Australian Government
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VUMR Modelling Reference Case, 2009-10 to 2059-60

Productivity Commission
Staff Working Paper

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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.

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Preface

This technical paper updates the 2012 modelling reference case used by the Productivity Commission to assess the impacts of a range of reforms being progressed by the Council of Australian Governments (PC 2012b).

Earlier versions of this reference case have supported modelling undertaken for a number of Commission inquiries, including *Australia's Automotive Manufacturing Industry* (PC 2014), *Workplace Relations Framework* (PC 2015b) and *Migrant Intake into Australia* (PC 2016).

The focus of this paper is to develop a dynamic reference case to run with the Victoria University Multi-Region (VUMR) model.[1] The reference case provides a simplified general counterfactual or simplified projection of the economy against which the impacts of potential policies can be assessed. Specific adaptations may be needed on a case-by-case basis to this reference case to assess the impact of policies in particular subject matter areas.

The paper outlines the general assumptions adopted, the basis on which these assumptions are made and the model projections of their impact. The reference case does not represent a forecast of the size and composition of the economy into the future.

The supplement has benefited from feedback received from participants at a modelling workshop held on 24 June 2015, and from consultations conducted as part of the relevant inquiries.

This staff working paper was prepared by Owen Gabbitas and Umme Salma under the supervision of Paul Gretton.

The authors are grateful to Phil Bomford for assistance received, to participants at a number of modelling workshops that provided useful feedback and for comments received from Commission staff.

[1] The model can be obtained from the Centre of Policy Studies at the Victoria University www.vu.edu.au/centre-of-policy-studies-cops).

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ANZSIC	Australian and New Zealand Standard Industrial Classification
ASEAN	Association of Southeast Asian Nations
ASFR	Age-specific fertility rate
AUST	Australia
CGE	Computable general equilibrium (model)
CIE	Centre for International Economics
COAG	Council of Australian Governments
CoPS	Centre of Policy Studies
DCD	Dual rate of cost diminution
DFAT	Department of Foreign Affairs and Trade
DIAC	Department of Immigration and Citizenship
DIBP	Department of Immigration and Border Protection
DIIS	Department of Industry, Innovation and Science
DIMA	Department of Immigration and Multicultural Affairs
DSP	Disability support pension
FDI	Foreign direct investment
GDP	Gross domestic product
GFC	Global financial crisis
GFS	Government finance statistics
GNE	Gross national expenditure
GSP	Gross state product
GST	Goods and services tax
GTEM	Global trade and environment model
GVA	Gross value added
HFCE	Household final consumption expenditure
ICT	Information and communications technology
IEA	International Energy Agency
IMF	International Monetary Fund

IPD	Implicit price deflator
LHS	Left hand side
LNG	Liquefied natural gas
MFP	Multifactor productivity
MMRF	Monash Multi-Regional Forecasting (model)
MYEFO	Mid-Year Economic and Fiscal Outlook
NEM	National Electricity Market
NOM	Net overseas migration
NSW	New South Wales
NT	Northern Territory
OECD	Organisation for Economic Co-operation and Development
PC	Productivity Commission
PEFO	Pre-election Economic and Fiscal Outlook
PPP	Population, participation and productivity (framework)
QLD	Queensland
RBA	Reserve Bank of Australia
RHS	Right hand side
SA	South Australia
SITC	Standard International Trade Classification
TAS	Tasmania
TFR	Total fertility rate
TWI	Trade weighted index
US	United States
VIC	Victoria
VUMR	Victoria University Multi-Region (model)
VURM	Victoria University Regional Model (same as VUMR)
WA	Western Australia

1 Introduction

The Productivity Commission has traditionally used economy-wide computable general equilibrium (CGE) modelling to illustrate the impacts of widely-based economic policy changes. These models and modelling frameworks have undergone considerable changes since first used in the 1980s.

The early modelling frameworks were *comparative* in the sense that they compared the economy before and after policy or other economic changes (box 1.1, left panel). They were *static* in the sense that they did not trace out the time path by which the economy transitioned to the new outcome (the adjustment path). These models typically focused on the national economy, with the fiscal and demographic aspects determined outside the model.

More recently, the Commission has used dynamic CGE modelling frameworks to report on both the impacts of policy and other changes and the timescale over which these impacts may occur. The current framework consists of a dynamic multi-region (states and territories) model with fully developed fiscal and demographic modules incorporated in to it. This approach was used to report on, among other things, the impacts of national reform (PC 2012a) and changes in *Australia's Automotive Manufacturing Industry* (PC 2014).

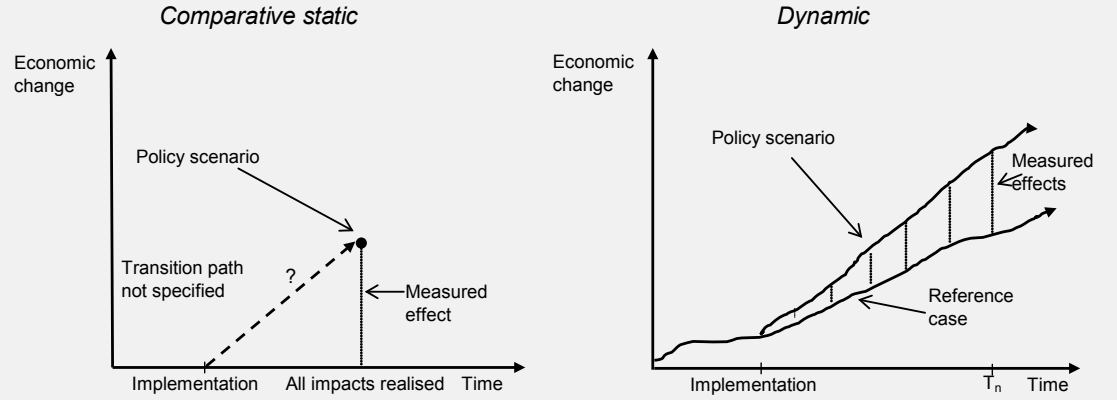
A dynamic modelling framework involves imposing an assessment of the direct impacts of a policy scenario through time (either actual or potential) on a CGE model and comparing how the economy-wide impacts vary over time relative to a projected 'reference case'. This reference case represents how the economy may have evolved over time in the absence of the policy changes being examined (box 1.1, right panel).

The reference case provides an indicative path of the economy over time based on 'business as usual' policy settings and parameters. It provides the modelling 'counterfactual' against which the impact of policy or other economic change scenarios are evaluated. That is, the impact of a change will be measured as the difference between the modelling scenario and the reference case scenario (box 1.1, right panel). The reference case abstracts from short- to medium-term variation in economic activity, as it makes the assumption that the variables will move smoothly towards their longer-term projections from their values in the base year. On occasions, this base year value can diverge considerably from the estimated equilibrium value in the model. The modelling reference case is therefore a simplified projection of the progression of the economy, rather than a forecast of the size and composition of the economy.

Box 1.1 Comparative-static and dynamic approaches to assessing economy-wide impacts

Under a comparative-static approach, the impact of a policy or other change is measured against the representation of the economy in a benchmark period. It compares the effect on the economy pre- and post-full adjustment to the policy change. This approach provides 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 dynamic approach models the impacts of a policy or other economic change through time. Like the comparative-static approach, the impacts can be dynamically assessed in each year against the level and structure of the economic activity in the model database. Alternatively, these impacts can be assessed against a 'reference case' that, at least stylistically, represents the prospective evolution of the economy in the absence of the policy change being examined (right panel). The reference case represents a general counterfactual against which the dynamic impacts can be assessed rather than a forecast of the economy through time. An advantage of the alternative approach is that the impacts will incorporate the effect of future changes in the level and structure of economic activity (including demographic change). These interactions are likely to be more important where the policy being examined has long gestation or implementation periods, or where the changes in future economic activity have a material effect on the magnitude or timing of the impacts of the policy being examined.

The dynamic CGE model currently being used by the Commission is the Victoria University Multi-Region (VUMR) model, which was developed by the Centre of Policy Studies (CoPS) at Victoria University. The VUMR model was previously known as the Monash Multi-Regional Forecasting (MMRF) model (CoPS 2014).[1] The database for the current model is based on economic data for the 2009-10 financial year (CoPS 2015).

[1] The model was renamed when the Centre of Policy Studies moved from Monash University to Victoria University in February 2014. The model is also sometimes referred to as the Victoria University Regional Model (VURM).

The reference case documented in this paper was developed to support a number of Commission inquiries, including *Workplace Relations Framework* (PC 2015b) and *Migrant Intake* (PC 2016).

It projects the level and broad structure of the economy from the database reference year of 2009-10 through to 2059-60. It updates and extends the modelling reference case that was used to assess the impacts of Council of Australian Governments' (COAG) reforms (PC 2012b).

2 Developing the reference case

This chapter outlines the role played by the modelling reference case in assessing the impacts of reform or policy change and how the reference case documented in this paper is developed.

2.1 About the reference case

As discussed, the reference case in a dynamic model represents a projection of the path of the economy over time, based on assumptions about the impacts of existing policy settings and other factors influencing the evolution of the economy. It forms the base line against which the likely effects of a modelling scenario or 'shock' of particular interest on the development and/or composition of the economy are compared (see box 1.1 in chapter 1).

The dynamic CGE model has two advantages over comparative-static CGE. First is that it is explicit about the timescale over which changes induced by policy or other shocks are likely to occur. Second, it allows for interactions between a particular policy scenario being assessed and other influences on the economy, environment and society. For example, the economic impact of reforms that seek to improve the quality of school education will depend on, among other things, the number of students affected at each point in time as well as how these students interact with the labour market over their working lives. This in turn depends on the state of the economy at the time students are entering the labour market (due to hysteresis and other effects). So, to the extent that the reference case captures this over time, the estimation of the impact of a policy shock will be improved. Hence, the importance of the reference case is in providing a consistent framework for policy analysis rather than providing a prediction of the future.

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

First, past trends (for example in productivity, prices and sectoral changes) may not always provide the most appropriate indicators of future trends. Any reference case makes assumptions about how these may evolve over time.

Second, past trends embody the results of policy reforms and other changes over the period on which they are based. In making projections based on these trends, there is an implicit assumption that the impacts of past policies or other change will continue. Yet to the extent that such changes have worked through the system, using trends based on rates of change will tend to overstate future change. For example, participation rates of women have risen considerably over the past few decades, but such growth rates will inevitably slow as they

get closer to full participation. In these situations, the use of levels data may be more appropriate for ascertaining future growth rates than the application of historical trends. Hence judgment is needed in making 'business as usual' assumptions.

A suitably constructed reference case should be transparent about the mechanisms and parameters that determine the path of economic activity in the model.

