technology) to first leave Australia or gain experience in their professional field to gain permanent residency
2003	Increase in the minimum length of study required in Australia for overseas students to qualify for bonus points and the work experience exemption under the general skilled migration program (from one to two years)
	Increase in the number of points awarded for completion of Australian honours, masters, and PhD degrees
2004	Expansion of the migration occupations in demand list to include accountants and a number of trade occupations
2005	Inclusion of engineering-related occupations and more trade occupations (such as cooking and hospitality) in the migration occupations in demand list
	Introduction of a trade skills training visa allowing employers to recruit people from overseas to undertake apprenticeships
2006	Increase in the base level of English proficiency required by general skilled migration visa applicants, and introduction of a skilled work experience requirement for some previously exempt overseas students applying for permanent residency
2007	Abolition of New Zealand-specific permanent residence visas as part of reform of the general skilled migration program
2008	Increase in the number of places offered in the skilled migration program by 37 000
	Introduction of a 'demand driven' model for determining permanent skilled migration, introduction of a 'critical skills list' to apply to independent skilled visa applicants; and an increase in the number of employee-sponsored visas
2009	Two cuts to the general skilled migration program quota, reducing it by 20 per cent
	Removal of building and manufacturing trades from the critical skills list, leaving it to consist mainly of health, medical, engineering, and IT professionals
	Introduction of a series of integrity measures associated with student visas
2010	Issue of a new 'skilled occupations list', containing 181 occupations — a reduction of 219 compared to the previous list
	Removal of occupations such as cooking and hairdressing from the skilled occupations list. The inclusion of such occupations previously had contributed to growth in overseas student enrolments in the vocational education and training sector
	Introduction of rules for temporary skilled graduate visas for students studying for an occupation not on the skilled occupations list

Sources: DIAC (2011b); DIMA (2001); Evans (2008a,b,c; 2009; 2010); Koleth (2010); Parliamentary Library (2010).

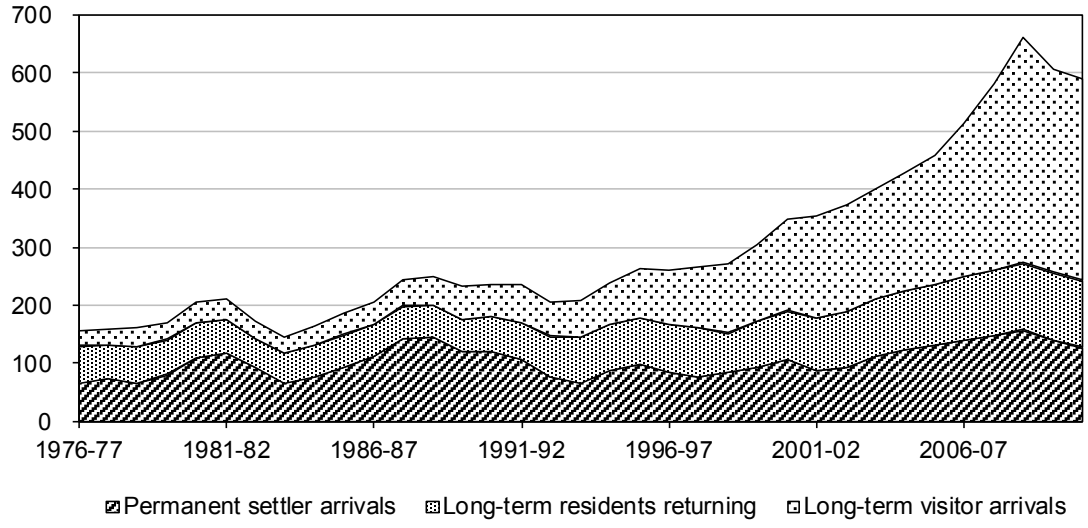
Figure 8.14 **Australian net overseas migration, 1921 to 2010**



a From July 1925, figures are net permanent and long-term migration. From 1971 to 2006, net overseas migration (NOM) is the difference between permanent and long–term arrivals and permanent and long–term departures. From the September quarter 2006 onwards, estimates for NOM are the difference between the number of incoming travellers who stay in Australia for 12 months or more and the number of outgoing travellers who leave Australia for 12 months or more.

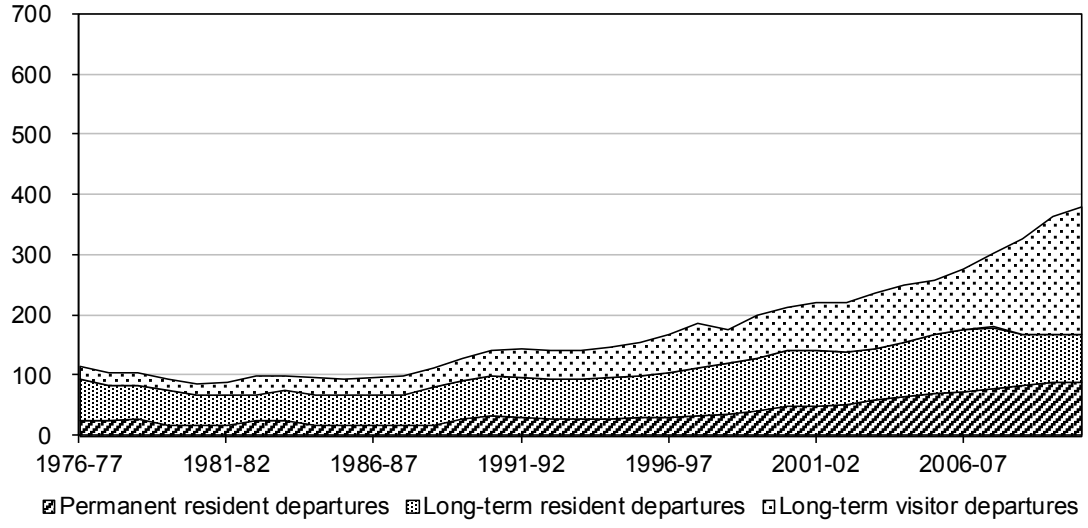
Source: Estimates based on ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, September 2011, Cat. no. 3101.0); Phillips, Klapdor and Simon–Davies (2010).

Figure 8.15 **Overseas arrivals to Australia, 1976-77 to 2010-11**
Thousands of persons



Source: ABS (*Overseas Arrivals and Departures, Australia*, March 2012, Cat. no. 3401.0).

Figure 8.16 **Overseas departures from Australia, 1976-77 to 2010-11**
Thousands of persons

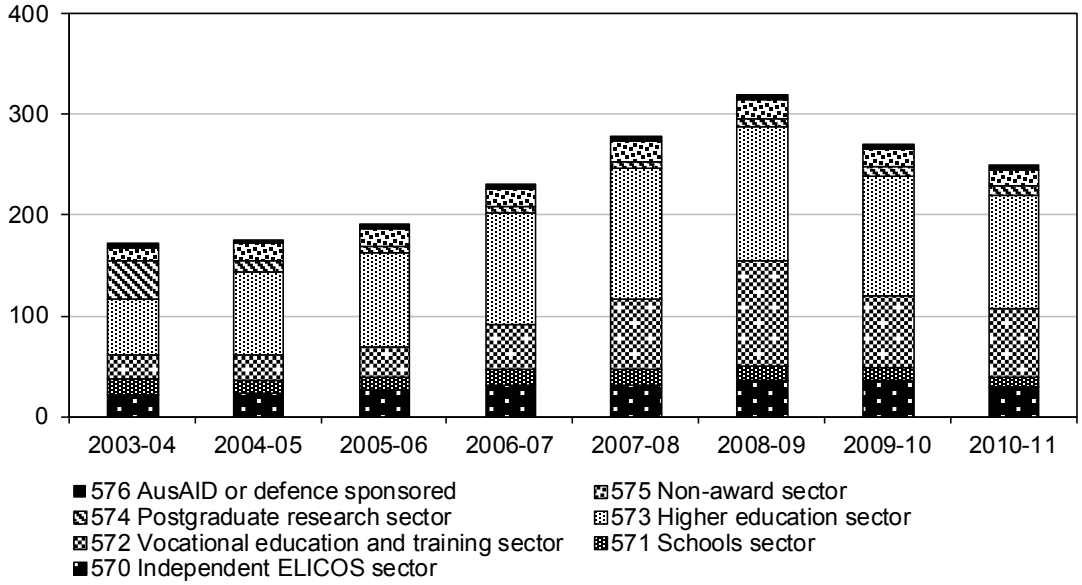


Source: ABS (*Overseas Arrivals and Departures, Australia*, March 2012, Cat. no. 3401.0).

The number of international student visas granted increased from 172 000 in 2003-04 to a peak of 320 000 in 2008-09 (figure 8.17). The largest increases came from vocational education and training (increasing by over 300 per cent, or 78 962 students) and higher education (increasing by about 150 per cent, or 78 748 students).

Figure 8.17 **Number of student visa applications granted by subclass, Australia, 2003-04 to 2010-11**

Thousands



a From 2004-05 onwards, masters by coursework students were eligible for higher education (subclass 573) visas. Prior to this, they were eligible for postgraduate research (subclass 574) visas.

Sources: DIAC (2010, p. 17; 2011a, p. 17).

The increase in overseas students can be attributed partly to changes to the migration rules in 2001. The Government announced that overseas students that had successfully completed their studies at an Australian educational institution, and had skills considered to be in demand, could apply for permanent residency onshore under the general skilled migration program. Such students were no longer required to return home to apply for Australian residency, and were also exempted from being required to obtain work experience in their chosen occupation. This resulted in a rise in the number of successful applications for permanent residency.

The number of student visas granted dropped in 2009-10, coinciding with a tightening of the rules from 1 January 2010. From then on, prospective overseas students were required to demonstrate that they had access to at least $18 000 to finance their living expenses in Australia, an increase of $6000 over the amount previously required. In addition, the appreciation of the Australian dollar significantly exacerbated this increase, effectively raising the cost of studying in Australia. Reforms to the general skilled migration program in February 2010 also reduced the number of occupations on the skilled occupations list, including the removal of hairdressing and cooking. The reduction in the skilled occupations list had a particularly large effect on the vocational education and training sector.

Since the path from overseas student to permanent resident has been restricted, the number of overseas students could decline further.

The influx of international students had a large effect on the age composition of migrants between 2004-05 and 2008-09, particularly those aged 15 to 30 years (figure 8.18). This influx affected the age profile of the Australian population, as migration is the main source of demographic change for these age groups (as deaths are relatively infrequent).

The sex ratio of net overseas migrants varies across time and age and is particularly volatile for over 50 year olds (this is due to the small number of migrants in those age groups) (figure 8.19).

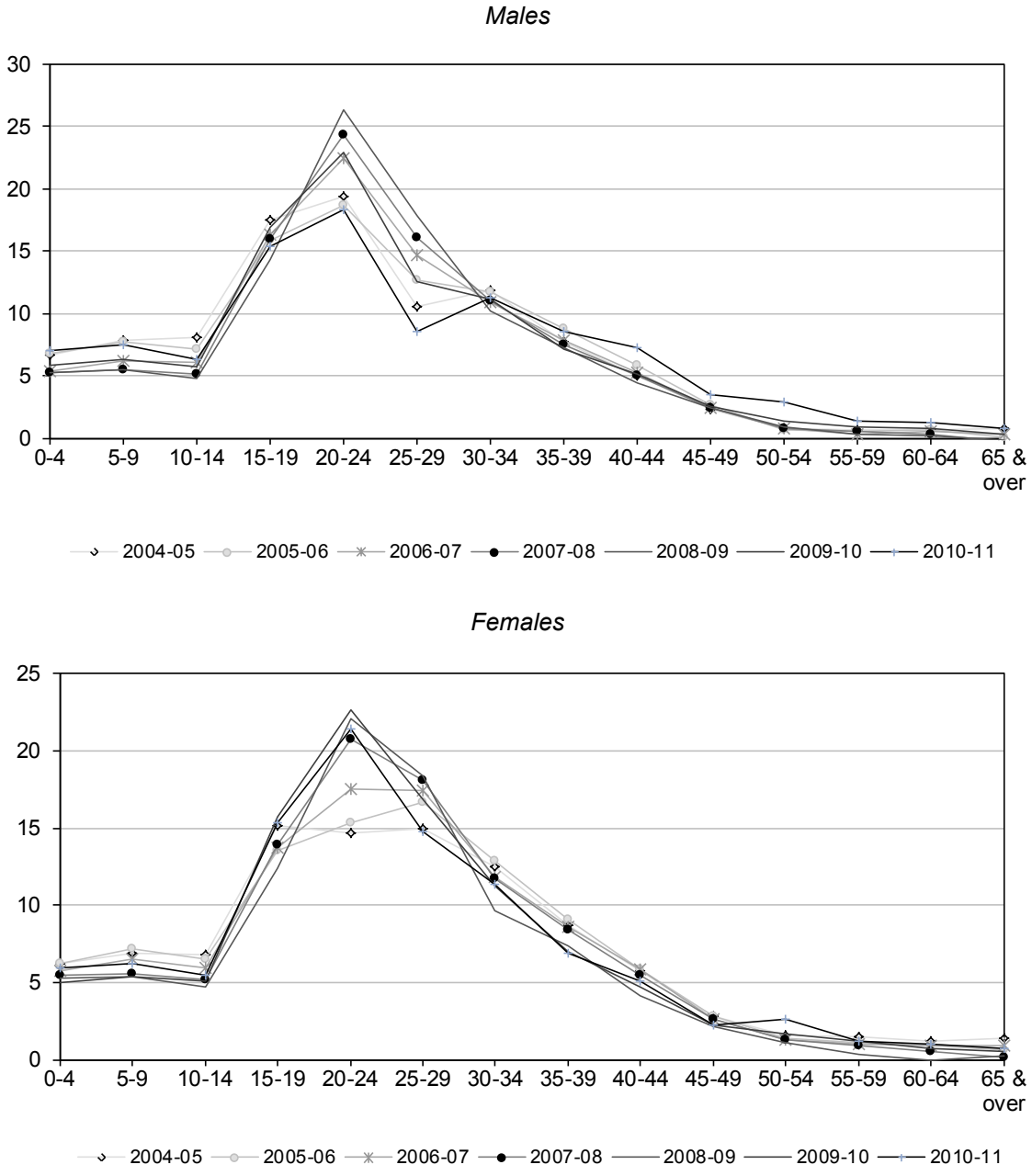
Comparison of recent projections

The *Intergenerational Report 2010* (Australian Government 2010, p. 7) projected that net overseas migration would decline relatively sharply from an annual average of around 244 000 over the three years to June 2009 to 180 000 people per year from 2012 and remain at that level to 2050. As net overseas migration is fixed at 180 000 people per year from 2012, net overseas migration was projected to decline from 0.7 per cent of the population in 2020 to 0.5 per cent in 2050. The age-gender profile of overseas migration was projected to remain constant at its 2010 level.

The ABS series B projections have net overseas migration declining to 180 000 per year in 2008 and remaining at that level until 2101. The series A projections have net overseas migration declining to 220 000 in 2011 and remaining at that level, while the series C projections have net overseas migration declining to 140 000 in 2011 and remaining at that level. The net overseas migration projections in series B are equivalent to a decline from 0.7 per cent of the population in 2020 to 0.5 per cent in 2050 (table 8.8).

Figure 8.18 **Share of net overseas migrants to Australia by age and gender, 2004-05 to 2010-11**

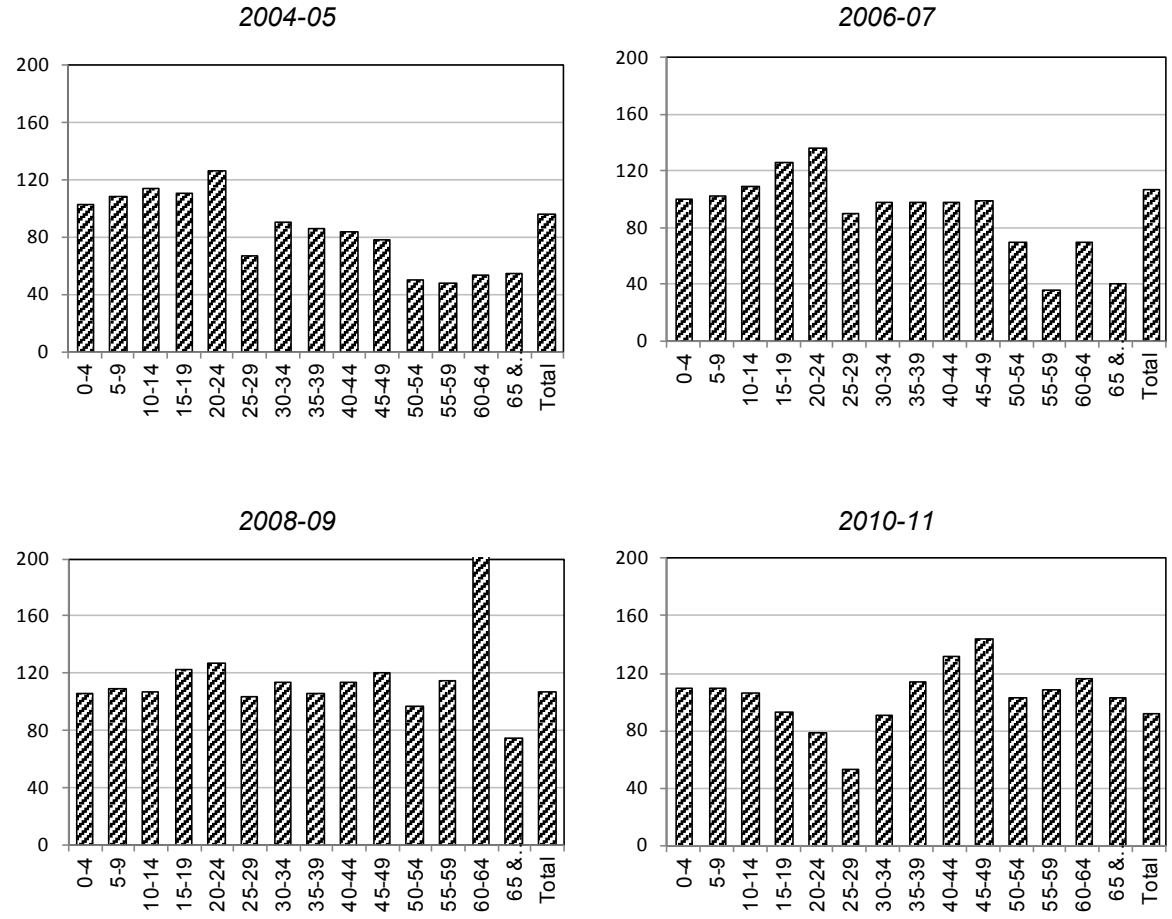
Per cent



Source: ABS (*Migration, Australia*, 2009-10, Cat. no. 3412.0).

Figure 8.19 **Sex ratio of net overseas migration to Australia by age, 2004-05 to 2010-11**[a,b]

Male migrants per 100 female migrants



a NOM arrivals less NOM departures. **b** There were net outflows of males aged 65 years and over and females aged 60 to 64 years in 2008-09. The ratio of male net overseas migration aged 60 to 64 years to 100 female net overseas migration in 2008-09 is 1225.

Source: Estimates based on ABS (*Migration, Australia*, 2009-10, Cat. no. 3412.0).

Table 8.8 **Survey of Australian net overseas migration projections to 2050**

Per cent of the Australian population

Projection	*2020*	*2030*	*2040*	*2050*
ABS (series B)	0.7	0.6	0.6	0.5
Intergenerational Report 2010	0.7	0.6	0.6	0.5
Continuation of historical average from 1920 to 2010	0.6	0.6	0.6	0.6

Sources: ABS (*Population Projections, 2006 to 2101*, 2008, Cat. no. 3222.0); Australian Government (2010, p. 7); Commission estimates.

Towards a modelling reference case

Net overseas migration by age, gender and state in the model database are set out in chapter 3 (tables 3.15 and 3.16).

The modelling reference case uses actual net overseas migration by age, gender and state from 2006-07 to 2009-10.[8] The average age and gender shares over this period are shown in table 8.9.

From 2010-11 until the end of the projection period, reflecting the longer-term historical average, net overseas migration each year has been assumed to be 0.6 per cent of the beginning-of-year population (table 8.10 and figure 8.20). The age, gender and state distribution of this migration is determined by the database shares at the beginning of each simulation year and is updated during each simulation year.

Table 8.9 **Age and sex ratios of Australian net overseas migration, 2005-06 to 2008-09**[a]

Age	*Share of NOM*	*Sex ratio*
	Per cent	Male migrants per 100 female migrants
0-4	5.7	104.7
5-9	6.2	105.9
10-14	5.7	107.0
15-19	14.6	117.8
20-24	21.0	122.3
25-29	16.4	88.9
30-34	11.6	98.5
35-39	8.1	100.1
40-44	5.4	104.8
45-49	2.5	104.0
50-54	1.2	71.5
55-59	0.7	71.3
60-64	0.6	94.6
65 and over	0.3	90.2
Total	100.0	104.5

a Average of 2005-06 to 2008-09.

Source: ABS (*Migration, Australia*, 2008-09, Cat. no. 3412.0).

8 The level of net overseas migration by state was sourced from ABS (*Australian Demographic Statistics*, June 2010, Cat. no. 31010DO001_201006) and excludes other territories. The gender distribution by age group and state was sourced from ABS (*Population by Age and Sex, Australian States and Territories*, June 2009, Cat. no. 3201.0) and the distribution by individual years of age was inferred based on the existing age distribution of population in that state.

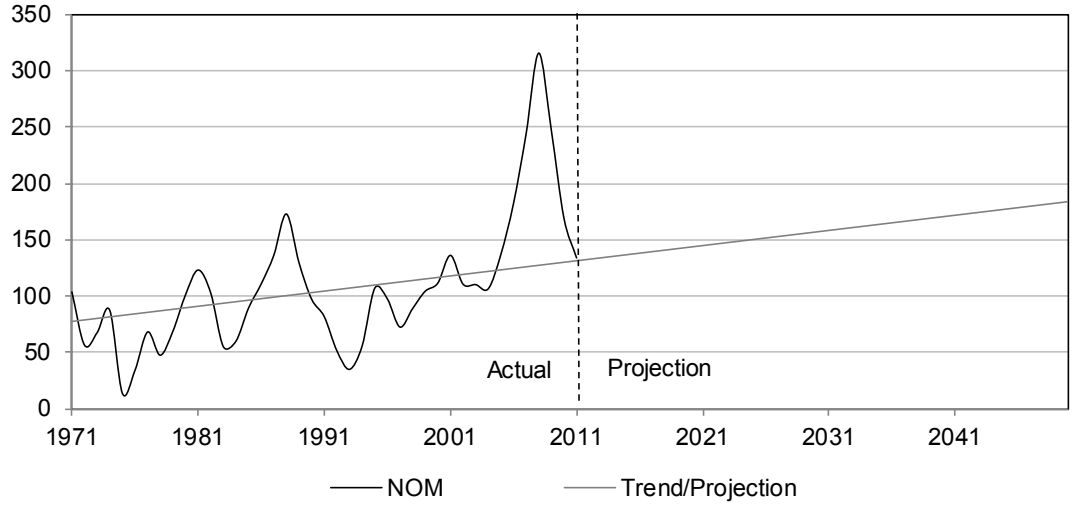
Table 8.10 **Australian net overseas migration projections in the modelling reference case to 2050**

	2020	*2030*	*2040*	*2050*
Proportion of the population (per cent)	0.6	0.6	0.6	0.6
Level (persons per year)	148 200	167 200	186 300	206 100

Source: Commission estimates.

Figure 8.20 **Australian net overseas migration to 2050**[a]

Thousands of persons



a Actual data to 2009. Projection to 2050.

Sources: Estimates based on ABS (*Australian Historical Population Statistics*, 2008, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, September 2011, Cat. no. 3101.0); Phillips, Klapdor and Simon-Davies (2010).

8.5 Towards a modelling reference case

The fertility, mortality and overseas migration assumptions adopted in the modelling reference case are set out in tables 8.3, 8.5 and 8.10, respectively. The annual improvement in mortality rates by age, gender and state are detailed in tables 3.13 and 3.14 of chapter 3. Interstate migration is modelled endogenously in the modelling reference case, and is linked to changes in the labour market, which respond to differences in real wage changes by occupations across states.

The implications of these assumptions, including the level of population and its distribution across states, ages and gender, are set out in chapter 15.

9 Labour market

Changes in labour supply (labour inputs) are an important source of economic growth and form an important part of any modelling reference case.

Changes in labour inputs over time occur through changes in the number of people in the economy at each working age (which occurs through demographic change) and through labour market-specific considerations which determine the annual supply of labour by each person of working age.

The demographic assumptions adopted in the modelling reference case are outlined in chapter 8. These assumptions will determine the population at each working age (assumed to be 15 years and over) in the stylised modelling reference case.

The annual supply of labour per person of working age will be determined by:

- the labour force participation rate at each working age (the share of the working-age population at each age that is employed or actively looking for work);
- the employment share at each working age (the share of the labour force at each age that is employed); and
- the annual number of hours worked per person at each working age.

The productivity of these labour inputs is discussed in chapter 10.

This chapter outlines the specific assumptions adopted for each of these sources of labour market change in the stylised modelling reference case. The first section outlines recent historical trends and changes in workforce composition. The next section details the key labour market projections adopted in several recent studies. The next section outlines the labour market component of the stylised modelling reference case used to assess the impacts of COAG reforms (PC 2012). The final section draws these assumptions together.

Given the wide range of economic and social factors that influence the operation of labour markets through time, the discussion focuses on the longer-term trends to develop the labour market component of the modelling reference case. It abstracts from the short-term, cyclical and seasonal fluctuations that affect labour markets. The resulting projections do not represent forecasts of the future.

9.1 Historical perspective

Labour force participation rates

Labour force participation rates have increased steadily since the late 1970s, growing by an average of 0.2 per cent a year (figure 9.1). Gender-wise, labour market participation has been a mixed story.

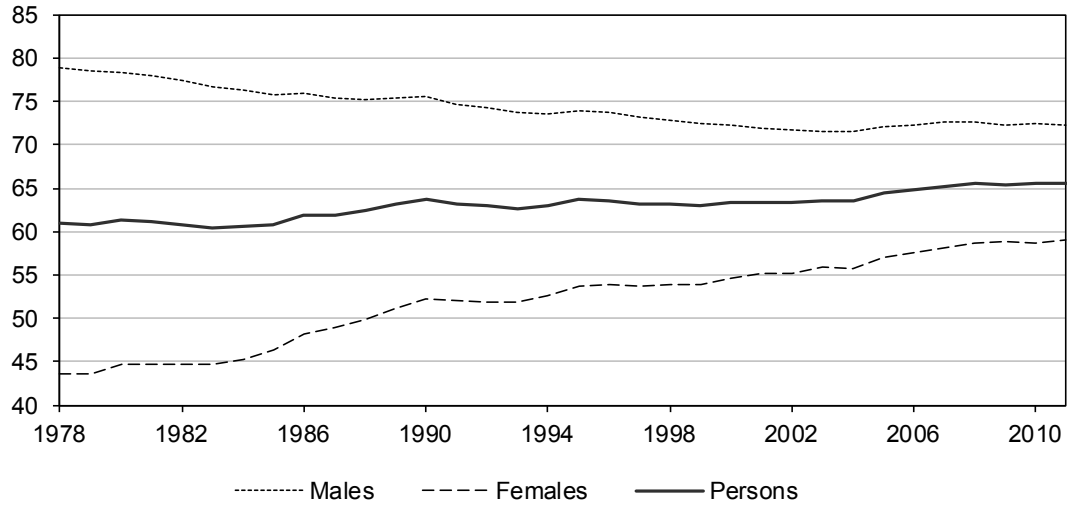
- In the case of women, participation rates have increased markedly over the last few decades. This has been associated with a number of factors including: increased levels of educational attainment; changing social norms such as greater acceptance of working mothers; declining fertility rates; better access to childcare services; and greater availability of part-time work and more flexible working arrangements (Gilfillan and Andrews 2010; Australian Government 2010).
- Conversely, after declining between 1978 and 2004, participation rates for men have levelled off in the last decade or so. One reason for this decline was from the 'discouraged worker effect' associated with reductions in employment in the manufacturing and agricultural sectors that affected males more than females and greater difficulty in finding employment in the expanding services sector.

This increase in participation rates has occurred in all states, although there have been some substantial short-run fluctuations (figure 9.2). Aside from the Northern Territory, all jurisdictions have experienced broadly similar fluctuations over time and the differences in actual rates between states have been maintained over time.

Age-specific participation rates for both men and women have also varied between 1978 and 2011 (figure 9.3). For both groups, participation rates for those aged 55 years and over have trended upwards in recent years (after initially falling for men). For women, the trend of increased workforce participation has been reflected for most age groups, although the most substantial increases have occurred for those aged 45 years and over. For men, the decline in workforce participation has been driven primarily by the younger age groups — although all age groups under 60 have experienced falls over the period.

Figure 9.1 **Australian labour force participation rates by gender, 1978 to 2011**[a]

Per cent

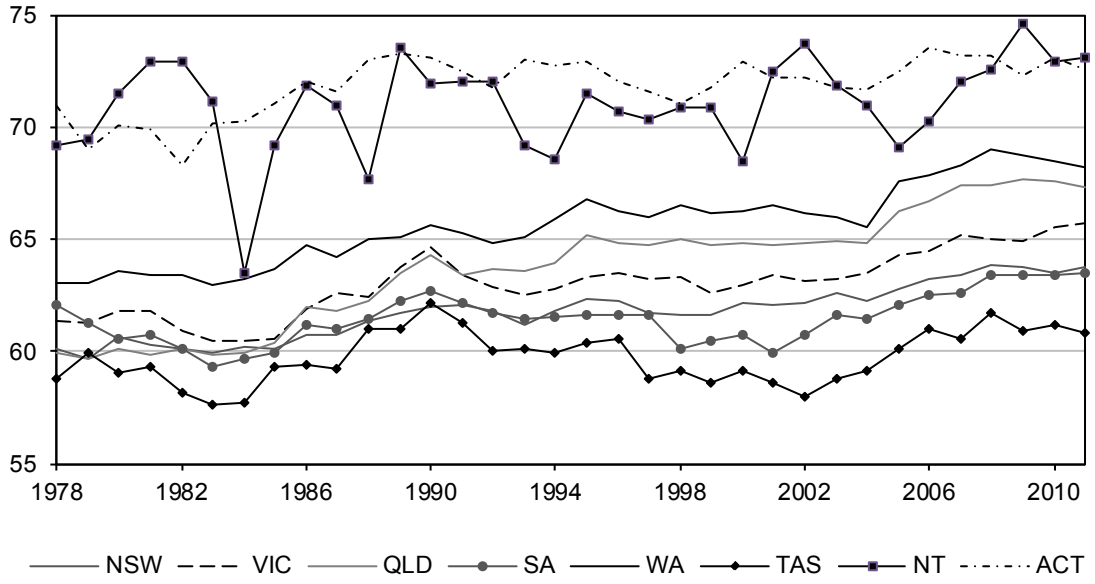


a The labour force as a share of the civilian population aged 15 years and over.

Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6202.0).

Figure 9.2 **Labour force participation rates by state, 1978 to 2011**[a]

Per cent

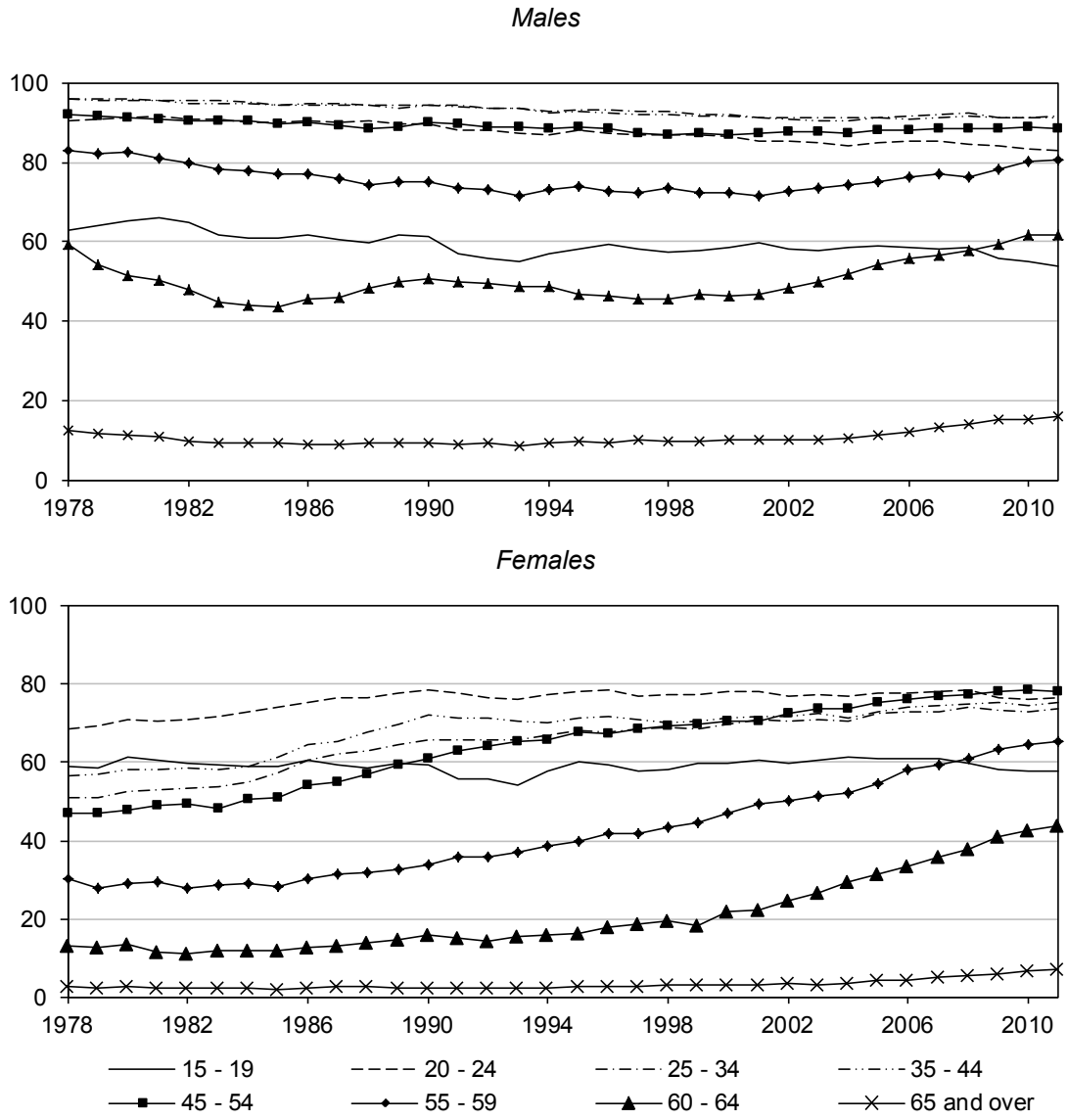


a The labour force in each state as a share of the civilian population aged 15 years and over in that state.

Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6202.0).

Figure 9.3 **Age-specific national labour force participation rates by gender, 1978 to 2011**[a]

Per cent



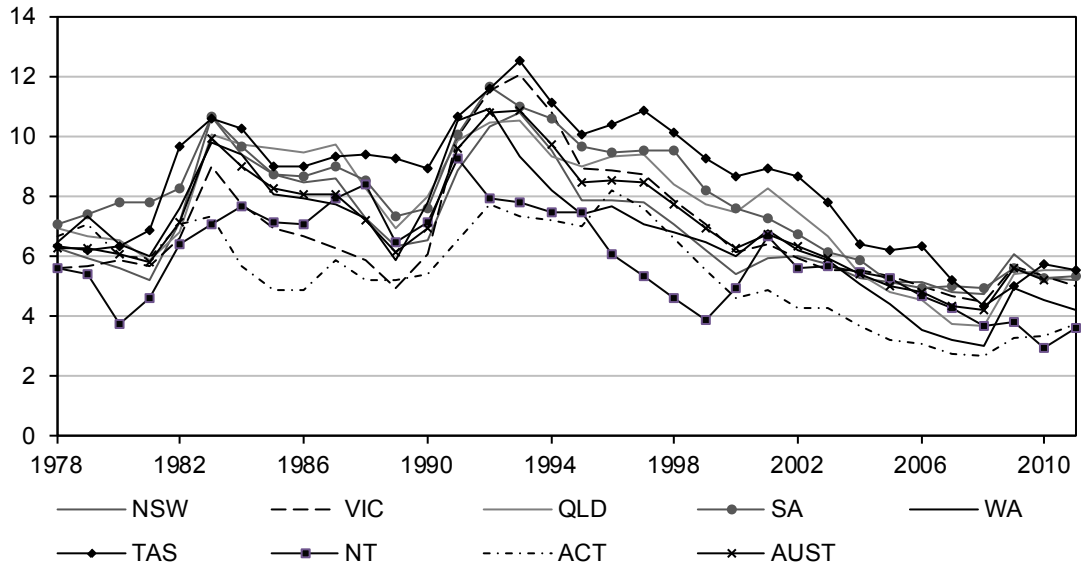
a The labour force in each age group as a share of the civilian population aged 15 years and over in that age group.

Source: ABS (*Labour Force, Australia, Detailed - Electronic Delivery*, April 2012, Cat. no. 6291.0.55.001).

Employment rates

After years of sustained economic growth in Australia, and notwithstanding increases in unemployment rates during the 1980s and early 1990s, there has been an increase in the share of the labour force engaged in employment (the employment rate) since the late 1970s. This longer-term trend towards increased employment has meant that the share of the labour force that is unemployed (the unemployment rate) has declined over the same time period, falling from 6.3 per cent in 1978 to approximately 5 per cent in April 2012 (figure 9.4).

Figure 9.4 **National and state unemployment rates, 1978 to 2011**[a]
Per cent



a The number of unemployed persons expressed as a share of the labour force.

Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6291.0.55.001).

Over the same time period, the trends in employment and unemployment rates have been broadly consistent across all states (figure 9.4). Unemployment rates have steadily declined since the early 1990s, notwithstanding a slight increase around the time of the Global Financial Crisis. At their lowest point in recent years, unemployment levels were below 5 per cent in most jurisdictions in 2011.