2.2 Factors influencing the reference case

The reference case presented here extends from 2009-10 to 2059-60 to support the assessment of policy changes with longer implementation and gestation periods. The modelled path of the economy over time will be conditioned by a range of assumptions about Australia's broad economic policy settings, the performance of 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 impacts of particular economic change, 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 would 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 gross domestic product (GDP) through lump-sum transfers to, or from, households, with government revenues and expenditures varying in line with indicators of activity and price, 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 (detailed in box 2.1 at the end of this chapter).[2]

[2] This approach is often referred to as the 'population, participation and productivity' (PPP) framework.

From 1974-75 to 2013-14:

- Australia's population increased annually by around 1.3 per cent, and accounted for about 40 per cent of the annual increase in national output (real gross value added (GVA)), which grew by 3.2 per cent per year (figure 2.1).[3]
- Increased labour force participation contributed an additional 0.1 percentage points to the increase in annual output, reflecting the net effect of:
  - positive contributions from an increase in the share of the population that is of working-age (+0.3 percentage points) and labour market participation (+0.1 percentage point); and
  - a negative contribution from a fall in average hours worked per person (-0.3 percentage points).
- Collectively, population growth and increased labour force participation meant that growth in labour inputs, expressed in terms of hours worked, contributed 1.4 percentage points, or about 45 per cent, to the annual increase in national output.[4]
- Increases in labour productivity — constant price gross value added (output) per hour of labour inputs used — added a further 1.7 percentage points per year to growth.

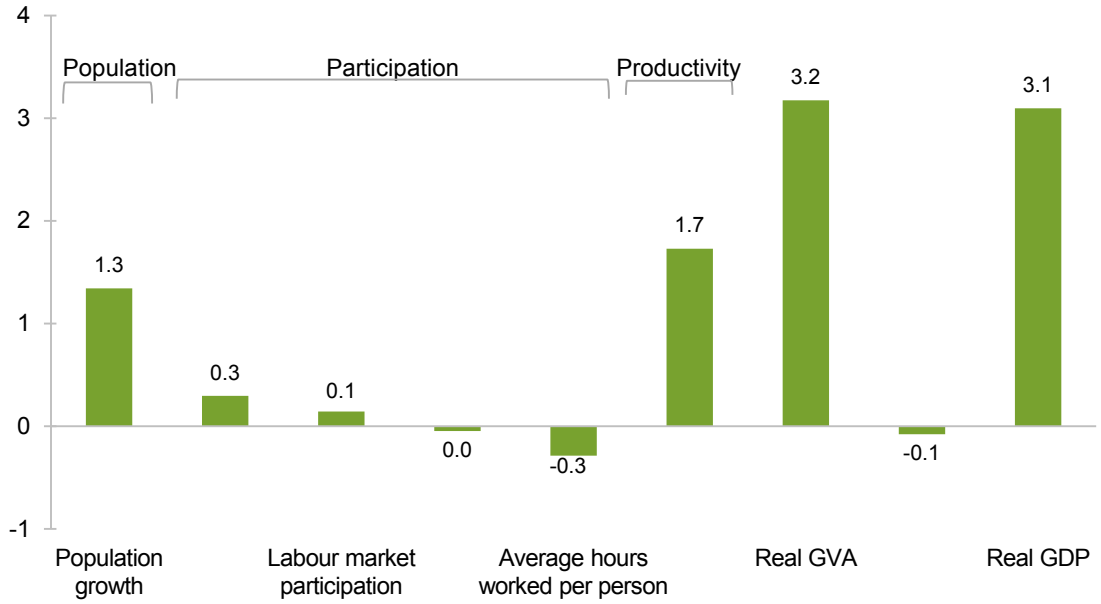
Historically, 60 per cent of the growth in labour productivity has come from capital deepening — reflecting changes in the use of capital per unit of labour input. The remaining 40 per cent of the growth came from changes in the productivity of labour and/or capital brought through technological or organisational change — termed multifactor productivity (MFP) growth.

3 The period of historical analysis used in this document varies depending on data availability. Much of the industry data used is available on a more-or-less consistent basis from 1974-75.

4 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.

Figure 2.1 **Contributions to real GDP growth, 1974-75 to 2013-14[a]**

Percentage points per year



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

Sources: Estimates based on ABS (*Population by Age and Sex, Australian States and Territories*, Cat. no. 3201.0); ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia*, Cat no. 6202.0); ABS (*Labour Force Historical Timeseries, Australia*, 1966 to 1984, Cat. no. 6204.0.55.001).

2.3 The reference case modelling environment

Development of the reference case requires assumptions about possible future changes in the population of Australia, participation in the workforce, employment and labour productivity. It also requires assumptions about other factors that might influence future income levels and the distribution of output and employment between activities and regions, including changes in foreign trade and the composition of household and government demand.

General approach

The modelling environment used for the VUMR reference case assumes that:

- The price of household final consumption expenditure (HFCE) is the model numeraire. That is, all price changes in the model are expressed in relative terms compared to changes in aggregate consumer prices. 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.
- Population growth and the aggregate supply of labour are determined by the demographic and labour market characteristics of the population as represented in the cohort-based demographic module in the VUMR model, and using the demographic and labour market assumptions outlined in chapters 5 and 6. The number of households in each state is assumed to change in line with state population. The unemployment rate by occupation in each state is held exogenous (fixed).
- 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 the values in the VUMR database (CoPS 2015). The adjustment process is outlined in CoPS (2014).
- The budget position (deficit or surplus) is held fixed as a share of GDP or gross state product (GSP) through the use of lump-sum transfers to, or from, households.
- Average tax rates are assumed to remain fixed so that nominal government revenue (other than from the lump-sum tax) moves in line with the various tax bases.
- Nominal government expenditure (including government consumption and other outlays) moves in line with the underlying drivers of economic activity in VUMR (such as population, unemployment, aggregate economic activity and prices) (detailed in the annex to chapter 11).
- National and regional household consumption are determined by post-tax household disposable income.
- The balance on current account varies with the balance of trade and net payments overseas, and is assumed to be funded by changes in net foreign liabilities. It varies as a ratio of GDP in local currency prices.

The starting point

Chapter 3 outlines the 2009-10 VUMR database that forms the starting point for developing the reference case.

Chapter 4 outlines the general approach used to 'uprate' the VUMR database to reflect the level and broad structure of the economy in 2013-14 based on published data. Uprating is particularly important as 2009-10, which represented the most recent Input-Output database available at the commencement of this work, was a somewhat unusual year. This is due to the influence of the global financial crisis and the government response, emergence of the mining investment boom, and the millennial drought. The specific shocks used in the uprating are outlined in each of the thematic chapters (chapters 5 to 11).

Detailed reference case assumptions

The detailed assumptions that underpin the reference case are developed thematically.

Chapter 5 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 used in other studies along with the accompanying key assumptions that underpin those projections. The chapter concludes by presenting the population assumptions contained in the reference case.

Chapter 6 reports on national developments in *participation* in the workforce by people of working age (defined as 15 years and over). 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. This analysis is extended to state and territory labour markets. The chapter reports on the future labour market assumptions used in other studies, which inform the labour market assumptions contained in the reference case. These assumptions are presented at the end of the chapter.

National developments in *labour productivity* are reported in chapter 7. The chapter distinguishes between contributions to labour productivity growth arising from capital deepening and from MFP growth. The chapter also reports labour productivity growth by broad industry category along with projections of future trends in productivity growth used in other studies. Options for modelling technical and organisational changes underpinning multifactor productivity growth in the reference case are also considered. The chapter concludes by presenting the labour productivity growth assumptions contained in the reference case.

Chapters 8 to 11 report on factors that may influence national income and the distribution of activity between industries and regions.

- Chapter 8 reports on historical trends in Australian *foreign trade*, available longer-term projections used in other studies, and the approach used in the reference case.
- Chapter 9 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 the approach used in the reference case to model overseas remittances.
- Chapter 10 reports on historical trends in *government finances* and the composition of government final consumption expenditure. It also considers the implications of demographic change on the pattern of demand for government services. The chapter outlines the methodology used in the reference case to implement the assumption that nominal budget balances remains fixed as a share of GDP.

- Chapter 11 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 and residential care services).

Each of these chapters:

- reviews recent historical trends in aggregate and by component;
- outlines the implications of a continuation of past trends into the projection period;
- examines comparable assumptions adopted in other studies, such as the Treasury's Intergenerational reporting and official modelling of carbon emission reduction policies; and
- states the assumptions that have been adopted in the reference case.

The reference case assumptions developed in each chapter cover three sub-periods:

- the period for which actual data (usually ABS) is available to uprate the model database (generally 2009-10 to 2013-14);
- the long-term trend used (generally 2017-18 to 2059-60); and
- a transition period over which the assumptions based on actual data are gradually adjusted (on a linear basis) to the long-term trends used (generally 2013-14 to 2017-18).[5]

The modelling reference case

Chapter 12 details the level and distribution of economic activity in the projection period to 2059-60 implied by the reference case assumptions outlined in the preceding chapters.

Some areas for further research

Chapter 13 concludes this paper by suggesting some areas for further research.

[5] The adjustment period for changes in demographic trends (chapter 4) occurs over longer time periods than most other adjustments in the reference case. Net overseas migration is unwound from the historically above average levels to 2024-25, while changes in fertility and mortality rates occur throughout the reference case to 2059-60.

Box 2.1 The population, participation and productivity (PPP) framework used in this paper

The PPP framework is used in this paper to decompose national production into the contributions made by the underlying sources of economic change.

In nominal terms, *gross domestic product* (GDP) is defined by the ABS in its *Australian System of National Accounts* (Cat. no. 5204.0) as the sum of:

- *gross value added* (GVA) — the value added in production by all industries in the economy; and
- *other taxes less subsidies on products*.

Removing the effects of price changes gives:

$$Real\ GDP = Real\ GVA + Real\ other\ taxes\ less\ subsidies\ on\ products$$

Real gross value added can be further decomposed into:

$$Real\ GVA = Population \times Labour\ market\ participation \times Labour\ productivity$$

This relationship is referred to as the 'PPP framework' for short.

Labour market participation can be further decomposed into:

$$\frac{Working-age\ population}{Population} \times \frac{Labour\ supply}{Working-age\ population} \times \frac{Employment}{Labour\ supply} \times \frac{Hours\ worked}{Employment}$$

Where:

$\frac{Real\ GVA}{Hours\ worked}$	labour productivity (annual real value added per hour worked);
$\frac{Working-age\ population}{Population}$	share of the population that is of working-age (taken here to be 15 years and over);
$\frac{Labour\ supply}{Working-age\ population}$	labour market participation rate (share of the working-age population that is in the labour market) (divided by 100);
$\frac{Employment}{Labour\ supply}$	employment rate (share of the labour market that is employed), which is the converse of the unemployment rate (both divided by 100); and
$\frac{Hours\ worked}{Employment}$	average hours worked per person employed in that year.