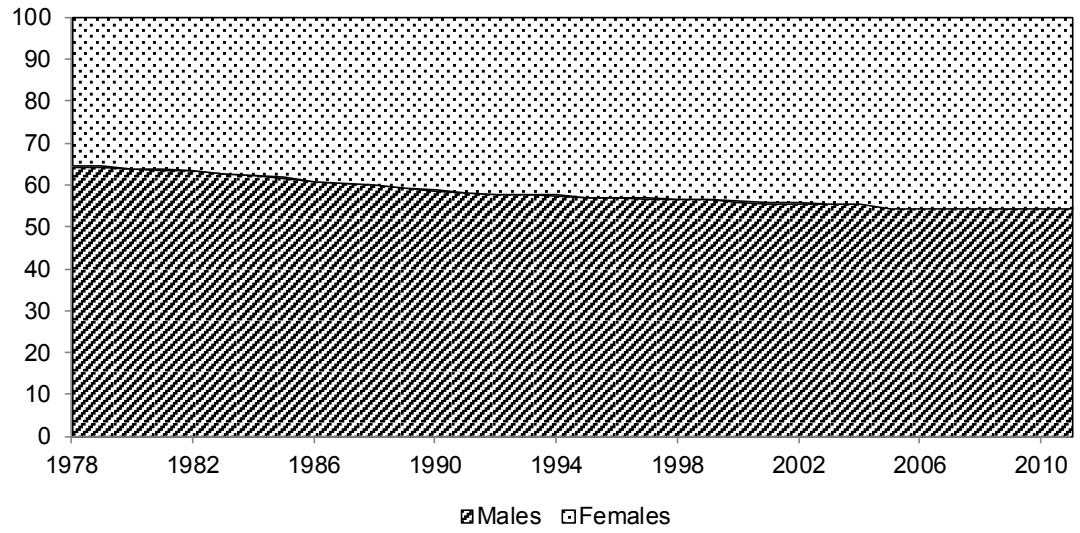
Other perceptible changes in the nature of employment in Australia over this period include:

- reflecting their increased participation in the labour force, there has been strong growth in female employment (figure 9.5);
- part-time employment has increased in importance, rising from 18 per cent of total employment in 1978 to 30 per cent (figure 9.6); and

- there has been a small, but discernible, increase in employment of those at older ages over the last decade (Gilfillan and Andrews 2010, p. 25).

These changes are interlinked. For example, female workers with children are more likely to participate in the labour market on a part-time rather than full-time basis in comparison to males. The same holds at older working ages. As a consequence of these changes, the proportion of workers in full-time employment has declined from 82 per cent to 70 per cent. Richer discussions of these trends and the associated economic changes are outlined in Abhayaratna and Lattimore (2007), Lattimore (2007), Abhayaratna, et al. (2008), and Gilfillan and Andrews (2010).

Figure 9.5 **Share of Australian employment by gender, 1978 to 2011**[a]
Per cent

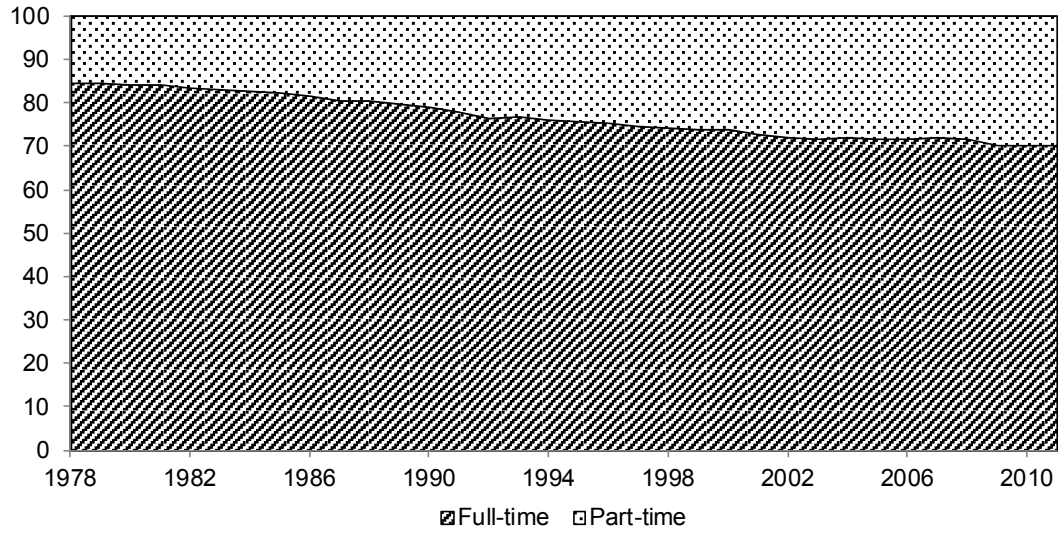


a The number of unemployed persons expressed as a share of the labour force.

Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6202.0).

Figure 9.6 **Australian full-time and part-time employment shares, 1978 to 2011**[a]

Per cent



a The share of persons employed on a full-time and part-time basis as a share of total employment. Part-time workers are those who usually work less than 35 hours a week (in all jobs).

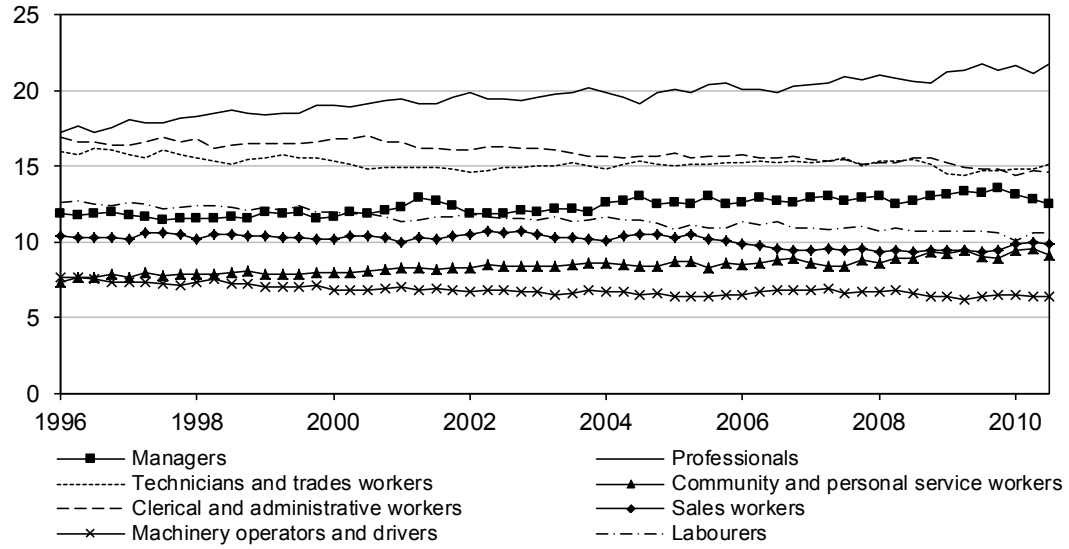
Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6202.0).

Employment by occupation

The occupational composition of total employment has changed over time (figure 9.7). The most notable increase between 1996 and 2011 has been in the employment of *professionals*, increasing from 17 to 22 per cent of total employment. Employment shares of *managers* and *community and personal service workers* have also increased, albeit not as substantially. All other employment categories have decreased as a share of total employment. The most notable declines have occurred in the categories of *clerical and administrative workers*, *labourers* and *machinery operators and drivers*.

Figure 9.7 **Shares of national employment by occupation, August 1996 to August 2011**

Per cent

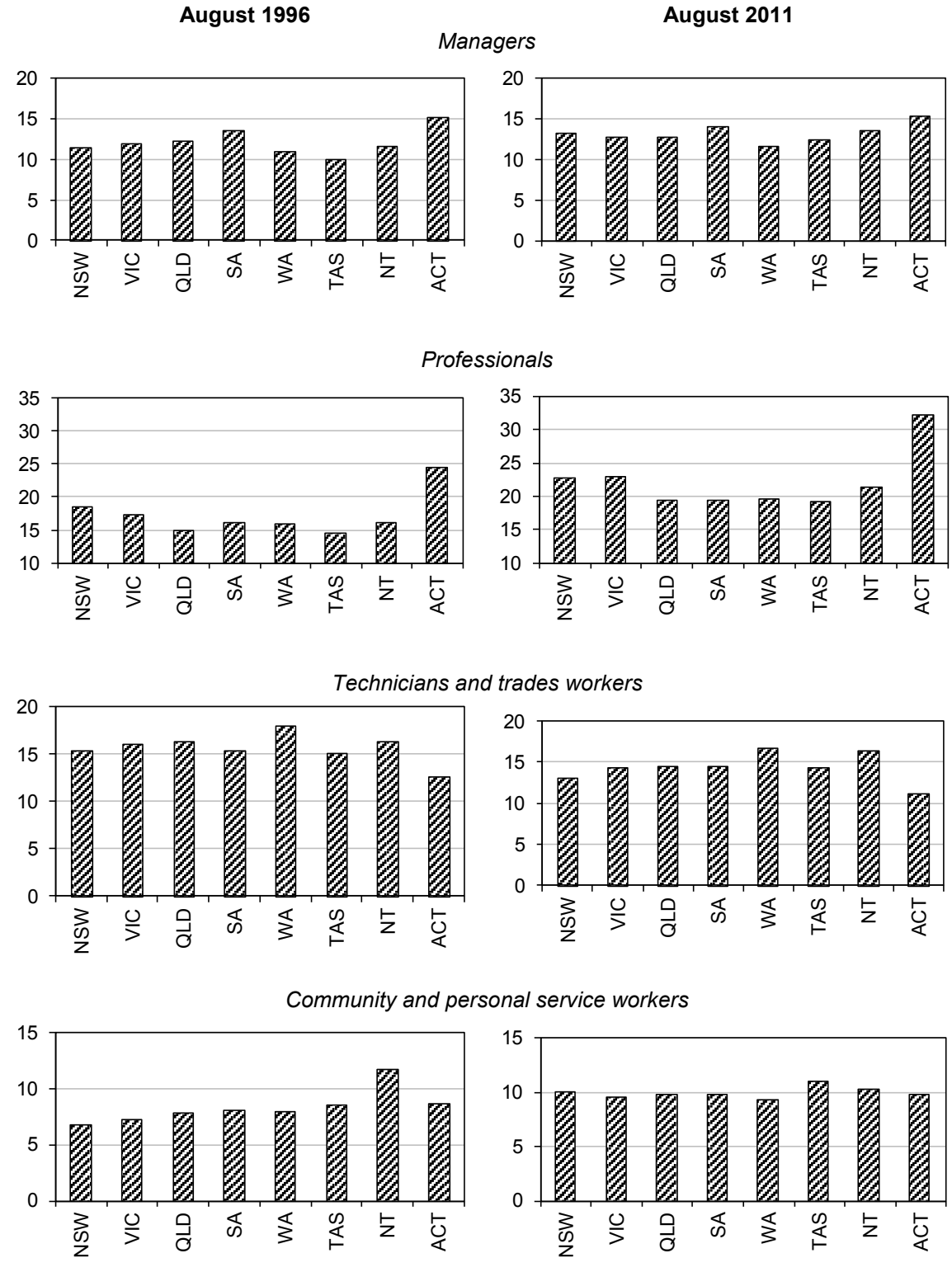


Source: ABS (*Labour Force, Australia, Detailed, Quarterly*, February 2012, Cat. no. 6291.0.55.003).

National trends in occupation shares are broadly reflected at the state level (figure 9.8). Further, occupational composition is generally similar across jurisdictions, apart from the Australian Capital Territory, where employment is skewed towards office-based occupations.

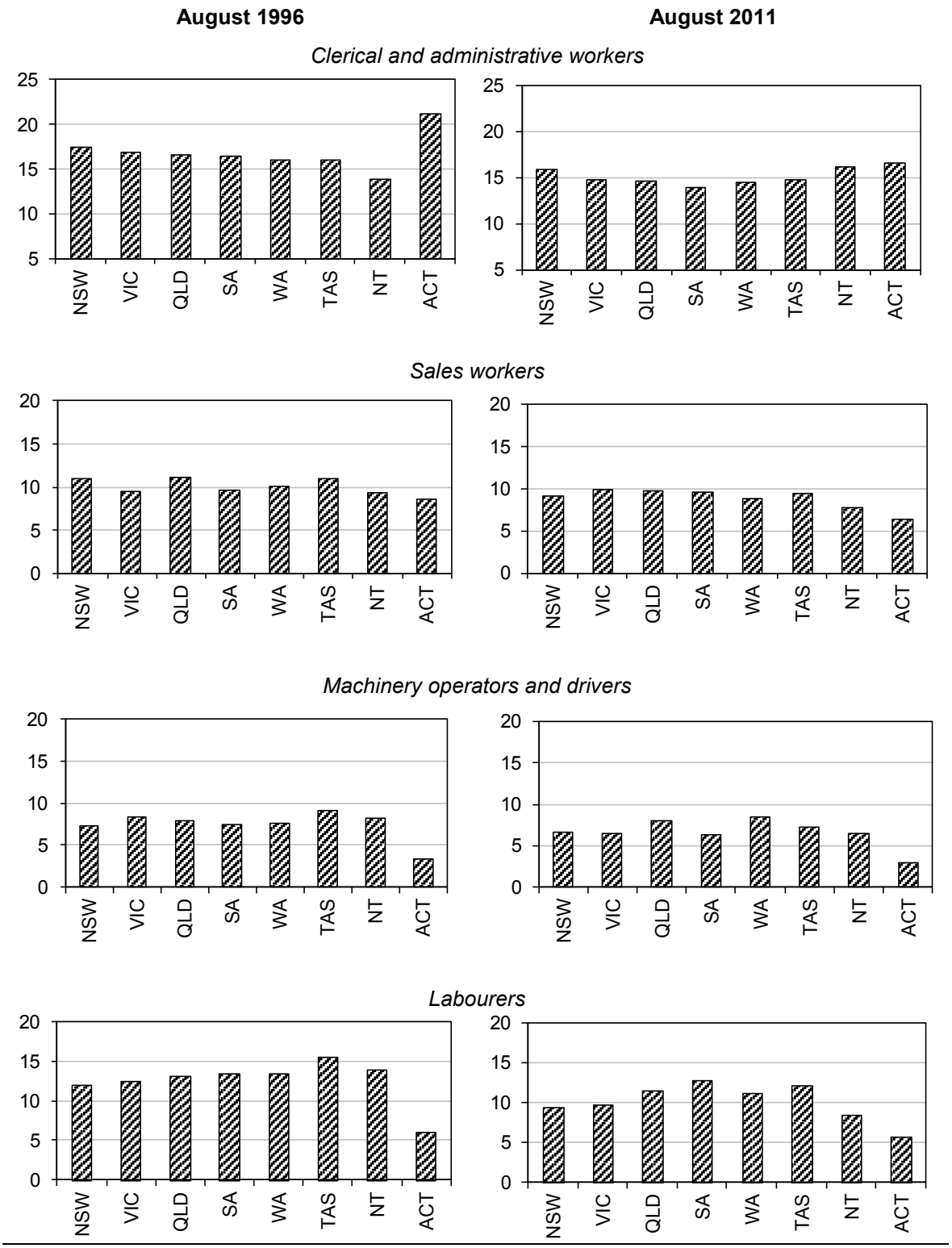
Figure 9.8 **State shares of total employment by occupation, August 1996 and August 2011**

Per cent



(Continued next page)

Figure 9.8 **(continued)**

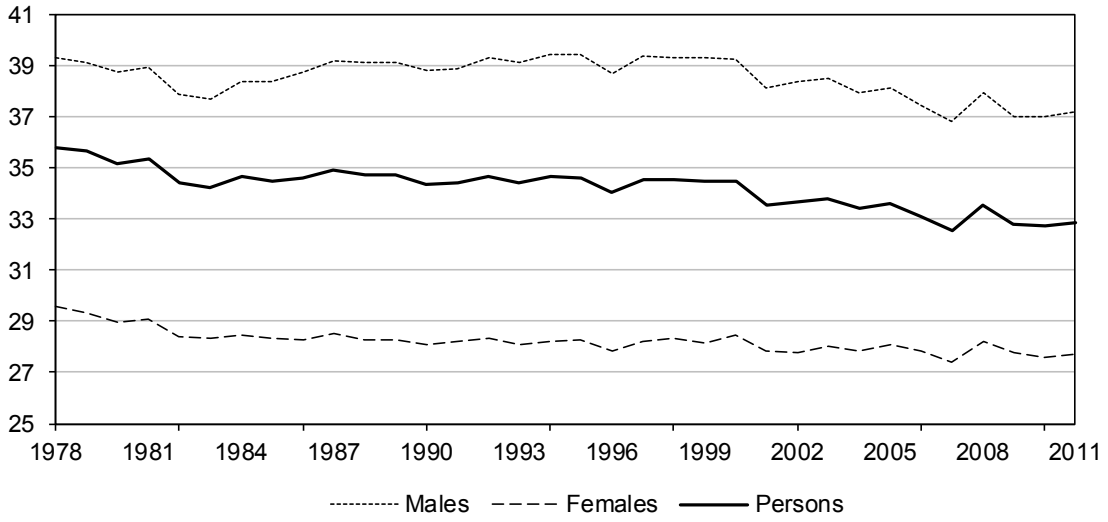


Source: ABS (*Labour Force, Australia, Detailed, Quarterly*, February 2012, Cat. no. 6291.0.55.003, Data Cube E09).

Average hours worked

The annual supply of labour inputs per worker in Australia, expressed in terms of hours worked per week, has declined gradually since 1978, falling from an average of just under 36 to 33 hours per week (figure 9.9). This decline has occurred for both males and females.

Figure 9.9 **Average hours worked by gender, Australia, 1978 to 2011**[a]
Hours per week



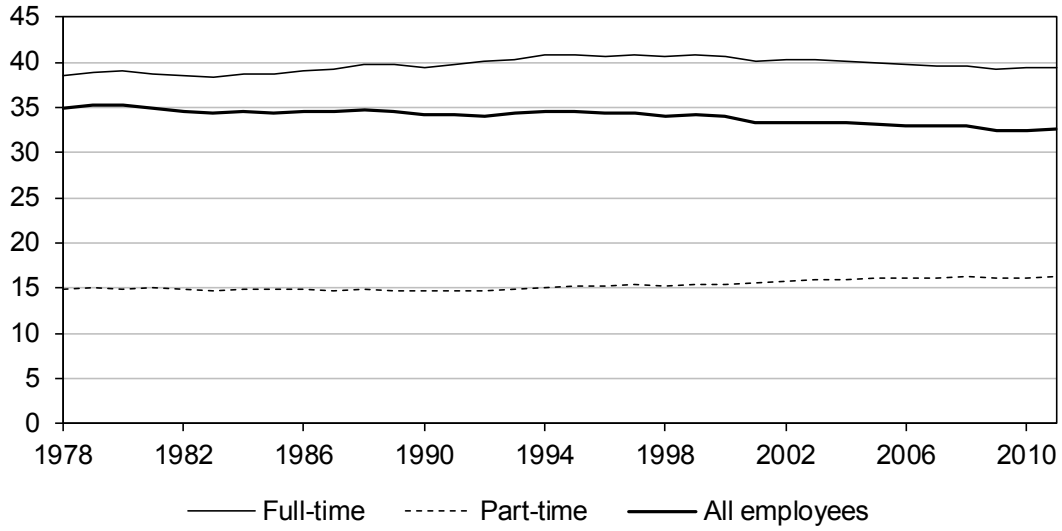
a Annual hours worked by full-time and part-time employees, expressed on a weekly basis.

Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6291.0.55.001, Data Cube EM1).

The data indicates that this decline in the average is attributable to the increased share of part-time employment, rather than as a result of a reduction in the average number of hours by full-time or part-time employees (which have remained more-or-less constant at roughly 40 and 15 hours per week, respectively) (figure 9.10).

Figure 9.10 **Average hours worked by full-time and part-time employees, 1978 to 2011**[a]

Hours per week



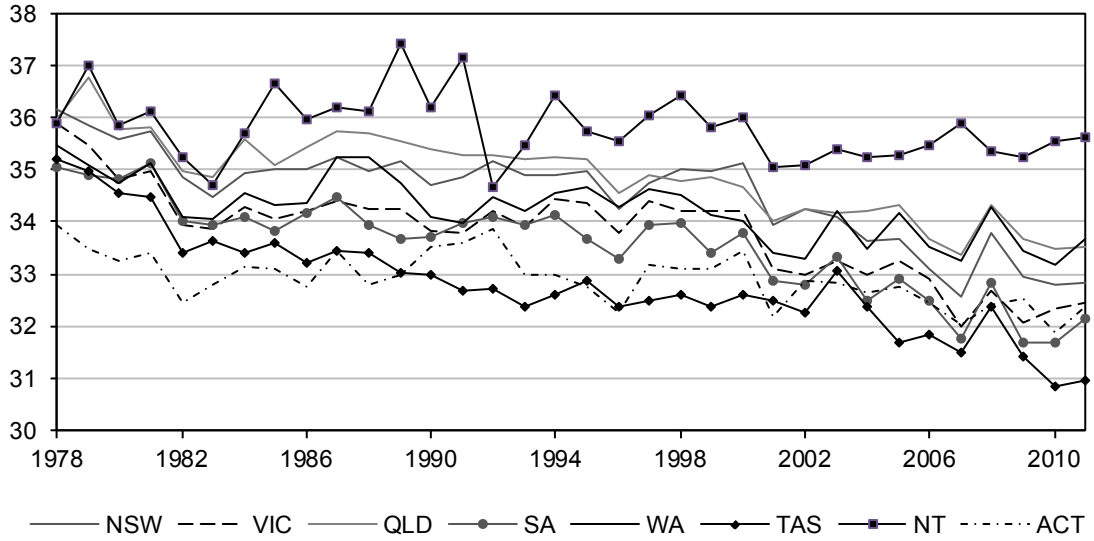
a Average annual hours worked by full-time and part-time employees expressed on a weekly basis. Part-time workers are those who usually work less than 35 hours a week (in all jobs).

Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6291.0.55.001, Data Cube EM1).

The fall in average hours worked nationally has been observed in all states (figure 9.11).

Figure 9.11 **Average hours worked by state, 1978 to 2011**[a]

Hours per week



a Average annual hours worked by full-time and part-time employees expressed on a weekly basis.

Source: ABS (*Labour Force, Australia*, April 2012, Cat. no. 6291.0.55.001, Data Cube EM1).

9.2 Projections used in other studies

A number of studies have put forward projections of labour market participation, employment (unemployment) and labour supply per person of working age (table 9.1). Projections from some of these studies are reviewed below.

Table 9.1 **Projections of changes in Australian labour supply to 2050**

Study	*Time period*	*Participation rate*[a]	*Unemployment rate*[b]	*Average hours worked*	*Supply of labour per person of working age*
		Per cent	Per cent	Hours per week	Hours per year
Day and Dowrick (2004)	2000 to 2040	-	-	-	0.2%
DTF Victoria (2005)	2003 to 2042	64 to 54.4 (Victoria)	na	na	Na
PC (2005b)	2003 to 2051	63.7 to 55.8	5.1 to 4.9	approximately 33.9 to 32.3	equivalent to -0.31%
Intergenerational Report 2010	2010 to 2050	65.1 to 60.6	5 over the period	34.1 to 33.6	equivalent to -0.18%

[a] The labour force as a share of the civilian population aged 15 years and over. [b] The number of unemployed persons expressed as a share of the labour force. The converse of the employment rate.

Sources: Day and Dowrick (2004); DTF Victoria (2005); PC (2005b); Australian Government (2010).

Labour force participation rates

The Commission's 2005 study into the *Economic Implications of an Ageing Australia* (PC 2005b) set out a number of age-specific projections of participation rates out to 2050 (table 9.2). These projections were based on historical trends up to 2003-04. For women, projected participation rates were expected to increase. Projected participation rates for men aged between 25 and 64 years were expected to fall modestly after 2010.

The *Intergenerational Report 2010* (Australian Government 2010) projected that age-specific labour force participation rates would stabilise or increase for all age groups (both men and women).

- For men aged 25–54, participation rates were projected to rise from 90.4 per cent in 2009-10 to 92.7 per cent in 2049-50. For those aged 55–69, the projected rise over the same period was from 58.5 to 61.0 per cent.

Table 9.2 **Labour force participation rate projections by sex and age, 2010 to 2050**[a]

Per cent of working-age population

Age group	*2010*	*2020*	*2030*	*2040*	*2050*
Males					
15–19	59.7	60.3	60.5	60.5	60.5
20–24	83.5	83.9	84.0	84.0	84.0
25–29	88.9	87.9	88.0	88.1	88.1
30–34	90.3	87.8	88.0	88.1	88.1
35–39	89.9	87.0	86.1	86.2	86.2
40–44	88.8	86.5	84.0	84.2	84.2
45–49	88.1	86.4	83.7	82.7	82.9
50–54	85.5	84.5	82.5	80.2	80.4
55–59	74.1	74.3	73.1	70.9	70.1
60–64	51.6	52.9	52.4	51.1	49.7
65–69	24.7	29.0	29.8	29.6	28.7
70+	5.9	7.4	8.0	8.0	7.9
Females					
15–19	63.3	64.0	64.0	64.0	64.0
20–24	77.6	78.6	78.6	78.6	78.6
25–29	76.6	78.2	78.6	78.6	78.6
30–34	70.8	73.1	74.2	74.2	74.2
35–39	71.0	74.1	75.6	75.9	75.9
40–44	75.2	77.8	79.4	80.2	80.2
45–49	80.3	81.6	83.4	84.2	84.3
50–54	75.8	78.3	80.1	81.3	81.8
55–59	60.5	66.6	67.7	69.2	69.8
60–64	34.0	41.8	43.2	44.2	44.8
65–69	11.6	16.2	17.9	18.2	18.6
70+	1.6	2.6	3.1	3.2	3.3

a The labour force as a share of the civilian population aged 15 years and over.

Source: PC (2005b).

- For women aged 25–54, participation rates were projected to rise from 74.7 per cent in 2009-10 to 79.7 per cent in 2049-50. For those aged 55–69, the projected rise over the same period was from 40.9 to 45.1 per cent.

Employment rates

Most of the studies identified assume little change in employment rates over the projection period (table 9.1). PC (2005b) assumed that unemployment would fall from 5.1 per cent in 2003 to 4.9 per cent in 2051. The *Intergenerational Report 2010* assumed that the unemployment rate remained constant at 5 per cent throughout the projection period to 2050.

Average hours worked

Most of the studies reviewed indicate a decline in average hours worked over the projection period.

- The Commission (PC 2005b) projected a fall in the average weekly hours worked for working men over the period 2010 to 2050 (based on trends observed in 2003-04) (table 9.3). In contrast, average hours by women were projected to increase slightly for most age groups (except those aged between 35 to 39 years and those aged over 70 years).
- The *Intergenerational Report 2010* projected, in line with the fall in average weekly hours worked per worker from 35.7 in 1997-98 to 34.1 in 2009-10, a continued decline in average weekly hours worked to 33.6 in 2049-50.

Table 9.3 **Average hours worked projections by sex and age to 2050**
Hours per week

	2010	*2020*	*2030*	*2040*	*2050*
Males					
15–19	22.4	22.4	22.4	22.4	22.4
20–24	32.9	32.4	32.4	32.4	32.4
25–29	38.3	37.7	37.6	37.5	37.5
30–34	39.8	39.4	39.0	38.9	38.8
35–39	40.6	40.3	40.3	40.2	40.2
40–44	40.7	40.2	40.0	40.0	40.0
45–49	40.5	40.1	40.1	40.1	40.1
50–54	40.0	39.7	39.7	39.6	39.6
55–59	39.6	39.6	39.6	39.6	39.6
60–64	36.3	35.7	35.4	35.3	35.3
65–69	30.8	29.9	29.7	29.7	29.7
70+	25.8	24.6	24.5	24.5	24.5
Females					
15–19	17.9	17.9	17.9	17.9	17.9
20–24	28.2	28.2	28.3	28.3	28.3
25–29	32.1	32.1	32.1	32.1	32.1
30–34	29.3	29.5	29.5	29.5	29.5
35–39	27.0	26.8	26.8	26.8	26.8
40–44	27.8	27.8	27.8	27.8	27.8
45–49	29.5	29.6	29.6	29.6	29.6
50–54	29.6	29.8	29.8	29.8	29.8
55–59	28.1	28.2	28.2	28.2	28.2
60–64	24.3	24.5	24.5	24.5	24.5
65–69	21.1	21.2	21.2	21.2	21.2
70+	16.8	16.7	16.7	16.7	16.7

Source: PC (2005b).

The supply of labour per person of working age

Some studies have made assumptions about the future supply of labour per person of working age in Australia (table 9.1).

- Based on historical trends of increasing aggregate labour market participation and falling average hours worked per person employed, Day and Dowrick (2004) suggested that the supply of labour per person of working age (defined as those aged between 15 and 64) could increase by 0.2 per cent per year.
- The Victorian Department of Treasury and Finance (2005) projected that aggregate labour force participation in Victoria would fall from 64 per cent in 2003-04 to 54.4 per cent in 2041-42 as a result of population ageing.
- Based on its 2005 demographic and labour market projections, the Commission projected that labour market participation rates would fall from 63.7 per cent in 2003 to 55.8 per cent in 2051 as a result of population ageing. Combined with a fall in the average hours worked per person employed, this translates into a 0.31 per cent per year fall in the supply of labour per person of working age.
- The *Intergenerational Report 2010* projected that (beyond the medium-term estimates) ageing of the population would reduce labour force participation rates from 65.1 to 60.6 per cent by 2050 and reduce the supply of labour per person of working age by 0.18 per cent per year.

9.3 Towards a modelling reference case

The historical trends and projections documented above provide a starting point to develop the labour market assumptions in the stylised modelling reference case. However, where the reasons underpinning these historical trends may not necessarily be present going forward, the projections attempt to stylistically take future developments into account.

Labour force participation rates

Participation rates have changed substantially over time and available projections, both from the Commission and from the *Intergenerational Report 2010*, assume that they will continue to change into the future. Accordingly, for the modelling reference case, some exogenous shocks to participation rates have been imposed.

The historical analysis indicates that trends in labour force participation vary by gender and by age. It is not unreasonable to suppose that these trends in labour force participation by age and gender will continue into the future. Given this, the

participation rates in the modelling reference case are differentiated by age and gender (detailed in table 9.4). Notwithstanding that there are some differences between the Commission's 2005 projections and the more recent projections in *Intergenerational Report 2010*, the projections are based on the projections in the earlier study owing to the greater age and gender detail.

These participation rate projections are applied to the model as *percentage changes* in the age and gender-specific labour force participation rates in the model database. Specifically, they are applied as shocks to the variable `d_partrate(a,g,s)`. However, because the available projections are aggregated at the national level, the convention of applying the same shock for each age/gender cohort to each state has been adopted. This will maintain the existing relativities in participation rates between jurisdictions.

As illustrated in table 9.4, there is some variation in the magnitude of the shocks included in the modelling reference case for the different age/gender groups. In many cases, however, there is no substantial change in the assumed participation rates over the projection period.

Employment rates

The historical growth in the rate of employment is the consequence of a range of factors, many of which are unlikely to be present over the projection period. For example, as much of the growth in employment in Australia arose after major microeconomic reforms and internationalisation of the Australian economy during the 1980s and 1990s, it may be difficult to maintain the contribution of such reforms over the projection period as Australian productivity *levels* converge towards international best practice.

Available projections generally assume little or no change in unemployment rates over time. In line with these, there has been no attempt to impose any exogenous changes in unemployment on the modelling reference case. Changes in the mix of full-time and part-time employment are incorporated into the hours worked shocks in the modelling reference case.

Table 9.4 **Labour force participation rate changes used in the modelling reference case by gender and age to 2050**

Average annual change, per cent

	2010s	*2020s*	*2030s*	*2040s*
Males				
15–19	0.1	0.0	0.0	0.0
20–24	0.0	0.0	0.0	0.0
25–29	-0.1	0.0	0.0	0.0
30–34	-0.3	0.0	0.0	0.0
35–39	-0.3	-0.1	0.0	0.0
40–44	-0.3	-0.3	0.0	0.0
45–49	-0.2	-0.3	-0.1	0.0
50–54	-0.1	-0.2	-0.3	0.0
55–59	0.0	-0.2	-0.3	-0.1
60–64	0.2	-0.1	-0.2	-0.3
65–69	1.6	0.3	-0.1	-0.3
70+	2.4	0.8	0.0	-0.2
Females				
15–19	0.1	0.0	0.0	0.0
20–24	0.1	0.0	0.0	0.0
25–29	0.2	0.0	0.0	0.0
30–34	0.3	0.1	0.0	0.0
35–39	0.4	0.2	0.0	0.0
40–44	0.3	0.2	0.1	0.0
45–49	0.2	0.2	0.1	0.0
50–54	0.3	0.2	0.1	0.1
55–59	1.0	0.2	0.2	0.1
60–64	2.1	0.3	0.2	0.1
65–69	3.4	1.0	0.2	0.2
70+	4.5	2.1	0.3	0.2

Source: Commission estimates.

Average hours worked

Available projections assume that there is likely to be a small decline in the average number of hours worked over the next forty years. The historical data indicate the decline in average hours worked per person employed is the result of an increase in the share of part-time employment rather than the result of reductions in the average number of hours worked by full-time or part-time employees.

This trend towards part-time work is likely to continue into the projection period, especially with an ageing population. Given this, it is assumed in the modelling reference case that average hours worked by each worker in MMRF (which does

not differentiate between full-time and part-time employment) falls by 0.2 per cent per year.

Supply of labour by occupation

The historical trends indicate that there have been substantial changes in the occupational composition of the Australian workforce over time, with a move away from manual labour to office-based and higher skill occupations. Given this, the composition of the workforce is unlikely to remain constant over the projection period, especially given the capital deepening of Australian production that is occurring (the amount of capital employed per unit of labour — discussed in chapter 10).

In the standard version of MMRF, changes in the occupational structure of the labour force are determined outside the model and imposed on the model via exogenous shocks, That is, in the absence of such shocks, each occupation's share of employment is held fixed.

There are three approaches that could be taken to address this issue:

- exogenously project occupation shares and shock the model accordingly (similar to the approach taken for participation rates);
- allow occupations to adjust endogenously in response to changes in real wages; or
- remove the occupation specification from the model.

For this study, the occupation shares have been allowed to adjust endogenously in the model (option 2). However, it has been assumed that occupations are not perfectly substitutable and imperfect transformation between the occupations has been introduced. As noted in chapter 5, the modelling reference case allows the occupational composition of the workforce to gradually adjust in response to changes in real wage differences across occupations.

Summary

The implications of the changes in labour force participation, employment rates and average hours worked that form the labour market component of the modelling reference case are set out in chapter 15.

10 Productivity

Productivity is a measure of output from a production process, per unit of input. Growth in output per unit of labour input — labour productivity — is estimated to have accounted for over half of Australia's GDP growth over the last 35 years, with the remainder contributed by growth in labour inputs (chapter 7).

This chapter reports on productivity trends in Australia with reference to the factors that contribute to the growth in labour productivity, in aggregate and by industry. It distinguishes between contributions to labour productivity growth due to the deployment of additional capital per unit of labour input (capital deepening) and, for the 'market sector', improvements in multifactor productivity (box 10.1). Economy-wide information is presented for the 35-year period from 1974-75 to 2009-10 (section 10.1). Disaggregated industry information is also presented where details are available (section 10.2).

Against this background, this chapter also reports productivity projections and modelling assumptions employed in recent economy-wide modelling studies (section 10.3). It then considers possible factors underlying measured changes in labour productivity and MFP (including changes in energy, material and other intermediate inputs) (section 10.4). Section 10.5 outlines the labour productivity growth scenario applied in the modelling reference case, including a stylised approach for modelling underlying technological and organisational change.

10.1 Economy-wide perspective

Annual average growth

Over the 35 years from 1974-75 to 2009-10, output of the economy, as measured by real gross domestic product, increased on average by 3.2 per cent per year.[1] Labour inputs (measured in terms of total hours worked) increased by an average of 1.6 per cent per year and capital inputs by 3.3 per cent (figure 10.1, left hand panel).

1 Real gross value added output increased on average by 3.3 per cent per year.

Box 10.1 **MFP and the market and non-market sectors**

MFP growth is defined in growth accounting as the growth in output that is not directly attributable to growth in labour and capital inputs. Accordingly, the estimation of MFP growth requires a measure of output that is independent of the use of labour and capital inputs.

MFP estimates are limited to those industries for which relevant information on industry inputs and output is available. These industries are collectively termed the 'market sector' by the ABS. For those industries which lack an independent measure of output (that is, the 'non-market' sector and ownership of dwellings), it is impractical to disaggregate output growth into the contribution made by capital, labour and MFP.

Productivity growth data for the market sector in aggregate are available from 1974-75, while data for 12 of the 16 industries that make up the market-sector are available from 1986-87. Growth data for the remaining four market sector industries are only available from 1995-96. The 12-industry market sector accounted for just around 60 per cent of gross domestic product in 2009-10 (and industry gross value added, GVA), while the four additional industries take the total contribution of the market sector to just over 70 per cent of gross domestic product (just over 75 per cent of industry GVA).