Collectively, these terms give:

$$Real\ GDP = [Population] \times \left[\frac{Working-age\ population}{Population} \times \frac{Labour\ supply}{Working-age\ population} \times \frac{Employment}{Labour\ supply} \times \frac{Hours\ worked}{Employment}\right] \times \left[\frac{Real\ GVA}{Hours\ worked}\right] \times \left[\frac{Real\ GDP}{Real\ GVA}\right]$$

Where:

$\frac{Real\ GVA}{Hours\ worked}$	Labour productivity

This paper applies this levels framework in percentage change terms to decompose the growth in real output into the contributions made by growth in each of these components over time.

3 The VUMR model database

This chapter provides an overview of the 2009-10 VUMR model database that forms the starting point for the development of the modelling reference case. It commences by summarising the 2009-10 database developed by the CoPS (section 3.1). It concludes by summarising the disaggregation of the returns to capital subsequently introduced to reflect the strong growth in export prices of individual mining commodities that were not driven by higher production costs (section 3.2).

3.1 Summary of the 2009-10 model database

The 2009-10 database was developed by the CoPS for the Productivity Commission and The Treasury. The database is based on the historical ABS *Input-Output Tables* for 2009-10 and represents the level and structure of the Australian and state and territory economies in 2009-10. The database is documented in CoPS (2015), and summarised below in box 3.1.

Starting initially from the 2009-10 database, the modelling reference case progressively 'uprates' the level and structure of the Australian and state and territory economies in each simulation year using the assumptions and methodologies outlined in chapters 4 to 11.

This section contains data tables from the 2009-10 VUMR model database covering:

Detailed data tables

Database structure

- the industry structure (table 3.1);
- the commodity structure, margin services and product taxes (table 3.2);

Macroeconomic aggregates

- components of GSP and GDP on the expenditure and income sides (table 3.3 and 3.4, respectively);
- higher-level demographic aggregates (table 3.5);

Box 3.1 Construction of the 2009-10 VUMR model database

The Centre of Policy Studies was engaged by the Productivity Commission and The Treasury to develop the 2009-10 VUMR model database.

The database has a reference year of 2009-10. 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*, 2009-10, Final, Cat. no. 5209.0.55.001). Supplementary sources were used to provide additional demographic, labour market and other data needed to provide a complete 'snapshot' of the economy in 2009-10. CoPS disaggregated 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 CoPS in this task, the Productivity Commission and The Treasury supplied various state and national control targets based on published ABS data. The CoPS 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 meant that the resulting database did not necessarily align with all 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 demographic module has been compiled by the Commission based on various ABS demographic publications.

The construction of the 2009-10 VUMR database is documented in CoPS (2015).

Government Finance Statistics module

- government revenue, expenditure and fiscal balances (table 3.6, 3.7 and 3.8, respectively);

Cohort-based demographic module data

- population by age and state, males and females (table 3.9 and 3.10, respectively);
- fertility rate assumptions by state (table 3.11);
- mortality rates by age and state, males, and females (table 3.12 and 3.13, respectively);
- annual change in mortality rates by age and state, males and females used to update the mortality rates (table 3.14 and 3.15, respectively);
- net overseas migration by age and state, males and females (table 3.16 and 3.17, respectively);
- net interstate migration by age and state, males and females (table 3.18 and 3.19, respectively); and
- labour market participation rates by age and state, males and females (table 3.20 and 3.21, respectively).

Table 3.1 **VUMR industries**

1. Sheep & beef cattle
2. Whole milk & dairy cattle
3. Other animals
4. Crops & grains
5. Other agriculture
6. Fishing, hunting & aquaculture
7. Forestry & logging
8. Agriculture, forestry, fishing support services
9. Coal mining
10. Oil extraction (includes condensate)
11. Gas extraction
12. Liquefied natural gas production
13. Iron ore mining
14. Non-ferrous metal ore mining
15. Non-metallic mineral mining
16. Exploration & mining support services
17. Meat products
18. Dairy products
19. Other food product manufacturing
20. Beverage & tobacco product manufacturing
21. Textiles, clothing & footwear
22. Sawmill & other wood products
23. Pulp, paper & paper products
24. Printing & recorded media
25. Petroleum & coal products
26. Basic chemical & chemical products
27. Polymer & rubber products
28. Non-metallic mineral products
29. Cement, lime & concrete
30. Iron & steel
31. Alumina
32. Aluminium
33. Other non-ferrous metals
34. Metal products
35. Motor vehicles & parts
36. Other equipment
37. Other manufacturing
38. Electricity generation: coal
39. Electricity generation: gas
40. Electricity generation: hydro
41. Electricity generation: renewables
42. Electricity generation: alternative
43. Electricity supply (retail & wholesale)
44. Gas supply
45. Water supply, sewerage & drainage
46. Waste collection, treatment & disposal
47. Residential building construction
48. Non-residential building construction
49. Construction services
50. Wholesale trade
51. Retail trade
52. Accommodation & food services
53. Road freight transport
54. Road passenger transport
55. Rail freight transport
56. Rail passenger transport
57. Pipeline transport
58. Water transport
59. Air transport
60. Transport services nec
61. Publishing, information & media
62. Telecommunication services
63. Banking services
64. Finance services other than banking
65. Insurance services
66. Superannuation fund services
67. Other financial services
68. Ownership of dwellings
69. Business services
70. Public administration & regulatory services
71. Defence
72. School education
73. Non-school education
74. Health care services
75. Residential care & social assistance
76. Arts & recreation services
77. Automotive repair & maintenance
78. Other repair & maintenance
79. Personal & other services

Table 3.2 **VUMR commodities, margin services and product taxes**

1. Sheep & beef cattle
2. Whole milk & dairy cattle
3. Other animals
4. Crops & grains
5. Other agriculture
6. Fishing, hunting & aquaculture
7. Forestry & logging
8. Agriculture, forestry, fishing support services
9. Coal mining (includes condensate)
10. Oil extraction
11. Gas extraction
12. Liquefied natural gas production
13. Iron ore mining
14. Non ferrous metal ore mining
15. Non-metallic mineral mining
16. Exploration & mining support services
17. Meat products
18. Dairy products
19. Other food product manufacturing
20. Beverage & tobacco product manufacturing
21. Textiles, clothing & footwear
22. Sawmill & other wood products
23. Pulp, paper & paper products
24. Printing & recorded media
25. Petrol[a]
26. Aviation fuel[a]
27. Other petroleum & coal products[a]
28. Diesel[a]
29. Refined liquefied petroleum gas[a]
30. Basic chemical & chemical products
31. Polymer & rubber products
32. Non-metallic mineral products
33. Cement, lime & concrete
34. Iron & steel
35. Alumina
36. Aluminium
37. Other non-ferrous metals
38. Metal products
39. Motor vehicles & parts
40. Other equipment
41. Other manufacturing
42. Electricity generation: coal
43. Electricity generation: gas
44. Electricity generation: hydro
45. Electricity generation: renewables
46. Electricity generation: alternative
47. Electricity supply (retail & wholesale)
48. Gas supply
49. Water supply, sewerage & drainage
50. Waste collection, treatment & disposal
51. Residential building construction
52. Non-residential building construction
53. Construction services
54. Wholesale trade
55. Retail trade
56. Accommodation & food services
57. Road freight transport
58. Road passenger transport
59. Rail freight transport
60. Rail passenger transport
61. Pipeline transport
62. Water transport
63. Air transport
64. Transport services nec
65. Publishing, information & media
66. Telecommunication services
67. Banking services
68. Finance services other than banking
69. Insurance services
70. Superannuation fund services
71. Other financial services
72. Ownership of dwellings
73. Business services
74. Public administration & regulatory services
75. Defence
76. School education
77. Non-school education
78. Health care services
79. Residential care & social assistance
80. Arts & recreation services
81. Automotive repair & maintenance
82. Other repair & maintenance
83. Personal & other services

(continued next page)

Table 3.2 (continued)

Transport & distribution margin services	*Product taxes*
Electricity transmission, distribution, on selling & electricity market operation (part of commodity 47)	*Goods & services taxes:*
Gas supply (part of commodity 48)	Intermediate input demand
Wholesale trade (part of commodity 54)	Investment demand
Retail trade (part of commodity 55)	Household demand
Food & beverage services (part of commodity 56)	*Other non-GST taxes less subsidies:*
Road freight transport (part of commodity 57)	Australian & State government taxes on intermediate use
Rail freight transport (part of commodity 59)	Australian & State government taxes on investment use
Pipeline transport (part of commodity 61)	Australian & State government taxes on households
Water & other transport (part of commodity 62)	Australian government taxes on exports
Air & space transport (part of commodity 63)	
Transport services & storage (part of commodity 64)	
Insurance & superannuation funds (part of commodity 68)	

a Jointly produced by the *Petroleum & coal products* industry (industry 25).

Source: CoPS (2015).

Table 3.3 **Components of GSP and GDP on the expenditure side in the VUMR database, 2009-10**

$ million

Component	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
Household consumption	239 133	177 391	138 367	49 500	72 150	14 425	7 674	12 603	711 243
Investment	91 634	80 141	78 332	21 526	66 706	5 956	5 584	7 519	357 398
State government consumption	41 898	34 439	29 120	10 793	16 854	3 889	3 357	2 512	142 862
Australian Government consumption	22 988	17 635	12 826	5 425	6 061	1 877	2 212	21 597	90 621
Net purchases from the NEM[a]	195	-26	-3	-7	0	-1	0	-158	0
Interstate exports	108 105	66 135	43 876	21 973	18 528	9 119	4 425	5 696	277 856
Interstate imports	-50 366	-43 130	-62 942	-27 452	-49 858	-14 085	-9 245	-20 778	-277 856
International exports	54 134	31 272	51 328	10 001	87 658	3 285	5 802	1 064	244 544
International imports	-97 837	-65 884	-38 211	-8 266	-36 730	-1 035	-3 521	-1 457	-252 941
Change in stocks	-684	-574	-295	-92	198	59	-8	-16	-1 411
Gross state/domestic product	**409 199**	**297 399**	**252 398**	**83 401**	**181 566**	**23 490**	**16 280**	**28 583**	**1 292 316**

[a] Sales of electricity to the national electricity market less purchases of electricity from the NEM.

Source: CoPS (2015).