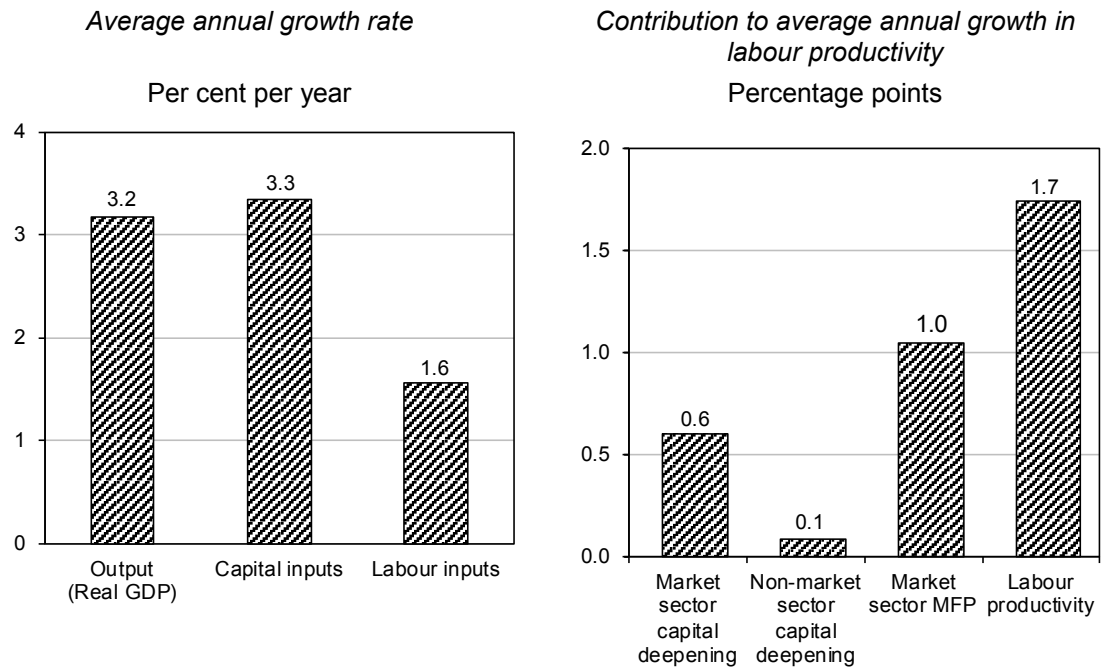
Industry coverage of the market and non-market sectors in Australia

ANZSIC 2006 industry divisions

Market sector (12 industries)	**Non-market sector (3 industries)**
Agriculture, forestry & fishing	Public administration & safety
Mining	Education & training
Manufacturing	Health care & social assistance
Electricity, gas, water & waste services	**Other activities**
Construction	Ownership of dwellings
Wholesale trade	
Retail trade	
Accommodation & food services	
Transport, postal & warehousing	
Information, media & telecommunications	
Financial & insurance services	
Arts & recreation services	
Market sector (4 industries)	
Rental, hiring and real estate services	
Professional, scientific & technical services	
Administrative & support services	
Other services	

Source: ABS (*Australian National Accounts: National Income, Expenditure and Product*, December 2010, Cat. no. 5206.0).

Figure 10.1 **Growth in output, capital inputs, labour inputs and labour productivity for the whole economy, 1974-75 to 2009-10**[a]



[a] Real GDP is adopted as the measure of output for the whole economy. Labour inputs are measured as average hours worked per week by employed persons in each quarter multiplied by 52 weeks. Capital inputs are measured by net capital stock for the economy. Real GDP also includes taxes less subsidies on products and the statistical discrepancy. Labour productivity is calculated as real GDP per hour worked, while MFP is calculated as the growth in output not accounted for by growth in labour and capital inputs, taxes less subsidies on products and the statistical discrepancy. Capital deepening is additional capital inputs per unit of labour input.

Source: Commission estimates based on ABS *(Australian System of National Accounts*, 2009-10, Cat. no. 5204.0*);* ABS (*Australian National Accounts: National Income, Expenditure and Product*, December 2010, Cat. no. 5206.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, February 2011, Cat. no. 6291.0.55.003); ABS (*Experimental Estimates of Industry Multifactor Productivity,* 2010-11, Cat. no. 5260.0.55.002*)*.

With national output increasing ahead of labour inputs, national labour productivity increased by an annual average of 1.7 per cent between 1974-75 and 2009-10 (figure 10.1, right hand panel). Available information indicates that MFP growth (as measured for the market sector) contributed over one-half of estimated national labour productivity growth, with capital deepening contributing the remainder.

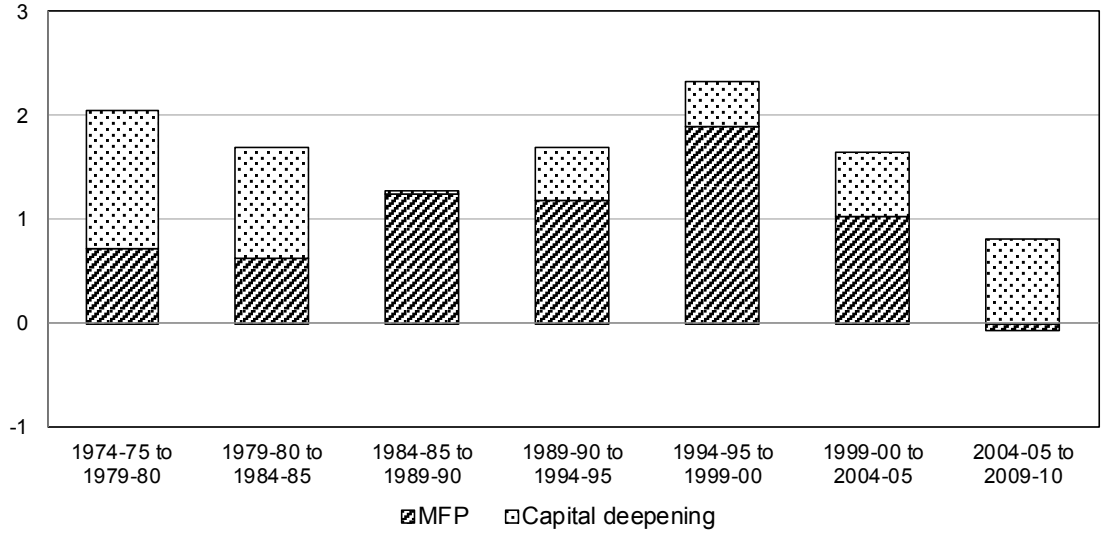
Contributions to labour productivity have varied over time

The relative contributions made by capital deepening and MFP to labour productivity growth have varied across time (figure 10.2). In the decade from the mid-1970s to the mid-1980s, the contributions of capital deepening and the productivity of labour and capital (MFP) were broadly similar. In the following two decades — from the mid-1980s to the mid-2000s — increases in MFP, including the increased utilisation of capital, provided the main source of growth in labour

productivity. The relatively high MFP growth over this period was associated with a series of economic reforms that promoted competition in product and factor markets, which included National Competition Policy and reform of the labour market. From the mid-2000s, the level of labour and capital inputs increased ahead of national output, and the contribution of MFP to labour productivity growth declined. In part, this productivity decline reflects the substantial capital investment in the mining and utility industries that have yet to be matched by higher output over the period, and the effects of drought on agricultural production.

Figure 10.2 **Contributions of MFP and capital deepening to national labour productivity growth, 1974-75 to 2009-10[a]**

Per cent per year



a Each column represents the average labour productivity growth over the period specified.

Source: Commission estimates based on ABS *(Australian System of National Accounts*, 2009-10, Cat. no. 5204.0*);* ABS (*Australian National Accounts: National Income, Expenditure and Product*, December 2010, Cat. no. 5206.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, February 2011, Cat. no. 6291.0.55.003); ABS (*Experimental Estimates of Industry Multifactor Productivity,* 2009-10, Cat. no. 5260.0.55.002*)*.

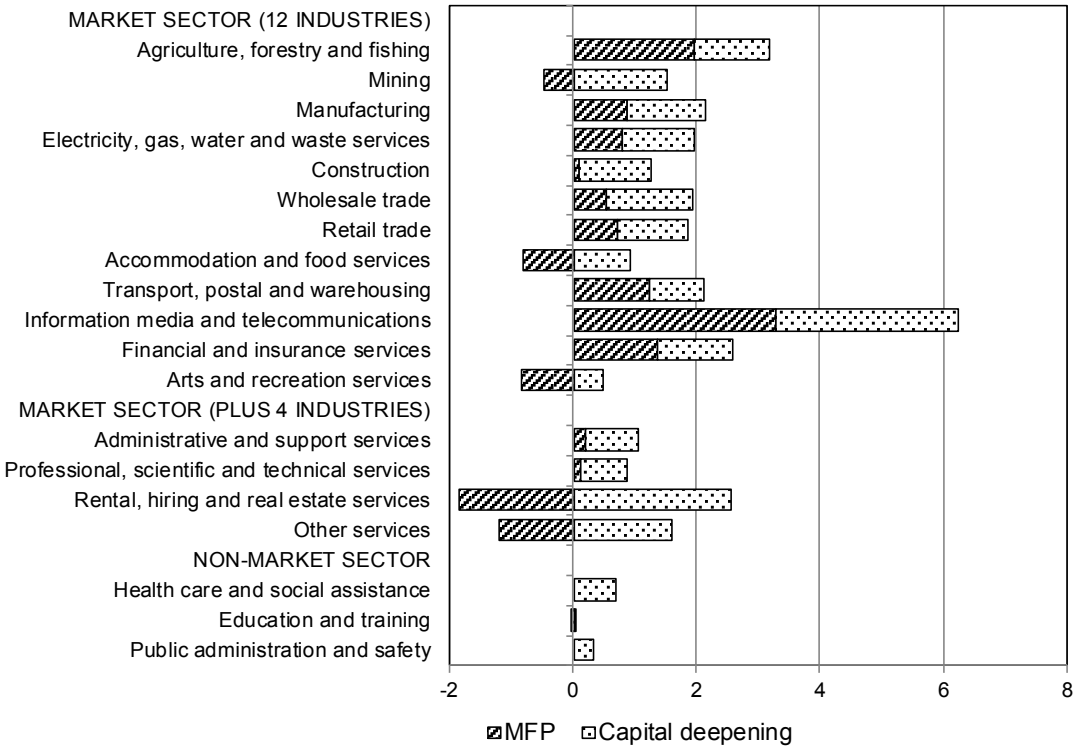
10.2 Sectoral perspective

Market sector and other industry divisions

For most industry sectors, measured labour productivity in Australia grew over the 35 years from 1974-75 to 2009-10 (figure 10.3). However, the rate of increase has varied, both with changes in capital deepening and MFP. For example, while capital deepening has contributed to labour productivity growth in mining, measured MFP has declined, as labour and capital inputs combined have increased ahead of output.

Figure 10.3 **Contribution of MFP and capital deepening to industry labour productivity growth, 1974-75 to 2009-10**[a,b,c]

Per cent per year



a The current ABS series of labour inputs by industry is classified by ANZSIC 2006 and is available for the period 1985-86 to 2009-10. This series is projected back to 1974-75 using trend information classified by ANZSIC 1993 industry. Similarly, capital input growth is measured using the ABS capital service series for the period 1985-86 to 2009-10, while growth in net capital stocks was used to project changes in capital inputs back over the period 1974-75 to 1984-85. Industry output is measured by industry gross value added. **b** Each bar represents the average labour productivity growth over the period specified. **c** The ownership of dwellings industry does not employ any labour inputs. The average annual growth rate in capital inputs and output for the ownership of dwellings industry over this period is 3.8 per cent.

Source: Commission estimates based on ABS *(Australian System of National Accounts*, 2009-10, Cat. no. 5204.0*);* ABS (*Australian National Accounts: National Income, Expenditure and Product*, December 2010, Cat. no. 5206.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, February 2011, Cat. no. 6291.0.55.003); ABS (*Experimental Estimates of Industry Multifactor Productivity,* 2009-10, Cat. no. 5260.0.55.002*)*.

As output has increased at a slower rate than input use, measured MFP has declined for four additional service sectors — accommodation and food services; arts and recreation services; rental, hiring and real estate services; and other services.

Reflecting the difficulty in measuring the output of many public sector activities independently of input use, labour productivity in health care and social assistance, education and training, and public administration and safety are assumed to change with the capital intensity of production.

Recent developments in sectoral productivity trends

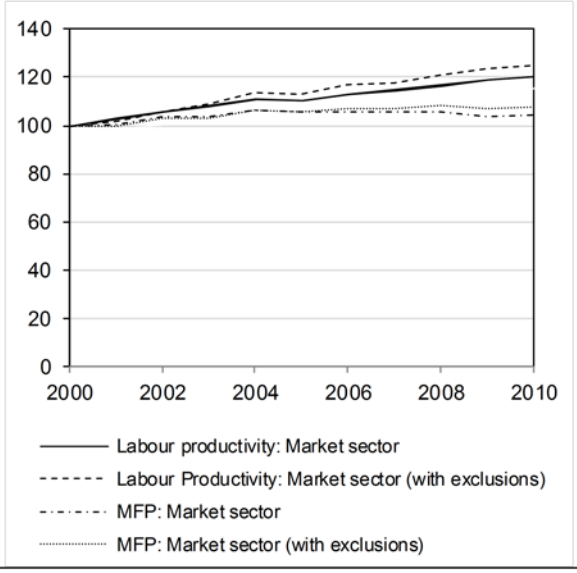
In addition to average labour productivity growth varying between industries for the 35 years examined, the contribution of individual sectors to the aggregate changes has varied between years. For example, the above average MFP growth during the 1990s reflected relatively high productivity growth in the information media & telecommunications and financial & insurance services sectors associated with the introduction of information and communications technology (ICT) (Gretton et al. 2003).

During the 2000s, aggregate labour productivity and MFP growth in the mining and electricity, gas, water and waste services (EGWW) sectors has declined relative to historical standards (figure 10.4).

The remainder of this section examines recent growth trends in these sectors.

Figure 10.4 **Productivity growth in the market sector, 1999-00 to 2009-10**[a]

Index (Reference year: 1999-00=100)



[a] Exclusions: mining and electricity, gas, water and waste services sectors.

Source: Commission estimates based on ABS (*Experimental Estimates of Industry Multifactor Productivity*, 2010-11, Cat. no. 5260.0.55.002).

Mining

Mining sector productivity increased from the early-1980s to the turn of the century. However, sectoral productivity has declined since the early 2000s (figure 10.5).

Several factors have contributed to the decline in estimated mining sector productivity, in particular:

- the 'boom-bust' nature of the sector and long leads times between new capital investment and the corresponding increase in output;

- strong growth in commodity prices that make it profitable to (temporarily) increase output without commensurate increases in the efficiency with which capital and labour inputs are used;
- depletion of high quality natural resources in operating mines and available economically exploitable deposits, requiring increased capital and labour inputs per unit of output, given the prevailing technologies; and
- current production demands that exceed the capacity of labour with mining-related training and experience, leading to the employment of less skilled and, at least initially, less productive workers (Topp et al. 2008).

Figure 10.5 **Productivity growth in mining, 1974-75 to 2009-10[a]**

Index (Reference year: 1999-00=100)

a Excluding exploration and other mining services.

Source: Commission estimates based on ABS (*Experimental Estimates of Industry Multifactor Productivity*, 2010-11, Cat. no. 5260.0.55.002.

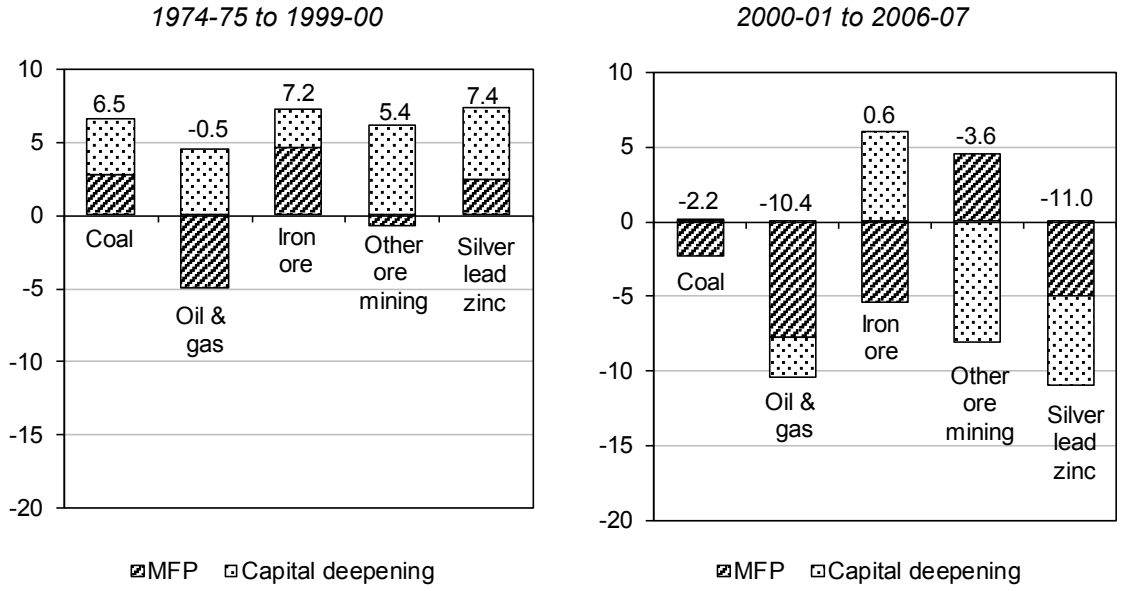
Productivity trends have differed within the mining industry

Information on productivity trends for mining industry product groups provide a disaggregated view of industry productivity trends. From 1974-75 to 1999-00, labour productivity is estimated to have increased across all mining products other than oil and gas (figure 10.6, left hand panel). In comparison to the historical trends, however, available information shows a decline in labour productivity across most products from the early 2000s (figure 10.6, right hand panel). Over this period, while output has increased ahead of historical averages, capital and labour inputs have grown even faster. This reflects the increase in investment that has occurred in response to strong world demand for Australian mining products, particularly iron ore and coal.[2]

2 Moreover, in all but iron ore mining, the ratio of capital to labour has fallen as mines hire more workers relative to investment in new capital.

Figure 10.6 **Contributions to labour productivity growth by mining product, 1974-75 to 1999-00 and 2000-01 to 2006-07**

Per cent per year



a Values denote average labour productivity growth rates.

Source: Commission estimates based on Topp et al. (2008).

Electricity, gas, water and waste services

The EGWW sector has experienced a decline in productivity growth since the late 1990s (figure 10.7). Some of the main factors influencing this decline are:

- the construction of new facilities for the provision of water services (including desalination and water pumping) associated with expanding conurbations and recent severe droughts, many of which are yet to substantially contribute to output;
- a shift away from large coal to gas-fired power stations and renewable energy sources (such as wind and solar) which require more capital per unit of output;
- the increase in the level of peak household demand for electricity during summer, requiring greater reserve capacity; and
- in recent years, a cyclical pattern of investment associated with replacing ageing network infrastructure (Topp and Kulys 2012).

Figure 10.7 **Productivity growth in electricity, gas, water and waste services, 1985-86 to 2009-10**

Index (Reference year: 1999-00=100)

Source: ABS (*Experimental Estimates of Industry Multifactor Productivity,* 2010-11, Cat. no. 5260.0.55.002).

10.3 Projections used in other studies

Recent studies have provided projections of future trends in productivity for Australia based on historical trends and international comparisons.

Carbon emissions reduction and carbon price policy modelling

Productivity projections underpin the modelling reference cases used in three distinct, but related, studies of carbon emission reduction policies in Australia:

- *Australia's Low Pollution Future* (Australian Government 2008);
- *Garnaut Climate Change Review* (Garnaut 2008); and
- *Strong Growth, Low Pollution* (Treasury 2011).

The approach used to model productivity growth appears to be broadly similar in these three studies. The projections developed for *Australia's Low Pollution Future* informed the modelling undertaken for the *Garnaut Climate Change Review* and were then updated, and in some cases revised, in *Strong Growth, Low Pollution*.

This section reports on the productivity projections used in the MMRF modelling in these three studies. However, as there is some uncertainty as to precisely what was done in any one study, this section draws on the discussion in all three studies.[3] Given the updated nature of the projections in *Strong Growth, Low Pollution*, the following discussion focuses more on the assumptions employed in that study.

These studies outline three sources of productivity growth in the reference case:

- exogenous changes in labour productivity for the economy as a whole (referred to as 'aggregate labour productivity');
- exogenous changes in labour productivity by industry (referred to as 'sector-specific labour productivity'); and
- exogenous changes in the use of intermediate inputs in production.

Given their focus on modelling emission levels, these studies also employ additional sector-specific emissions- or energy-related assumptions.

The aggregate labour productivity assumptions in *Strong Growth, Low Pollution* were imposed as labour augmenting technical change (Treasury 2011, p. 169). Treasury forecasts and budget projections were used to 2014-15. After that, it is unclear what assumptions, if any, were made regarding aggregate labour productivity to 2050. A table in that study reports average productivity growth rates by decade — 1.4 per cent during the 2010s and 1.6 per cent thereafter (table 10.1), implying an average of approximately 1.5 per cent per year to 2050. However, it is not clear whether this productivity growth was imposed on the modelling or arose as a consequence of other assumptions made.

[3] These uncertainties arise from not knowing precisely what productivity assumptions were employed in each year and what values were imposed. The reference cases for *Australia's Low Pollution Future* and *Strong Growth, Low Pollution* extend to 2050, while that used for the *Garnaut Climate Change Review* extends to 2100.

Table 10.1 **Key macroeconomic growth assumptions to 2050 in *Strong Growth, Low Pollution***

Average annual growth rate; per cent per year

Decade	*Employment*	*Labour productivity*	*Real GDP*
2010s	1.6	1.4	3.0
2020s	1.1	1.6	2.6
2030s	1.0	1.6	2.6
2040s	0.9	1.6	2.5

Source: Treasury (2011, p. 168).

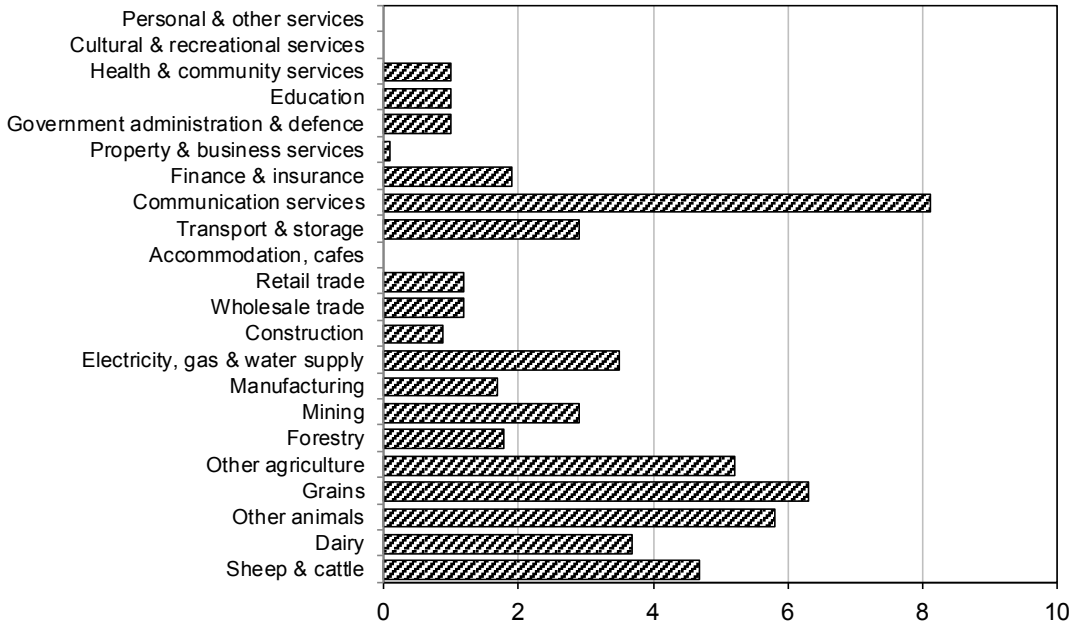
The changes in labour productivity by industry sector, which were modelled as labour augmenting technical change, introduce compositional detail into the aggregate labour productivity story.[4] The sector-specific growth rates initially used in *Strong Growth, Low Pollution* represent the average annual growth in labour augmenting technical change from 1976 to 2007 in the ABS *National Accounts* and remove the effect of capital deepening on output from MFP (figure 10.8).[5] The modelling assumes that, after 2014-15, sector-specific labour augmenting technical change 'gradually transitions to the assumed aggregate rate of 1.6 per cent per year' (Treasury 2011, p. 169).

4 If aggregate and sector-specific productivity shocks are applied in the same year, the modelling presumably also includes a residual balancing item to ensure that the sector-specific productivity shocks align with aggregate labour productivity for the economy as a whole.

5 To implement this, Treasury scaled MFP to a labour-augmented measure by weighting the calculated MFP by (the inverse of) the industry specific average labour income share.

Figure 10.8 **Sector-specific labour augmenting technical change growth in *Strong Growth, Low Pollution*, 1975-76 to 2006-07**

Average annual growth rate, per cent per year



Source: Treasury (2011, p. 170).

The *Strong Growth, Low Pollution* modelling also allowed for changes in the use of intermediate inputs in production (table 10.2**)**. The non-energy-related assumptions were:

> … based on a historical decomposition analysis by Giesecke (2004). Treasury validates intermediate input usage estimates in MMRF using a data set from the Centre for Integrated Sustainability Analysis at University of Sydney. Reflecting uncertainty about the persistence of historical trends over long timeframes, the intermediate input changes are assumed to decline linearly to zero between 2020 and 2050. MMRF implements the change in the intermediate input usage in a cost-neutral way, so total factor productivity remains unchanged. (Treasury 2011, pp. 170-1)

The *Strong Growth, Low Pollution* reference case also included a 0.5 per cent per year improvement in energy efficiency for all sectors other than transport, iron and steel, non-metallic minerals, non-ferrous metals, chemicals, rubber and plastics, which adopted sector-specific energy efficiency assumptions (p. 158).

These assumptions collectively imply a decline in the total use of intermediate inputs per unit of output over time (box 10.2).

Table 10.2 **Intermediate input technological change projections to 2050 in *Strong Growth, Low Pollution*[a]**

Intermediate input use growth per unit of output for all industries, per cent per year

MMRF commodity	*2010 to 2020*	*2020 to 2030*	*2031 to 2040*	*2041 to 2050*
Sheep & cattle	-0.2	-0.2	-0.1	0.0
Dairy cattle	-0.2	-0.2	-0.1	0.0
Other animals	-0.2	-0.2	-0.1	0.0
Forestry	-0.5	-0.4	-0.3	-0.1
Coal mining	-0.5	-0.5	-0.5	-0.5
Gas mining	-0.5	-0.5	-0.5	-0.5
Other mining	-1.5	-1.2	-0.8	-0.3
Meat products	0.5	0.4	0.2	0.1
Textiles, clothing & footwear	-2.0	-1.6	-1.0	-0.4
Wood products	-0.2	-0.2	-0.1	0.0
Paper products	-0.2	-0.2	-0.1	0.0
Printing	-0.4	-0.3	-0.2	-0.1
Gasoline	-0.5	-0.5	-0.5	-0.5
Diesel	-0.5	-0.5	-0.5	-0.5
LPG	-0.5	-0.5	-0.5	-0.5
Air fuel	-1.0	-1.0	-1.0	-1.0
Other fuel	-0.5	-0.5	-0.5	-0.5
Chemicals	-0.7	-0.6	-0.4	-0.1
Rubber & plastic products	0.5	0.4	0.2	0.1
Non-metal construction products	-0.5	-0.4	-0.3	-0.1
Cement	-0.3	-0.2	-0.2	0.1
Iron & steel	-1.0	-0.8	-0.5	-0.2
Aluminium	-1.0	-0.8	-0.5	-0.2
Other metals manufacturing	-0.1	-0.1	-0.1	0.0
Metal products	-0.1	-0.1	-0.1	0.0
Other manufacturing	-0.5	-0.4	-0.3	-0.1
Electricity supply	-0.8	-0.6	-0.5	-0.5
Water supply	-1.0	-0.8	-0.5	-0.2
Construction	0.5	0.4	0.2	0.1
Trade	0.5	0.4	0.2	0.1
Accommodation & hotels	-1.5	-1.2	-0.8	-0.3
Road transport: passenger	0.7	0.6	0.3	0.1
Road transport: freight	0.7	0.6	0.3	0.1
Rail transport: passenger	0.4	0.3	0.2	0.1
Rail transport: freight	0.4	0.3	0.2	0.1
Air transport	0.5	0.4	0.2	0.1
Communication services	1.0	0.8	0.5	0.2
Financial services	0.5	0.4	0.2	0.1
Business services	1.5	1.2	0.7	0.3

a Annual change in the use of the commodity identified per unit of output across all industries. Energy commodities have economy-wide energy efficiency term applied. Excludes commodities that have no intermediate input efficiency shocks applied.

Source: Treasury (2011, p. 171).

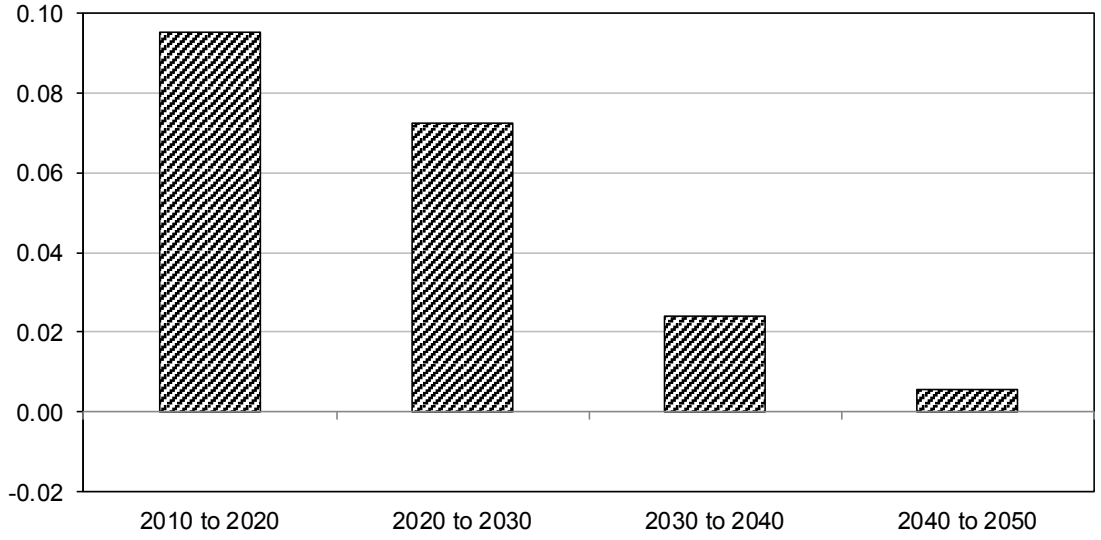
Box 10.2 **Implied total intermediate input technical change**

Technological changes in the use of individual products will flow through to affect total intermediate input use per unit of output. Using product group weights derived from the ABS *Input-Output Tables*, the Commission has calculated the total intermediate input changes implied by the product-specific intermediate input technical change assumptions adopted in *Strong Growth, Low Pollution* (Treasury 2011, p. 171). The relevant input-output weight is the ratio of intermediate input usage by each product expressed as a proportion of total Australian production (that is, the gross output of all industries).

Such calculations suggest that, in the early years of the Treasury projection period, there would be an increase in the use of intermediate inputs per unit of output, albeit at a decreasing rate (see figure). This increase occurs because service industry favouring technical change outweighs material and energy saving technical change. By 2041, the application of the projected intermediate input technical changes implies an overall decrease in intermediate input technical change.

Implied intermediate input technical change, 2010 to 2050

Per cent per year



Source: Commission estimates based on ABS (*Australian National Accounts: Input-Output Tables — Electronic Publication,* 2005-06, Cat. no. 5209.0); Treasury (2011, p. 171).

To avoid possible double counting between assumed intermediate input efficiency improvements and labour productivity changes that might arise from the use of primary inputs in production, total factor productivity in *Strong Growth, Low Pollution* is constrained over the period to be 'cost neutral'. As a result, reductions in total intermediate input requirements per unit of output are assumed to be offset by increases in the required use of labour to produce the same level of output.

The earlier carbon emissions modelling studies provide some additional insights into the modelling of labour productivity in the reference case. *Australia's Low Pollution Future* states that:

> … Treasury forecasts and budget projections for aggregate labour productivity growth until 2011-12'. … Budget projections assume labour productivity growth of 1¾ per cent per year. This is based on 30-year trends from the ABS *National Accounts*, which indicate that aggregate labour productivity — expressed in terms of GDP per hour worked — for the Australian economy averaged around 1¾ per cent per year from 1975-76 to 2006-07. … In the reference scenario, aggregate Australian labour productivity growth is assumed to gradually slow from 1¾ per cent to 1½ per cent per year over the ten years to the mid-2020s. This outcome, of 1½ per cent for long-term aggregate Australian labour productivity growth, is consistent with the long-term labour productivity growth assumption for the United States. (Australian Government 2008, p. 235)

This indicates that, at least in the reference case for *Australia's Low Pollution Future*, aggregate labour productivity was modelled out beyond the budget projections, presumably to 2050. This was operationalised in MMRF by 'adjusting the labour-augmenting technical change variable at an industry level' (p. 235). This interpretation as to how aggregate labour productivity was modelled is consistent with the assumptions detailed in the *Garnaut Review* (2008, Technical Paper no. 3, p. 10), which drew on the reference case used in *Australia's Low Pollution Future*.

This indicates that the carbon emissions reduction modelling may have involved applying all three productivity shocks to 2050: aggregate labour productivity; sector-specific labour productivity; and intermediate input use productivity.

Intergenerational Report 2010

The *Intergenerational Report 2010* (Australian Government 2010) specifies productivity improvements in terms of labour productivity at the national level. The report assumes that the 30 year historical average growth rate in labour productivity for the whole economy of 1.6 per cent per annum continues for the next 40 years.

This growth rate is lower than the 30 year average of 1.75 per cent used in the *Intergenerational Report 2007* (Australian Government 2007) and reflects the lower measured productivity in recent years.

Some implications for the development of a modelling reference case

The productivity projections in the studies reviewed involve a number of key modelling assumptions.

First, national labour productivity has been projected to increase at pre-specified rates over the projection period.

Second, in the carbon emission reduction modelling, a number of detailed assumptions have been applied that would affect the relative competitiveness of activities and the distribution of activity. In particular:

- primary factor, or multifactor productivity, is attributed to labour augmenting technical change;
- changes in the intensity of intermediate inputs of products are attributed to intermediate input augmenting technical change; and
- total factor productivity is modelled as adjusting to avoid possible double counting between assumed changes in the intensity of intermediate input use and labour productivity.

While these assumptions provide for a targeted approach to projecting and modelling productivity change, they do not allow for a number of other possible influences on productivity, including:

- changes affecting the distribution of activity between sectors and the relative importance of labour and capital inputs and intermediate inputs (that is, compositional changes); and
- technological and organisational changes that affect the productivity of capital.

As additional background to the development of the reference case, the following section draws on available data to outline in broad terms possible sources of productivity change and the service potential of inputs. It pays particular attention to the likely underlying sources of measured productivity growth.

10.4 Possible sources of productivity changes

As noted, technical and organisational changes add to the productivity of available labour and capital. Such changes augment available inputs and can increase output above levels that would otherwise be feasible. Improvements in input augmenting technical change commonly referred to include:

- *labour augmenting* technical change, which increases the effectiveness of labour inputs used in production — typified by a 'Harrod-Neutral' production function;
- *capital augmenting* technical change, which improves the effectiveness of capital inputs used in production — typified by a 'Solow-Neutral' production function; and

- *multifactor augmenting* technical change, which improves the effectiveness of primary factors used in production (typically, labour and capital inputs) — typified by a 'Hicks-Neutral' production function.

In addition to improvements in the productivity of resources resulting from technical and organisational change, the service potential or 'quality' of inputs can improve. Education, training and work experience will improve labour quality, while technological advances in investment products (or new product varieties) can improve the quality of capital. Ideally, measures of labour and capital inputs would reflect technical change and improvements in service potential embodied in labour and capital inputs. The difference between growth in output and inputs would then provide a measure of input augmenting (or disembodied) technical and organisational change. However, in practice:

- Some adjustments are made to the capital-service input series for the market sector to take account of changes in quality (that is, the relative productivity of individual capital inputs), affording estimates of quality-adjusted inputs of capital services to production (see ABS 2000).
- Labour inputs by industry are combined into a single category and measured in terms of hours worked without adjustment for relative productivity per hour worked of employed persons of different levels of technical skill or experience.

Because MFP is conventionally estimated as the change in output not attributed to measured inputs, changes in the quality of labour and other inputs and information gaps are implicitly incorporated in measured MFP in published productivity series. Despite this limitation, some statistical indicators support broad assessments of the prevalence of changes in input quality and the possible influence of technological and organisational change on the effectiveness of capital and labour inputs.

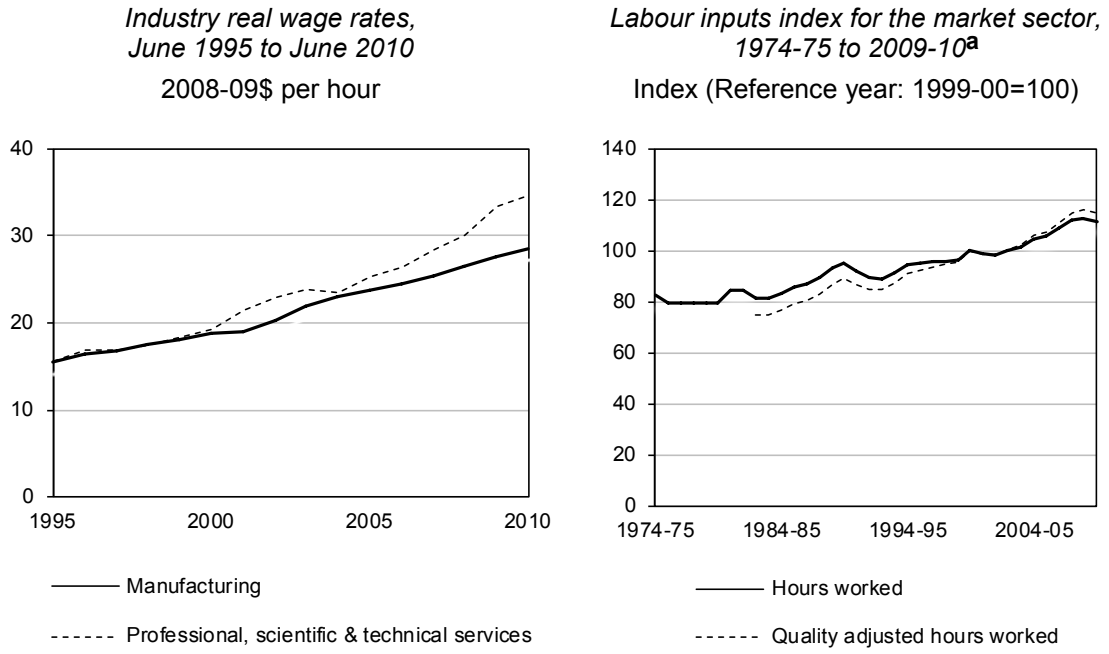
Labour inputs

Available indicators suggest that the quality of the labour force is improving.

Opportunities for higher real wages can arise from labour augmenting technological change, higher skill levels and the transferring of labour between activities and occupations. Over the 15-year period from June 1995 to June 2010, real wages have increased on average by 2.3 per cent annually. Over the same period, there was change in the composition of the labour force towards professional occupations relative to employment in other occupations. There has also been a decline in clerical and administrative workers, labourers, and machinery operators and drivers relative to other categories (chapter 9).

Occupational categories for professional workers are associated with tertiary and higher-level qualifications and higher relative wage rates are indicative of higher productivity. Since the mid-1990s, real wage increases have been concentrated in industries that tend to have higher-skilled occupations (figure 10.9, left hand panel).

Figure 10.9 **Trends in labour inputs used in production**



a Quarterly average hours worked in a week are calculated from the quarterly survey of industry hours worked in a survey week divided by the number employed quarterly. The average weekly earnings for each industry are then divided by the average weekly hours worked and corrected for inflation using the Consumer Price Index.

Source: Commission estimates based on ABS (*Labour Force, Australia, Detailed, Quarterly*, May 2012, Cat. no. 6291.0.55.003); ABS (*Average Weekly Earnings, Australia*, February 2012, Cat. no. 6302.0); ABS (*Consumer Price Index, Australia*, March 2012, Cat. no. 6401.0); ABS (*Experimental Estimates of Industry Multifactor Productivity*, 2010-11, Cat. no. 5260.0.55.002).

For the market sector, experimental estimates by the ABS suggest that labour inputs adjusted to take account of work experience and education increased by 1.6 per cent per year over the period 1983-84 to 2009-10 (the period for which quality adjusted hours worked is available). By contrast, labour inputs measured on an hours worked basis increased by 1.2 per cent per year over the same period (figure 10.9, right hand panel).

To the extent that improvements in labour quality are subsumed in MFP estimates, any input augmenting technical change, for labour or labour and capital combined, induced by technological and organisational change cannot be directly observed.

Capital inputs

While some adjustments for the quality of capital inputs are made, the incidence or scale of any capital or capital and labour combined input augmenting technical change cannot be directly observed. Nevertheless, there are some indicators that provide a guide to the scope for such changes. For example, asset replacement and new investment provide the opportunity to take up potentially more efficient technologies that could spill over to raise the productivity of labour and capital. The potential for such spillovers would be influenced by both the growth in new investment and the depreciation cycles for existing assets — estimated by the ABS to be 18 years on average for machinery and equipment employed across market sector activities, with some variation between sectors. That is, capital stocks would be fully replaced with new models, on average, every second decade or so. Moreover, within each asset class, the effective life of an asset varies significantly, implying a more rapid turnover for some items. For example, the average asset life for computers and related equipment is only four years, implying a faster rate of turnover of fixed capital.

With the turnover of assets and the introduction of new technologies comes the opportunity to augment older capital items, through retrofitting and other modifications, enabling multifactor augmenting technological and organisational changes within firms. For example, the introduction of ICT has been assessed as contributing to structural change and an acceleration in productivity growth during the 1990s in countries characterised by ICT-intensive growth.[6]

Intermediate inputs, and material and energy use

Productivity analyses of national economies predominantly focus on the MFP productivity of labour and capital. However, the measurement and interpretation of MFP can also be influenced by the choice of output measure and the treatment of intermediate inputs in production (box 10.3).

6 A study of Australian firm level data showed that the rapid take up of computers by firms had a positive effect on MFP growth in the mid-1990s (Gretton et al. 2002, 2003). A parallel study of Canadian firms found that those firms using advanced ICT had better productivity performance than other firms between 1988 and 1997 (Baldwin and Sabourin 2002).

Box 10.3 **Productivity effects of intermediate input technical change**

The two basic measures of output used in productivity analysis are:

- *gross output* (Y), which includes intermediate inputs (I), such as materials, energy and services, used in the production, as well as the primary inputs of labour (L) and capital (K); and
- *value added*, which excludes intermediate inputs used in production (Y-I).

Either output measure can be used to estimate partial measures of productivity growth, such as labour productivity. Both output measures can also provide a basis for more comprehensive measures of productivity growth, such as:

- multifactor productivity (MFP), which is typically used to measure changes in the productivity of capital and labour using the value added concept of output:

$$MFP = \frac{Y - I}{K + L}$$; and

- total factor productivity (TFP), which is used to measures changes in the productivity of all inputs using the gross output concept:

$$TFP = \frac{Y}{I + K + L}.$$

The value added approach to calculating MFP has some notable advantages. It is easy to use because it ignores inter-industry and intra-industry flows of goods and services. It can be calculated at the industry level and meaningfully compared to the national economy or against other sectors. Estimating growth of value adding output, however, often involves the assumption of no change in the ratio of intermediate inputs to gross output (the Leontief assumption). The application of this assumption therefore attributes all changes in technology and the organisation of production to changes in the productivity of labour and capital. This is misleading if the efficiency of labour and capital has not been the source of this productivity growth.

In contrast, TFP estimates provide a comprehensive measure of productivity improvements from disembodied technical change in all inputs, particularly at the industry level. By allowing for changes in the use of intermediate inputs as well as primary factor inputs, it takes into account the key sources of productivity change.

The difference between MFP and TFP productivity growth is less pronounced at the national level than at the sectoral or industry level. At the national level, the difference between the measures arises from the proportion of intermediate inputs sourced as imports. At the industry level, the higher the share of intermediate inputs, the more TFP can diverge from MFP.

Technological and organisational changes that result in more efficient use of intermediate inputs will increase output per unit of labour and capital. Such changes may occur with:

- new product varieties and changes in the quality of intermediate goods and services inputs that raise the effective output per unit of input of the intermediate-good produced;
- changes in industry organisation and ways of working *between* industries (for example, through subcontracting, outsourcing and inter-industry trade) that reduce the effective resource cost per unit of output; and
- changes in technology and organisation of production *within* industries to reduce energy, material and other input requirements per unit of output (such as through energy efficiency improvements or reductions in regulatory red tape).

The first and second points would tend to be associated with intermediate product deepening — an *increase* in the incidence of intra- and inter-industry transactions and higher output per unit of value adding input (that is, labour and capital). The third point would be associated with a *decrease* in the intensity of energy and material inputs per unit of output.

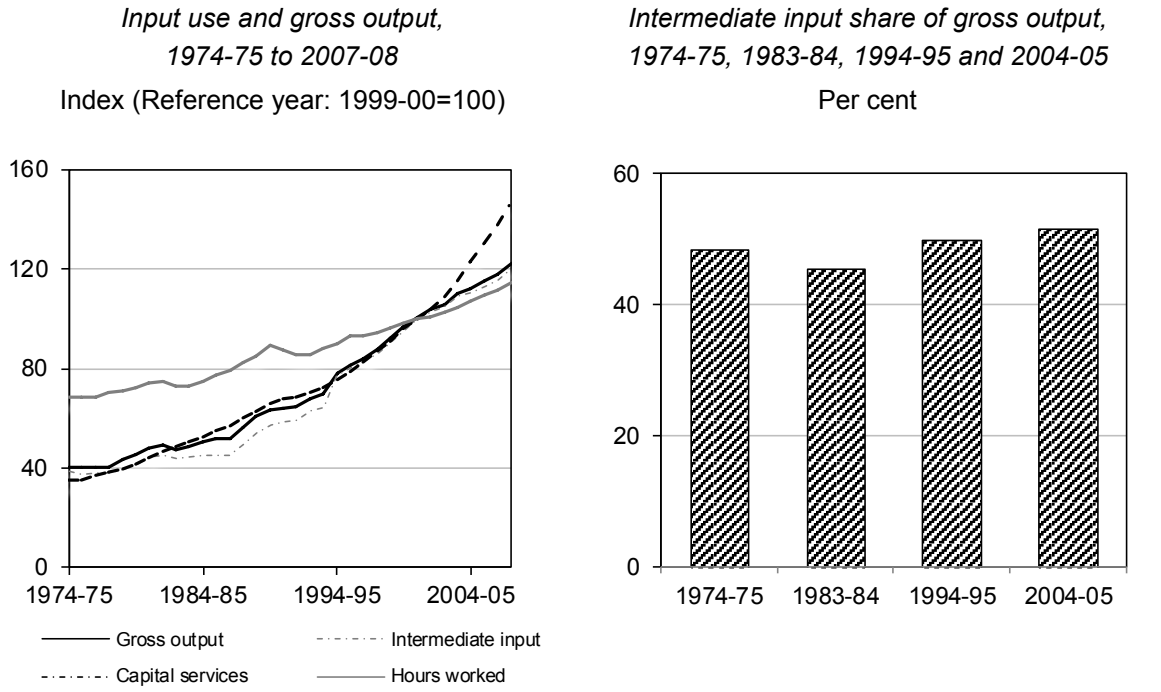
Available information from the EU KLEMS project indicates that aggregate intermediate input use in Australia has increased broadly in line with gross output — 3 and 3.1 per cent per year, respectively — over the last few decades (figure 10.10, left hand panel). That data also indicates that labour inputs (measured as hours worked) increased at around 1.5 per cent per year.[7]

Australian input-output data also suggest that the ratio of intermediate inputs to aggregate Australian production (that is gross output) has remained relatively stable, as measured in Australian *Input-Output Tables* (figure 10.10, right hand panel). Nevertheless, consistent with the EU KLEMS series, the estimates, if anything, suggest some intermediate input deepening may have occurred.

---

7 The EU KLEMS work undertaken by the Groningen Institute uses ABS *National Accounts* and the *Supply-Use Tables* data. Its aggregate series for inputs and outputs, as published in this chapter, is largely in line with methods adopted to construct the other series reported earlier in the chapter. The fiscal year data from the ABS is converted to calendar years, such that 1970-71 equals 1970. Gross value added at the national level before 1989 is not available at basic prices and is calculated from gross value added at market prices minus net tax on products (by applying a constant rate of net taxes on production based on data from 1989 to 2005). The hours worked series is in line with the ABS Labour Force Survey aggregate series and the *Supply-Use Tables* favorably compare with trends in GDP at constant prices.

Figure 10.10 **Intermediate inputs used in production**[a]



a Data published by the EU KLEMS project is sourced from the Australian Bureau of Statistics.

Sources: EU KLEMS (2009); ABS (*Australian National Accounts: Input-Output Tables*, Various, Cat. no. 5209.0).

While the aggregate intermediate intensity of production has remained relatively stable since the mid-1970s, the intensity of individual input use has varied. For example, energy intensity (including residential energy consumption) declined at an average rate of 1 per cent per year over the period 1974-75 to 2009-10.[8] However, the decline has not been uniform across sectors. The manufacturing, construction, transport, commercial services and residential sectors have had declining energy intensity on average, while the mining sector has increased its annual energy intensity by an average of 2.1 per cent.

10.5 Towards a modelling reference case

As discussed, the previous Australian studies reviewed have focused on projected changes in national labour productivity and, where applicable, have adopted the simplifying assumption that projected changes in MFP are attributed to labour augmenting technological change, while changes in the mix of intermediate inputs

8 Commission estimates based on ABARES (2011b) and ABS (*Australian National Accounts: National Income, Expenditure and Product*, December 2010, Cat. no. 5206.0).

are influenced by product-specific intermediate input augmenting technological change.

As in the previous modelling studies reviewed in this chapter, the reference case used in this study requires simplifying assumptions about how the relationship between productive inputs and outputs — that is, productivity — evolves over time. It requires assumptions about the nature of the underlying contributions of technological and organisational change to productivity growth.

Labour productivity

Because of the theoretical and practical possibility that technological and organisational change can affect the productivity of capital as well as labour, this study does not seek to attribute all projected MFP growth to labour augmenting technical change. Rather, industry-specific labour productivity (the exogenous variable) is projected forward on the basis of recent changes and longer-term historical trends, while capital deepening is modelled on the basis of the relative returns to capital across activities. For market sector activities, that part of projected labour productivity that is not accounted for by capital deepening is determined to be MFP arising from 'primary factor augmenting' technical change (the endogenous variable). For non-market activities, MFP growth is assumed to be zero in line with Australian national accounting practice. For example, the industry *ownership of dwellings* is conventionally not recorded as employing labour. Accordingly, labour productivity for this activity is recorded as zero and output grows in line with capital input use.

Growth in aggregate labour productivity is determined by the projected growth of labour productivity at the industry level and the relative contribution of industries to national employment and output.

The MMRF modelling reference case used in this study adopts a scenario for industry-level labour productivity based on historical trends in measured productivity (table 10.3). Given the availability of information, most projections are made at the ANZSIC industry division level and then applied to the corresponding MMRF industries.

Table 10.3 **Labour productivity growth projections to 2050 in the modelling reference case by MMRF industry**

Per cent per year

MMRF industry	*1974-75 to 2009-10*	*2006 to 2010*	*2011 to 2020*	*2021 to 2030*	*2031 to 2040*	*2041 to 2050*
Livestock	3.2	1.0	2.4	3.2	3.2	3.2
Crops	3.2	1.0	2.4	3.2	3.2	3.2
Dairy	3.2	1.0	2.4	3.2	3.2	3.2
Other agriculture	3.2	1.0	2.4	3.2	3.2	3.2
Forestry	3.2	1.0	2.4	3.2	3.2	3.2
Fishing	3.2	1.0	2.4	3.2	3.2	3.2
Coal mining	4.6	-10.9	-0.8	4.6	4.6	4.6
Oil mining	-2.7	-6.0	-2.1	0.0	0.0	0.0
Gas mining	-2.7	0.0	0.7	1.0	1.0	1.0
Iron ore mining	5.7	-14.0	-1.2	5.7	5.7	5.7
Other metal ore mining	1.0	-2.6	-0.3	1.0	1.0	1.0
Other mining	1.0	-2.6	-0.3	1.0	1.0	1.0
Meat products	2.1	1.3	1.8	2.1	2.1	2.1
Dairy products	2.1	1.3	1.8	2.1	2.1	2.1
Other food, beverages & tobacco	2.1	1.3	1.8	2.1	2.1	2.1
Textiles, clothing & footwear	2.1	1.3	1.8	2.1	2.1	2.1
Wood products	2.1	1.3	1.8	2.1	2.1	2.1
Paper products	2.1	1.3	1.8	2.1	2.1	2.1
Printing	2.1	1.3	1.8	2.1	2.1	2.1
Petrol	2.1	1.3	1.8	2.1	2.1	2.1
Other petroleum & coal products	2.1	1.3	1.8	2.1	2.1	2.1
Chemical products	2.1	1.3	1.8	2.1	2.1	2.1
Rubber & plastic products	2.1	1.3	1.8	2.1	2.1	2.1
Other non-metal mineral products	2.1	1.3	1.8	2.1	2.1	2.1
Cement & lime	2.1	1.3	1.8	2.1	2.1	2.1
Iron & steel	2.1	1.3	1.8	2.1	2.1	2.1
Alumina	2.1	1.3	1.8	2.1	2.1	2.1
Aluminium	2.1	1.3	1.8	2.1	2.1	2.1
Other non-ferrous metals	2.1	1.3	1.8	2.1	2.1	2.1
Metal products	2.1	1.3	1.8	2.1	2.1	2.1
Motor vehicles & parts	2.1	1.3	1.8	2.1	2.1	2.1

(Continued next page)

Table 10.3 **(continued)**

MMRF industry	*1974-75 to 2009-10*	*2006 to 2010*	*2011 to 2020*	*2021 to 2030*	*2031 to 2040*	*2041 to 2050*
Other equipment	2.1	1.3	1.8	2.1	2.1	2.1
Other manufacturing	2.1	1.3	1.8	2.1	2.1	2.1
Electricity generation: coal	2.0	-5.7	-0.7	2.0	2.0	2.0
Electricity generation: gas	2.0	-5.7	-0.7	2.0	2.0	2.0
Electricity generation: oil	2.0	-5.7	-0.7	2.0	2.0	2.0
Electricity generation: hydro	2.0	-5.7	-0.7	2.0	2.0	2.0
Electricity generation: other	2.0	-5.7	-0.7	2.0	2.0	2.0
Electricity supply	2.0	-5.7	-0.7	2.0	2.0	2.0
Gas supply	2.0	-5.7	-0.7	2.0	2.0	2.0
Water & sewerage services	2.0	-5.7	-0.7	2.0	2.0	2.0
Residential construction	1.3	1.1	1.2	1.3	1.3	1.3
Non-residential construction	1.3	1.1	1.2	1.3	1.3	1.3
Wholesale trade	1.9	0.4	1.4	1.9	1.9	1.9
Retail trade	1.8	2.9	2.2	1.8	1.8	1.8
Mechanical repairs	1.8	2.9	2.2	1.8	1.8	1.8
Hotels, cafes & accommodation	0.1	-0.6	-0.1	0.1	0.1	0.1
Road freight transport	2.1	0.7	1.6	2.1	2.1	2.1
Road passenger transport	2.1	0.7	1.6	2.1	2.1	2.1
Rail freight transport	2.1	0.7	1.6	2.1	2.1	2.1
Rail passenger transport	2.1	0.7	1.6	2.1	2.1	2.1
Pipeline transport	2.1	0.7	1.6	2.1	2.1	2.1
Water transport	2.1	0.7	1.6	2.1	2.1	2.1
Air transport	2.1	0.7	1.6	2.1	2.1	2.1
Services to transport	2.1	0.7	1.6	2.1	2.1	2.1
Communication services	6.2	5.9	6.1	6.2	6.2	6.2
Financial services	2.6	3.4	2.9	2.6	2.6	2.6
Ownership of dwellings[a]	3.8	3.0	3.5	3.8	3.8	3.8
Business services[b]	0.7	-0.9	0.1	0.7	0.7	0.7
Government administration & defence	0.3	0.3	0.3	0.3	0.3	0.3
Education	0.0	-1.0	-0.4	0.0	0.0	0.0
Health	0.7	0.5	0.6	0.7	0.7	0.7
Community services	0.7	0.5	0.6	0.7	0.7	0.7
Other services[c]	0.3	-0.2	0.1	0.3	0.3	0.3

a As the ownership of dwellings industry does not employ any labour, the growth rates presented represent the average growth rates for industry output (real gross value added). **b** Business services is the weighted-average of: rental, hiring & real estate services; professional, scientific & technical services; and administrative & support services. **c** Other services is the weighted-average of: arts & recreation services; and other services.

Source: Commission estimates.

Labour productivity growth over the period 2005-06 to 2009-10 is modelled in line with measured average annual changes for that period. In keeping with the assumed unwinding of the terms of trade (chapter 11), projected labour productivity growth is then assumed to converge over the next eight years — that is, from 2009-10 to 2017-18 — to the historical average measured for the period 1974-75 to 2009-10. Industry-specific labour productivity is then assumed to remain constant at this historical average to 2049-50.

An exception is made for the mining industries. Historical labour productivity and MFP trends exist for eight mining sub-sectors — coal, oil and gas, iron ore, other metal ores (including bauxite), copper ore, gold ore, mineral sands and silver-lead-zinc ore (Topp et al. 2008, p. 26). The available data indicate considerable variation in labour productivity and MFP across sectors and through time. Two of these mining sectors — coal and iron ore — align closely with the mining industries in MMRF. Consequently, the modelling reference case for coal and iron ore mining transition to these long-term sectoral trends. However, given the difficulty in mapping the productivity data for the remaining mining sectors, it is assumed that the other MMRF mining industries, other than oil mining grow, at the historical average for the mining sector (1 per cent per year). As oil extraction in Australia is a mature industry, it is assumed that the long-term trend for oil extraction is zero.

Given that it does not employ any labour, it is assumed that the long-run growth rate in labour productivity for the ownership of dwellings industry is the 3.8 per cent per year historical growth in output.[9]

Sensitivity testing

As illustrated in chapter 7, the assumptions made about productivity growth play an important role in determining the overall level of economic activity in a modelling reference case. Such assumptions also potentially play an important role in determining the composition of economic activity across industries and, indirectly, across states.

The sensitivity of the reference case detailed in chapter 15, and the timeframe over which the impacts of COAG reforms are expected to accrue, has been tested by varying some of the key assumptions.

- The first sensitivity test unwinds industry labour productivity and the terms of trade to long-run trends over 15 years to 2024-25 (compared to the eight years in

9 The ownership of dwellings industry contributes to output of the Australian economy and, hence, to aggregate labour productivity (real GDP per hour worked).

the modelling reference case); unwinds productivity in all mining industries other than oil to the long-run trend for the mining sector as a whole (rather than the mining industry-specific long-run trend); and sets the labour productivity improvement for the ownership of dwellings industry to zero (compared to the 3.8 per cent in the modelling reference case).

- Given that aggregate labour productivity in the modelling reference case is projected to be less than the long-run trend (1.3 compared to 1.7 per cent per year), the second sensitivity test involves increasing labour productivity in each industry by an additional 30 per cent per year (≈1.7/1.3×100−100).

Intermediate input use

The use of intermediate inputs across the economy can change because of:

- changes in the industry structure of the economy; and
- technological changes that affect the use of intermediate inputs in production.

It would be desirable to incorporate technological changes in the use of intermediate inputs in production. However, the absence of detailed, internally consistent and reliable industry data on the use of intermediate inputs throughout the economy prevent the modelling of intermediate input technical change using historical trends in the same way as that used for labour productivity.

In the absence of such data, intermediate input usage in the reference case is determined by changes in the industry structure of the economy that result from the other reference case assumptions (including the productivity of primary factor input uses in individual sectors). The fixed proportions (Leontief) assumption in the model implies that intermediate input use in each industry will move in line with changes in industry gross output. This stylised approach is broadly in line with the available aggregate data, which indicates that intermediate input use moves broadly in line with gross output.

11 Terms of trade

Being a small and open economy, Australia is significantly influenced by changes in international markets. Such changes are, therefore, an important aspect of the economic environment in which the COAG reforms are assessed and warrant their inclusion in the modelling reference case.

This chapter provides an overview of Australia's interaction with international goods and services markets — the nature of Australia's exports and imports, their relative prices and composition. It focuses on the longer-term trends that shape the level and composition of economic activity, abstracting from short-run variations. However, given the magnitude of the rise in the terms of trade over the last decade, recent developments warrant particular consideration given the potential impact on the level and composition of future economic activity in Australia. At some point in the future, increases in the global production of those commodities that have contributed to the strong increase in the terms of trade could be expected to bring the terms of trade back towards more historic levels. Given this, the chapter canvasses projections of the unwinding of Australia's terms of trade presented in other studies. The chapter concludes by presenting the terms of trade projections used in the modelling reference case.

The associated changes in foreign investment and income flows between Australia and the rest of the world are discussed in chapter 12.

11.1 Terms of trade in a balance of payments context

The world market plays an influential role in determining Australia's economic performance and national income. The value of trade is recorded as a component of the 'current account' in the balance of payments.

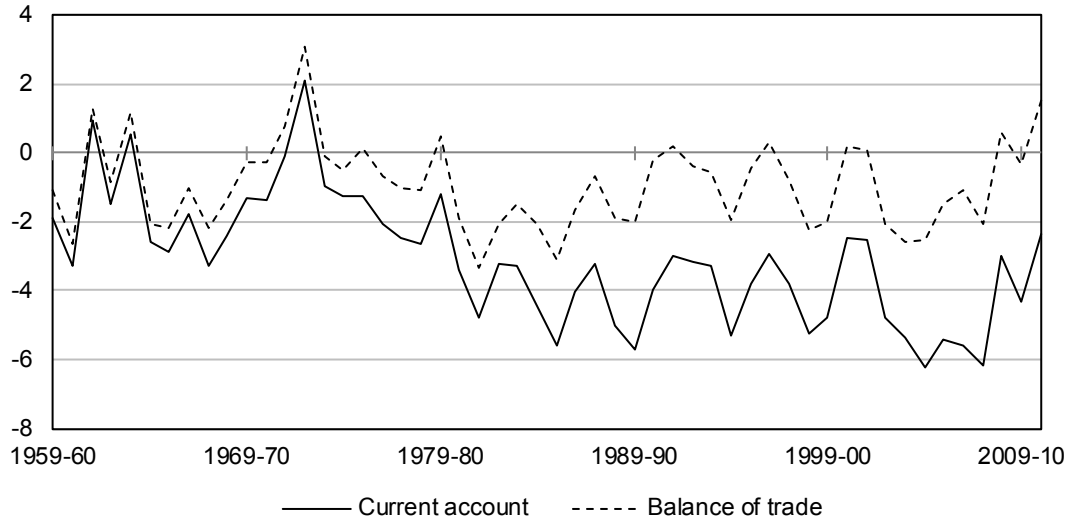
The current account is made up of the balance of trade (the value of exports minus imports), net factor income (for example, from interest and dividends) and net current transfer payments (such as remittances of non-resident workers and foreign aid).

Since the 1980s, the current account has maintained, on average, a fairly stable deficit of 4 per cent of gross domestic product (figure 11.1). There is, however, a

growing gap between the balance of goods and services traded (balance of trade) and the current account balance. This gap has been driven by increases in the flow of payments servicing Australia's stock of foreign liabilities (foreign ownership of the domestic capital stock is discussed in broad terms in chapter 12). Despite this growing gap, yearly gyrations in the current account are largely associated with changes in the balance of trade.

Figure 11.1 **Australian current account deficit and balance of trade, 1959-60 to 2010-11**

Per cent of GDP



Sources: ABS (*Australian System of National Accounts*, 2010-11, Cat. no. 5204.0); ABS (*Balance of Payments and International Investment Position, Australia*, December 2011, Cat. no. 5302.0).

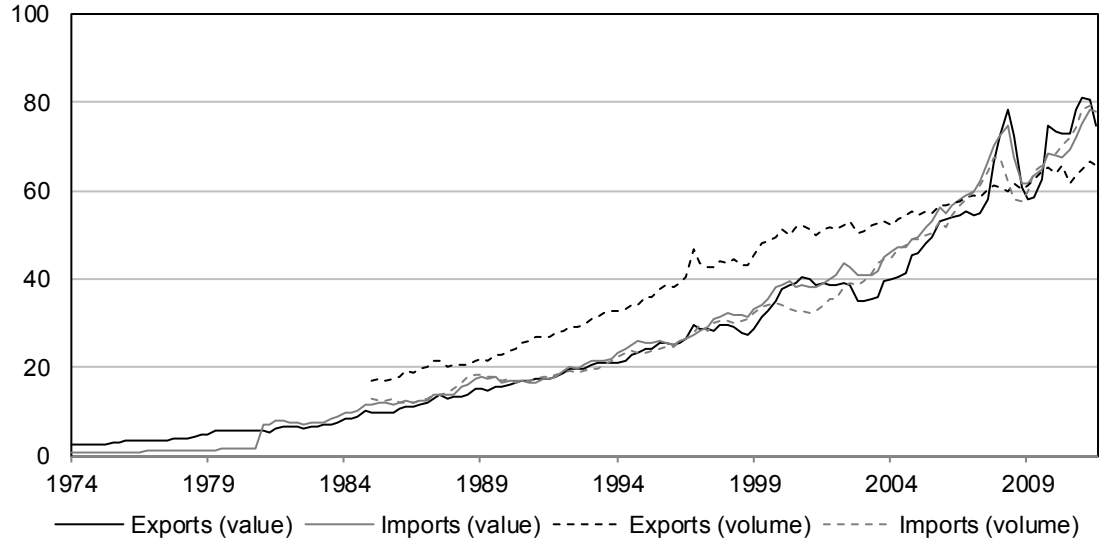
The balance of trade represents the value of exports minus the value of imports. These values are influenced by both price and quantity (volume) effects. The value and volume of both exports and imports have both increased over time (figure 11.2).

A number of factors have influenced this observed changes in export and import volumes. Export volumes have increased to meet global demand for Australian goods and services and with the growing international competitiveness of Australian industry. Rising national income and reduced trade barriers have contributed to a rapid rise in the import volumes since the 1950s (Dark and Hawkins 2005). Related factors such as the internationalisation of firms have also contributed.

The quantity of goods and services exported and imported have historically increased in roughly similar proportion (figure 11.2). This implies that changes in the relative prices of exports and imports have been the main factor behind changes in the balance of trade and the current account.

Figure 11.2 **Australian goods and services exports and imports, September quarter 1974 to December quarter 2011**[a]

$ billion



a Exports and imports by values are expressed in current prices. Export and import volumes are expressed in chain volume terms with a reference year of 2009-10.

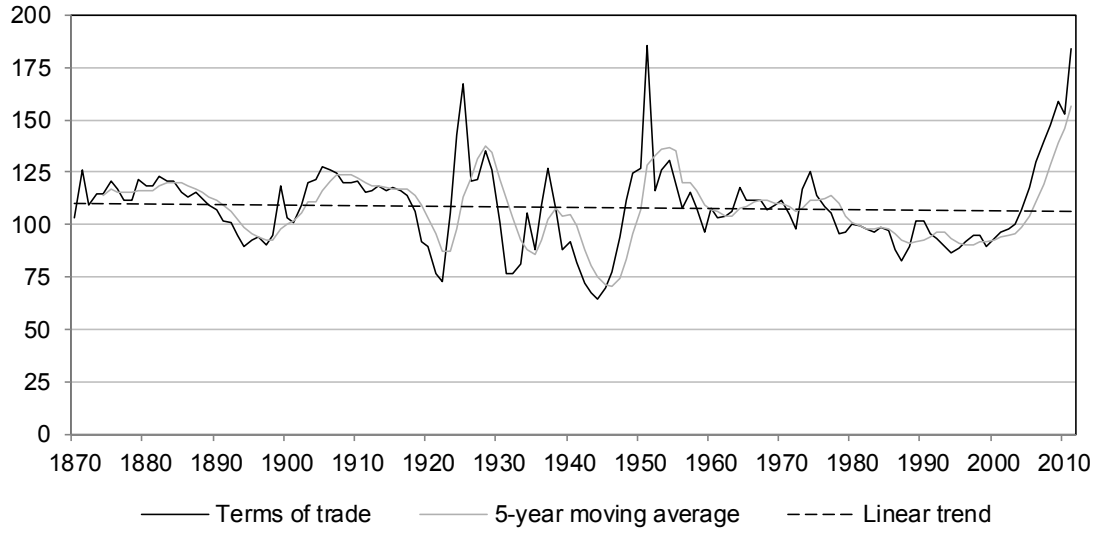
Source: RBA (*Balance of Payments – Exports and Imports*, Statistical table H3, 6 June 2012).

Changes in the relative prices of exports and imports are represented by the terms of trade. The terms of trade is a measure (expressed as an index) of the ratio of export prices to import prices (both expressed in Australian dollars). It represents the quantity of foreign goods and services that can be purchased with a given value of domestically produced goods and services. It is influenced by the level and composition of goods and services traded, and changes in their relative prices.

11.2 Historical perspective

Over the past 140 years, the linear trend of Australia's terms of trade has been generally flat. Despite this, there has been considerable short-run variability over some periods (figure 11.3). Indeed, the current five-year moving average has Australia's terms of trade at its highest level in history — 65 per cent above the average level for the 20th Century, and 85 per cent above the trend level for the 20th Century (Stevens 2011).

Figure 11.3 **Australia's terms of trade, 1870 to 2011**[a]
Index (Reference year: 2002-03=100)



a Index of the ratio of goods and services export prices to import prices (both expressed in Australian dollars).

Sources: Gillitzer and Kearns (2005); ABS (*Australian System of National Accounts*, 2010-11, Cat. no. 5204.0).

Short-run cycles

The short-run peaks and troughs in Australia's terms of trade have been driven by a number of influences. The first significant deviation was a rapid decline in the terms of trade at the end of World War I. Following this, the economic boom of the 1920s resulted in higher commodity export prices, particularly for wool, leading to a rapid increase in the terms of trade. However, this trend was reversed when prices and trade declined during the Great Depression. The terms of trade further deteriorated with the commencement of World War II.

There have since been two rapid rises in the terms of trade. First, the terms of trade almost tripled between 1944 and 1951, as the world price of wool and metals rose in response to the Korean War. Second, economic growth in emerging economies, particularly China, since 2000 has contributed to higher prices for Australian commodity exports (especially iron ore and coal). This has led to a sharp rise in the terms of trade and a doubling in the value of Australian exports.

Long-term trends

Australia's long-term terms of trade has declined marginally over time, falling by approximately 0.1 per cent per annum on average over the past 140 years. This

longer-run trend is partly the result of the composition of Australia's exports and imports.

Some research (for example, Harvey et al. 2010) has suggested that countries which are predominately exporters of primary commodities and importers of manufacturing goods are likely to experience falling terms of trade over time as a result of their trade mix — this is known as the Prebisch-Singer hypothesis (Prebisch 1950; Singer 1950). Over the past 100 years in Australia, commodities have dominated exports (about four fifths), while manufactured goods have comprised the majority of imports (Gillitzer and Kearns 2005).

However, some empirical studies have suggested that Australia's primary commodity mix, with a significant mining component, is not likely to follow this trend. Grant, Hawkins and Shaw (2005), for example, find that there does not appear to be a long-run tendency for the prices of commodities from mining to fall relative to manufactures. Further, other studies suggest that Australia's terms of trade is not characterised by a long-run downward trend, but can instead be explained by a one-off downward adjustment in the early 1920s (Cuddington, Ludema and Jasasuriya 2002). This is supported by the observed price increases in commodities since the mid-1980s, which have offset the 30-year decline that preceded this period (Gillitzer and Kearns 2005).

11.3 Understanding movements in the terms of trade

Australia's terms of trade has been driven by longer-term trends in the nominal prices of products traded, the type and source of goods and services traded and short- to medium-term fluctuations in the price of particular commodities. The contribution of these factors to changes in Australia's terms of trade is discussed in this section.

Trends in prices and the type and source of goods and services traded

Australia is a small, open economy with little ability to influence relative world prices of exports and imports, especially over the longer term. As a price taker for exports and imports, the changes in the terms of trade over time are representative of changes in world supply and demand as well as the relative composition of goods and services being traded by Australia. In recent years, export prices have been rising at a faster rate than import prices (figure 11.4).

Figure 11.4 **Australian export and import prices, September quarter 1983 to March quarter 2012**

Index (Reference year: 1989-90=100)

Source: ABS (*International Trade Price Indexes, Australia,* March 2012, Cat. no. 6457.0).

Exports

The price of Australian goods exports has increased by approximately 2.8 per cent per year since September 1989 (figure 11.5). 'Non-rural' goods, including minerals, have been the main driver of the price increases over this period.

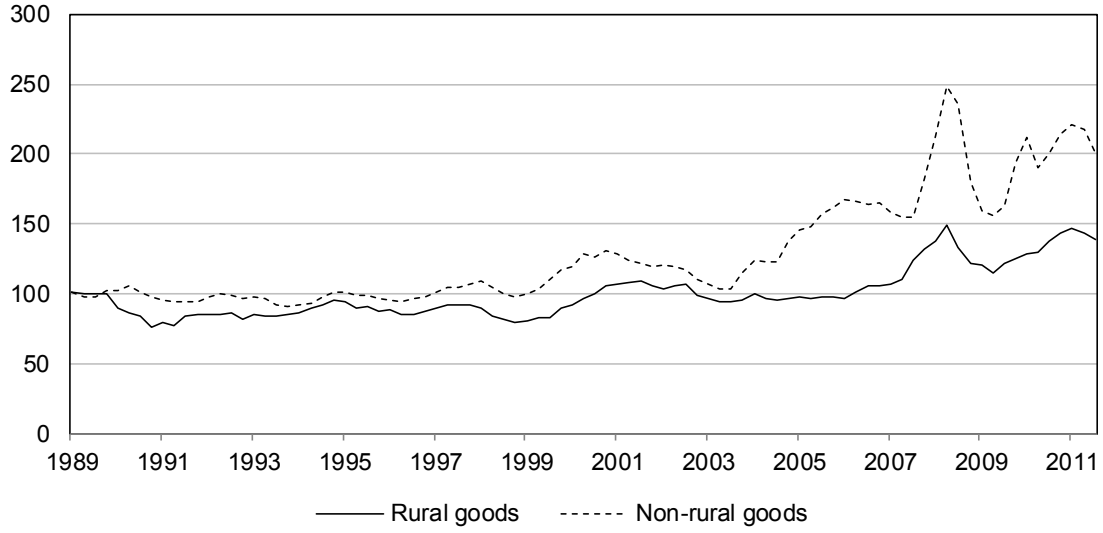
The compositional changes in Australian exports have meant that average export prices have risen relative to world commodity prices (Gillitzer and Kearns 2005). Broadly, this is a result of a shift towards non-rural commodities and, in particular, minerals such as iron ore and crude oil in the 1960s and 1970s (figure 11.6**)**.

Imports

The price of imported goods has been increasing by approximately 1.7 per cent on average annually since September 1983 (figure 11.7). However, this overall increase has not been consistent across categories of imported goods, particularly in recent years (figure 11.8).

Figure 11.5 **Australian export price indexes, September quarter 1989 to March quarter 2012**[a]

Index (Reference year: 1989-90=100)

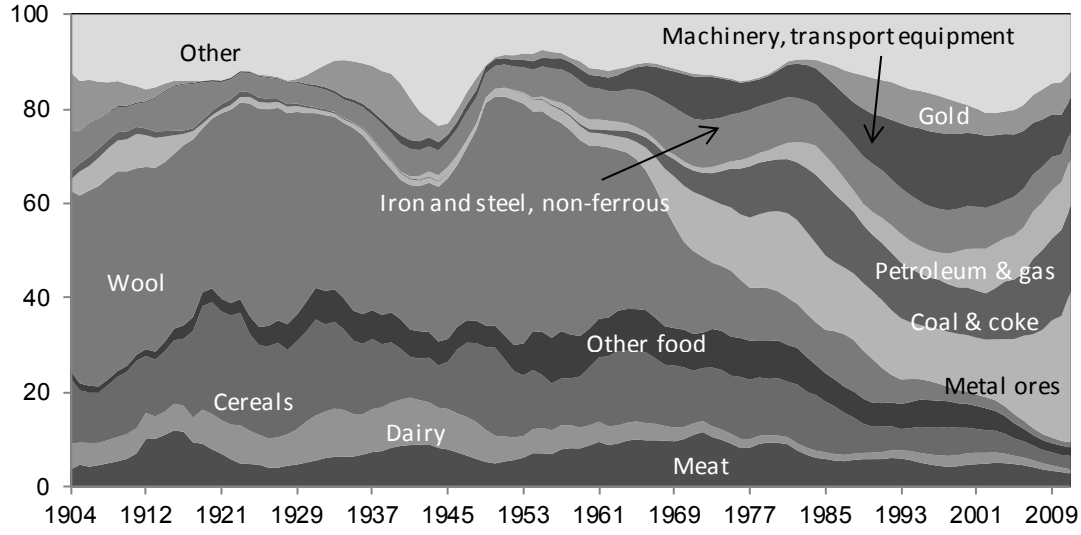


a Non-rural goods excludes monetary gold.