Table 3.4 **Components of GSP and GDP on the income side in the VUMR database, 2009-10**

$ million

Component	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
Cost of labour	222 671	164 191	135 622	45 326	81 541	13 351	8 221	18 339	689 261
Cost of capital	143 504	100 666	90 244	28 976	84 743	7 608	6 553	8 005	470 299
Cost of agricultural land	1 714	1 598	1 606	683	935	207	83	2	6 828
GST revenue	15 696	11 675	9 222	3 065	4 872	904	549	846	46 830
Tariff revenue	1 218	910	527	129	428	16	43	24	3 295
Other indirect taxes	12 302	9 689	7 967	2 604	5 128	742	469	682	39 582
Other costs	12 095	8 669	7 210	2 619	3 920	662	361	685	36 221
Gross state/domestic product	**409 199**	**297 399**	**252 398**	**83 401**	**181 566**	**23 490**	**16 280**	**28 583**	**1 292 316**

Source: CoPS (2015).

Table 3.5 **Demographic data in the VUMR database, 2009-10[a]**

Thousands of persons

Measure	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[c]
Population	7 054	5 372	4 329	1 609	2 240	504	226	355	21 689
Working-age population[b]	5 704	4 377	3 457	1 320	1 803	407	173	290	17 531
Labour force	3 633	2 824	2 324	830	1 235	247	129	206	11 426
Employment	3 402	2 657	2 198	787	1 168	236	125	198	10 771
Unemployment	231	167	126	43	67	10	5	8	655
Unemployment rate (per cent)	6.3	5.9	5.4	5.2	5.4	4.1	3.5	3.6	5.7

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: CoPS (2015).

Table 3.6 **Government revenue in the VUMR database, 2009-10**

$ million

Revenue item	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*State & local*	*Aust Govt*[a]
Taxation revenue	21 121	16 715	11 668	4 337	7 259	1 094	490	1 106	63 790	265 383
Taxes on goods & services:	5 036	4 466	2 976	885	1 236	249	129	222	15 199	78 205
General taxes	0	0	0	0	0	0	0	0	0	1 247
GST	0	0	0	0	0	0	0	0	0	44 511
Excises and levies	4	69	0	0	0	0	0	0	73	25 303
International trade	0	0	0	0	0	0	0	0	0	5 762
Gambling	1 706	1 632	927	401	176	99	61	53	5 055	0
Insurance	1 761	1 403	508	347	428	64	29	57	4 597	0
Use of motor vehicles	2 255	1 437	1 651	464	895	130	46	114	6 992	0
Other[b]	-690	-75	-110	-327	-263	-44	-7	-2	-1 518	1 382
Factor inputs:	16 085	12 249	8 692	3 452	6 023	845	361	884	48 591	519
Payroll	6 148	4 056	2 674	900	2 298	261	152	273	16 762	507
Property	9 937	8 193	6 018	2 552	3 725	584	209	611	31 829	12
Income taxes:	0	0	0	0	0	0	0	0	0	186 659
Individuals	0	0	0	0	0	0	0	0	0	124 941
Enterprises	0	0	0	0	0	0	0	0	0	60 654
Non-residents	0	0	0	0	0	0	0	0	0	1 064
Australian Govt grants to states:	22 560	19 055	14 066	6 210	7 269	2 277	2 922	1 334	75 693	0
GST-tied[c]	13 472	10 155	8 239	4 098	3 588	1 647	2 406	906	44 511	0
Other current[d]	9 088	8 900	5 827	2 112	3 681	630	516	428	31 182	0
Sales of goods and services	21 989	12 199	16 429	4 714	17 015	3 224	1 024	942	77 536	19 210
Interest received	1 288	1 051	1 813	705	734	157	140	90	5 978	5 411
Other revenue	12 373	8 559	11 317	3 598	6 936	1 213	1 232	562	45 790	6 511
GFS Revenue	**79 331**	**57 579**	**55 293**	**19 564**	**39 213**	**7 965**	**5 808**	**4 034**	**268 787**	**296 515**

[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: CoPS (2015).

Table 3.7 **Government expenditure in the VUMR database, 2009-10**

$ million

Expenditure item	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*State & local*	*Aust Govt*[a]
Gross operating expenses	0	0	0	0	0	0	0	0	0	7 573
Personal benefit payments:[b]	0	0	0	0	0	0	0	0	0	11 861
Unemployment benefits[c]	0	0	0	0	0	0	0	0	0	29 870
Disability support pension (DSP)[d]	0	0	0	0	0	0	0	0	0	49 218
Age pensions[e]	0	0	0	0	0	0	0	0	0	98 522
Other personal benefit payments[f]	0	0	0	0	0	0	0	0	0	44 511
Grant expenses:	0	0	0	0	0	0	0	0	0	31 170
Australian Government to the states:	0	0	0	0	0	0	0	0	0	75 681
GST-tied[g]	0	0	0	0	0	0	0	0	0	12
Other current	0	0	0	0	0	0	0	0	0	8 808
Local governments	7 150	3 269	5 465	1 728	2 891	668	539	552	22 262	16 561
Universities	7 150	3 269	5 465	1 728	2 891	668	539	552	22 262	101 062
Private sector	4 607	2 411	4 857	1 314	1 528	442	320	286	15 765	13 842
Property expenses	682	267	20	130	4	0	10	3	1 116	8 472
Subsidy expenses	1 220	1 671	752	486	745	24	166	53	5 117	24 425
Capital transfers	545	913	245	69	470	0	39	9	2 290	0
Other expenditure[h]	0	0	0	0	0	0	0	0	0	0
GFS Expenditure	**74 920**	**56 088**	**55 641**	**18 658**	**37 580**	**7 712**	**5 291**	**3 977**	**259 867**	**349 560**

[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: CoPS (2015).

Table 3.8 **Fiscal balances in the VUMR database, 2009-10**

$ 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: CoPS (2015).

Table 3.9 **Population by age and state in the VUMR database, males, 30 June 2009**

Thousands

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
0	49.7	36.0	32.0	10.1	15.8	3.4	2.0	2.5	151.6
1	48.6	35.8	31.5	9.9	15.6	3.4	1.9	2.4	149.2
2	48.2	35.4	30.8	9.6	15.5	3.4	1.9	2.4	147.2
3	46.9	34.5	30.2	9.6	14.9	3.3	1.9	2.4	143.7
4	45.8	33.4	29.5	9.4	14.6	3.3	1.8	2.2	140.1
5	45.0	33.4	28.7	9.6	14.5	3.1	1.8	2.2	138.2
6	44.9	32.8	28.3	9.3	14.1	3.1	1.8	2.2	136.5
7	44.4	32.6	29.0	9.5	14.2	3.2	1.8	2.0	136.7
8	45.3	33.1	29.5	9.5	14.6	3.3	1.9	2.1	139.1
9	45.4	33.0	29.3	10.0	14.6	3.3	1.7	2.1	139.4
10	45.2	33.4	29.2	10.0	15.1	3.4	1.7	2.1	140.0
11	45.2	33.7	29.5	10.0	14.8	3.3	1.8	2.1	140.5
12	45.9	34.0	29.5	10.1	15.0	3.5	1.7	2.2	141.8
13	45.9	34.2	30.0	10.4	15.3	3.5	1.7	2.1	143.1
14	46.7	35.0	30.6	10.7	15.3	3.7	1.8	2.3	146.1
15	46.6	35.2	30.5	10.4	15.4	3.6	1.7	2.3	145.6
16	46.8	35.1	30.5	10.7	15.4	3.5	1.7	2.4	146.2
17	47.5	36.0	30.4	10.9	15.5	3.5	1.6	2.6	148.0
18	48.5	37.9	30.7	11.1	16.0	3.5	1.8	2.8	152.4
19	50.8	40.3	31.3	11.6	16.8	3.6	1.9	3.0	159.2
20	50.4	41.1	30.7	11.7	17.0	3.4	1.9	3.2	159.4
21	49.9	41.5	31.0	11.5	17.1	3.3	2.0	3.3	159.6
22	49.9	42.3	31.7	11.5	17.7	3.3	2.1	3.2	161.7
23	51.7	42.7	32.6	11.6	18.3	3.2	2.2	3.4	165.7
24	52.5	43.0	33.1	11.7	18.1	3.2	2.1	3.3	167.0
25	52.2	42.3	33.0	11.7	18.1	3.1	2.3	3.3	165.9
26	52.4	42.0	32.9	11.3	18.2	3.0	2.3	3.3	165.4
27	51.7	40.8	31.9	10.8	17.4	2.9	2.1	3.1	160.7
28	51.2	39.7	31.2	10.5	16.8	2.8	2.2	3.0	157.2
29	49.5	38.7	29.9	10.1	16.2	2.8	1.9	2.8	151.9
30	48.8	37.9	28.9	10.0	16.0	2.7	1.9	2.9	149.1
31	47.7	37.4	28.4	9.8	15.8	2.7	1.8	2.8	146.4
32	47.7	37.1	28.7	10.0	15.4	2.7	1.9	2.7	146.3
33	47.9	36.9	29.0	10.0	15.8	2.9	2.0	2.7	147.1
34	48.6	37.5	29.8	10.2	15.7	2.9	1.9	2.7	149.4
35	49.7	38.3	30.9	10.3	15.9	3.0	1.9	2.7	152.7
36	50.9	39.0	31.8	10.8	16.7	3.1	1.9	2.7	156.8
37	52.8	40.4	32.7	11.4	17.7	3.4	2.0	2.8	163.2
38	52.8	41.0	33.5	11.8	18.0	3.5	2.1	2.9	165.5
39	49.5	39.8	31.8	11.4	17.3	3.4	1.9	2.8	158.0
40	49.7	36.0	32.0	10.1	15.8	3.4	2.0	2.5	151.6