Source: ABS (*International Trade Price Indexes, Australia,* March 2012, Cat. no. 6457.0).

Figure 11.6 **Share of Australian goods exports, 1904 to 2011**

Per cent

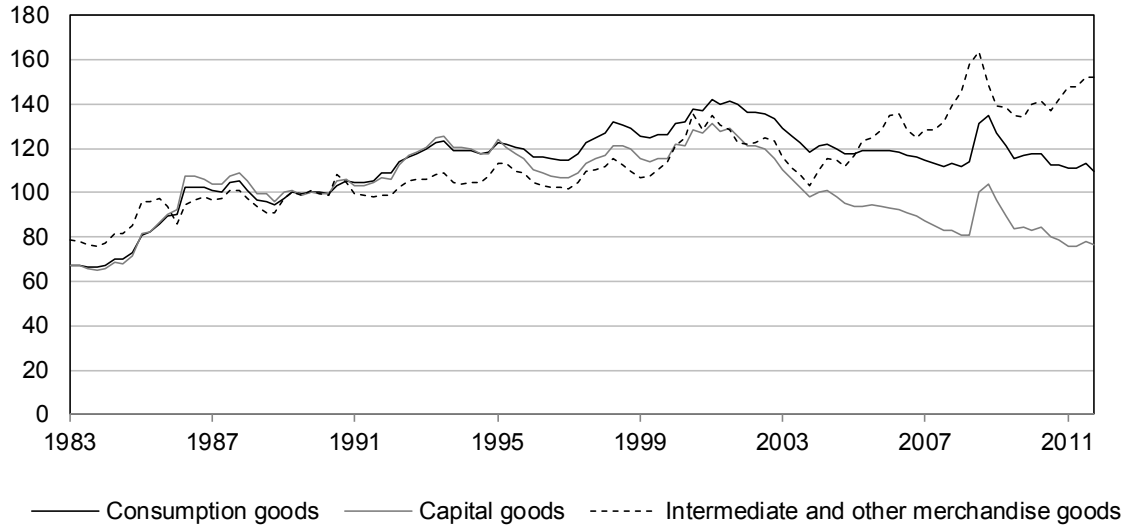


a Data are 5-year moving averages.

Sources: Gillitzer and Kearns (2005); ABS (*International Trade in Goods and Services, Australia,* December 2011, Cat. no. 5368.0).

Figure 11.7 **Prices of Australian imported goods by broad category, September quarter 1983 to March quarter 2012**

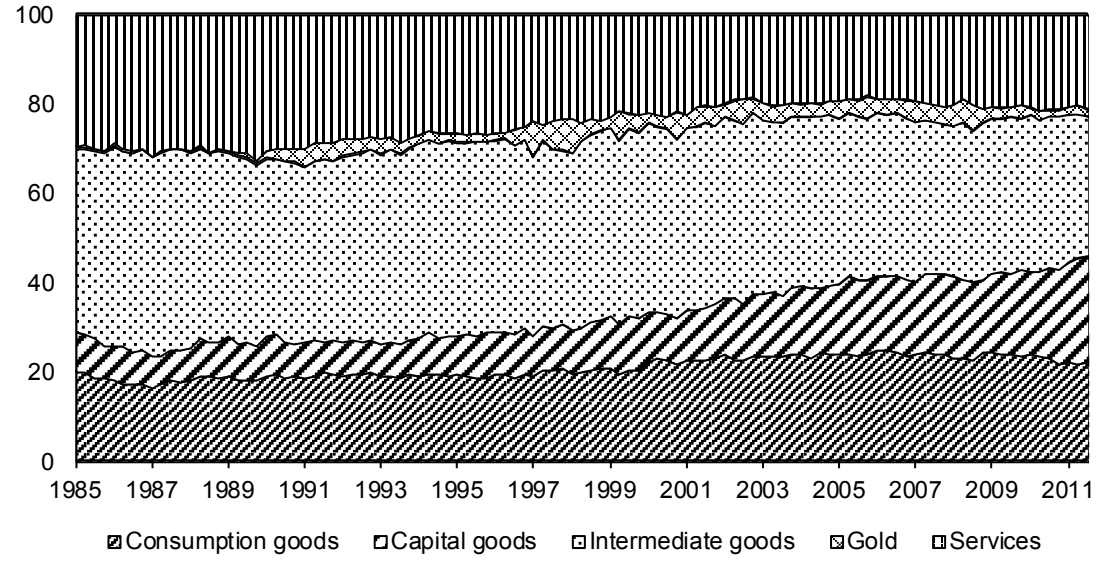
Index (Reference year: 1989-90=100)



Source: ABS (*International Trade Price Indexes, Australia,* March 2012, Cat. no. 6457.0).

Figure 11.8 **Share of Australian goods and services import volumes, September quarter 1985 to March quarter 2012**[a]

Per cent



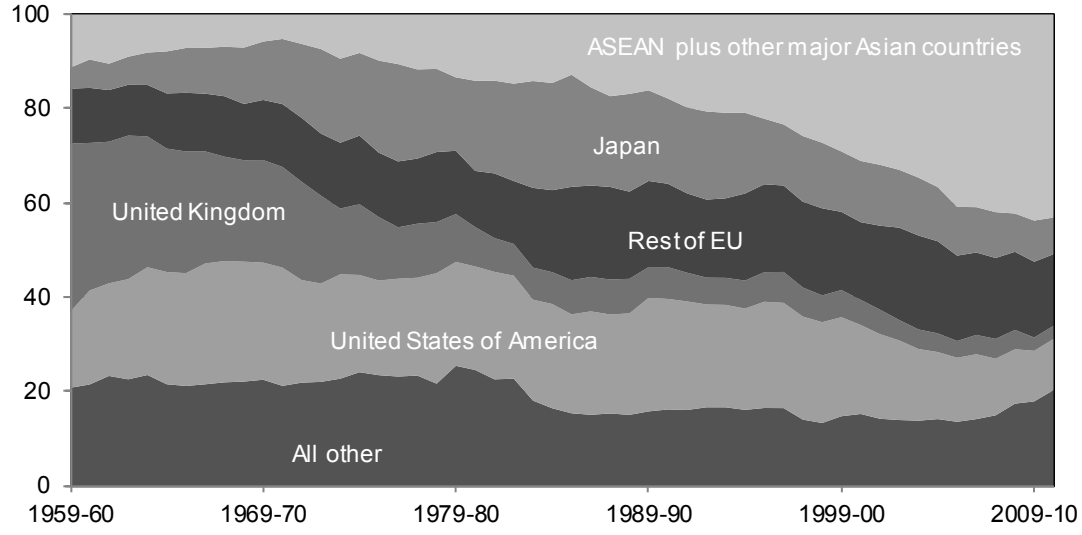
a The reference year for the chain volume series is 2009-10.

Source: Based on RBA (*Balance of Payments — Exports and Imports*, Statistical table H3, 6 June 2012).

Although the broad composition of goods and services imported into Australia, in quantity terms, has been similar since the mid-1980s, there has been a relative decline in the importance of service imports and an increase in the relative contribution of capital goods imports (figure 11.9). Within the categories of imported goods, there have been some changes in the relative importance of individual items, for example, there has been an increase in the quantity of information and communication equipment imported by consumers and firms. However, because of declining prices, the value of information and communication equipment as a proportion of total imports has not changed greatly (Dark and Hawkins 2005).

The destinations from which imports are sourced has changed over time. An increasing share of imports from emerging economies in Asia, particularly China, has occurred (figure 11.9). This shift generally reflects the move to lower cost supplies, dampening, and, in some cases, reducing prices. These factors have contributed to lower real prices of imported goods in recent years.

Figure 11.9 **Share of Australian imports by country, 1959-60 to 2010-11**[a,b]
Per cent



a ABS data used to extend the Reserve Bank of Australia (RBA) data after 1997-98. **b** ASEAN plus other major Asian economies includes: ASEAN, China, Korea, Taiwan and Hong Kong.

Sources: RBA (*Australian Economic Statistics, 1949-50 to 1996-1997*, Table 1.6); ABS (*International Merchandise Imports, Australia*, March 2012, Cat. no. 5439.0).

Volatility driven by fluctuations in individual commodity prices

The volatility experienced in the terms of trade over time has been largely due to changes in export prices for particular commodity groups, such as rural

commodities, which historically have dominated Australia's exports, and more recently mining commodities.

During the latter half of the 20th Century, the diversification of the export base beyond rural commodities contributed to higher export values and reduced terms of trade volatility. By the end of the 20th Century, assisted by the floating of the Australian dollar in December 1983, the terms of trade were thought to be more stable and future price shocks were expected to be shorter and of smaller impact (Gillitzer and Kearns 2005).

However, since 2000, commodity prices have risen sharply. The current resource boom differs from previous booms, such as the 1850s gold rush or the 1980s energy boom, as it has exhibited higher price increases for a considerably longer duration. The current resource boom is being driven by strong global demand for minerals, particularly from China and India (Gruen 2011; Stevens 2011). The resulting price increases have been concentrated in minerals such as iron ore, black coal, crude oil and base metals.

A number of factors have helped sustain the high resource prices in the current boom. These include: continued strong growth in demand from China and India, long lead times for investment projects that affect global supply responses, and the mining of more marginal reserves with higher extraction costs, which increase supply costs for new sites compared to existing sites.

11.4 Some perspectives on the outlook for Australia's terms of trade

The future terms of trade will depend on global supply and demand for Australia's exports and imports, and the relative efficiency with which these products are produced. While Australia has relatively stable import trends and diversified exports, periodic volatility in the prices of commodity exports is likely to continue. Based on past experience, the main source of uncertainty regarding terms of trade projections is likely to come from uncertain surrounding future mineral prices.

The high levels of demand for Australian minerals are unlikely to undergo any considerable abatement as China (box 11.1) and India continue their strong economic development.

Box 11.1 **China's demand for Australian resources**

China is the principal destination for Australia's exports, accounting for almost a quarter of total exports. These exports mainly comprise intermediate inputs.

The level of production in China is influenced by economic activity in the United States, Hong Kong and Japan — China's three principal export destinations (DFAT 2010a). The recent global downturn has reduced economic activity in the North Atlantic economies and Japan, slowing demand for manufactured goods exported from China. This has reduced demand for Australian mineral exports (Roberts and Rush 2010), leading to concerns regarding the sustainability of China's exports and, therefore, demand for Australian exports.

However, China's real economic growth, which averaged 10 per cent annually over the past decade, is driven by both the manufacturing export industry and by domestic infrastructure and housing investment. Since 2000, exports have contributed to about a third of China's economic growth, while about half of its growth has been derived from gross fixed capital accumulation and a fifth from domestic consumption (Roberts and Rush 2010). This suggests that, if China continues on its development path, there are reasons to suggest that strong demand will continue for Australia's commodity exports notwithstanding sluggish growth from other advanced economies.

Sources: Gruen (2011); Stevens (2011); Roberts and Rush (2010).

Despite this expected strong growth in demand, future prices remain hard to predict, as global production will continue to increase, particularly as capacity enhancing investments in mining and the energy sector by suppliers across the globe take effect. For example, investments in major coal exporting countries, such as Indonesia, Colombia and South Africa, are well underway. These and other new investments are likely to increase the global supply of Australia's major export commodities in the short to medium term. Similarly, supplies of iron ore from both Australia and Brazil, the world's two largest producers, are expected to increase alongside global copper production driven in large part by increases in Peru, but also from Australia, the United States, Africa and Chile. Investment in the Australian mining sector as a whole is now twice as high as the average rate for the previous 25 years, with more growth expected in resource sector projects (Stevens 2011). Given the considerable time taken between discovering new deposits, undertaking investment and developing a fully operational mine, these investments will gradually feed through into increased global supply and lower world prices (all other things being equal).

ABARES commodity price forecasts involve a gradual decline in bulk commodity prices over the period to 2016 (2011a, pp. 128–9). Over time, the forecasts assume that the high exchange rate will put competitive pressure on non-commodity exports, with the Australian dollar weakening in the medium- to longer-term (with

the trade weighted index (TWI) expected to moderate to around 70 by 2015-16). This would have a downward effect on the terms of trade, as the cost of imports in Australian dollars increases.

These forecast price declines may be partly offset by continued declines in world manufactured goods prices stemming from strong productivity growth in China's manufacturing industry and global competition (O'Connor and Orsmond 2007).

Overall, there is a broad consensus that the terms of trade is likely to fall. However, uncertainty remains as to how long the current conditions will remain and the level of the terms of trade over the longer term (Stevens 2011). As China is Australia's main source of imports, the Australian dollar price of goods from China will be influential in determining Australia's future terms of trade.

11.5 Projections used in other studies

The terms of trade assumptions employed in other Australian studies have been used to inform the modelling reference case applied to the MMRF model:

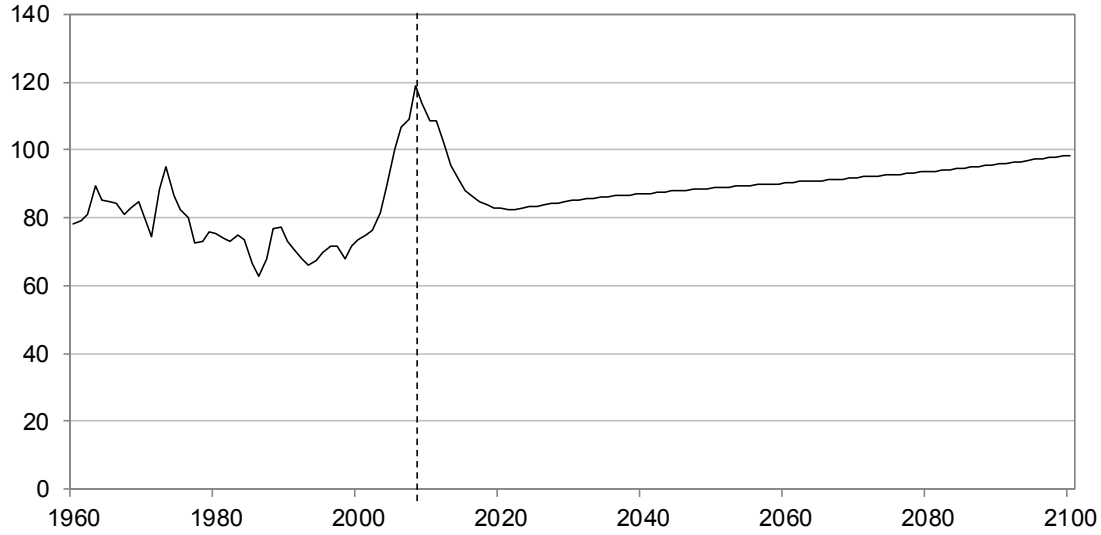
- *Australia's Low Pollution Future* (Australian Government 2008);
- *Intergenerational Report 2010* (Australian Government 2010); and
- *Strong Growth, Low Pollution* (Treasury 2011).

Australia's Low Pollution Future

Australia's Low Pollution Future provided terms of trade projections to 2100 (figure 11.10). Treasury forecasts from the then current federal budget were imposed on the MMRF model, followed by a step-down approach until 2020-21 (the methodology adopted in recent federal budgets). The terms of trade increased by almost 14 per cent in 2010-11, and was projected to decline 0.25 per cent in 2011-12 and 3 per cent in 2012-13.

Figure 11.10 **Terms of trade projections to 2100 in *Australia's Low Pollution Future*[a,b]**

Index (Reference year: 2005=100)



a Index of the ratio of export prices to import prices. **b** Actual data to 2009. Projections to 2100.

Source: Australian Government (2008, p. 240).

Over the decade following 2011-12, the implied assumption was for a downward trend in the terms of trade, as export prices converge to prices that reflect long-term supply and demand for key commodities. From 2020-21, the MMRF model endogenously determined the terms of trade to 2100 based on long-term world demand for the commodities that Australia exports and imports (as determined by the GTEM model).

The projections indicated a gradual rise in real global prices for oil, gas and coal. The price increases incorporated higher marginal costs of extraction due to resource depletion of energy commodity stocks along the lines of International Energy Agency (IEA) projections. More specifically, south eastern gas supplies in Australia were assumed to be depleted over the next 20 years. Liquefied natural gas facilities in Queensland were expected to develop, leading to a convergence with international gas prices by 2029-30.

The Government's modelling also imposed energy supply constraints on the MMRF model based on external sources such as Geoscience Australia. Gas production was assumed to cease in South Australia and Victoria by 2020 and 2030, respectively, and national opportunities for oil production were extinguished by 2030. No constraints were imposed on black or brown coal production, which were estimated to have sufficient proven reserves for 90 and 490 years of production, respectively (Geoscience Australia and ABARE 2010, pp. 131–2).

The terms of trade assumptions adopted in *Australia's Low Pollution Future* were also used in the *Garnaut Climate Change Review* (Garnaut 2008).

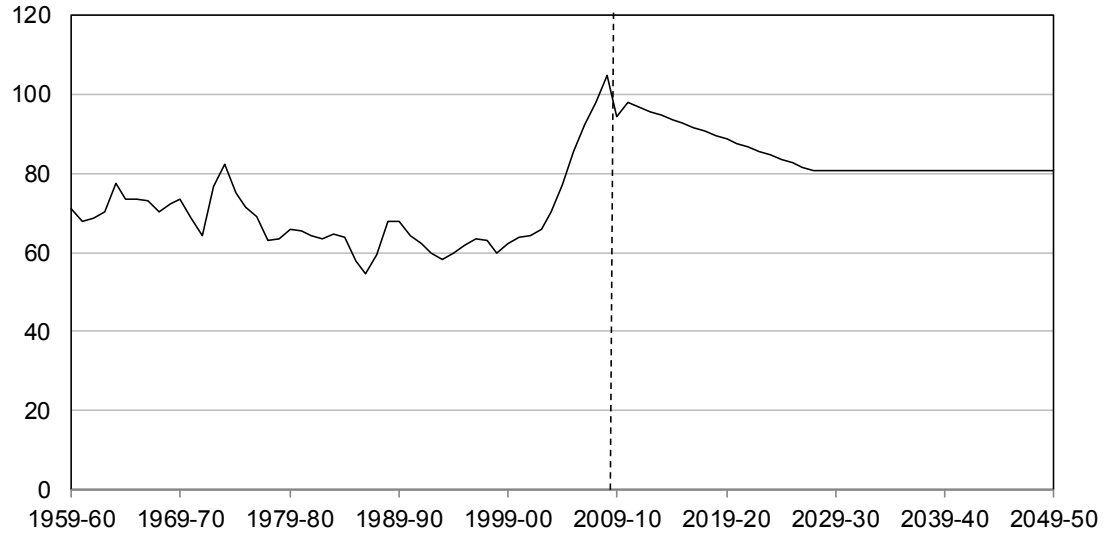
Intergenerational Report 2010

The *Intergenerational Report 2010* assumed that the terms of trade would gradually decline from the then current high level (figure 11.11). It was then expected to stabilise from 2027-28 until the end of the projection period in 2049-50. This is consistent with the Australian Government's projection in the 2009-10 *Mid-Year Economic and Fiscal Outlook* (Australian Government 2009).

This contrasts with the projections in *Australia's Low Pollution Future*, which assumes that, after an initial fall from historically high levels, the terms of trade rises over the longer-term to 2100.

Figure 11.11 **Terms of trade projections to 2050 in *Intergenerational Report 2010*** [a,b]

Index (Reference year: 2007-08=100)



a Index of the ratio of export prices to import prices. **b** Actual data to 2008-09. Projections to 2049-50.

Source: Australian Government (2010, p. 19).

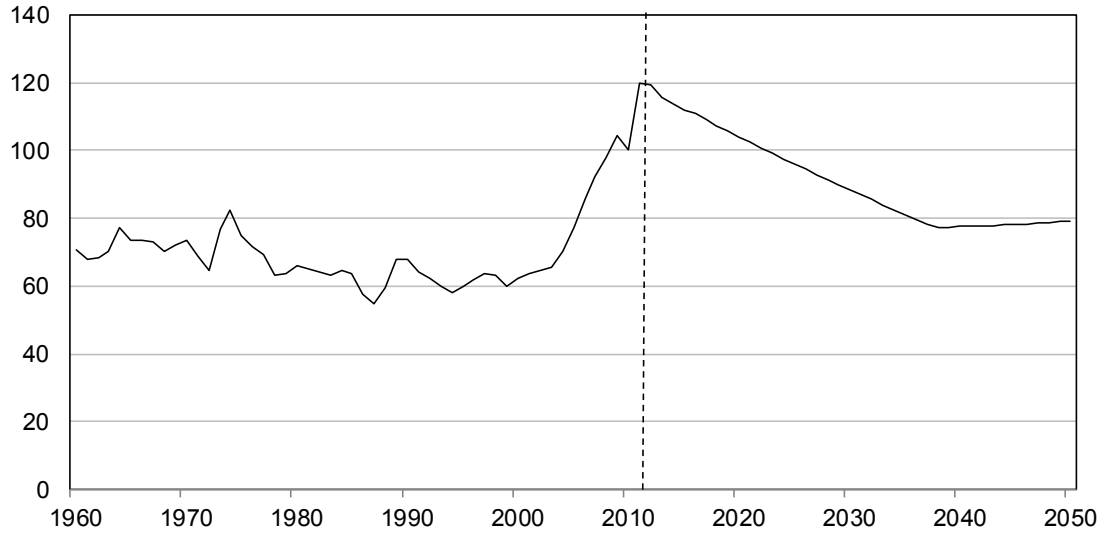
Strong Growth, Low Pollution

Strong Growth, Low Pollution updated *Australia's Low Pollution Future* (Australian Government 2008). The modelling used the same medium-term path for the terms of trade as the then current budget, a projected decline of around 20 per cent over a 15-year period. The terms of trade was then assumed to continue declining until 2037-38. In later years, it grew modestly reflecting the long-term

expectations of world demand and supply for Australia's key exports, as modelled within GTEM (figure 11.12).

Figure 11.12 **Terms of trade projections to 2050 in *Strong Growth, Low Pollution*** [a,b,c]

Index (Reference year: 2010=100)



a Index of the ratio of export prices to import prices. **b** Medium term global action. **c** Actual data to 2011. Projections to 2050.

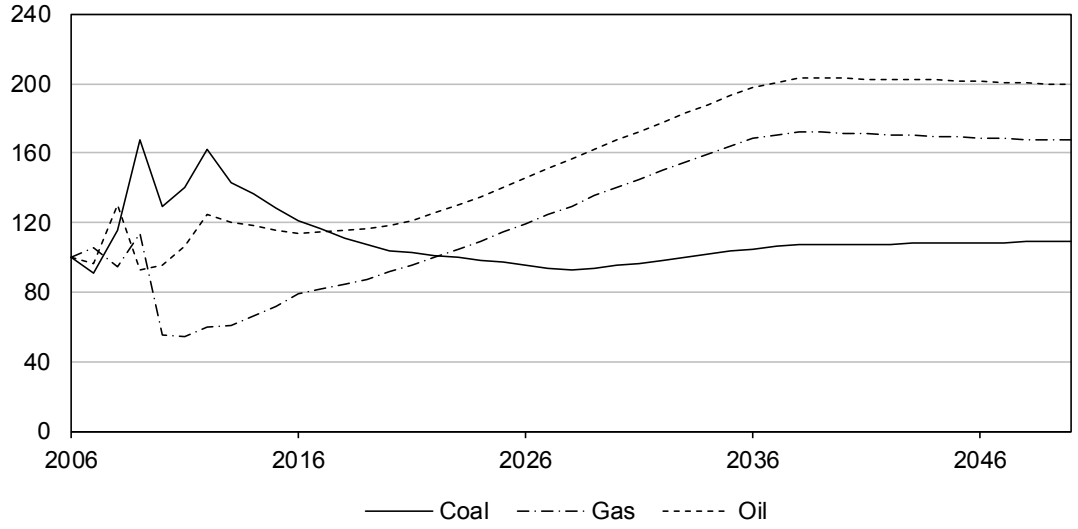
Source: Treasury (2011, p. 166).

The main differences from the earlier study are that the terms of trade was assumed to unwind over a longer timeframe (to 2037-38 rather than to 2020-21) and that the longer-term trend of a gradual increase is less pronounced. The timeframe for the unwinding of the terms of trade is also longer than that used in the *Intergenerational Report 2010*.

The reference case for *Strong Growth, Low Pollution* also includes projections for real oil, gas and coal prices. The oil and gas prices are based on projections from the IEA and rise strongly in real terms to 2035 and remain constant thereafter (figure 11.13). This strong growth reflects the assumptions of rapidly increasing world demand and rising extraction costs from more marginal resources. In comparison, the real coal prices used are based on Treasury projections of a gradual rise to 2028 and constant prices thereafter.

Figure 11.13 **Real coal, gas and oil price projections to 2050 in *Strong Growth, Low* Pollution**[a]

Index (Reference year: 2006=100)



a Projections reflect the medium global action scenario and are based on 2010 Australian dollars.

Source: Treasury (2011, p. 64).

11.6 Towards a modelling reference case

As discussed, international factors will continue to play an important role in shaping the Australian economy and the composition of economic activity.

Assumptions about the external sector are an important part of any modelling reference case, especially in single country models such as MMRF that do not explicitly model changes in international demand, supply and trade. Without these assumptions, domestic considerations alone would determine model projections of the structure of the Australian economy.

The recent strong rise in the Australian terms of trade that commenced around 2000 has made it even more important to take these external assumptions into account, as resulting changes in economic activity are beginning to be reflected in the official economic statistics that are used to construct the MMRF model database. The rise in the terms of trade means that mining industries such as coal and iron ore accounted for a relatively larger share of national activity in 2005-06 than they have done historically. This will affect modelled projections of economic activity.

However, as the discussion in section 11.5 highlights, simplifying assumptions are needed. Further, these assumptions are often arbitrary and will be subject to re-assessments in light of new information.

The reference case assumptions would ideally reflect, at least stylistically, the growth in the terms of trade that has occurred since 2005-06 and its likely future unwinding, both for the economy as a whole and for key products traded internationally (such as wool, wheat, black coal, crude oil, gas, iron ore, gold, meat products, air travel, business services and education services). This involves identifying the speed at which the terms of trade could unwind, the level to which it unwinds, and the relative contribution made by each product traded.

This approach requires the ability to decompose aggregate changes in the terms of trade that are published by the ABS into the contributions made by changes in the price of individual export and import products.

As published, the ABS terms of trade can be decomposed into the price changes for broad product groupings based on the Standard International Trade Classification (SITC) that is used by the ABS in the *Balance of Payments and International Investment Position* (Cat. no. 5302.0). These groupings are, however, too aggregated for use with the ABS *Input-Output Tables* and with the MMRF model. For example, the prices of mining products are reported for: coal, coke and briquettes; other mineral fuels; metalliferous ores and metal scrap; and petroleum, petroleum products and related materials. Most of these SITC groups span more than one MMRF commodity. Furthermore, the SITC classifications also combine many of the mining activities, such as oil extraction and metal ore mining, with their downstream processing (the latter are part of manufacturing in the ABS *Input-Output Tables*, which are used to construct the MMRF database). As a result, it is not possible to identify specific contributions made, for example, by iron ore and gas prices to the change in the terms of trade from available ABS *Balance of Payments* data. Nor is it possible for the Commission to map from the SITC classifications to the Input-Output Product Group classification used by the ABS in the *Input-Output Tables* as the concordance (mapping) is confidential.

Consequently, the Commission cannot satisfactorily decompose changes in the terms of trade published by the ABS into the contributions made by the export and import prices of the commodities specified in the MMRF model.

Given this, the Commission's approach in its modelling of the external sector in the reference case has been guided by the approach used by the Treasury in its MMRF climate change modelling (Australian Government 2008, Treasury 2011).

The Commission's approach involves:

- imposing an aggregate terms of trade shock (applied to the MMRF variable `nattot`);

- applying commodity-specific shocks to key export commodities (covering export prices and, in some instances, export volumes); and
- allowing the model to determine the changes in export prices for a pre-determined set of export commodities (in this case, all of the remaining traditional exports — the set `TOTADJ`[1]) to ensure that the terms of trade change by the required amount (by introducing and endogenising a new export price shift term, `natf4p_tot`, that effectively operates over the set `TOTADJ`).

The Commission has modelled the actual terms of trade to 2010-11 (figure 11.14). This is linearly unwound to reach 2004-05 levels (prior to the terms of trade boom and broadly indicative of the long-term historical average) in 2017-18 and assumed to remain constant at this level to 2049-50. The time period over which the terms of trade are unwound is the same as that used to transition from current industry productivity growth rates to their longer-term average (discussed in chapter 10).

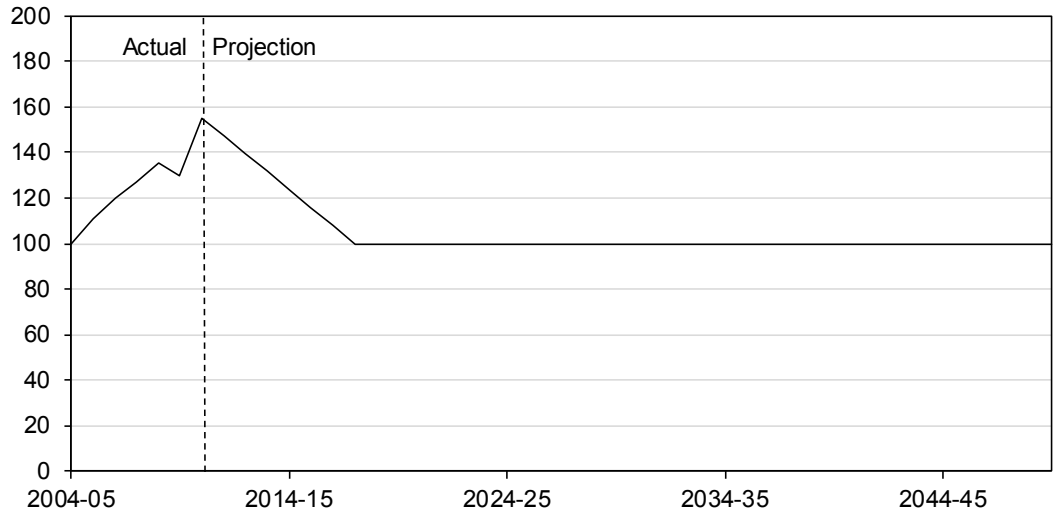
Given marked differences in changes to the world prices of particular commodities in the mining sector and the timing of these changes, the Commission has imposed commodity-specific shocks for key mining and related exports: black coal, crude oil, gas, iron ore, non-iron ore, alumina and aluminium.[2] The basic approach used for these commodities is similar to that used for the aggregate terms of trade shocks to ensure internal consistency: actual data is used to 2010-11, before being unwound to reach 2004-05 price levels in 2017-18 and remaining constant thereafter (figure 11.15). The two exceptions were alumina and aluminium, which had returned to 2004-05 price levels by 2010-11 and did not require any further unwinding. Actual export volumes were also applied for coal, oil, gas and iron ore to 2009-10 (figure 11.16), as export volumes and prices moved differently for particular commodities (especially for coal and iron ore). All of the export price and volume shocks were targeted to key exporting (rather than producing) states. All of the data used were sourced from ABARES *Australian Commodities* or *Australian Commodity Statistics* (2011a).

1 The set of all remaining traditional export commodities consists of: livestock; crops; other agriculture; forestry; fishing; other mining; meat products; dairy products; other food, beverages and tobacco; wood products; petrol; other petroleum and coal products; chemical products; rubber and plastic products; iron and steel; other non-ferrous metals; metal products; motor vehicles and parts; other equipment; other manufacturing; business services; and education.

2 Non-iron ore export price changes are calculated as the weighted-average of the export price changes for: copper, gold, lead, manganese ore, nickel, silver, tin, titanium minerals, uranium oxide, zinc and zircon.

Figure 11.14 **Terms of trade to 2049-50 in the modelling reference case**[a,b,c]

Index (Reference year: 2004-05=100)

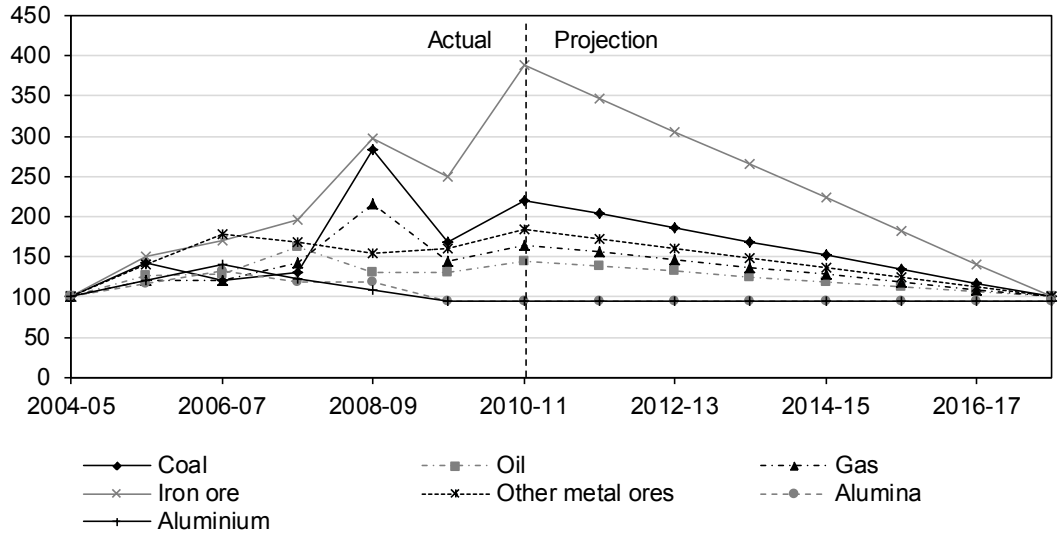


a Index of the ratio of export prices to import prices. **b** Actual data to 2010-11. Projection: 2010-11 to 2049-50. **c** Model shocks expressed as annual percentage changes.

Source: Commission estimates based on Treasury (2011, p. 166).

Figure 11.15 **Commodity prices imposed to 2017-18 in the modelling reference case**[a,b,c]

Index (Reference year: 2004-05=100)

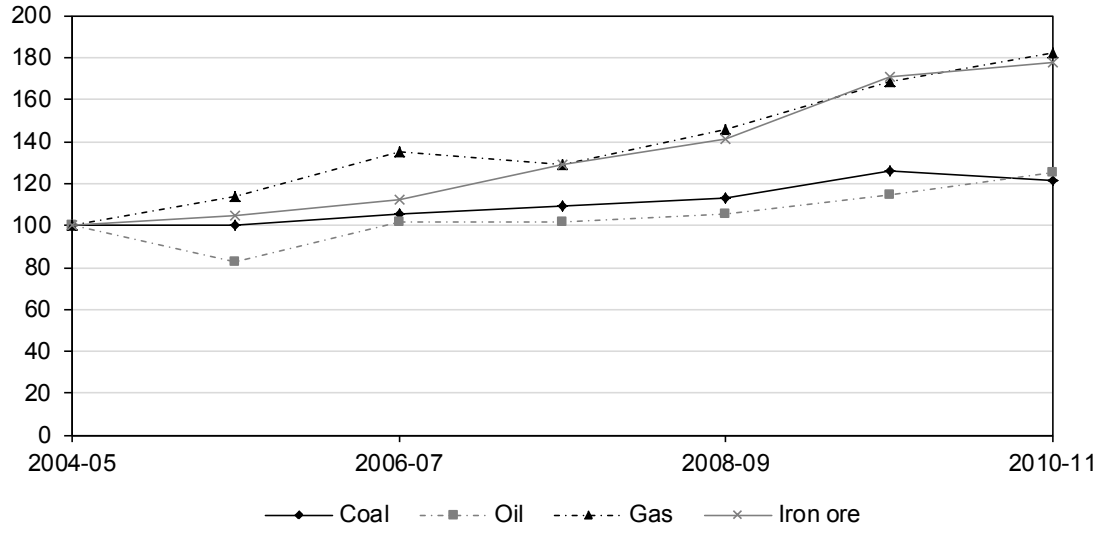


a Actual data to 2010-11. Projection: 2010-11 to 2017-18. **b** Model shocks expressed as annual percentage changes. **c** Alumina and aluminium export price shocks imposed to 2009-10.

Source: Commission estimates based on ABARES (2011a).

Figure 11.16 **Commodity volumes imposed to 2010-11 in the modelling reference case**[a,b]

Index (Reference year: 2004-05=100)



a Actual data to 2010-11. **b** Model shocks expressed as annual percentage changes.

Source: Commission estimates based on ABARES (2011a).

12 Foreign investment and income

It is important in formulating a modelling reference case to recognise the distinction between the level of *production* in Australia (indicated by gross domestic product) and *income* flowing from that production (and from other sources) which accrues to Australians (indicated by net national income). The difference between these two measures reflects the net claim on Australian production falling to non-residents by virtue of foreign investment and other international financial transfers.

This chapter provides an overview of developments in foreign investment and income flows between Australia and the rest of the world. The chapter then outlines the foreign investment component of the modelling reference case. The associated changes in the terms of trade and goods and services trade with the rest of the world are discussed in chapter 11.

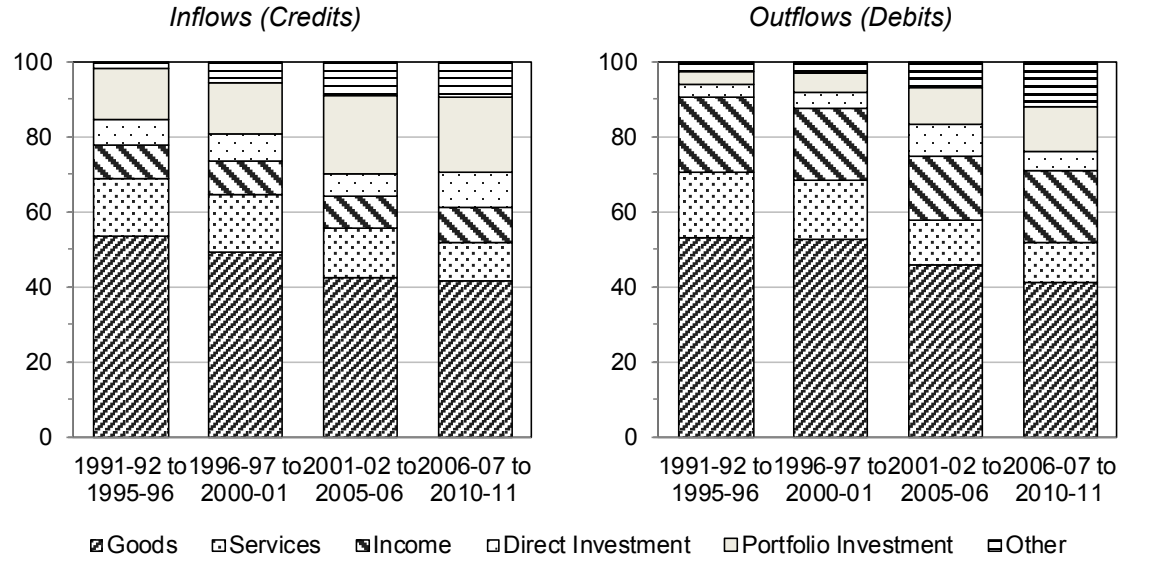
12.1 Australia's foreign investment and income flows in a balance of payments context

The main focus of Australia's balance of payments transactions remains on merchandise imports and exports, which accounted for 41 per cent of balance of payments transactions (both credits and debits) in 2010-11, down from 49 per cent in 1990-91. The share of services trade relating to 'direct services', such as transport, tourism, cross-border supply of business services and the provision of education services, has also declined over this period.

While merchandise trade remains the single largest type of transaction in terms of balance of payments inflows and outflows, international capital flows and direct investment have increased in relative importance, notwithstanding the global financial crisis-driven turnaround in 2008-09 (figure 12.1). Inflows of portfolio investment increased as a share of balance of payments transactions from an average of 13 per cent in the 1990s to 20 per cent in the 2000s and direct investment increased slightly from 6 to 8 per cent over this period. Portfolio investment outflows as a share of balance of payments transactions increased from 3 to 10 per cent, and Australian direct investment abroad increased from 4 per cent to 7 per cent of transactions.

Figure 12.1 **Australia's balance of payments inflows and outflows, 1991-92 to 2010-11**

Per cent



Source: ABS (*Balance of Payments and International Investment Position, Australia*, June 2011, Cat. no. 5302.0).

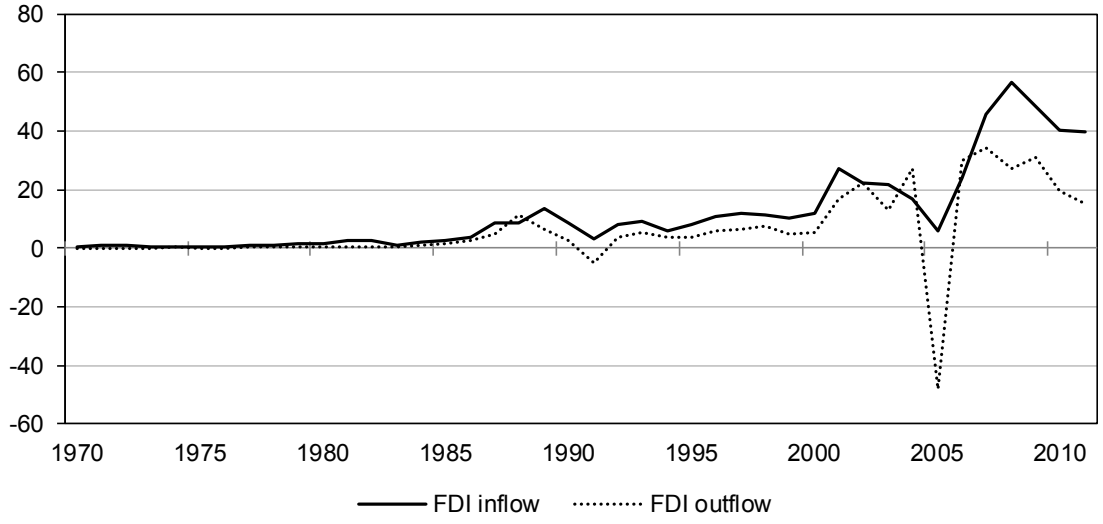
The increases in gross direct investment and portfolio income in balance of payments transactions reflect the increasing globalization of Australia's capital markets, coupled with growth abroad and the commercial incentive for market access. Domestic and international reforms over the past three decades have also contributed to this development. These include major financial deregulation in Australia in the 1980s followed by ongoing pro-competitive financial and other economic reforms. Foreign direct investment (FDI) is one of the more stable forms of capital inflow because it typically involves a substantial commitment from the investor. Portfolio investment, in comparison, can be recalled relatively quickly and comes with no effective management control or necessarily lasting commitment.

Trends in Australia's direct investment

The economic reforms of the 1980s helped create a more open and outward looking environment for Australian businesses. In the decade leading up to these reforms, direct investment inflows were typically some four to five times greater than outflows. Since that time, foreign direct investment outflows have moved more or less in line with inflows. Recently, the growth in foreign investment associated with the mining boom has seen inflows grow ahead of outflows (figure 12.2).

Figure 12.2 **Australia's foreign direct investment inflows and outflows, 1970 to 2011**[a]

$ billion



a The temporary decline in outflows in 2004-05 coincided with the relocation of News Corporation from Australia to the United States.

Source: ABS (*Balance of Payments and International Investment Position, Australia,* September 2011, Cat. no. 5302.0).

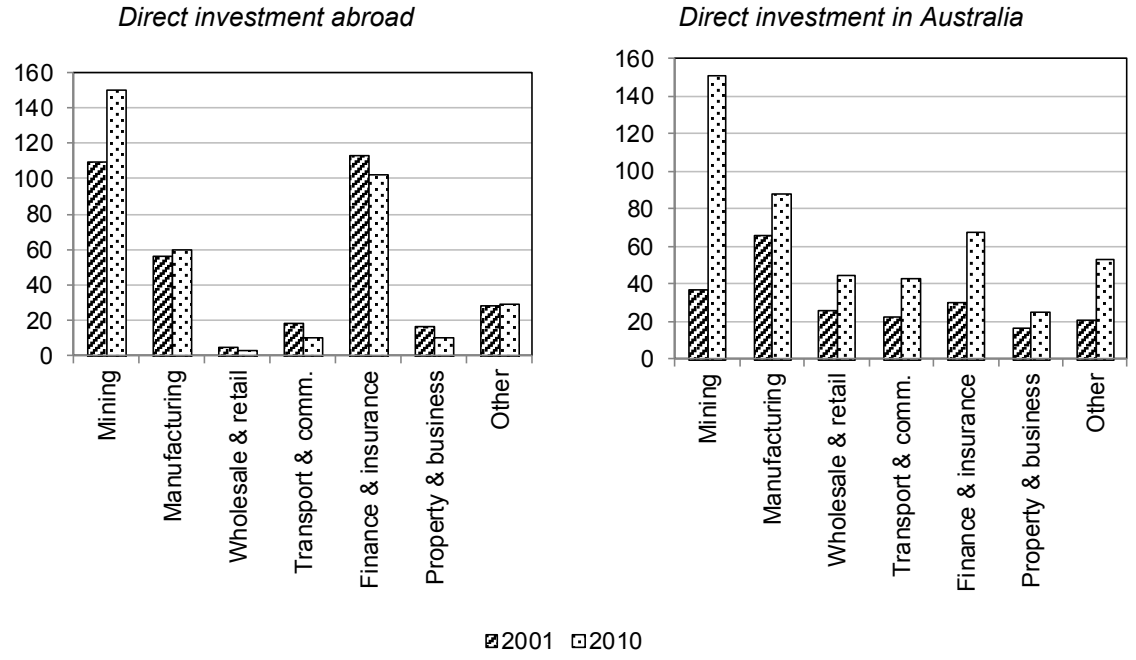
Traditionally, foreign direct investment in Australia has been concentrated in the manufacturing sector (figure 12.3, right hand panel).[1] Since the early 2000s, however, foreign direct investment in other sectors has increased in importance. In particular, the level of inward investment in mining has more than quadrupled and now exceeds that in manufacturing. The level of inward investment in services activities, including wholesale and retail trade and finance, has also increased substantially.

With respect to Australian direct investment abroad, finance and insurance, mining and manufacturing remain the three largest sectors, although mining has also experienced the largest growth (figure 12.3, left hand side panel).

1 The 'stock' of FDI is a measure of all such investment at a point in time. It reflects the accumulated effects of all previous FDI activity and the effects of exchange rate changes and other revaluations on the value of FDI. Stock data abstract from the substantial year to year variation that occurs in annual 'flow' data.

Figure 12.3 **Industry composition of the stock of Australia's foreign direct investment, 2001 and 2010**

$ billion

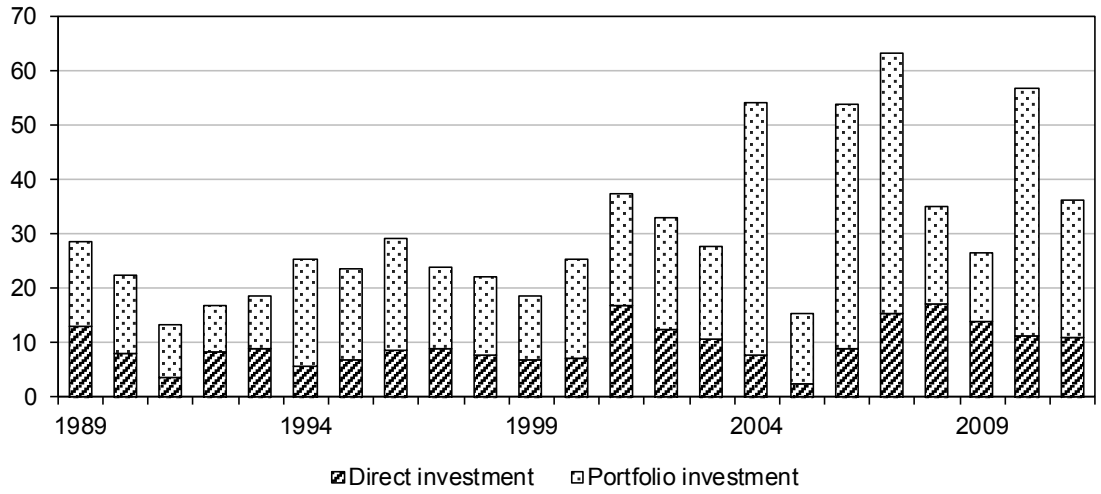


Source: ABS (*International Investment Position, Australia: Supplementary Statistics*, 2010, Cat. no. 5352.0).

Australia's direct and portfolio investment in a national context

Direct and portfolio investment by offshore businesses augments national savings to fund new investment activities. The economy-wide average for the foreign ownership share of industry capital has a historical average of around 20 per cent going back to 1960. This share has increased in recent years, averaging about 30 per cent during the 1990s and 40 per cent during the 2000s. Portfolio investment has been the larger portion of this offshore element (about two-thirds from 1989 to 2011), with the remainder from foreign direct investment (figure 12.4).

Figure 12.4 **Direct and portfolio investment as a share of Australian gross fixed capital formation, 1989 to 2011**
Per cent



Sources: ABS (*Balance of Payments and International Investment Position, Australia*, June 2011, Cat. no. 5302.0); ABS *Australian System of National Accounts*, 2010-11, Cat. no. 5204.0).

12.2 Towards a modelling reference case

Net national income in Australia depends on the *income* from Australian production that flows to Australian residents and foreign-sourced *income* that accrues to Australian residents. The MMRF model determines this flow of *income* by deducting the net claim of non-residents from domestic production (as reflected in the income account balance).[2]

It is, therefore, important in formulating a modelling reference case to take into account the claim of non-residents on Australian production and how these claims might change over time. This requires assumptions about the distribution of income generated in production that accrues to domestic and foreign investors (which depends on assumptions about capital ownership and returns on non-equity (debt) investments). It also requires assumptions about investment income earned overseas and the nature of the securities generating that income (that is, equities or debt).

The approach used in MMRF to modelling foreign investment and income flows is set out in box 12.1.

2 Net national income also takes into account depreciation of the capital stock.

Box 12.1 Modelling of foreign investment and net international income flows in MMRF

The modelling of foreign investment in the Australian economy, Australian investment abroad, and the associated financial flows is highly stylised in MMRF.

To support this stylised modelling of international financial flows and investment income, the model database distinguishes between equity and debt, where:

- equity investment includes direct investment and portfolio investment in shares and other equity instruments; and
- debt investment includes bonds, deposits and other non-equity securities.

Level of foreign investment in Australia

The aggregation of these two components represents the level of net foreign investment in Australia. Changes in foreign investment are modelled by reference to changes in the current account balance — that is, Australia's net borrowing from the rest of the world. In the model, the current account balance is determined by:

- income from exports of goods and services less the outflows associated with importing goods and services (the trade account balance);
- net income from international investment (the income account balance); and
- international transfers such as foreign aid (net current transfers).

The level of foreign investment is denominated in Australian dollars, and does not take into account the effect of price and exchange rate effects. Equity investment is assumed to account for 35 per cent of the current account balance, with changes in debt investment being calculated as the residual. These changes are used to update the level of foreign equity and debt investment in the model database.

Foreign investment income

Changes in net income from foreign investment are modelled as:

- changes in investment income on equity (such as dividends and reinvested earnings) — modelled as the gross flow of after-tax profit remitted overseas, which is determined by applying foreign ownership shares (table 12.1) to non-labour income for each MMRF industry, less any withholding and other taxes paid by non-residents, and
- changes in investment income on debt (such as interest payments) — modelled by applying an exogenous interest rate to the opening stock of net debt.

The important issue for modelling foreign investment and income flows in the modelling reference case is how they will change over the course of the projection period and whether the approach used in MMRF provides a sufficiently suitable approximation for assessing the impacts of COAG reforms.

The available data indicate that foreign investment — both inwards and outwards — has increased over time. At least in terms of the growth in foreign direct investment, which aligns quite closely with what is modelled in MMRF and consists of both equity and debt investment, the movement in inflows and outflows has been broadly similar over the last 40 years, except for the late 2000s, where inflows associated with the mining boom grew at a faster rate than outflows.

Given this relatively stable long-term trend between foreign investment inflows and outflows, the Commission has modelled changes in foreign investment in its modelling reference case using the standard relationships in MMRF.

While MMRF distinguishes between domestic and foreign ownership of capital, it does not distinguish the degree of management influence conferred by that ownership — that is, between direct and portfolio investment.

The relative level of funding of domestic capital through foreign equity investment is determined by these (fixed) ownership shares. Net borrowing (lending) requirements from the rest of the world that are not met through (net) equity investment are assumed to be met through debt (such as bonds, deposits and other non-equity securities).

Table 12.1 **Foreign equity ownership shares by MMRF industry, 2005-06**
Per cent

MMRF industry	*Share*	*MMRF industry*	*Share*
1. Livestock	20	33. Other manufacturing	50
2. Crops	20	34. Electricity generation: coal	20
3. Dairy	20	35. Electricity generation: gas	20
4. Other agriculture	20	36. Electricity generation: oil	20
5. Forestry	20	37. Electricity generation: hydro	20
6. Fishing	20	38. Electricity generation: other	20
7. Coal mining	40	39. Electricity supply	20
8. Oil mining	50	40. Gas supply	20
9. Gas mining	30	41. Water & sewerage services	20
10. Iron ore mining	20	42. Residential construction	20
11. Other metal ore mining	20	43. Non-residential construction	20
12. Other mining	20	44. Wholesale trade	20
13. Meat products	20	45. Retail trade	20
14. Dairy products	20	46. Mechanical repairs	20
15. Other food, beverages & tobacco	20	47. Hotels, cafes & accommodation	20
16. Textiles, clothing & footwear	20	48. Road freight transport	20
17. Wood products	20	49. Road passenger transport	20
18. Paper products	20	50. Rail freight transport	20
19. Printing	20	51. Rail passenger transport	20
20. Petrol	20	52. Pipeline transport	20
21. Other petroleum & coal products	40	53. Water transport	20
22. Chemical products	30	54. Air transport	20
23. Rubber & plastic products	20	55. Services to transport	20
24. Other non-metal mineral products	20	56. Communication services	20
25. Cement & lime	20	57. Financial services	10
26. Iron & steel	40	58. Ownership of dwellings	0
27. Alumina	60	59. Business services	10
28. Aluminium	60	60. Government administration & defence	0
29. Other non-ferrous metals	20	61. Education	0
30. Metal products	30	62. Health	0
31. Motor vehicles & parts	50	63. Community services	0
32. Other equipment	20	64. Other services	20

Shares are constant across States.

Source: MMRF database.

13 Patterns of household expenditure

This chapter outlines factors that influence the patterns of household final consumption expenditures. It then sets out some past trends in Australian household consumption and reports approaches to projecting household demand adopted in recent studies. Drawing on past trends and recent approaches, the chapter concludes with a scenario for the modelling reference case.

13.1 Factors influencing patterns of household expenditure

Expenditure patterns of households can change over time for several reasons. These include changes in: disposable income; wealth; relative prices; age; health status; and consumer preferences (tastes). Patterns of household expenditure can also be influenced by changes in the provision of government services and government social security and other income and tax transfers, and the conditions under which they are provided (such as in the areas of education and health).

Because household final consumption expenditure accounts for over half of gross national spending, household expenditure decisions can have important flow-on effects on the distribution of economic activity between industries and regions, indirectly influencing the aggregate level of economic activity.

In an economy-wide model such as MMRF, the level and composition of household consumption spending through time would be determined by future levels of income, relative prices and the economic behavioural assumptions contained in the model. However, potential changes that may occur because of other factors such as changes in demography, taste (including between domestic and imported supplies), or institutional arrangements would need to be determined outside the model and applied exogenously.

Assessing the likely prevalence and scale of such changes is important for developing a reference case, particularly if projection periods are relatively long or the scale of such changes are large.

13.2 Historical perspective

This section provides a historical perspective of changes in the composition of household expenditure. It illustrates changes in household expenditure shares over time and highlights some differences in expenditure shares across different household types.

Change in household expenditure shares

There has been some change in the composition of household expenditure (in current prices) over time (table 13.1). Drawing on the ABS *Australian National Accounts*, there have been decreases in the shares of expenditure accounted for by food, clothing & footwear, and furnishing & household equipment. Conversely, the shares of expenditure accounted for by housing, health, communication and education services have increased. Some categories, such as transport and electricity, have remained relatively stable as a share of expenditure.

Table 13.1 **Household final consumption expenditure shares in the *National Accounts*, current prices, 1959-60 to 2009-10**[a]

Per cent

Expenditure group	*1959-60*	*1969-70*	*1979-80*	*1989-90*	*1999-00*	*2009-10*
Food	18.0	14.9	13.4	11.5	10.3	10.4
Alcoholic beverages & tobacco	6.3	5.3	4.4	3.6	3.8	3.5
Clothing & footwear	10.2	8.1	6.5	5.4	3.9	3.5
Rent & other dwelling services	8.8	12.1	16.2	18.3	17.9	19.8
Electricity, gas & other fuel	2.3	2.1	1.8	2.0	1.8	2.1
Furnishings & household equipment	9.3	8.0	7.7	7.0	5.7	4.8
Health	3.8	4.5	5.1	4.4	4.9	5.8
Transport	11.5	13.0	12.8	12.4	12.0	10.4
Communication	0.6	0.8	1.2	1.3	2.3	2.6
Recreation & culture	9.1	8.9	9.5	10.2	11.7	10.8
Education services	1.0	1.4	1.4	2.4	3.1	4.0
Hotels, cafes & restaurants	9.5	8.8	7.9	6.8	7.4	6.9
Miscellaneous goods & services	9.7	12.2	12.1	14.7	15.1	15.4

a Categories are not the same as those in the ABS *Household Expenditure Surveys*.

Source: ABS (*Australian System of National Accounts*, 2010-11, Cat. no. 5204.0).

An alternative way to look at the change in household expenditure shares over time is to use chain volume measures rather than current price values. Chain volume measures remove the effect of price changes and provide an indication of changes in consumption volumes (real terms). For instance, food has decreased as a share of consumption in both nominal and real terms, whereas the share accounted for by housing has remained relatively stable in real terms, despite its nominal share increasing with house prices (table 13.2). Another deviation between the two sets of figures is for alcoholic beverages & tobacco, which has remained relatively constant as a share of nominal expenditure over the last two decades, but has almost halved in volume terms.

Table 13.2 **Household final consumption expenditure shares in the *National Accounts*, chain volume terms, 1989-90 to 2009-10**[a]

Per cent

Expenditure group	*1989-90*	*1999-00*	*2009-10*
Food	12.4	10.8	10.4
Alcoholic beverages & tobacco	6.4	4.6	3.5
Clothing & footwear	3.6	3.0	3.5
Rent & other dwelling services	20.8	20.7	19.8
Electricity, gas & other fuel	2.5	2.4	2.1
Furnishings & household equipment	5.0	4.5	4.8
Health	5.5	4.7	5.8
Transport	10.1	11.0	10.4
Communication	0.9	2.0	2.6
Recreation & culture	7.6	9.5	10.8
Education services	4.4	4.0	4.0
Hotels, cafes & restaurants	7.9	7.9	6.9
Miscellaneous goods & services	15.3	15.4	15.4

a Categories are not the same as those in the ABS Household Expenditure Surveys.

Source: ABS (*Australian System of National Accounts*, 2010-11, Cat. no. 5204.0).

Another source of data on changes in household expenditure over time is the ABS *Household Expenditure Survey* (table 13.3). The *Household Expenditure Survey* also allows disaggregation of expenditure patterns by household characteristics. While the categories are not directly reconcilable with those from the National Accounts, they paint a similar picture of trends. Over the period from 1984 to 2009-10:

- the share of expenditure on food & beverages has decreased, although the category remains the second largest share of household expenditure in 2009-10, as reported in the survey;

- clothing & footwear and household furnishings & equipment have also declined substantially in terms of their shares of expenditure, as have alcoholic beverages & tobacco; and
- expenditure on housing and medical and health expenses have increased.

Some categories, such as domestic fuel and power and transport, have remained relatively constant as a share of household expenditure.

Table 13.3 **Household expenditure shares in the *Household Expenditure Survey*, 1984 to 2009-10**[a]
Per cent

Broad expenditure group	*1984*	*1988–89*	*1993–94*	*1998–99*	*2003–04*	*2009–10*
Current housing costs	12.8	14.3	14.2	13.9	16.1	18.0
Domestic fuel & power	2.9	2.6	2.8	2.6	2.6	2.6
Food & non–alcoholic beverages	19.7	19.1	18.4	18.2	17.1	16.5
Alcoholic beverages	3.4	3.4	2.9	2.9	2.6	2.6
Tobacco products	1.6	1.4	1.5	1.5	1.3	1.0
Clothing & footwear	6.5	6.1	5.6	4.6	4.0	3.6
Household furnishings & equipment	7.7	7.4	6.6	6.0	5.8	4.7
Household services & operation	4.3	4.8	5.2	5.9	6.1	5.5
Medical care & health expenses	3.9	4.3	4.5	4.6	5.1	5.3
Transport	16.3	15.1	15.5	16.9	15.6	15.6
Recreation	11.9	11.8	13.2	12.7	12.8	13.1
Personal care	1.8	2.0	1.9	2.0	1.9	1.9
Miscellaneous goods & services	7.2	7.8	7.6	8.2	8.9	9.4

[a] The expenditure categories reported are not the same as those from the National Accounts.

Source: ABS (*Household Expenditure Survey, Australia: Summary of Results*, 2009-10, Cat. no. 6530.0).

Observed differences in expenditure between household types

In addition to trends in the composition of household expenditure over time, analysing expenditure differences on the basis of household characteristics — in this case, age, income and state of residence — may provide further insights about possible future directions in household expenditure. For instance, an ageing population is likely to result in increased consumption of those goods and services favoured by older age groups.

Age

Expenditure shares reported for some categories varied considerably across age groups in 2009-10 (table 13.4). The most notable variation is in the cost of housing, which decreases markedly as a share of expenditure as age increases. Conversely,

medical care and health expenses are reported as increasing with age. There is some increase in the share accounted for by food across older age groups.

Table 13.4 **Household expenditure shares by age group in the *Household Expenditure Survey*, 2009-10**

Per cent

Broad expenditure group	*15–24*	*25–34*	*35–44*	*45–54*	*55–64*	*65 and over*
Current housing costs	23.4	25.5	21.3	15.1	13.3	11.7
Domestic fuel & power	1.9	2.2	2.6	2.6	2.8	3.5
Food & non–alcoholic beverages	14.7	14.9	15.9	17.2	16.8	18.7
Alcoholic beverages	4.2	2.7	2.3	2.9	2.6	2.2
Tobacco products	1.2	0.8	1.0	1.1	1.1	0.9
Clothing & footwear	4.2	3.6	3.6	3.8	3.7	3.0
Household furnishings & equipment	3.7	4.0	4.8	4.8	5.8	4.4
Household services & operation	5.0	5.0	6.1	4.8	5.5	6.6
Medical care & health expenses	2.1	3.9	4.3	4.9	6.5	9.5
Transport	15.2	15.9	14.2	17.0	17.5	12.7
Recreation	13.2	11.8	12.2	13.0	14.2	15.0
Personal care	1.9	1.7	1.8	2.1	2.0	2.1
Miscellaneous goods & services	9.0	8.0	10.0	10.7	8.3	9.7
Mean gross weekly household income	*$1 476*	*$1 855*	*$2 001*	*$2 150*	*$1 685*	*$838*

Source: ABS (*Household Expenditure Survey, Australia: Summary of Results*, 2009-10, Cat. no. 6530.0).

Income

The shares of expenditure accounted for by most categories of household expenditure decrease as household incomes rise (table 13.5). The largest falls are in categories such as housing costs, food, power and household services. The largest reported increases in relative shares as incomes increase occur in categories such as clothing and footwear, recreation, transport and miscellaneous goods and services. Medical and health expenses as a proportion of total household expenditures do not change substantially with income.

Table 13.5 **Household expenditure shares by gross income quintile in the *Household Expenditure Survey*, 2009-10**

Per cent

Broad expenditure group	*Lowest*	*Second*	*Third*	*Fourth*	*Highest*
Current housing costs	20.8	19.4	19.6	18.7	15.6
Domestic fuel & power	4.0	3.4	2.7	2.5	2.0
Food & non–alcoholic beverages	18.3	18.3	16.8	16.6	15.2
Alcoholic beverages	1.9	2.4	2.7	2.7	2.8
Tobacco products	1.4	1.5	1.3	1.1	0.5
Clothing & footwear	2.7	3.2	3.3	3.4	4.2
Household furnishings & equipment	4.9	4.9	4.2	4.6	5.1
Household services & operation	6.6	6.1	5.3	5.3	5.2
Medical care & health expenses	6.9	4.8	5.8	5.0	5.0
Transport	12.3	14.0	14.6	15.3	17.8
Recreation	12.0	12.4	12.5	13.7	13.4
Personal care	1.9	1.9	1.8	2.0	2.0
Miscellaneous goods & services	6.2	7.7	9.4	9.2	11.1

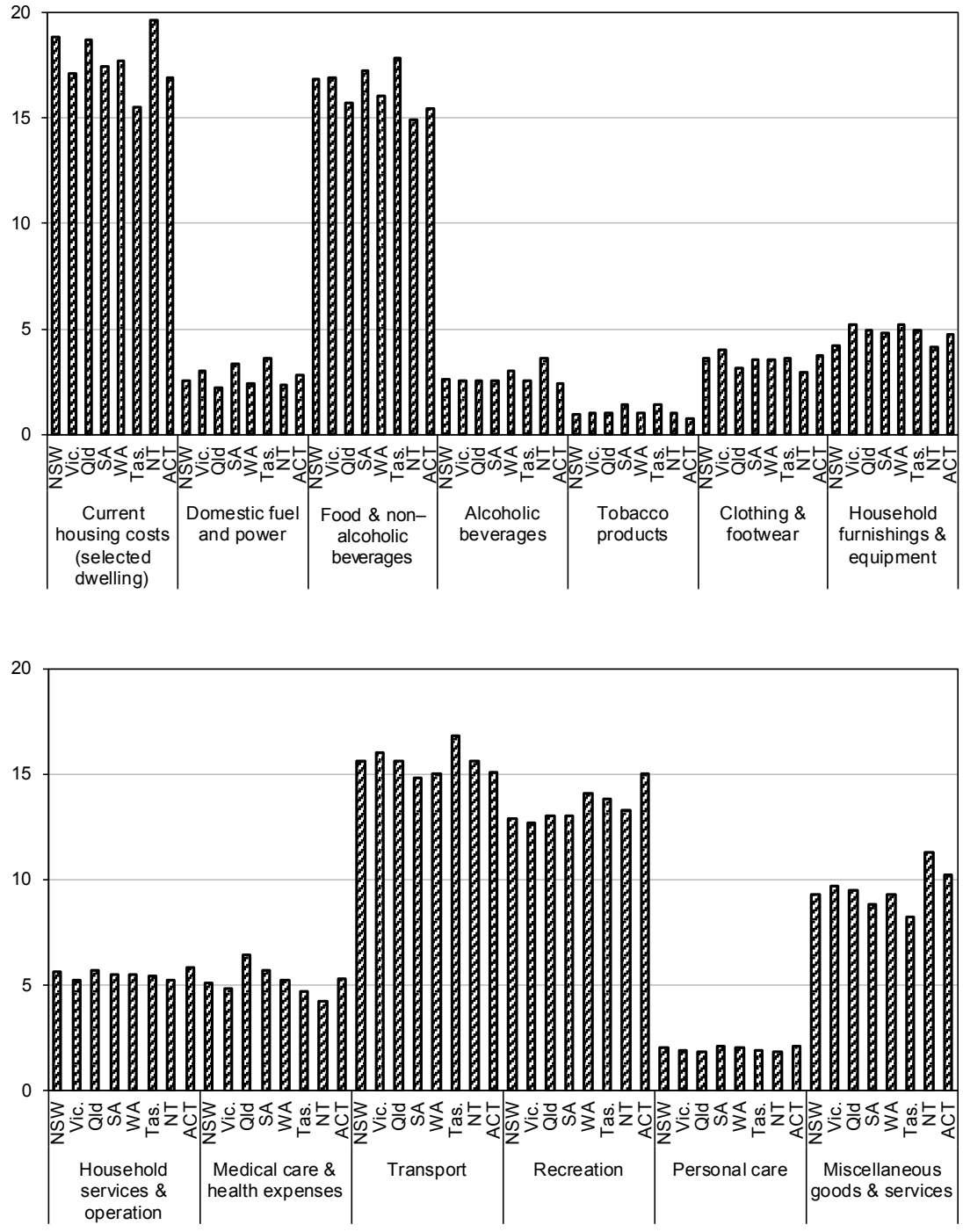
Source: ABS (*Household Expenditure Survey, Australia: Summary of Results*, 2009-10, Cat. no. 6530.0).

State of residence

There do not appear to be large differences in household expenditure shares across states (figure 13.1). Some notable differences include relatively less spending on housing in Tasmania, but a higher share of expenditure on housing costs in the Northern Territory. Conversely, the share of household expenditure on food is highest in Tasmania and lowest in the Northern Territory.

Figure 13.1 **Household expenditure shares by state of residence in the *Household Expenditure Survey*, 2009-10**

Per cent



Source: ABS (*Household Expenditure Survey, Australia: Summary of Results*, 2009-10, Cat. no. 6530.0).

13.3 Projections used in other studies

It can be difficult to decompose changes in household consumption into those arising solely from changes in taste and preference (taste effects) from those attributable to other factors such as changes in household income, wealth, relative prices, age and health status.

Nevertheless, taste changes may be included in a reference case to proxy all of the other determinants of household consumption that are not explained by the other components of the reference case and the subsequent behavioural responses incorporated in the model.

Some recent studies incorporate changes in household tastes into their projections.

Strong Growth, Low Pollution (Treasury 2011) included a range of household taste shocks in its modelling reference case (table 13.6). In general, these shocks represent a continuation of the trend away from the consumption of basic commodities, such as food, towards services, with the largest increase being in the consumption of communication services. These shocks are reduced to zero between 2020 and 2050. However, it is difficult to reconcile the derivation of these shocks with the changes reported in the ABS *National Accounts* and *Household Expenditure Survey* (tables 13.1 and 13.3) owing to differences in the commodity classifications used.[1]

The *Intergenerational Report 2010* (Australian Government 2010) is another recent source of projections. Of particular note is the projected increase in government spending on health, which is projected to increase from 4 per cent of government expenditure in 2009-10 to 7.1 per cent in 2049-50. The increase in spending is driven by a combination of an ageing population and an assumed increase in demand for health services. While this projection deals with government spending, it is possible that similar trends could be expected in terms of household expenditure on health services.

1 The commodity classification used by the Treasury in its MMRF modelling is an aggregation of that used by the ABS in its *Input-Output Tables* (from which the model database is derived) supplemented with some climate change-related commodities, such as biofuels.

Table 13.6 **Average annual growth in household tastes to 2050 in *Strong Growth, Low Pollution***

Per cent per year

MMRF commodity	*2010 to 2020*	*2020 to 2030*	*2030 to 2040*	*2040 to 2050*
Biofuels	1.0	0.8	0.5	0.2
Forestry	-1.5	-1.2	-0.8	-0.3
Coal mining	-0.6	-0.5	-0.3	-0.1
Paper products	-1.0	-0.8	-0.5	-0.2
Printing	-1.0	-0.8	-0.5	-0.2
Chemicals	0.8	0.7	0.4	0.1
Water supply	-0.5	-0.4	-0.3	-0.1
Trade	0.5	0.4	0.2	0.1
Accommodation & hotels	0.5	0.4	0.2	0.1
Air transport	1.5	1.2	0.8	0.3
Communication services	3.0	2.5	1.5	0.5
Financial services	0.5	0.4	0.2	0.1
Business services	1.0	0.8	0.5	0.2
Public services	2.3	1.9	1.1	0.4
Other services	1.0	0.8	0.5	0.2
Private transport	-0.2	0.0	0.0	0.0
Private electricity	0.5	0.4	0.2	0.1

Source: Treasury (2011, p. 172).

13.4 Towards a modelling reference case

Given the available information about changes in the composition of household expenditure over time and the difficulty in decomposing the source of those changes, the modelling reference case used for the final report does not include a comprehensive range of household taste change shocks. Nevertheless, under the parameterisation of the MMRF model, outlays on services would be projected to increase as incomes rise over time.

Further, adjustments have been made in the modelling reference case with respect to health expenditure. As recognised in the *Intergenerational Report* 2010, expenditure on health care and health-related services is expected to increase as the population progressively ages. However, the scale of any increases in health-service output, the balance between public and private outlays, and the means of funding those outlays is uncertain at this stage. Therefore, for the modelling reference case, the future increase in health expenditure is modelled through an increase in government expenditure. Details of the modelling are provided in chapter 14.

14 Government finances

Government expenditures — which are concentrated on government administration, defence and the provision of services such as transport, education, health, defence and social assistance — account for over a third of GDP. Accordingly, government taxation and expenditure activities can substantially affect the level and distribution of activity in the Australian economy. Assumptions about the broad direction of revenue and expenditure decisions of governments over time are therefore an important consideration in developing a reference case.

This chapter sets out some past trends in government revenue raising and expenditures and outlines the assumptions about longer-term trends in the relationship between government revenues, expenditures and balances. Because of the longer-term focus of the study, the modelling reference case abstracts from adjustments in fiscal parameters that might be associated with addressing short to medium-term issues and macro-economic management of the business cycle and associated matters.

14.1 Historical perspective

Government revenue

Governments in Australia raise revenues primarily through the taxation of incomes and economic activity, with the Australian Government holding the majority of the government revenue raising responsibilities.[1]

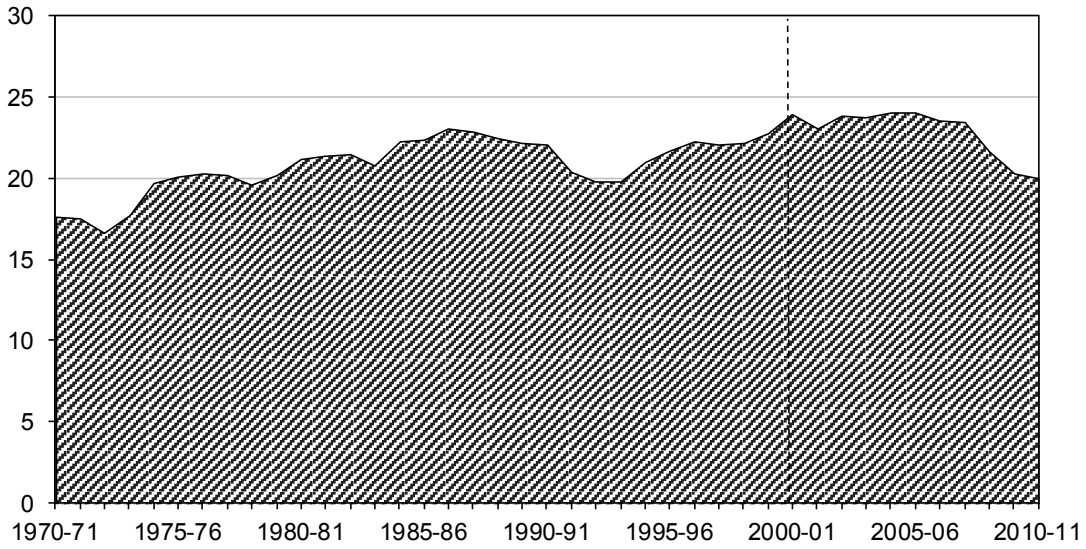
The tax take of the Australian Government has varied from 17 per cent in the 1970s to 24 per cent of GDP now (figure 14.1). Since the introduction of the GST in 1999-00 (vertical line in figure 14.1), the total tax take of the Australian

[1] However, the Australian Government's expenditure responsibilities are much lower as the State and Territory governments (and local governments incorporated in each state) account for around half the expenditure responsibilities. This creates a vertical fiscal imbalance between the two levels of government. For instance, the Australian Government accounted for approximately 68 per cent of total government revenues raised in 2009-10, but only around 51 per cent of total expenditure.

Government has been relatively high by historical standards, although it has tapered off with the recent downturn in economic activity.

Figure 14.1 **Australian Government tax take as a share of GDP, 1970-71 to 2010-11**[a]

Per cent



a The vertical line denotes the introduction of the GST in July 2000.

Source: Australian Government (2011, p. 363).