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Table 3.9 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
41	48.7	39.4	31.0	11.4	17.1	3.5	1.8	2.6	155.4
42	47.2	38.0	29.8	11.2	16.5	3.3	1.7	2.5	150.2
43	46.9	36.7	29.6	10.9	16.2	3.2	1.7	2.4	147.7
44	47.3	36.5	29.4	11.1	16.2	3.2	1.8	2.4	147.8
45	47.9	36.8	29.7	11.2	16.1	3.4	1.7	2.4	149.2
46	49.9	37.4	30.9	11.6	16.7	3.6	1.7	2.4	154.2
47	50.6	38.0	30.8	11.7	16.8	3.6	1.8	2.4	155.6
48	50.9	38.0	31.1	11.6	16.5	3.8	1.7	2.5	156.0
49	50.3	37.4	30.9	11.9	16.3	3.8	1.7	2.5	154.7
50	48.6	36.3	29.9	11.4	15.9	3.7	1.6	2.4	149.8
51	47.7	36.3	29.1	11.3	15.6	3.6	1.6	2.3	147.5
52	46.9	34.9	28.2	11.1	15.2	3.7	1.5	2.3	143.9
53	46.4	34.2	27.8	10.8	15.1	3.6	1.5	2.2	141.6
54	45.3	34.3	27.6	10.8	15.1	3.7	1.5	2.2	140.4
55	44.2	32.8	26.8	10.7	14.2	3.4	1.4	2.1	135.6
56	43.0	31.8	26.0	10.2	13.9	3.3	1.4	2.1	131.6
57	42.5	31.6	26.1	10.3	13.7	3.5	1.3	2.1	131.1
58	40.9	30.7	25.7	9.9	13.4	3.5	1.3	2.0	127.2
59	40.7	29.8	25.2	9.8	13.3	3.4	1.3	1.9	125.5
60	40.3	29.4	25.0	9.9	12.7	3.3	1.2	2.0	123.8
61	39.2	28.7	24.5	9.6	12.4	3.2	1.1	1.9	120.5
62	40.1	29.2	24.7	9.5	12.6	3.3	1.0	1.8	122.2
63	41.1	30.4	25.7	10.2	12.9	3.5	1.1	1.9	126.8
64	35.4	26.1	21.7	8.4	10.5	2.9	0.9	1.6	107.5
65	34.0	24.4	21.1	8.0	9.9	2.8	0.8	1.4	102.4
66	32.6	23.2	19.7	7.6	9.6	2.8	0.7	1.3	97.5
67	29.2	21.1	17.6	7.1	8.5	2.5	0.6	1.2	87.9
68	28.4	21.2	17.5	6.8	8.6	2.4	0.6	1.2	86.6
69	26.8	19.8	16.1	6.3	7.7	2.2	0.6	1.0	80.6
70	25.9	19.2	15.5	6.1	7.4	2.1	0.5	1.0	77.7
71	24.5	18.3	14.4	6.0	7.1	2.1	0.4	0.9	73.7
72	23.4	17.2	13.5	5.6	6.7	1.9	0.4	0.9	69.5
73	22.7	16.5	12.7	5.5	6.3	1.8	0.3	0.8	66.6
74	21.2	15.7	11.9	5.1	5.8	1.6	0.3	0.8	62.4
75	19.5	14.5	10.7	4.8	5.4	1.6	0.3	0.7	57.4
76	18.7	14.1	10.0	4.7	4.9	1.5	0.2	0.6	54.7
77	17.9	13.3	9.6	4.5	4.8	1.4	0.2	0.6	52.1
78	17.2	12.5	9.2	4.2	4.5	1.4	0.2	0.6	49.9
79	16.8	12.7	8.9	4.1	4.5	1.3	0.2	0.6	49.1
80	16.0	12.1	8.4	4.2	4.2	1.2	0.2	0.5	46.7

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Table 3.9 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
81	14.8	11.1	7.7	3.9	3.8	1.1	0.1	0.5	43.0
82	13.9	10.3	7.0	3.7	3.5	1.0	0.1	0.5	40.0
83	12.5	9.4	6.4	3.3	3.2	1.0	0.1	0.4	36.3
84	11.3	8.5	5.8	3.1	2.9	0.9	0.1	0.4	32.9
85	10.0	7.4	5.1	2.6	2.5	0.8	…	0.3	28.7
86	8.6	6.4	4.4	2.3	2.1	0.6	…	0.3	24.8
87	7.4	5.4	3.7	2.0	1.8	0.5	…	0.2	21.2
88	6.4	4.8	3.2	1.7	1.5	0.5	…	0.2	18.3
89	5.2	3.9	2.7	1.4	1.2	0.4	…	0.2	15.0
90	4.1	3.1	2.2	1.1	1.1	0.3	…	0.2	12.1
91	2.8	2.1	1.5	0.8	0.7	0.2	…	0.1	8.2
92	2.3	1.6	1.2	0.6	0.5	0.2	…	0.1	6.4
93	1.7	1.3	1.0	0.5	0.5	0.1	…	0.1	5.2
94	1.3	1.0	0.7	0.4	0.4	0.1	…	0.1	4.0
95	1.0	0.7	0.5	0.3	0.3	0.1	…	…	2.9
96	0.7	0.6	0.4	0.2	0.2	0.1	…	…	2.1
97	0.5	0.4	0.2	0.1	0.1	…	…	…	1.4
98	0.3	0.2	0.2	0.1	0.1	…	…	…	0.9
99	0.2	0.2	0.1	0.1	0.1	…	…	…	0.6
100+[b]	0.1	0.1	0.1	…	…	…	…	…	0.4
Total	**3 502.9**	**2 663.3**	**2 162.7**	**795.7**	**1 129.4**	**250.3**	**118.3**	**176.3**	**10 799.0**

… zero or less than 50. [a] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories)*. [b] 100 years and over.

Source: Estimates based on: ABS (*Population by Age and Sex, Australian States and Territories*, June 2014, Cat. no. 3201.0).

Table 3.10 **Population by age and state in the VUMR database, females, 30 June 2009**

Thousands

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
0	47.4	34.3	30.1	9.6	14.8	3.2	1.9	2.3	143.6
1	46.5	34.0	29.7	9.6	15.1	3.2	1.9	2.2	142.1
2	45.5	33.5	28.7	9.5	14.7	3.2	1.8	2.2	139.1
3	44.4	33.0	28.5	9.1	14.5	3.1	1.8	2.2	136.7
4	42.9	31.7	27.9	9.1	13.8	3.0	1.7	2.1	132.2
5	42.3	31.7	27.5	8.9	13.6	2.9	1.7	2.1	130.7
6	42.5	31.2	26.9	9.0	13.8	2.9	1.8	2.0	130.0
7	42.1	31.2	27.4	9.1	13.6	3.0	1.7	2.0	130.1
8	42.8	31.2	28.0	9.3	13.9	3.1	1.8	2.1	132.0
9	43.3	31.9	27.7	9.4	14.1	3.2	1.6	2.1	133.2
10	42.8	31.8	27.8	9.6	14.3	3.3	1.6	2.1	133.3
11	43.0	31.3	28.2	9.6	14.1	3.1	1.6	2.0	133.0
12	43.4	32.2	28.4	9.7	14.2	3.3	1.5	2.1	134.9
13	43.4	32.4	28.5	9.8	14.3	3.3	1.5	2.1	135.2
14	44.4	33.2	29.1	9.9	14.5	3.4	1.6	2.1	138.2
15	44.2	33.3	28.7	10.0	14.6	3.3	1.5	2.2	137.7
16	44.1	33.8	28.7	10.2	14.6	3.3	1.6	2.3	138.5
17	44.3	34.0	29.5	10.4	14.7	3.3	1.5	2.4	140.3
18	46.2	35.7	29.5	10.5	15.3	3.4	1.6	2.7	144.7
19	47.4	37.7	30.0	11.0	15.8	3.2	1.6	2.9	149.7
20	47.3	38.2	30.0	10.9	16.1	3.2	1.6	3.1	150.3
21	46.9	38.9	30.2	10.9	16.0	3.1	1.6	3.1	150.7
22	47.7	38.7	30.6	10.9	16.1	3.1	1.7	3.0	151.9
23	49.2	39.6	31.5	11.1	16.5	3.1	1.9	3.0	155.9
24	50.5	40.5	32.0	11.0	16.6	3.1	2.0	3.1	158.8
25	50.9	40.3	31.6	11.0	16.4	3.0	2.1	3.2	158.3
26	51.5	40.3	31.7	10.7	16.3	2.9	2.1	3.1	158.7
27	50.9	39.7	30.4	10.4	16.0	3.0	2.0	3.2	155.5
28	50.4	39.1	30.0	10.3	15.7	3.0	2.1	3.0	153.6
29	49.1	38.2	29.5	9.9	15.4	2.8	1.9	2.9	149.8
30	48.7	37.7	29.0	9.7	15.4	2.9	1.8	2.8	148.0
31	48.2	37.1	28.8	9.7	15.0	2.8	1.8	2.7	146.1
32	48.4	36.9	29.0	9.9	15.1	2.7	1.8	2.6	146.5
33	48.4	37.3	29.4	9.8	15.3	2.9	1.9	2.5	147.5
34	49.2	38.1	29.9	10.0	15.5	3.1	1.7	2.6	150.0
35	50.6	39.3	30.7	10.3	15.7	3.1	1.8	2.8	154.2
36	52.1	39.8	32.2	10.8	16.2	3.4	1.8	2.8	159.0
37	53.8	41.9	33.5	11.5	17.2	3.6	1.8	2.9	166.2
38	54.3	43.2	34.0	11.7	17.4	3.7	1.9	2.8	169.0
39	50.8	40.6	32.1	11.4	16.7	3.5	1.8	2.7	159.5
40	50.2	40.3	31.6	11.4	16.6	3.5	1.7	2.6	157.9

(continued next page).

Table 3.10 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
41	48.2	38.8	30.4	11.1	16.1	3.4	1.6	2.5	152.1
42	47.7	37.6	30.1	11.0	15.8	3.4	1.6	2.4	149.6
43	47.7	37.8	29.9	11.2	15.8	3.3	1.6	2.6	150.0
44	48.7	37.9	30.5	11.3	16.1	3.5	1.5	2.5	152.0
45	50.7	38.6	31.3	11.6	16.3	3.7	1.5	2.6	156.3
46	51.7	38.9	31.9	11.8	16.6	3.7	1.6	2.5	158.6
47	51.3	38.7	31.9	11.9	16.3	3.8	1.5	2.6	158.1
48	51.3	38.5	31.4	12.0	16.3	4.0	1.6	2.6	157.7
49	49.8	37.6	30.4	11.7	15.9	3.9	1.4	2.5	153.2
50	48.6	36.9	29.8	11.6	15.6	3.7	1.4	2.5	150.2
51	48.4	36.0	29.1	11.2	15.1	3.6	1.4	2.4	147.2
52	46.8	35.3	28.2	11.3	14.9	3.7	1.4	2.4	143.8
53	45.8	34.8	27.7	11.0	14.9	3.6	1.4	2.3	141.5
54	45.0	33.8	27.2	10.6	14.4	3.5	1.3	2.3	138.1
55	43.6	32.8	26.5	10.6	13.9	3.5	1.3	2.2	134.3
56	43.3	32.6	26.0	10.6	13.7	3.5	1.2	2.2	133.1
57	41.6	31.3	25.3	10.3	13.2	3.3	1.1	2.1	128.4
58	41.0	31.2	25.1	10.3	12.9	3.3	1.1	2.1	127.0
59	40.5	30.7	25.0	10.1	12.6	3.3	0.9	2.0	125.1
60	39.2	29.6	24.1	9.8	12.3	3.2	0.9	1.9	121.0
61	39.6	30.2	23.9	9.9	11.9	3.2	0.8	1.9	121.6
62	41.0	31.3	24.9	10.5	12.4	3.4	0.8	2.0	126.2
63	35.2	26.3	21.0	8.8	9.9	2.9	0.7	1.6	106.3
64	34.1	25.0	20.7	8.5	9.6	2.8	0.6	1.5	102.9
65	32.8	24.3	19.3	8.0	9.4	2.6	0.6	1.4	98.4
66	29.7	21.9	17.5	7.4	8.4	2.4	0.5	1.2	89.1
67	28.9	21.7	17.1	7.1	8.4	2.4	0.4	1.2	87.2
68	27.6	20.3	15.7	6.6	7.8	2.2	0.5	1.1	81.8
69	26.5	19.8	15.1	6.6	7.5	2.1	0.4	1.0	79.0
70	25.6	19.2	14.4	6.5	7.3	2.0	0.3	1.0	76.2
71	24.6	18.5	13.1	6.2	6.9	2.0	0.3	0.9	72.5
72	23.9	17.7	12.8	6.0	6.5	1.9	0.2	0.9	70.1
73	23.3	17.4	12.1	5.7	6.4	1.8	0.2	0.8	67.7
74	22.1	16.4	11.6	5.4	6.0	1.7	0.2	0.8	64.1
75	20.8	16.0	10.8	5.3	5.6	1.7	0.2	0.8	61.1
76	20.5	15.5	10.6	5.2	5.5	1.6	0.2	0.7	59.7
77	20.1	14.9	10.2	5.1	5.3	1.5	0.2	0.7	58.0
78	20.3	15.2	10.5	5.3	5.2	1.6	0.2	0.6	58.8
79	19.9	15.0	10.0	5.1	5.1	1.5	0.1	0.6	57.4
80	19.0	14.1	9.5	5.0	4.7	1.4	0.1	0.6	54.6