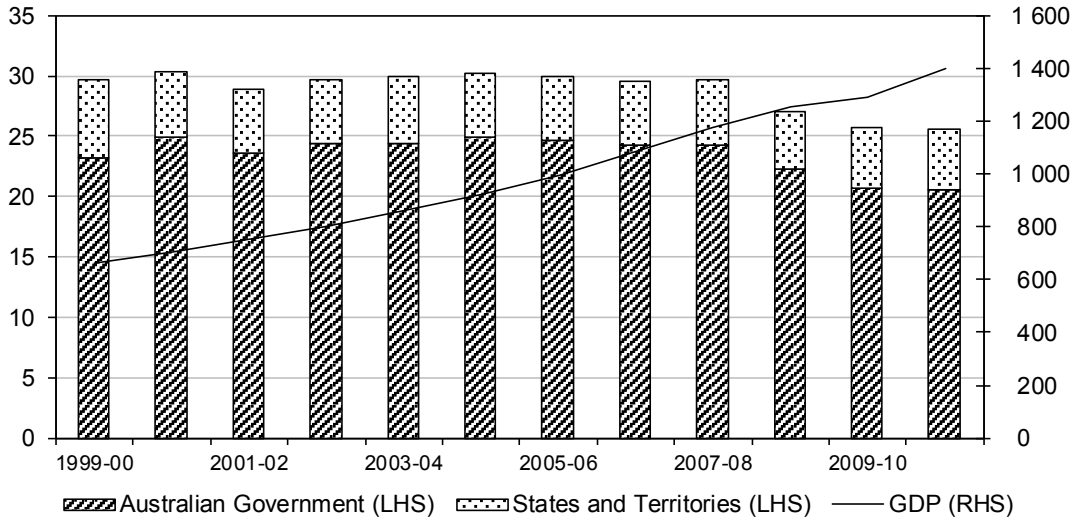
Since the introduction of the GST in 1999-00, the total Australian, State and Territory (including local) government tax take (as a share of GDP) has been relatively stable at close to 29 per cent of GDP over the period, although it has decreased since 2007-08 (figure 14.2).

Income taxes (personal and company) account for the greatest share of revenue — averaging 58 per cent of the total tax take since 1999-00. Other trends in Australia's taxation revenues include:

- GST revenue has accounted for, on average, 13 per cent of the total tax take since the GST was introduced;
- other indirect taxes have accounted for, on average, 13 per cent; and
- State and Territory governments' tax revenues are dominated by payroll tax, property taxes and stamp duties.

Figure 14.2 **Australian, State and Territory government tax take, 1999-00 to 2010-11**

Per cent of GDP (LHS), $ billion (RHS)



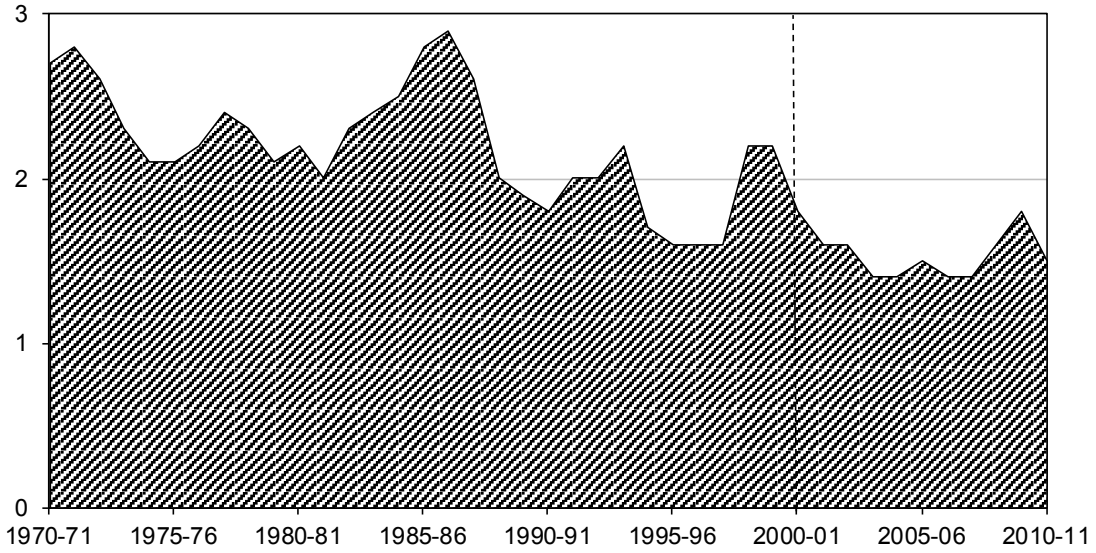
Sources: ABS (*Taxation Revenue, Australia*, 2008-09, 2010-11, Cat. no. 5506.0); ABS (*Australian System of National Accounts*, 2010-11, Cat. no. 5204.0).

Tax collection is not the only source of government funds. Governments also collect revenue from receipts from the sale of goods and services, interest, dividends, royalties and seigniorage from circulating note and coin production. For the Australian Government, non-taxation receipts have averaged 1.5 per cent of GDP since 2000-01 (figure 14.3). Across all levels of government, non-taxation receipts have accounted for close to 18 per cent of all government revenue since 1999-00.

In total, government revenue (tax and non-tax) since 1999-00 has averaged 35 per cent of GDP (ABS *Government Finance Statistics, Australia*, 2008-09, 2010-11, Cat. no. 5512.0; *Australian System of National Accounts*, 2010-11, Cat. no. 5204.0).

Figure 14.3 **Australian Government non-tax revenue as a share of GDP, 1970-71 to 2010-11**[a]

Per cent



a The vertical line denotes the introduction of the GST in July 2000.

Source: Australian Government (2011, p. 363).

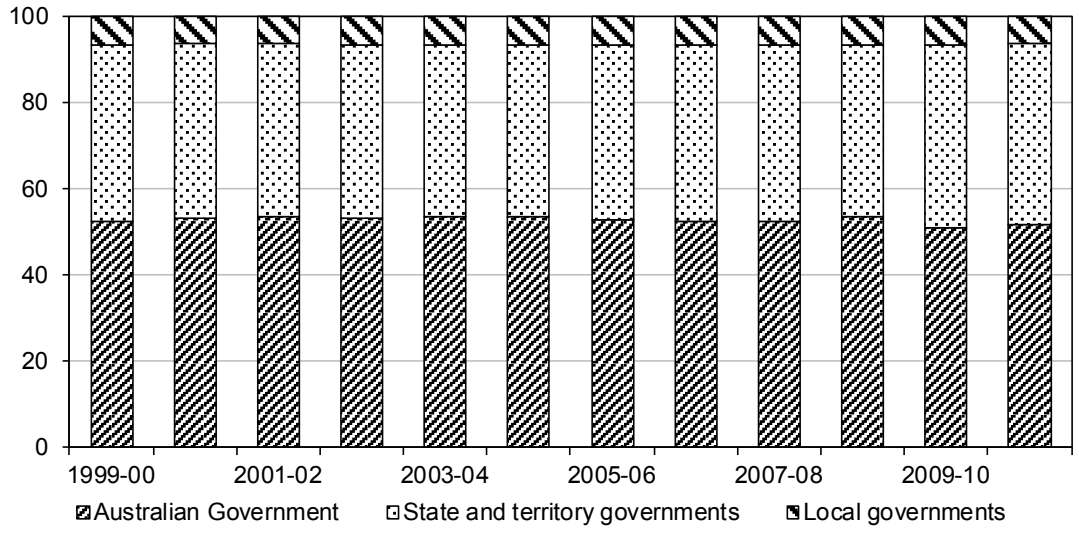
Government expenditure

Government expenditures have generally matched government revenues. Although different data sources yield different results for both revenues and expenditures, on average since 1999-00, government expenditures have been generally less than revenues raised — by about 1 per cent of GDP (ABS, *Government Finance Statistics, Australia*, 2008-09 and 2010-11, Cat. no. 5512.0).

The share of total government expenditure made by each level of government has remained stable over the past 10 years (figure 14.4). On average, the Australian Government has accounted for 53 per cent of total expenditures, with State and Territory and local governments accounting for 40 and 7 per cent, respectively.

Figure 14.4 **Share of total government expenditure by level of government, 1999-00 to 2010-11**

Per cent

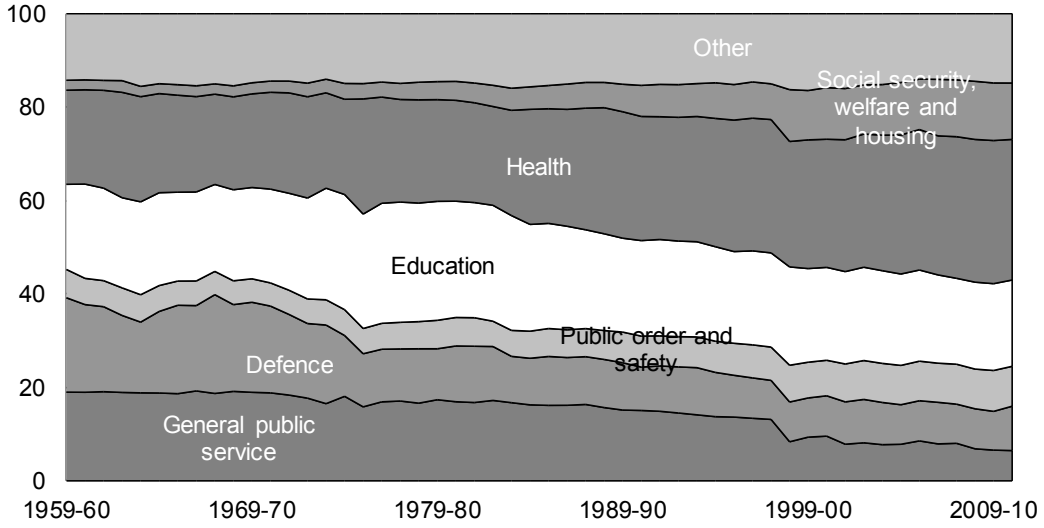


Source: ABS (*Government Finance Statistics*, 2009-10 and 2010-11, Cat. no. 5512.0).

Over the last half century, the importance of government expenditure items has changed in relative terms (figure 14.5). The largest relative increase in expenditures by government has been in the areas of health, and social security, welfare and housing. Both these expenditure items have increased in relative importance by 10 percentage points over the period. Conversely, expenditures on the general public service and defence have fallen, as a share of total expenditure, by 12 percentage points each.

Figure 14.5 **Share of government expenditure by sector, 1959-60 to 2010-11**[a]

Per cent



[a] Based on general government final consumption expenditures from the National Accounts. Total expenditures do not sum to total expenditures from other ABS publications.

Source: ABS (*Australian System of National Accounts*, 2010-11, Cat. no. 5204.0).

14.2 Projections used in other studies

The Australian and State and Territory government treasuries produce a number of projections relating to government revenue raising and expenditure. Most of these are for the short to medium term as part of budget and mid-year economic forecasts; however, The Treasury also produces projections over longer timeframes in the Intergenerational Reports. Both sets of projections are detailed in this section.

Budget and mid-year economic forecasts

Medium-term forecasts by the Australian and State and Territory government treasuries show the continuation of current revenue raising and expenditure patterns. Revenues and expenditures are expected to remain around 30 per cent of GDP over the medium term (table 14.1).[2] No large changes are forecast in the composition of government expenditure.

2 The analysis is based on the latest year for which comparable data exists across jurisdictions and does not take into account any subsequent revisions or updates in those jurisdictions that have handed down their budget for 2012-13 financial year.

Table 14.1 **Medium-term estimates of government revenues and expenditures, 2010-11 to 2014-15**

2010-11 budget and mid-year estimates

Government		*2010-11*	*2011-12*	*2012-13*	*2013-14*	*2014-15*
Australian	Revenue ($ million)	319 682	344 110	382 764	407 542	428 151
	Expenses ($ million)	354 348	371 637	379 935	400 623	418 863
NSW	Revenue ($ million)	55 059	59 351	60 712	63 712	65 331
	Expenses ($ million)	55 795	59 536	61 033	63 329	65 566
VIC	Revenue ($ million)	46 026	47 415	48 917	51 067	53 079
	Expenses ($ million)	45 509	47 267	48 697	50 158	51 806
Qld	Revenue ($ million)	41 957	44 416	43 631	48 150	50 257
	Expenses ($ million)	43 473	47 269	47 844	49 410	50 197
SA	Revenue ($ million)	15 138	15 749	15 685	16 028	17 122
	Expenses ($ million)	15 631	16 116	16 138	16 375	16 788
WA	Revenue ($ million)	23 764	25 233	26 232	27 209	28 202
	Expenses ($ million)	22 980	24 791	25 464	26 422	27 732
TAS	Revenue ($ million)	4 745	4 617	4 767	4 748	4 783
	Expenses ($ million)	4 777	4 731	4 719	4 763	4 781
NT	Revenue ($ million)	4 722	4 622	4 476	4 515	4 671
	Expenses ($ million)	4 388	4 527	4 487	4 542	4 708
ACT	Revenue ($ million)	3 873	3 982	4 117	4 286	4 513
	Expenses ($ million)	3 862	4 098	4 229	4 379	4 556
Total	Revenue ($ million)	514 966	549 485	591 337	627 215	627 984
	Expenses ($ million)	550 763	580 035	632 898	619 978	645 034
		2010-11	*2011-12*	*2012-13*	*2013-14*	*2014-15*
Grants to states	($ million)	94 277	96 320	95 129	100 269	101 053
Share of GDP	Revenue (per cent)	30	31	32	32	31
	Expenses (per cent)	33	33	34	32	31

Sources: Australian Government (2011); Government of South Australia (2011); Government of Western Australia (2011); Northern Territory Government (2011); NSW Government (2011); Parliament of Tasmania (2011); Queensland Government (2011); State Government of Victoria (2011).

Intergenerational Report 2010

The *Intergenerational Report 2010* (Australian Government 2010) contains a number of longer-term projections of government revenue raising and expenditures. The key projections and assumptions include:

- the Australian Government maintains a tax-to-GDP ratio of 23.5 per cent out to 2049-50; and
- Australian Government expenditures rise from around 26 per cent of GDP (inclusive of transfers to State and Territory governments) in 2009-10 to 27.1 per cent in 2049-50.

The increase in expenditures relative to revenue raising implies that the Australian Government will run a series of budget deficits over this period.

The main factor driving the change in expenditure relative to revenue is the ageing of the population. This is expected to further shift the composition of government expenditure over time, predominately towards the areas of health care and aged pensions (table 14.2).

Table 14.2 **Expenditure projections to 2050 in the *Intergenerational Report 2010***

Per cent of GDP

	2009-10	*2014-15*	*2019-20*	*2029-30*	*2039-40*	*2049-50*
Health	4.0	3.9	4.1	4.8	5.9	7.1
Aged care	0.8	0.8	0.9	1.2	1.6	1.8
Payments to individuals	6.9	6.5	6.6	6.8	6.9	6.9
Education	2.6	1.7	1.8	1.9	1.9	1.9
Public sector superannuation	0.4	0.4	0.4	0.3	0.2	0.2
Other	11.3	9.3	9.2	9.2	9.1	9.2
Total	26.0	22.6	23.0	24.2	25.6	27.1

Source: Australian Government (2010).

14.3 Towards a modelling reference case

Formulating a reference case for use within MMRF requires assumptions about the level and composition of Australian, State, Territory and local government revenue and expenditure over the projection period.

The longer-term approach adopted in this study abstracts from adjustments that might be associated with the achievement of short to medium-term fiscal policy objectives or spending priorities. Within this broad stylised framework, the modelling reference case makes the simplifying assumptions that all tax rates remain fixed (at their initial levels) and that government expenditures move in line with changes in the underlying drivers contained in MMRF (such as changes in real economic activity, unemployment and population growth).[3] It is also assumed that the net real budget balance remains fixed as a share of real GDP (for the Australian Government) and as a share of real GSP (for the State, Territory and local governments) through the use of lump-sum transfers to, or from, households.

[3] The annex at the end of chapter 2 contains a full listing of the government revenue and expenditure items included in the model and the economic drivers associated with each one.

As recognised in the *Intergenerational Report 2010* (and mentioned in chapter 13), expenditure on health care and health-related commodities is expected to increase as the population progressively ages. However, the scale of any increases in health service output, the balance between public and private outlays, and the means of funding of those outlays is uncertain at this stage.

In the absence of other information, the MMRF model was modified so that real government expenditure on health increases proportionately with the share of the population aged 65 years and over. The reference case also adopts the *Intergenerational Report 2010* assumption that increased health care costs associated with an ageing population are, in the first instance, funded through Australian and State government expenditure rather than household expenditure. The fiscal closure used assumes that this additional government expenditure is funded through lump-sum transfers from households.

15 The modelling reference case

As noted in chapter 7, the reference case has been used in this study to assess the timescale over which the benefits of reform could accrue, given current implementation plans.

With this objective in mind, the focus of the reference case is therefore on the relative distribution of activity between industries and jurisdictions — that is, the *structure* of the economy at the time the reforms come into effect. Inherent in the preparation of the reference case through to the financial year 2049-50 are projections of the *level* of economic activity.

This chapter reports the projected changes in the industry and demographic structure of the economy implied by the analysis in the previous chapters. It then reports projections of the level of output and employment, and the distribution of these projections across state and territories implied by the analysis.

As noted in earlier chapters, while the projections provide a useful basis for indicating the timescale over which the benefits of reform could be expected to occur, the projections of the aggregate level of economic activity are conditional on the assumptions modelled and should not necessarily be viewed as a reliable guide to the scale of the economy in the middle of the century. Given this is the first time that dynamic modelling has been used to assess the impacts of COAG reforms, the modelling reference case presented here should be considered as being experimental in nature. Given this, sensitivity testing is presented to gauge the robustness of the likely timescale presented over which the impacts of the COAG reforms assessed are expected to occur to alternative formulations for some of the key modelling assumptions adopted.

The reference case presented in this chapter is based on an updated MMRF database supplied by the Centre of Policy Studies. The use of this updated MMRF database, coupled with some refinement of the assumptions outlined in chapters 8 to 14, mean that the results presented here may differ from those in the discussion draft. The modelling reference case presented in this chapter has slightly higher aggregate labour productivity than that used in the final report, but the findings on the likely timescale over which the impacts of COAG reforms assessed are likely to occur remain the same.

15.1 Composition of activity

Sectoral

The projected structure of the economy out to 2049-50 is inherently sensitive to the reference case assumptions adopted, especially those concerning changes in (relative) labour productivity by industry and the terms of trade. The assumptions will affect:

- the size of the traded sector (particularly mining, agriculture, most manufacturing and some service industries) relative to the non-traded sector (some manufacturing and many service industries); and
- the composition of the traded sector (particularly the size of mining industries relative to agriculture and manufacturing).[1]

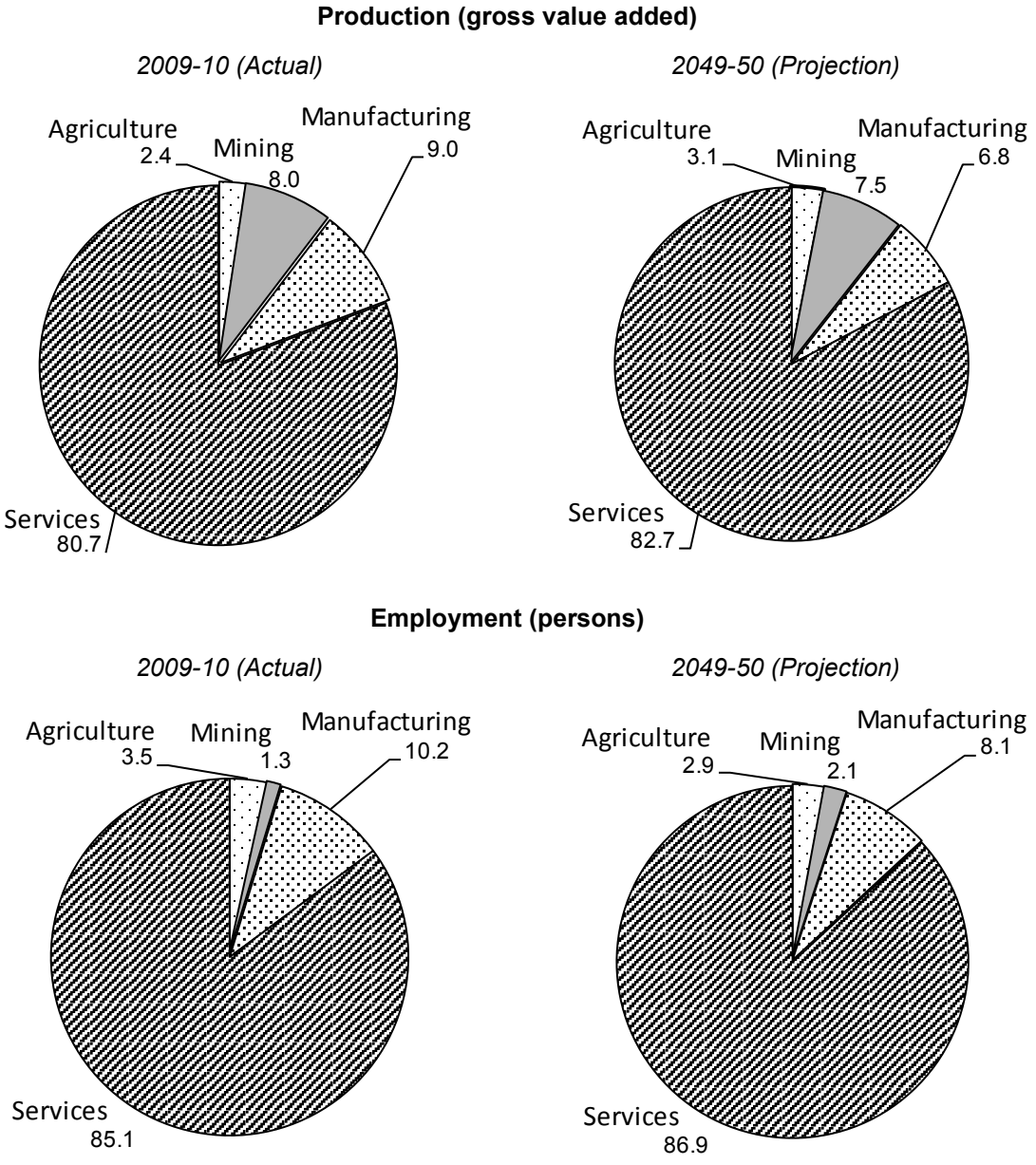
Given the reference case assumptions and the modelling approach adopted, the structure of the economy in 2049-50 is projected to be broadly similar to the current structure (figure 15.1). The unwinding of the terms of trade is projected to result in the agricultural and service shares of output increasing relative to mining and manufacturing. Although the output share for the agricultural sector is projected to increase because of the assumed continued increases in labour productivity, the sector is not projected to materially increase its share of total employment. The main projected changes in employment arise from a projected increase in service sector employment and a reduction in manufacturing employment.

Output (value added) and employment in agriculture, mining, manufacturing and services are projected to grow over the period to 2049-50 (figure 15.2). The increase in the contribution of agriculture is reflected by higher projected annual average output growth. Reflecting labour productivity growth assumptions, output is projected to increase ahead of employment in all sectors. While there is some variability across states, this sectoral story also holds across all states (figure 15.3).

1 Mining and other sector labour productivity is discussed in chapter 10.

Figure 15.1 **Actual and projected distribution of production and employment by broad industry sector, Australia, 2009-10 and 2049-50**

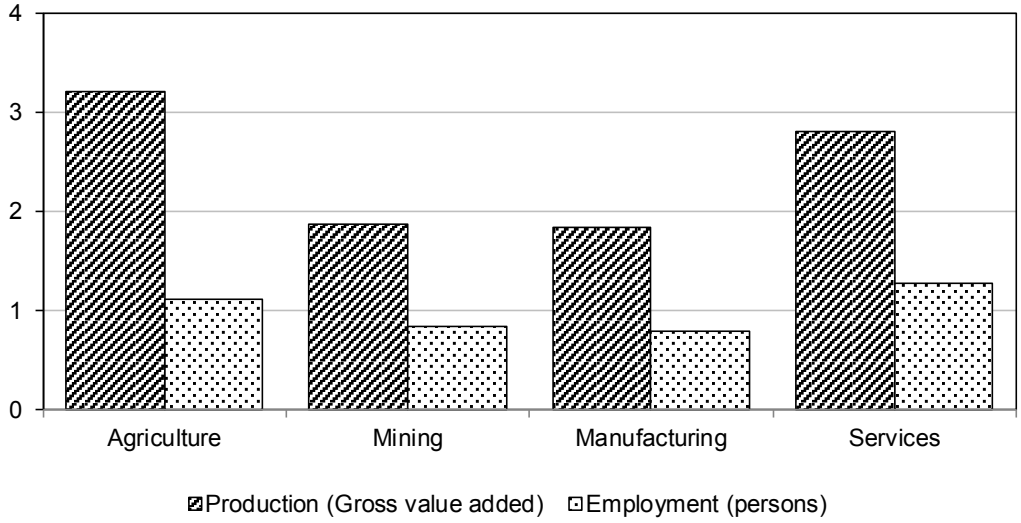
Per cent



Sources: ABS (2011, *Australian System of National Accounts*, 2010-11, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2011, Cat. no. 6291.0.55.003); Commission estimates.

Figure 15.2 **Projected average annual production and employment growth by broad industry, Australia, 2009-10 to 2049-50**

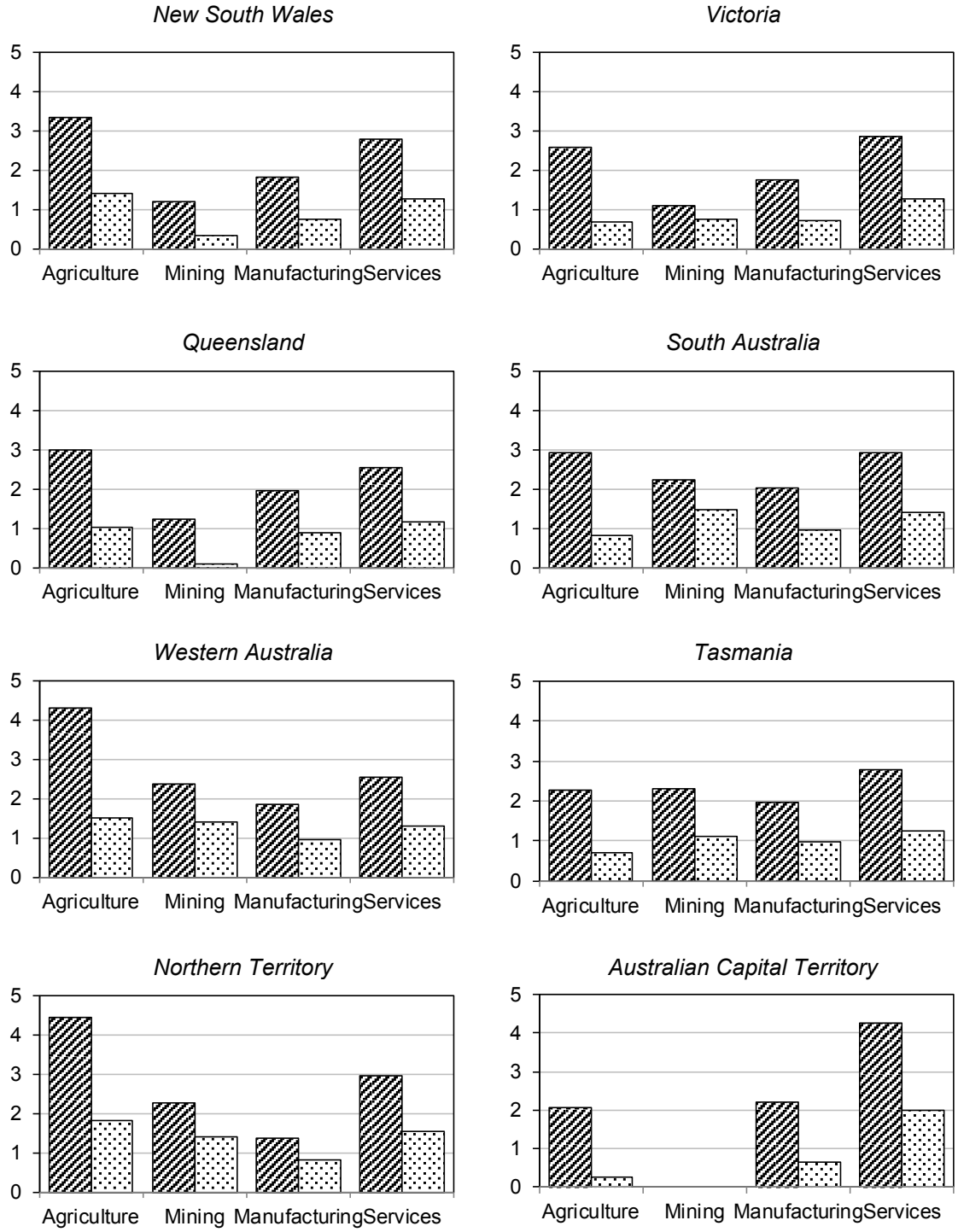
Per cent per year



Source: Commission estimates.

Figure 15.3 **Projected average annual production and employment growth by broad industry and state, 2009-10 to 2049-50**

Per cent per year



Source: Commission estimates.

Demography

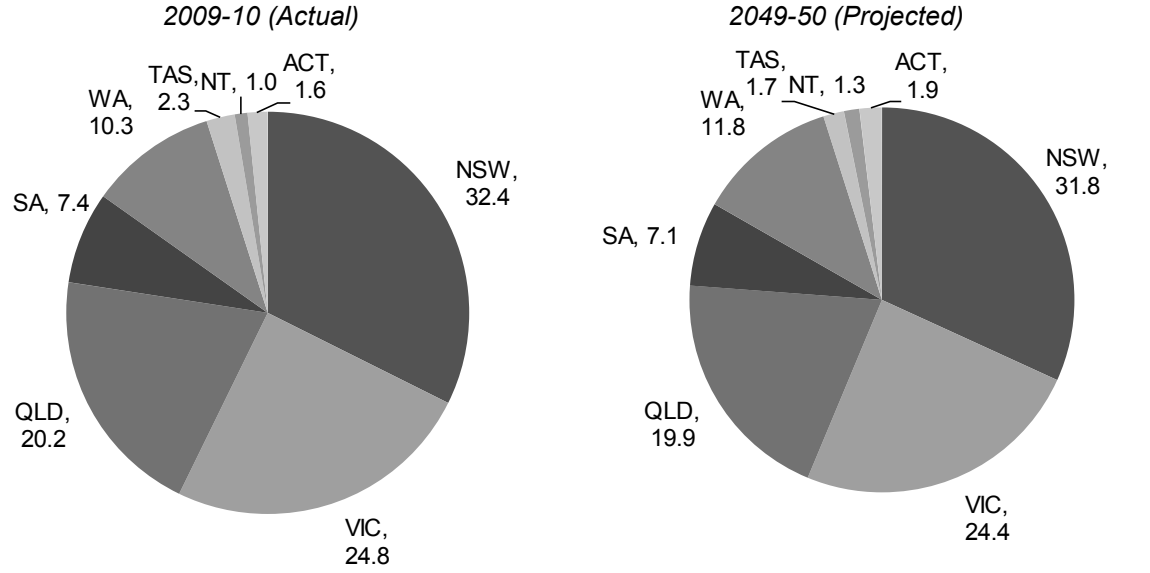
The distribution of population across states in 2049-50 is projected to be broadly similar to the current distribution (figure 15.4). Western Australia, Northern Territory and the Australian Capital Territory are projected to increase their share of the population by 2049-50 (rising from 10.3 to 11.9 per cent, 1.0 per cent to 1.3 per cent, and 1.6 to 1.9 per cent, respectively). The shares for the remaining states all decline slightly.

Reflecting the reductions in mortality rates implied by the assumed increases in life expectancy, the Northern Territory is projected to have the highest average annual population growth rate of 1.7 per cent (figure 15.5). The populations of the Australian Capital Territory (1.5 per cent), Western Australia (1.4 per cent), Queensland (1.2 per cent) and Victoria (1.2 per cent) are projected to grow faster than the national average of 1.1 per cent.

Reflecting an increase in the average age of the population and an associated reduction in the number of women of childbearing age, the general trend is for population growth across the states to slow towards 2049-50 from current levels (table 15.1).

Figure 15.4 **Actual and projected distribution of population across states, 2009-10 and 2049-50**

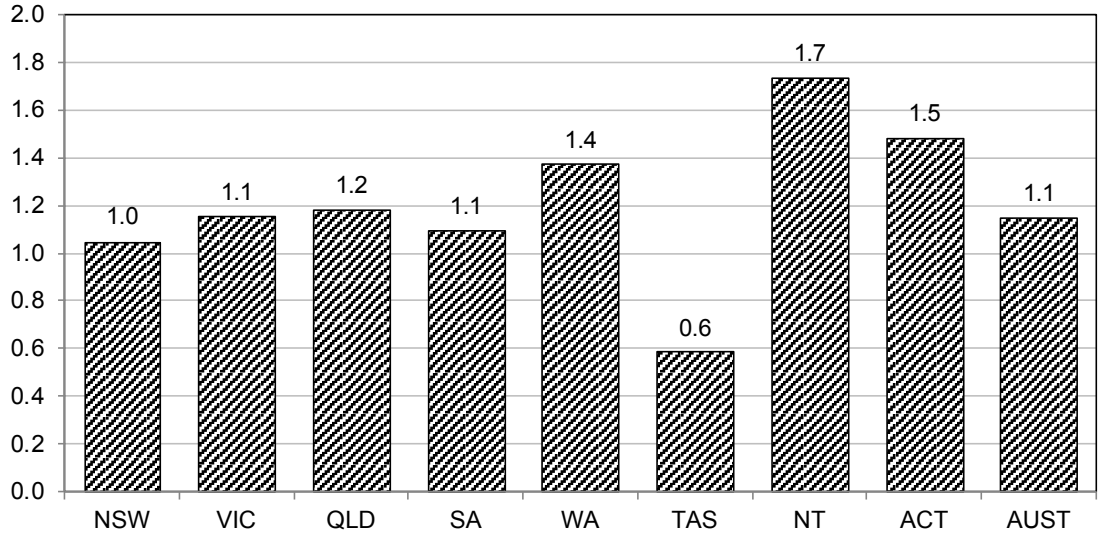
Per cent



Sources: ABS (*Australian Demographic Statistics*, June 2011, Cat. no. 3101.0); Commission estimates.

Figure 15.5 **Projected average annual growth in population by state, 2009-10 to 2049-50**

Per cent per year



Source: Commission estimates.

Table 15.1 **Actual and projected average annual changes in state population to 2049-50**

Per cent per year

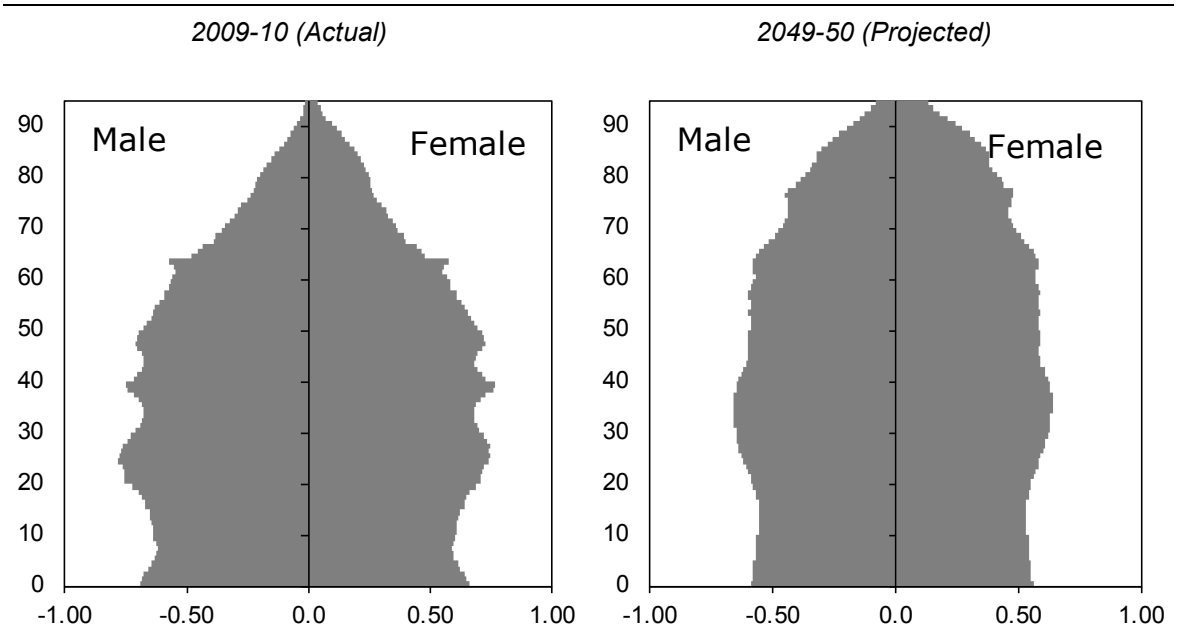
Decade	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
2000s (actual)	1.1	1.6	2.4	0.9	2.0	0.7	1.6	1.3	1.5
2010s	0.8	1.2	1.3	1.8	2.4	1.5	1.6	1.4	1.3
2020s	1.2	1.3	1.1	1.0	1.2	0.4	1.8	1.6	1.2
2030s	1.1	1.1	1.2	0.9	0.9	0.3	1.8	1.4	1.1
2040s	1.1	1.0	1.1	0.8	0.9	0.2	1.6	1.3	1.0

Source: ABS (*Australian Demographic Statistics*, June 2011, Cat. no. 3101.0); Commission estimates.

The demographic component of the modelling indicates a clear increase in the age profile of the Australian population ('ageing' of the population), both for males and females (figure 15.6). The share of the population aged 65 years and over — the 'dependency ratio' — is projected to rise from roughly 13 to 23 per cent by 2049-50. Conversely, the share of the population aged less than 15 years is projected to decline from 19 to 17 per cent.

Figure 15.6 **Actual and projected age profile by gender, Australia, 2009-10 and 2049-50**

Per cent of total



Sources: ABS (*Population by Age and Sex, Australian States and Territories*, June 2010, Cat. no. 3201.0); Commission estimates.