(continued next page)

Table 3.10 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[a]
81	18.3	13.6	9.2	4.8	4.6	1.3	0.1	0.6	52.5
82	17.2	13.0	8.4	4.7	4.3	1.2	0.1	0.6	49.5
83	16.2	12.3	8.1	4.5	4.0	1.2	0.1	0.6	47.0
84	15.4	11.4	7.6	4.2	3.7	1.2	0.1	0.5	44.1
85	14.0	10.4	6.7	3.7	3.3	1.0	0.1	0.5	39.8
86	12.7	9.2	6.1	3.5	3.0	1.0	0.1	0.5	36.0
87	11.4	8.4	5.6	3.2	2.7	0.9	0.1	0.4	32.6
88	9.9	7.5	4.9	2.8	2.4	0.7	…	0.3	28.6
89	8.1	6.2	4.1	2.2	2.1	0.6	…	0.3	23.7
90	6.1	4.5	3.1	1.6	1.5	0.4	…	0.2	17.6
91	5.3	3.8	2.6	1.4	1.2	0.4	…	0.1	14.9
92	4.5	3.2	2.2	1.2	1.0	0.4	…	0.1	12.7
93	3.6	2.6	1.7	0.9	1.0	0.3	…	0.1	10.2
94	2.9	2.2	1.4	0.8	0.8	0.2	…	0.1	8.4
95	2.2	1.6	1.0	0.6	0.6	0.1	…	0.1	6.2
96	1.5	1.1	0.7	0.5	0.4	0.1	…	…	4.4
97	1.1	0.8	0.6	0.3	0.3	0.1	…	…	3.2
98	0.8	0.6	0.3	0.2	0.2	…	…	…	2.2
99	0.5	0.4	0.3	0.2	0.1	…	…	…	1.5
100+[b]	0.8	0.6	0.4	0.2	0.2	0.1	…	…	2.2
Total	**3 550.8**	**2 708.6**	**2 166.0**	**813.2**	**1 110.8**	**254.1**	**107.7**	**178.5**	**10 889.8**

… zero or less than 50. [a] Excludes residents of Jervis Bay, Christmas Island or Cocos (Keeling) Islands (termed *Other territories)*. [b] 100 years and over.

Source: Estimates based on: ABS (*Population by Age and Sex, Australian States and Territories*, June 2014, Cat. no. 3201.0).

Table 3.11 **Fertility rates by state in the VUMR database, 2009-10**

Mother's age	*NSW*	*VIC*	*Qld*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
Total fertility rate (births per woman)									
	2.01	1.85	2.07	1.90	1.98	2.14	2.14	1.82	1.97
Age-specific fertility rates (births per 1000 women)[a]									
15	3.0	1.8	5.0	3.2	3.9	4.8	9.9	1.8	3.4
16	6.4	4.0	10.7	6.8	8.5	10.3	21.3	4.0	7.3
17	13.3	8.2	22.0	14.1	17.5	21.1	43.8	8.2	15.1
18	20.8	12.8	34.5	22.0	27.3	33.1	68.6	12.8	23.6
19	31.2	19.2	51.9	33.1	41.1	49.7	103.1	19.2	35.4
20	39.9	28.6	53.6	41.5	44.9	58.2	70.1	25.3	42.4
21	44.9	32.2	60.3	46.7	50.5	65.4	78.7	28.4	47.7
22	52.6	37.7	70.7	54.7	59.2	76.7	92.3	33.3	55.9
23	58.7	42.1	78.9	61.1	66.1	85.6	103.0	37.2	62.4
24	67.1	48.1	90.1	69.8	75.5	97.7	117.7	42.5	71.2
25	76.9	70.0	87.3	84.7	82.2	94.3	77.1	68.5	81.7
26	88.8	80.9	100.8	97.9	94.9	108.9	89.1	79.1	94.4
27	100.3	91.3	113.8	110.5	107.1	123.0	100.6	89.3	106.6
28	111.2	101.3	126.3	122.6	118.9	136.4	111.6	99.1	118.2
29	118.8	108.2	134.8	130.9	126.9	145.7	119.1	105.8	126.2
30	125.7	129.2	124.0	126.6	127.4	118.8	108.0	138.6	131.3
31	129.3	132.9	127.6	130.2	131.0	122.1	111.0	142.5	135.1
32	126.9	130.4	125.2	127.8	128.6	119.9	109.0	139.9	132.6
33	118.8	122.0	117.2	119.6	120.3	112.2	102.0	130.9	124.1
34	109.6	112.6	108.2	110.4	111.1	103.6	94.1	120.8	114.5
35	100.5	105.7	88.9	89.1	92.2	79.5	83.2	109.4	102.2
36	85.4	89.9	75.6	75.7	78.4	67.6	70.7	93.0	86.9
37	69.9	73.5	61.8	61.9	64.1	55.3	57.8	76.1	71.1
38	53.7	56.5	47.6	47.6	49.3	42.5	44.5	58.5	54.7
39	40.9	43.0	36.2	36.3	37.5	32.4	33.8	44.5	41.6
40	30.9	32.4	25.8	25.1	26.7	22.1	26.5	33.5	29.9
41	20.7	21.8	17.4	16.8	17.9	14.8	17.8	22.5	20.1
42	12.8	13.5	10.7	10.4	11.1	9.2	11.0	14.0	12.5
43	7.3	7.6	6.1	5.9	6.3	5.2	6.2	7.9	7.1
44	3.7	3.9	3.1	3.0	3.2	2.7	3.2	4.0	3.6
45	1.8	2.1	1.5	2.0	1.5	1.3	1.7	2.8	1.9
46	0.9	1.0	0.7	1.0	0.7	0.6	0.8	1.4	0.9
47	0.4	0.5	0.4	0.5	0.4	0.3	0.4	0.7	0.5
48	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.3	0.2
49	0.3	0.4	0.3	0.4	0.3	0.2	0.3	0.5	0.4
Sex ratio (males births per 100 female births)[b]									
	105.7	105.9	104.4	105.8	105.0	107.2	107.4	109.6	105.5

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 2009 and 2010.

Source: Estimates based on: ABS (*Australian Demographic Statistics*, March 2014, Cat. no. 3101.0); ABS (*Births, Australia*, 2013, Cat. no. 3301.0).

Table 3.12 **Mortality rates by age and state in the VUMR database, males, 2009-10[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	0.00384	0.00316	0.00475	0.00314	0.00301	0.00409	0.00660	0.00360
0	0.00081	0.00074	0.00094	0.00077	0.00074	0.00086	0.00140	0.00076
1	0.00007	0.00008	0.00010	0.00013	0.00011	0.00011	0.00058	0.00005
2	0.00013	0.00014	0.00017	0.00017	0.00017	0.00020	0.00067	0.00015
3	0.00011	0.00013	0.00013	0.00013	0.00012	0.00015	0.00042	0.00012
4	0.00010	0.00012	0.00011	0.00010	0.00011	0.00013	0.00035	0.00010
5	0.00009	0.00011	0.00010	0.00010	0.00009	0.00011	0.00029	0.00009
6	0.00009	0.00010	0.00008	0.00008	0.00010	0.00012	0.00025	0.00008
7	0.00009	0.00010	0.00009	0.00009	0.00009	0.00011	0.00023	0.00008
8	0.00009	0.00010	0.00008	0.00008	0.00009	0.00010	0.00023	0.00007
9	0.00009	0.00010	0.00008	0.00008	0.00009	0.00011	0.00025	0.00007
10	0.00009	0.00010	0.00009	0.00008	0.00010	0.00012	0.00027	0.00007
11	0.00009	0.00011	0.00010	0.00009	0.00011	0.00013	0.00032	0.00008
12	0.00010	0.00012	0.00012	0.00010	0.00012	0.00016	0.00038	0.00009
13	0.00012	0.00014	0.00015	0.00013	0.00016	0.00020	0.00048	0.00011
14	0.00018	0.00018	0.00022	0.00019	0.00022	0.00027	0.00062	0.00017
15	0.00027	0.00027	0.00033	0.00030	0.00032	0.00038	0.00080	0.00027
16	0.00039	0.00037	0.00044	0.00039	0.00044	0.00049	0.00097	0.00037
17	0.00047	0.00046	0.00054	0.00048	0.00055	0.00061	0.00115	0.00047
18	0.00054	0.00053	0.00062	0.00053	0.00062	0.00069	0.00130	0.00054
19	0.00058	0.00055	0.00066	0.00057	0.00067	0.00074	0.00141	0.00057
20	0.00057	0.00056	0.00068	0.00057	0.00068	0.00076	0.00148	0.00057
21	0.00056	0.00055	0.00067	0.00058	0.00068	0.00076	0.00154	0.00056
22	0.00056	0.00055	0.00067	0.00059	0.00069	0.00077	0.00160	0.00056
23	0.00057	0.00057	0.00069	0.00061	0.00071	0.00079	0.00166	0.00056
24	0.00058	0.00059	0.00071	0.00065	0.00074	0.00083	0.00173	0.00058
25	0.00061	0.00062	0.00075	0.00068	0.00078	0.00087	0.00180	0.00061
26	0.00064	0.00064	0.00078	0.00071	0.00081	0.00092	0.00186	0.00062
27	0.00066	0.00067	0.00082	0.00075	0.00086	0.00094	0.00193	0.00064
28	0.00069	0.00071	0.00085	0.00080	0.00090	0.00100	0.00199	0.00067
29	0.00073	0.00074	0.00090	0.00084	0.00094	0.00104	0.00204	0.00069
30	0.00077	0.00078	0.00093	0.00090	0.00098	0.00109	0.00211	0.00073
31	0.00080	0.00082	0.00098	0.00096	0.00103	0.00113	0.00216	0.00074
32	0.00084	0.00085	0.00101	0.00102	0.00107	0.00118	0.00223	0.00078
33	0.00089	0.00089	0.00107	0.00108	0.00112	0.00123	0.00229	0.00080
34	0.00093	0.00094	0.00111	0.00114	0.00117	0.00127	0.00237	0.00083
35	0.00098	0.00097	0.00116	0.00122	0.00122	0.00133	0.00245	0.00086
36	0.00104	0.00102	0.00121	0.00129	0.00128	0.00140	0.00254	0.00090
37	0.00110	0.00107	0.00127	0.00138	0.00133	0.00145	0.00264	0.00093
38	0.00117	0.00113	0.00134	0.00146	0.00140	0.00152	0.00276	0.00098
39	0.00125	0.00119	0.00140	0.00156	0.00147	0.00160	0.00288	0.00103
40	0.00134	0.00126	0.00149	0.00166	0.00155	0.00169	0.00304	0.00108