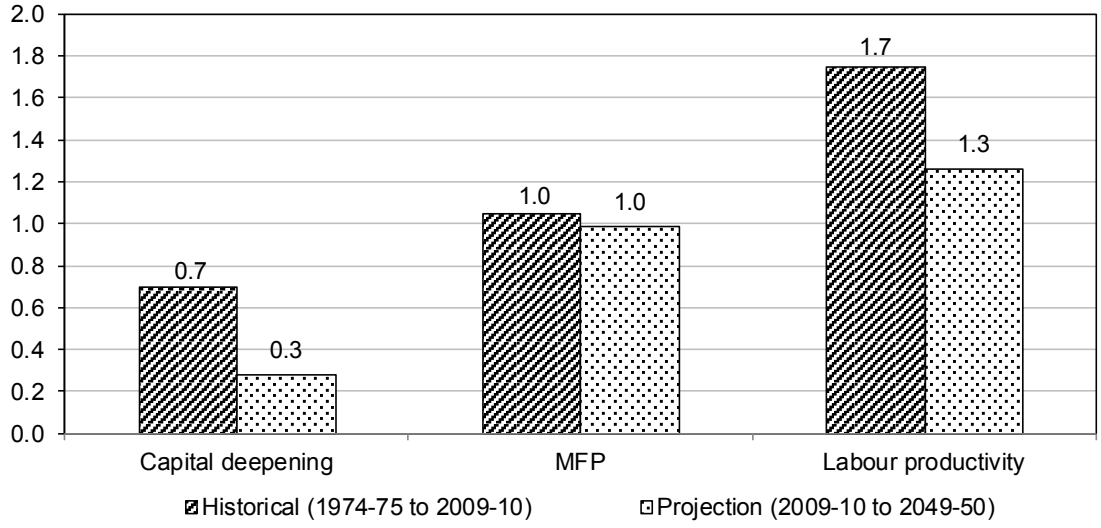
Productivity

As outlined in chapter 10, the labour productivity component of the modelling reference case has been specified at the industry level. For the modelling reference case, it has been assumed that labour productivity transitions (on average) from current (2009-10) levels to longer-term averages (1974-75 to 2009-10) over the period 2009-10 to 2017-18. Reflecting these assumptions, national labour productivity, multifactor productivity and capital deepening are projected to increase (figure 15.7). National labour productivity and capital deepening are projected to increase at lower rates than have occurred historically.

The lower projected growth in labour productivity reflects, among other factors:

- relatively low (by historical standards) current levels of productivity in a number of industries, most notably the mining and electricity, gas, water and waste sectors, and the assumption of a gradual return to their historically higher productivity levels (chapter 10); and
- short- to medium-term changes in industry composition favouring the mining sector, associated with historically high terms of trade to 2017-18 (chapters 10 and 11).

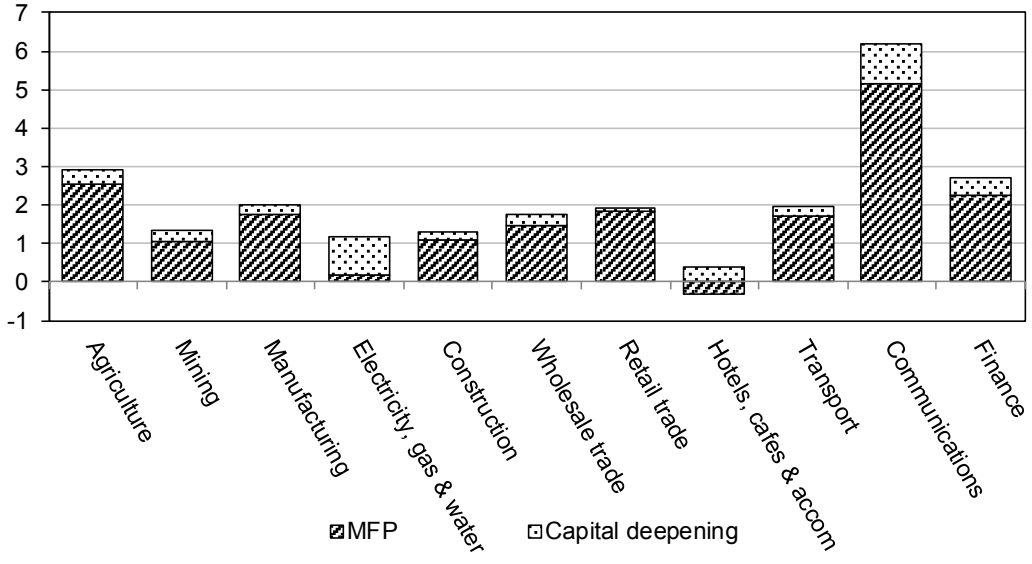
Figure 15.7 **Actual and projected average annual sources of labour productivity growth, Australia, 1974-75 to 2049-50**
Per cent per year



Source: Commission estimates.

Following historical trends, this growth in labour productivity to 2049-50 is assumed to be highest in the communications, agriculture and finance sectors and lowest in the accommodation and cafes, mining and utilities sectors (electricity, gas and water) (figure 15.8).

Figure 15.8 **Projected average annual sources of labour productivity growth, market sector, 2009-10 to 2049-50**
Per cent per year

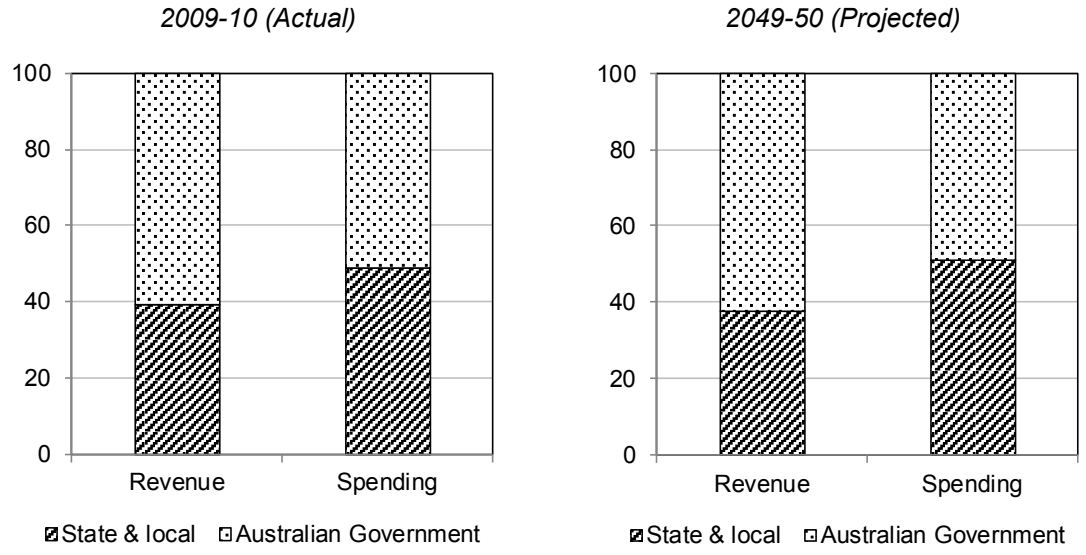


Source: Commission estimates.

Government finances

The own-source revenue and expenditure shares for the Australian Government and State and local governments are projected to remain broadly in line with current relativities (figure 15.9). That is, the Australian Government is projected to continue to raise approximately three-fifths of all government revenue to 2049-50, with the states continuing to undertake just over half of all government expenditure.

Figure 15.9 **Actual and projected fiscal shares, 2009-10 and 2049-50**
Per cent



[a] Australian Government: *GFS Revenue*. State, Territory & local: *GFS Revenue* less revenue from *Current grants and subsidies*. [b] Australian Government: *GFS Expenses* less revenue from *Current grants and subsidies* received by State, Territory & local governments. State, Territory & local: *GFS Expenses*.

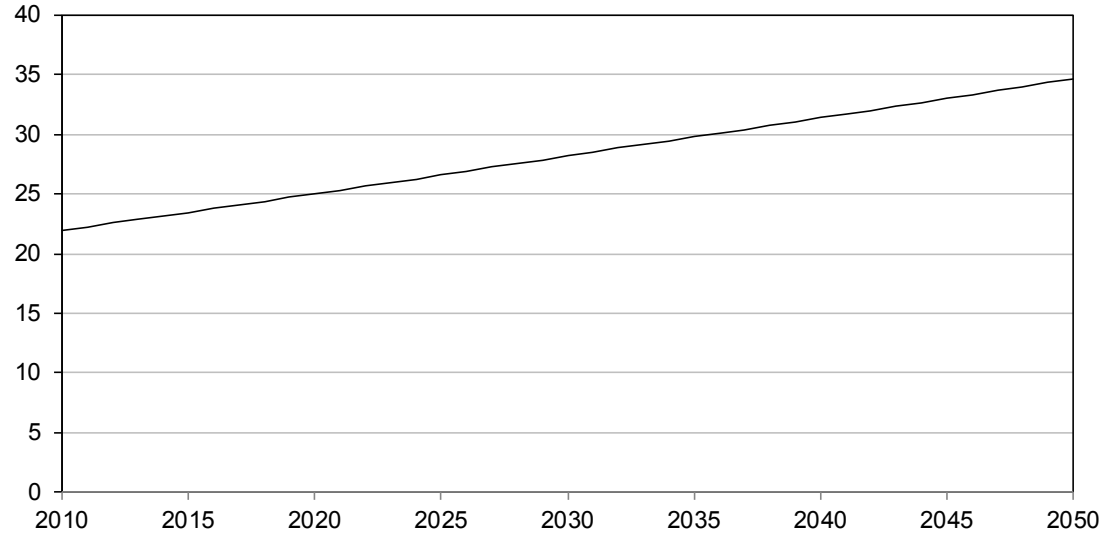
Sources: ABS (*Government Finance Statistics, Australia*, 2008-09, Cat. no. 5512.0); Commission estimates.

15.2 Aggregate view of the modelling reference case

Demography

Collectively, the assumptions concerning fertility, mortality and migration imply that the population of Australia increases at an average annual rate of 1.1 per cent to reach almost 35 million by 2049-50 (figure 15.10). This estimate is broadly in line with those of the ABS and *Intergenerational Report* reported in chapter 8 (34 million and 36 million, respectively). The difference in these estimates primarily reflects the total fertility rate assumptions used — 1.8 by the ABS, 1.9 in the *Intergenerational Report*, and (the mid-point) 1.85 used in this study.

Figure 15.10 **Projected total population of Australia, 2010 to 2050**[a]
Million, as at 30 June



[a] Excluding residents of Jervis Bay, Christmas Island and Cocos (Keeling) Islands (termed *other territories*).

Source: Commission estimates.

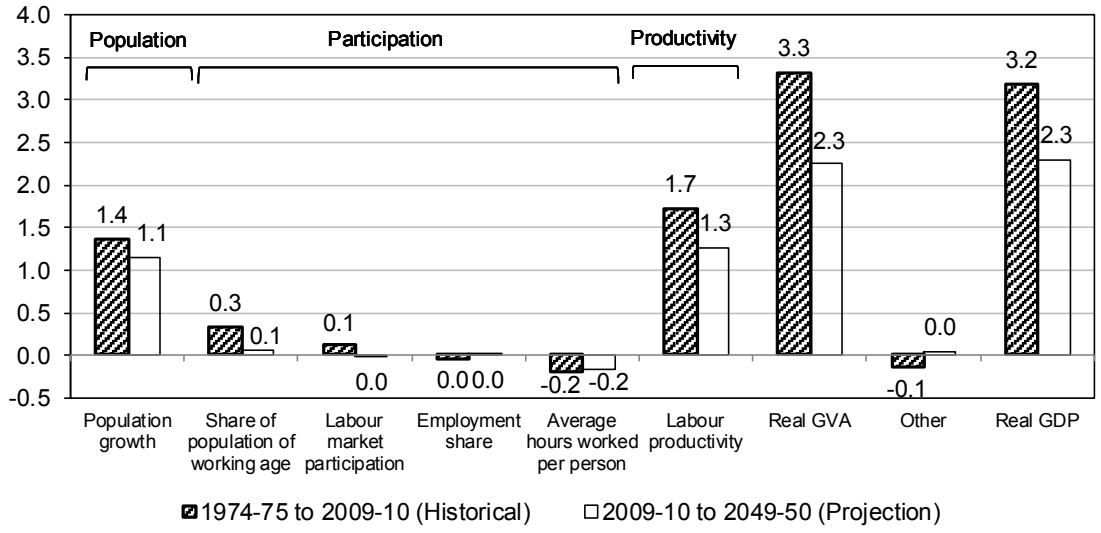
National output

Given the assumed demographic trends, national population growth is projected to contribute about 1.1 per cent per year to national output growth to 2049-50 (figure 15.11). The workforce participation assumptions contribute an additional 0.1 per cent per year to national output growth, while the labour productivity assumptions for individual industries contribute a further 1.3 per cent per year. These projected contributions are lower than the recorded historical averages since 1974-75.

Reflecting these assumed changes in demography, labour market participation and productivity, real gross domestic product of the Australian economy is projected to increase by an average of 2.3 per cent per year to 2049-50 (figures 15.12 and 15.13). The economy in 2049-50 is projected to be over two-and-a-half times bigger than it was in 2009-10.

Figure 15.11 **Actual and projected contributions to the growth in real gross domestic product, Australia, 1974-75 to 2049-50**[a]

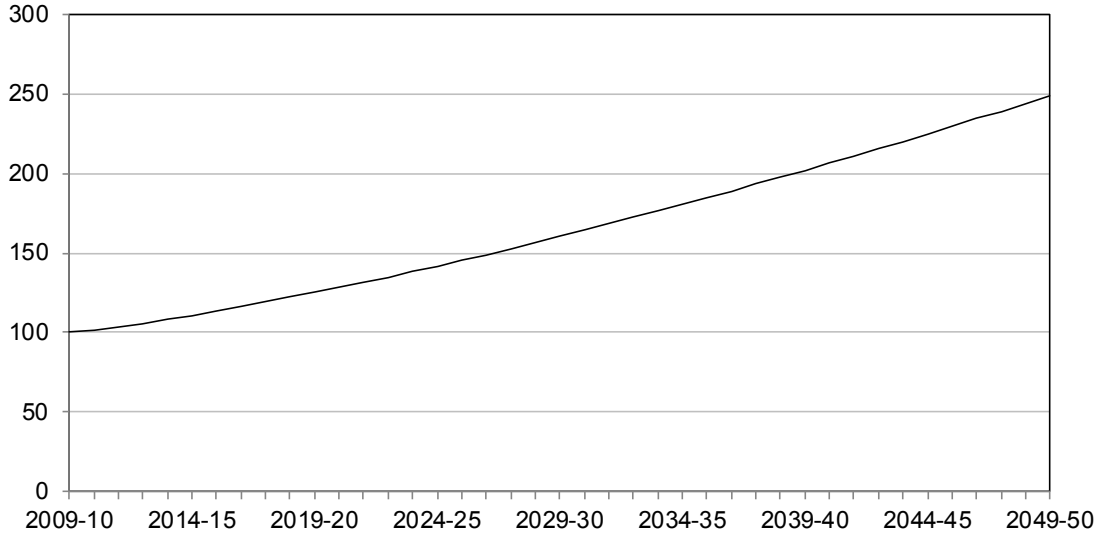
Per cent per year



Source: Commission estimates based on ABS (*Labour Force, Australia*, Cat no. 6202.0; *Population by Age and Sex, Australian States and Territories*, Cat. no. 3201.0; *Australian National Accounts: National Income, Expenditure and Product*, Cat. no. 5206.0; and *Labour Force Historical Timeseries, Australia*, 1966 to 1984, Cat. no. 6204.0.55.001).

Figure 15.12 **Projected growth in real gross domestic product, 2009-10 to 2049-50**

Index 2009-10=100



Source: Commission estimates.

State production

Given the projected changes in industry output and employment, real gross state product is projected to increase in all states to 2049-50 by between 2.2 and 2.6 per cent per year (figure 15.13). State production per person is similarly projected to increase in all jurisdictions (figure 15.13). Growth in output is projected to be relatively stable in individual states over the projection period (table 15.2).

15.3 Sensitivity testing

Alternative growth assumptions could yield different projections of the scale and composition of economic activity across industries and states over the projection period. More importantly for the Commission's final report, these alternative growth assumptions may influence the timeframe over which the impacts of the COAG reforms assessed are expected to occur.

To test the sensitivity of the modelling reference case and the finding that around 60 per cent of the impacts of the COAG reforms would be expected to occur by 2020, the Commission has undertaken two sensitivity tests that vary some of the key assumptions affecting the modelling reference case.

- The first sensitivity test unwinds industry labour productivity and the terms of trade to long-run trends over 15 years to 2024-25 (compared to the eight years in the modelling reference case); unwinds productivity in all mining industries other than oil to the long-run trend for the mining sector as a whole (rather than the mining industry-specific long-run trend) and sets the labour productivity improvement for the ownership of dwellings industry to zero (compared to the 3.8 per cent in the modelling reference case).
- The second sensitivity test involves increasing labour productivity in each industry by an additional 30 per cent per year, which proxies the increase in aggregate labour productivity required to achieve the long-run historical growth rate of 1.7 per cent per year.

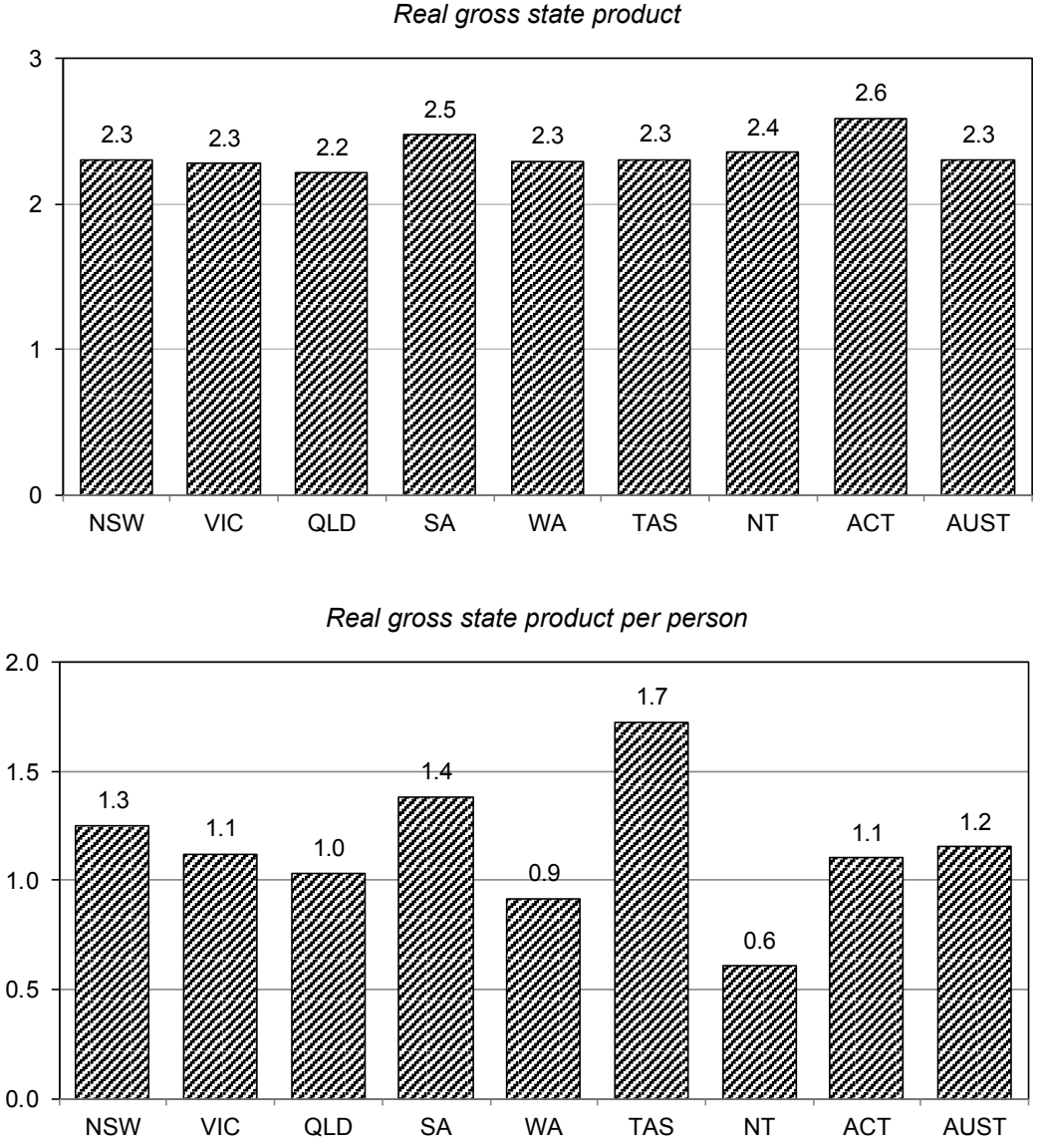
The sensitivity testing indicates that the level and composition of economic activity in the modelling reference case is reasonably sensitive to the growth assumptions adopted (table 15.3). These assumptions include:

- the labour productivity growth rates assumed for each industry;
- the aggregate level of labour productivity for the economy as a whole (which depends on the share of activity accounted for by each industry through time);
- the timeframe over which the terms of trade unwind; and

- the timeframe over which productivity in many industries revert back towards their longer-term historical trend growth rates and the ultimate level attained.

Figure 15.13 **Projected average annual growth in state production, 2009-10 to 2049-50**

Per cent per year



Source: Commission estimates.

Table 15.2 **Actual and projected average annual changes in real gross state product to 2049-50**

Per cent per year

Decade	*NSW*	*VIC.*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
2000s (actual)	2.0	2.9	4.3	2.7	4.4	2.4	3.7	3.0	3.0
2010s	2.0	2.2	2.2	3.0	3.4	3.1	2.0	2.2	2.4
2020s	2.6	2.5	2.4	2.6	2.4	2.3	2.5	2.8	2.5
2030s	2.4	2.3	2.3	2.3	2.0	2.1	2.5	2.7	2.3
2040s	2.2	2.1	2.1	2.1	1.8	1.9	2.4	2.5	2.1

Source: ABS (*Australian National Accounts: State Accounts*, 2010-11, Cat. no. 5220.0); Commission estimates.

Table 15.3 **Sensitivity of key aggregates in the modelling reference case to alternative growth rate assumptions**

Per cent

	2019-20	*2049-50*
Growth in real GDP:		
Modelling reference case[a]	2.5	2.1
First sensitivity test[b]	1.8	1.7
Second sensitivity test[c]	2.9	2.3
Mining sector share of national production:		
Modelling reference case[a]	11.5	7.6
First sensitivity test[b]	13.7	14.3
Second sensitivity test[c]	11.6	5.6

[a] The modelling reference case involves unwinding the industry labour productivity and the terms of trade to long-run trends over eight years to 2017-18 and setting the labour productivity improvement for the ownership of dwellings industry to its historical average of 3.8 per cent per year. [b] First sensitivity test involves unwinding the industry labour productivity and the terms of trade to long-run trends over 15 years to 2024-25; unwinds productivity in all mining industries other than oil to the long-run trend for the mining sector as a whole (rather than the mining industry-specific long-run trend) and sets the labour productivity improvement for the ownership of dwellings industry to zero. [c] Second sensitivity test involves increasing labour productivity in each industry by an additional 30 per cent per year to proxy achieving the historical average growth rate over the projection period.

Source: Commission estimates.

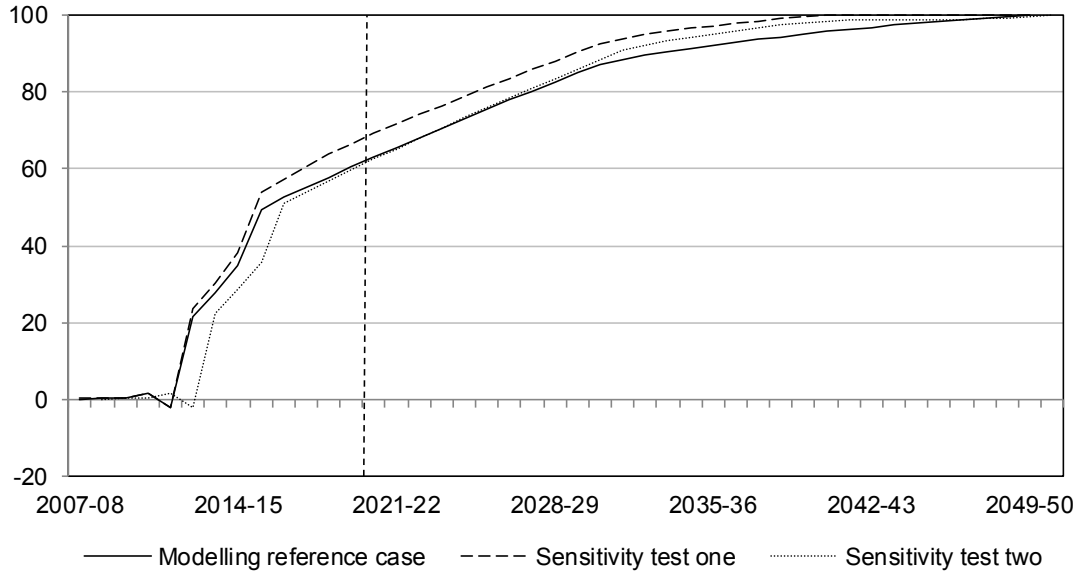
The sensitivity testing also indicates that, given current low productivity levels in many industries and taking into account expected changes in the composition of economic activity towards service industries that have lower (measured) productivity, it will be difficult for aggregate labour productivity over the projection period to match that of the last 35 years.

However, while the level and composition of economic activity in the modelling reference case may be reasonably sensitive to the growth assumptions adopted, the timeframe over which the impacts of the COAG reforms are expected to occur is

not. This indicates that the finding that around 60 per cent of the total economy-wide effects from the implementation of the agreed COAG business regulation reforms would be felt by 2020 is not particularly sensitive to the growth assumptions adopted in the modelling reference case (figure 15.4).

Figure 15.14 **Sensitivity of the timeframe over which the impacts of COAG business regulation reforms are expected to occur to alternative growth rate assumptions**[a]

Per cent of increase in real GDP



a The modelling reference case involves unwinding the industry labour productivity and the terms of trade to long-run trends over eight years to 2017-18 and setting the labour productivity improvement for the ownership of dwellings industry to its historical average of 3.8 per cent per year. First sensitivity test involves unwinding the industry labour productivity and the terms of trade to long-run trends over 15 years to 2024-25; unwinds productivity in all mining industries other than oil to the long-run trend for the mining sector as a whole (rather than the mining industry-specific long-run trend) and sets the labour productivity improvement for the ownership of dwellings industry to zero. Second sensitivity test involves increasing labour productivity in each industry by an additional 30 per cent per year to proxy achieving the historical average growth rate over the projection period.

Source: Commission estimates.

References

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) 2011a, *Australian Commodities*, March quarter, Canberra.

—— 2011b, *Australian Energy Statistics — Energy Update 2011*, 29 June.

Abhayaratna, J. Andrews, L., Nuch, H. and Podbury, T. 2008, *Part Time Employment: The Australian Experience*, Staff Working Paper, Productivity Commission, Canberra.

—— and Lattimore, R. 2007, *Workforce Participation Rates — How Does Australia Compare?*, Staff Working Paper, Productivity Commission, Canberra.

ABS (Australian Bureau of Statistics) 2000, *Australian System of National Accounts, Concepts, Sources and Methods*, Cat. no. 5216.0, 31 December.

ACT Government 2011, *Budget 2011-12: Budget Overview*, Budget Paper no. 3, Canberra.

Adams, P.D. and Mai, Y.H. 2002, 'Three Future Scenarios for Greenhouse Gas Emissions by Region in Australia', Paper presented at 5th Conference on Global Economic Analysis, 5–7 June, Taipei.

Australian Government 2007, *Intergenerational Report, 2007*, Canberra.

—— 2008, *Australia's Low Pollution Future*, Canberra.

—— 2009, *Mid-Year Economic and Fiscal Outlook, 2009-10*, Canberra.

—— 2010, *Australia to 2050: Future Challenges*, Canberra [Intergenerational Report, 2010].

—— 2011, *Mid-Year Economic and Fiscal Outlook, 2011-12*, Canberra.

Australian Government Actuary 2009, *Australian Life Tables, 2005–07*, Canberra.

Baldwin, J.R. and Sabourin, D. 2002, 'Impact of the Adoption of Advanced Information and Communication Technologies on Firm Performance in the Canadian Economy', STI Working Paper 2002/1, OECD, Paris.

Carmichael, G. 1998, 'Things Ain't What They Used To Be! Demography, Mental Cohorts, Morality and Values in Post-war Australia.', *Journal of the Australian Population Association*, vol. 15, no. 2, pp. 91–113.

Cica, N. 1998, *Abortion Law in Australia*, Research Paper 1 1998-99, Australian Parliamentary Library, Canberra.

Commonwealth of Australia 2005, *Federal Financial Relations 2005-06*, Budget Paper No. 3, Canprint Communications, Canberra.

CoPS (Centre of Policy Studies) 2007, *MMRF: Multi-Regional Forecasting Model — An Applied General Equilibrium Model of the Australian Economy*, Centre of Policy Studies, Monash University.

Cuddington, J.T., Ludema, R. and Jayasuriya, S.A. 2002, 'Prebisch-Singer Redux', Working Paper no. 140, Central Bank of Chile.

Cuxon, G., Temple, J., Fry, J. and Leong, L. 2008, *Modified Demographic and Economic Model (MoDEM 2.0)*, Model and Technical Paper, Productivity Commission, Melbourne.

Dark, D. and Hawkins, J. 2005, 'Why Have Australia's Imports of Goods Increased So Much?', *Economic Roundup*, Summer, Treasury, pp. 33–44.

Day, C. and Dowrick, S. 2004, 'Ageing Economics: Human capital, Productivity and Fertility', *Agenda*, vol. 11, no. 1, pp. 3–20.

Department of Treasury and Finance, Victoria, 2005, *Addressing Impacts of Population Ageing on Labour Force Participation: Strategic Policy Group Preliminary Report*, Melbourne.

DFAT (Department of Foreign Affairs and Trade) 2010, *China*, Fact sheet, Department of Foreign Affairs and Trade, Canberra.

DIAC (Department of Immigration and Citizenship) 2010, *Student Visa Program Trends, 2003-04 to 2009-10*, Report ID BR0109, Department of Immigration and Citizenship, Canberra.

—— 2011a, *Student Visa Program Trends, 2004-05 to 2010-11*, Report ID BR0109, Department of Immigration and Citizenship, Canberra.

—— 2011b, *Population Flows: Immigration Aspects 2009-10*, Department of Immigration and Citizenship, Canberra.

DIMA (Department of Immigration and Multicultural Affairs) 2001, *Immigration: Federation to Century's End*, Department of Immigration and Multicultural Affairs, Canberra.

EU KLEMS Database, March 2009, www.euklems.net.

Evans, C. 2008a, *Foreign Students Gain Automatic Work Rights in Australia*, Media Release, 25 April.

—— 2008b, *Budget 2008-09 — Australia Increases Commitment to Refugees*, Media Release, 13 May.

—— 2008c, *Migration Program gives Priority to Those with Skills Most Needed*, Media Release, 17 December.

—— 2009, *Budget 2009-10 — Humanitarian Program*, Media Release, 12 May.

—— 2010, *Budget 2010-11 — Humanitarian Program*, Media Release, 11 May.

Garnaut, R. 2008, *The Garnaut Climate Change Review*, Final Report, Cambridge University Press, Melbourne.

Geoscience Australia and ABARE, 2010, *Australian Energy Resource Assessment*, Canberra.

Giesecke, J. 2004, *The Extent and Consequences of Recent Structural Changes in the Australian Economy, 1997–2002: Results from Historical Decomposition Simulations with MONASH*, General Working Paper no. G-151, Centre of Policy Studies, Monash University, December.

Gilfillan, G. and Andrews, L. 2010, *Labour Force Participation of Women Over 45*, Staff Working Paper, Productivity Commission, Canberra.

Gillitzer, C. and Kearns, J. 2005, 'Long-Term Patterns in Australia's Terms of Trade', Discussion Paper no. 2005-01, Reserve Bank of Australia, Sydney.

Government of South Australia 2011, *2011-12 Mid-Year Budget Review*, Adelaide.

Government of Western Australia 2011, *2011-12 Budget: Economic and Fiscal Outlook*, Budget Paper no. 3, Perth.

Grant, A., Hawkins, J. and Shaw, L. 2005, 'Mining and Commodities Exports', *Economic Roundup*, Spring, Treasury, pp. 1–15.

Gretton, P. 1988, 'Export Supplies and Industry Transformation Prospects: An ORANI Extension', IMPACT Research Memorandum OA-444, Industries Assistance Commission, Canberra.

Gretton, P., Gali, J. and Parham, D. 2002, 'Uptake and Impacts of ICTs in the Australian Economy: Evidence from Aggregate, Sectoral and Firm Levels', Paper presented at OECD Workshop on ICT and Business Performance, Paris, Productivity Commission, Canberra, December.

—— 2003, 'The Effects of ICTs and Complementary Innovations on Australian Productivity Growth', Conference Paper, Productivity Commission, Canberra, July.

Gruen, D. 2011, 'The Resources Boom and Structural Change in the Australian Economy', Address to the CEDA Economic and Political Overview, February.

Harvey, D., Kellard, N., Madsen., J. and Wohar., M. 2010, 'The Prebisch-Singer Hypothesis: Four Centuries of Evidence', *Review of Economics and Statistics*, vol. 92, no. 2, pp. 367–77.

Heard, G. 2010, 'Interpreting Australia's Fertility Increase', *People and Place*, vol. 18, no. 2, pp. 10–8.

Horridge, M. 2003, *ORANI-G: A Generic Single-Country Computable General Equilibrium Model*, Documentation prepared for the Practical GE modelling Course, Centre of Policy Studies, Monash University, 23–27 June.

IC (Industry Commission) 1995, *Growth and Revenue Implications of National Competition Policy Reforms,* Report by the Industry Commission to the Council of Australian Governments, Australian Government Publishing Service, Canberra.

Koleth, E. 2010, *Overseas Students: Immigration Policy Changes 1997–May 2010*, Parliamentary Library Background Note, 18 June.

Lattimore, R. 2007, *Men Not at Work: An Analysis of Men Outside the Labour Force*, Staff Working Paper, Productivity Commission, Canberra.

—— 2008, 'FERTMOD: Software for Making Demographic Projections Under Different Fertility Assumptions', Technical paper, Productivity Commission, Canberra.

—— and Pobke, C. 2008, *Recent Trends in Australian Fertility*, Staff Working Paper, Productivity Commission, Canberra.

Northern Territory Government 2011, *Budget 2011-12: Fiscal and Economic Outlook,* Budget Paper no. 2, Darwin.

NSW Government 2011, *Half-Yearly Review 2011-12*, Sydney.

O'Connor, J. and Orsmond, D. 2007, 'The Recent Rise in Commodity Prices: A Long-Run Perspective', *Reserve Bank of Australia Bulletin*, Sydney, April.

Parliamentary Library 2010, *Migration to Australia since Federation: A Guide to the Statistics*, Background Note, 27 August.

Parliament of Tasmania 2011, *The Budget*, Budget Paper no. 1, Hobart.

PC (Productivity Commission) 1999, *Impacts of Competition Policy Reforms on Rural and Regional Australia*, Inquiry Report no. 8, Canberra.

—— 2000, General Tariff Review — Papers for Modelling Workshop, Appendix B, *Review of Australia's General Tariff Arrangements*, Canberra, 3 April.

—— 2005a, *Review of National Competition Policy Reforms*, Inquiry Report no. 33, Canberra.

—— 2005b, *Economic Implications of an Ageing Australia*, Research Report, Canberra.

—— 2005c, 'Technical Paper 1: Demographic Projections', *Economic Implications of an Ageing Australia*, Research Report, Canberra.

—— 2005d, 'Technical Paper 3: Cohort Analysis', *Economic Implications of an Ageing Australia*, Research Report, Canberra.

—— 2006, *Potential Benefits of the National Reform Agenda*, Report to the Council of Australian Governments, Canberra.

—— 2010a, *Impacts and Benefits of COAG Reforms: Reporting Framework*, Research Report, Canberra.

—— 2010b, *Population and Migration: Understanding the Numbers*, Commission Research Paper, December.

—— 2012, *Impacts of COAG Reforms: Business Regulation and VET*, Research Report, Canberra.

Penec, S. 2009, 'APPSIM — Cohort Component Population Projections to Validate and Align the Dynamic Microsimulation Model APPSIM', Working Paper no. 12, National Centre for Social and Economic Modelling, University of Canberra.

Phillips, J., Klapdor, M. and Simon−Davies, J. 2010, *Migration to Australia since Federation: A Guide to the Statistics*, Background Note, Australian Parliamentary Library, Canberra, 29 October.

Prebisch, R. 1950, 'The Economic Development of Latin America and its Principal Problems', Sponsored by the Economic Commission for Latin America, United Nations, New York, Reprinted in *Economic Bulletin for Latin America*, vol. 7, no. 1, pp. 1–22.

Queensland Government 2011, *State Budget 2011-12: Mid-Year Fiscal and Economic Review*, Brisbane.

Roberts, I. and Rush, A. 2010, 'Sources of Chinese Demand for Resource Commodities', Research Discussion Paper no. 8, Reserve Bank of Australia, Sydney.

Siedlecky, S. and Wyndham, D. 1990, *Populate and Perish*, Allen & Unwin, Sydney.

Singer, H.W. 1950, 'U.S. Foreign Investment in Underdeveloped Areas: The Distribution of Gains Between Investing and Borrowing Countries', *American Economic Review, Papers and Proceedings,* no. 40, pp. 473–85.

State Government of Victoria 2011, *2011-12 Victorian Budget Update*, Melbourne.

Stevens, G. 2011, 'The Resources Boom', Presentation at the Victoria University Public Conference on The Resources Boom: Understanding National and Regional Implications, Melbourne, 23 February.

Topp, V. and Kulys, T. 2012, *Productivity in Electricity, Gas and Water: Measurement and Interpretation*, Staff Working Paper, Productivity Commission, Canberra.

——, Soames, L., Parham, D. and Bloch, H. 2008, *Productivity in the Mining Industry: Measurement and Interpretation*, Staff Working Paper, Productivity Commission, Canberra.

Treasury (Department of the Treasury) 2011, *Strong Growth, Low Pollution, Modelling A Carbon Price*, Canberra, September.

Weston, R., Stanton, D., Qu, L. and Soriano, G. 2001, 'Australian Families in Transition: Some Socio-Demographic Trends 1901–2001', *Family Matters*, no. 60, pp. 12–23.