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Table 3.12 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
41	0.00145	0.00135	0.00158	0.00178	0.00164	0.00179	0.00320	0.00116
42	0.00156	0.00144	0.00169	0.00191	0.00174	0.00190	0.00339	0.00123
43	0.00169	0.00154	0.00181	0.00205	0.00185	0.00203	0.00360	0.00132
44	0.00184	0.00167	0.00194	0.00220	0.00198	0.00216	0.00383	0.00143
45	0.00200	0.00179	0.00209	0.00237	0.00212	0.00232	0.00410	0.00154
46	0.00219	0.00196	0.00227	0.00255	0.00228	0.00251	0.00438	0.00169
47	0.00239	0.00212	0.00246	0.00276	0.00245	0.00270	0.00469	0.00183
48	0.00262	0.00232	0.00268	0.00298	0.00264	0.00292	0.00503	0.00201
49	0.00287	0.00253	0.00291	0.00321	0.00285	0.00318	0.00541	0.00220
50	0.00313	0.00277	0.00317	0.00346	0.00309	0.00344	0.00581	0.00240
51	0.00342	0.00301	0.00344	0.00374	0.00333	0.00374	0.00623	0.00263
52	0.00373	0.00329	0.00374	0.00401	0.00360	0.00405	0.00668	0.00287
53	0.00407	0.00358	0.00406	0.00433	0.00388	0.00439	0.00715	0.00314
54	0.00442	0.00390	0.00441	0.00464	0.00419	0.00478	0.00766	0.00342
55	0.00480	0.00424	0.00478	0.00498	0.00451	0.00517	0.00820	0.00373
56	0.00521	0.00462	0.00518	0.00535	0.00487	0.00562	0.00877	0.00406
57	0.00566	0.00503	0.00563	0.00575	0.00526	0.00611	0.00939	0.00443
58	0.00616	0.00549	0.00612	0.00619	0.00569	0.00665	0.01004	0.00485
59	0.00671	0.00601	0.00667	0.00669	0.00618	0.00726	0.01077	0.00531
60	0.00732	0.00659	0.00728	0.00723	0.00673	0.00795	0.01156	0.00584
61	0.00801	0.00725	0.00797	0.00786	0.00734	0.00871	0.01241	0.00642
62	0.00878	0.00798	0.00873	0.00854	0.00803	0.00958	0.01335	0.00710
63	0.00962	0.00881	0.00960	0.00932	0.00881	0.01053	0.01439	0.00785
64	0.01056	0.00973	0.01054	0.01019	0.00967	0.01161	0.01552	0.00870
65	0.01161	0.01076	0.01161	0.01115	0.01064	0.01280	0.01675	0.00965
66	0.01277	0.01190	0.01279	0.01224	0.01173	0.01414	0.01812	0.01071
67	0.01407	0.01318	0.01411	0.01346	0.01295	0.01563	0.01963	0.01190
68	0.01552	0.01461	0.01557	0.01482	0.01431	0.01729	0.02129	0.01325
69	0.01712	0.01621	0.01720	0.01636	0.01584	0.01913	0.02312	0.01475
70	0.01890	0.01799	0.01902	0.01806	0.01754	0.02119	0.02514	0.01643
71	0.02087	0.01994	0.02103	0.01997	0.01943	0.02346	0.02737	0.01829
72	0.02308	0.02214	0.02326	0.02210	0.02154	0.02598	0.02984	0.02038
73	0.02554	0.02461	0.02578	0.02452	0.02394	0.02882	0.03262	0.02275
74	0.02837	0.02742	0.02864	0.02731	0.02668	0.03204	0.03577	0.02546
75	0.03159	0.03063	0.03192	0.03051	0.02983	0.03570	0.03936	0.02859
76	0.03530	0.03433	0.03567	0.03419	0.03346	0.03987	0.04346	0.03218
77	0.03954	0.03857	0.03997	0.03845	0.03764	0.04464	0.04815	0.03634
78	0.04439	0.04341	0.04490	0.04332	0.04243	0.05004	0.05349	0.04109
79	0.04992	0.04891	0.05049	0.04891	0.04790	0.05616	0.05955	0.04652
80	0.05617	0.05513	0.05680	0.05522	0.05409	0.06304	0.06639	0.05269

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Table 3.12 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
81	0.06320	0.06213	0.06390	0.06236	0.06107	0.07076	0.07409	0.05963
82	0.07105	0.06995	0.07184	0.07036	0.06889	0.07933	0.08265	0.06742
83	0.07981	0.07863	0.08064	0.07926	0.07760	0.08885	0.09241	0.07609
84	0.08944	0.08822	0.09038	0.08912	0.08722	0.09928	0.10295	0.08569
85	0.10000	0.09870	0.10100	0.09993	0.09777	0.11069	0.11423	0.09619
86	0.11143	0.11001	0.11252	0.11160	0.10917	0.12296	0.12674	0.10757
87	0.12364	0.12213	0.12478	0.12416	0.12138	0.13607	0.14009	0.11973
88	0.13671	0.13503	0.13793	0.13758	0.13446	0.15008	0.15434	0.13277
89	0.15044	0.14874	0.15191	0.15187	0.14837	0.16494	0.16958	0.14663
90	0.16524	0.16237	0.16512	0.16553	0.16158	0.17911	0.18409	0.15980
91	0.18099	0.17732	0.17830	0.17910	0.17471	0.19328	0.19958	0.17290
92	0.19603	0.19228	0.19290	0.19418	0.18925	0.20881	0.21616	0.18737
93	0.21257	0.20859	0.20993	0.21179	0.20637	0.22687	0.23510	0.20448
94	0.23225	0.22807	0.23419	0.23730	0.23160	0.24792	0.28753	0.22903
95	0.25094	0.24628	0.25271	0.25681	0.25041	0.26711	0.31076	0.24768
96	0.27173	0.26667	0.27335	0.27817	0.27136	0.28870	0.33621	0.26848
97	0.29152	0.28630	0.29335	0.29913	0.29139	0.30892	0.36121	0.28862
98	0.30973	0.30401	0.31125	0.31854	0.31001	0.32821	0.38412	0.30689
99	0.32907	0.32281	0.33024	0.33920	0.32982	0.34871	0.40849	0.32632
100+[c]	0.34079	0.34700	0.35101	0.35992	0.34938	0.37728	0.39024	0.34639

[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 2009–2011 and 2010–2012 converted from an 'exact age' 'basis to an 'age-at-last-birthday' basis using the methodology outlined in PC (2005). [c] 100 years and over.

Source: Estimates based on: ABS (*Life Tables, Australia,* 2009–2010 and 2010–2012, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.13 **Mortality rates by age and state in the VUMR database, females, 2009-10[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	0.00304	0.00247	0.00393	0.00263	0.00239	0.00305	0.00639	0.00206
0	0.00062	0.00058	0.00077	0.00067	0.00059	0.00036	0.00138	0.00050
1	0.00006	0.00008	0.00012	0.00015	0.00011	0.00018	0.00049	0.00004
2	0.00013	0.00011	0.00019	0.00010	0.00014	0.00006	0.00028	0.00011
3	0.00011	0.00009	0.00014	0.00008	0.00011	0.00007	0.00020	0.00008
4	0.00009	0.00009	0.00012	0.00006	0.00009	0.00005	0.00017	0.00007
5	0.00008	0.00007	0.00010	0.00006	0.00009	0.00006	0.00016	0.00006
6	0.00007	0.00007	0.00009	0.00005	0.00009	0.00005	0.00015	0.00006
7	0.00006	0.00007	0.00009	0.00005	0.00008	0.00005	0.00015	0.00005
8	0.00006	0.00007	0.00009	0.00005	0.00009	0.00006	0.00015	0.00005
9	0.00006	0.00007	0.00008	0.00006	0.00010	0.00006	0.00016	0.00005
10	0.00006	0.00007	0.00010	0.00006	0.00011	0.00007	0.00019	0.00005
11	0.00006	0.00008	0.00010	0.00007	0.00012	0.00008	0.00023	0.00006
12	0.00007	0.00010	0.00011	0.00008	0.00014	0.00009	0.00025	0.00006
13	0.00009	0.00010	0.00013	0.00011	0.00016	0.00012	0.00030	0.00007
14	0.00011	0.00014	0.00016	0.00014	0.00020	0.00015	0.00036	0.00011
15	0.00016	0.00018	0.00020	0.00017	0.00024	0.00020	0.00041	0.00014
16	0.00019	0.00022	0.00024	0.00022	0.00028	0.00025	0.00048	0.00017
17	0.00022	0.00024	0.00027	0.00025	0.00031	0.00028	0.00053	0.00020
18	0.00023	0.00024	0.00028	0.00025	0.00032	0.00030	0.00057	0.00021
19	0.00023	0.00025	0.00028	0.00026	0.00032	0.00032	0.00060	0.00021
20	0.00023	0.00024	0.00028	0.00026	0.00032	0.00032	0.00062	0.00021
21	0.00022	0.00023	0.00028	0.00025	0.00032	0.00033	0.00065	0.00020
22	0.00023	0.00024	0.00029	0.00027	0.00032	0.00035	0.00069	0.00020
23	0.00024	0.00023	0.00029	0.00027	0.00033	0.00036	0.00073	0.00020
24	0.00024	0.00024	0.00031	0.00028	0.00034	0.00038	0.00077	0.00021
25	0.00026	0.00024	0.00031	0.00030	0.00034	0.00040	0.00080	0.00020
26	0.00026	0.00025	0.00033	0.00031	0.00035	0.00041	0.00083	0.00020
27	0.00027	0.00027	0.00034	0.00032	0.00036	0.00044	0.00087	0.00021
28	0.00030	0.00027	0.00035	0.00034	0.00037	0.00046	0.00091	0.00023
29	0.00032	0.00030	0.00038	0.00038	0.00039	0.00049	0.00096	0.00024
30	0.00033	0.00031	0.00040	0.00040	0.00041	0.00053	0.00102	0.00025
31	0.00036	0.00034	0.00042	0.00044	0.00043	0.00056	0.00106	0.00026
32	0.00039	0.00037	0.00045	0.00047	0.00046	0.00059	0.00114	0.00029
33	0.00041	0.00040	0.00048	0.00050	0.00049	0.00063	0.00120	0.00030
34	0.00046	0.00044	0.00051	0.00055	0.00052	0.00067	0.00128	0.00034
35	0.00050	0.00048	0.00055	0.00061	0.00055	0.00072	0.00137	0.00036
36	0.00055	0.00053	0.00060	0.00066	0.00060	0.00078	0.00147	0.00040
37	0.00060	0.00059	0.00064	0.00072	0.00064	0.00082	0.00158	0.00044
38	0.00065	0.00064	0.00071	0.00079	0.00070	0.00089	0.00170	0.00049
39	0.00071	0.00071	0.00077	0.00086	0.00077	0.00096	0.00183	0.00054
40	0.00079	0.00078	0.00084	0.00094	0.00083	0.00104	0.00197	0.00060

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Table 3.13 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
41	0.00086	0.00086	0.00092	0.00103	0.00091	0.00111	0.00213	0.00066
42	0.00095	0.00095	0.00101	0.00112	0.00098	0.00121	0.00229	0.00074
43	0.00105	0.00105	0.00110	0.00123	0.00108	0.00131	0.00247	0.00081
44	0.00114	0.00114	0.00120	0.00132	0.00117	0.00142	0.00265	0.00089
45	0.00125	0.00125	0.00131	0.00144	0.00128	0.00152	0.00285	0.00099
46	0.00137	0.00136	0.00143	0.00155	0.00138	0.00165	0.00305	0.00108
47	0.00149	0.00147	0.00154	0.00169	0.00150	0.00178	0.00327	0.00119
48	0.00163	0.00159	0.00168	0.00181	0.00162	0.00193	0.00349	0.00130
49	0.00177	0.00172	0.00181	0.00195	0.00175	0.00208	0.00372	0.00143
50	0.00192	0.00187	0.00196	0.00209	0.00188	0.00225	0.00396	0.00155
51	0.00208	0.00199	0.00211	0.00224	0.00203	0.00242	0.00421	0.00168
52	0.00225	0.00214	0.00228	0.00240	0.00218	0.00261	0.00446	0.00183
53	0.00243	0.00230	0.00246	0.00257	0.00234	0.00282	0.00472	0.00198
54	0.00263	0.00249	0.00264	0.00275	0.00251	0.00306	0.00501	0.00215
55	0.00285	0.00269	0.00285	0.00294	0.00270	0.00331	0.00528	0.00234
56	0.00309	0.00289	0.00308	0.00315	0.00291	0.00358	0.00559	0.00255
57	0.00336	0.00313	0.00333	0.00340	0.00314	0.00391	0.00592	0.00278
58	0.00365	0.00337	0.00361	0.00365	0.00340	0.00427	0.00627	0.00304
59	0.00398	0.00364	0.00391	0.00396	0.00367	0.00465	0.00666	0.00334
60	0.00435	0.00398	0.00427	0.00428	0.00399	0.00511	0.00706	0.00368
61	0.00476	0.00435	0.00465	0.00465	0.00434	0.00560	0.00752	0.00404
62	0.00521	0.00473	0.00508	0.00506	0.00472	0.00616	0.00801	0.00446
63	0.00571	0.00516	0.00555	0.00551	0.00516	0.00678	0.00855	0.00493
64	0.00626	0.00568	0.00609	0.00602	0.00563	0.00747	0.00913	0.00544
65	0.00687	0.00624	0.00666	0.00658	0.00615	0.00824	0.00978	0.00601
66	0.00753	0.00686	0.00730	0.00720	0.00673	0.00908	0.01049	0.00665
67	0.00828	0.00758	0.00803	0.00791	0.00738	0.01003	0.01130	0.00737
68	0.00918	0.00845	0.00891	0.00878	0.00819	0.01116	0.01227	0.00825
69	0.01032	0.00955	0.01002	0.00987	0.00920	0.01256	0.01348	0.00936
70	0.01165	0.01083	0.01133	0.01118	0.01042	0.01417	0.01492	0.01067
71	0.01301	0.01210	0.01269	0.01252	0.01167	0.01587	0.01643	0.01203
72	0.01440	0.01336	0.01406	0.01389	0.01291	0.01760	0.01797	0.01341
73	0.01589	0.01487	0.01556	0.01539	0.01428	0.01949	0.01968	0.01491
74	0.01758	0.01658	0.01726	0.01709	0.01583	0.02164	0.02165	0.01662
75	0.01957	0.01860	0.01927	0.01911	0.01766	0.02410	0.02393	0.01862
76	0.02191	0.02099	0.02162	0.02148	0.01985	0.02698	0.02666	0.02100
77	0.02468	0.02385	0.02445	0.02433	0.02247	0.03035	0.02990	0.02384
78	0.02798	0.02727	0.02780	0.02773	0.02561	0.03429	0.03376	0.02721
79	0.03185	0.03131	0.03176	0.03173	0.02934	0.03888	0.03805	0.03117
80	0.03640	0.03603	0.03641	0.03644	0.03372	0.04419	0.04283	0.03584

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Table 3.13 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
81	0.04168	0.04157	0.04181	0.04191	0.03885	0.05029	0.04846	0.04125
82	0.04778	0.04792	0.04804	0.04821	0.04478	0.05726	0.05503	0.04749
83	0.05471	0.05520	0.05515	0.05542	0.05157	0.06517	0.06242	0.05462
84	0.06262	0.06350	0.06327	0.06363	0.05933	0.07410	0.07063	0.06272
85	0.07164	0.07295	0.07250	0.07299	0.06821	0.08418	0.08005	0.07197
86	0.08165	0.08348	0.08281	0.08345	0.07811	0.09535	0.09127	0.08229
87	0.09251	0.09490	0.09394	0.09474	0.08884	0.10741	0.10348	0.09342
88	0.10480	0.10784	0.10657	0.10753	0.10105	0.12096	0.11687	0.10605
89	0.11845	0.12218	0.12062	0.12174	0.11462	0.13592	0.13269	0.12007
90	0.13284	0.13733	0.13537	0.13672	0.12893	0.15164	0.15023	0.13483
91	0.14817	0.15351	0.15119	0.15275	0.14424	0.16840	0.16859	0.15060
92	0.16461	0.17083	0.16809	0.16989	0.16068	0.18628	0.18760	0.16753
93	0.18274	0.18992	0.18675	0.18878	0.17878	0.20583	0.20854	0.18610
94	0.20118	0.20948	0.20847	0.20811	0.19643	0.22638	0.25175	0.20326
95	0.21710	0.22663	0.22538	0.22492	0.21241	0.24416	0.27384	0.21973
96	0.23356	0.24421	0.24278	0.24229	0.22895	0.26212	0.29733	0.23662
97	0.25197	0.26406	0.26230	0.26168	0.24749	0.28229	0.32451	0.25579
98	0.26520	0.27875	0.27666	0.27591	0.26093	0.29727	0.34687	0.26937
99	0.27911	0.29426	0.29181	0.29092	0.27509	0.31304	0.37076	0.28366
100+[c]	0.32314	0.34075	0.33250	0.33703	0.32108	0.35683	0.38004	0.33066

[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 2009–2011 and 2010–2012 converted from an 'exact age' 'basis to an 'age-at-last-birthday' basis using the methodology outlined in PC (2005). [c] 100 years and over.

Source: Estimates based on: ABS (*Life Tables, Australia,* 2009–2011 and 2010–2012, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.14 **Annual change in mortality rates by age and state in the VUMR database, males, 2009-10[a]**

Per cent per year

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
Newborns	-4.69	-4.69	-4.69	-4.69	-4.69	-4.69	-7.17	-4.69
0	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-7.15	-4.68
1	-4.65	-4.65	-4.65	-4.65	-4.65	-4.65	-7.08	-4.65
2	-4.58	-4.58	-4.58	-4.58	-4.58	-4.58	-6.95	-4.58
3	-4.46	-4.46	-4.46	-4.46	-4.46	-4.46	-6.75	-4.46
4	-4.32	-4.32	-4.32	-4.32	-4.32	-4.32	-6.51	-4.32
5	-4.16	-4.16	-4.16	-4.16	-4.16	-4.16	-6.24	-4.16
6	-3.99	-3.99	-3.99	-3.99	-3.99	-3.99	-5.98	-3.99
7	-3.84	-3.84	-3.84	-3.84	-3.84	-3.84	-5.72	-3.84
8	-3.69	-3.69	-3.69	-3.69	-3.69	-3.69	-5.49	-3.69
9	-3.56	-3.56	-3.56	-3.56	-3.56	-3.56	-5.27	-3.56
10	-3.44	-3.44	-3.44	-3.44	-3.44	-3.44	-5.08	-3.44
11	-3.35	-3.35	-3.35	-3.35	-3.35	-3.35	-4.92	-3.35
12	-3.26	-3.26	-3.26	-3.26	-3.26	-3.26	-4.78	-3.26
13	-3.19	-3.19	-3.19	-3.19	-3.19	-3.19	-4.66	-3.19
14	-3.14	-3.14	-3.14	-3.14	-3.14	-3.14	-4.56	-3.14
15	-3.09	-3.09	-3.09	-3.09	-3.09	-3.09	-4.47	-3.09
16	-3.04	-3.04	-3.04	-3.04	-3.04	-3.04	-4.38	-3.04
17	-2.98	-2.98	-2.98	-2.98	-2.98	-2.98	-4.28	-2.98
18	-2.91	-2.91	-2.91	-2.91	-2.91	-2.91	-4.17	-2.91
19	-2.82	-2.82	-2.82	-2.82	-2.82	-2.82	-4.03	-2.82
20	-2.71	-2.71	-2.71	-2.71	-2.71	-2.71	-3.85	-2.71
21	-2.58	-2.58	-2.58	-2.58	-2.58	-2.58	-3.65	-2.58
22	-2.42	-2.42	-2.42	-2.42	-2.42	-2.42	-3.42	-2.42
23	-2.26	-2.26	-2.26	-2.26	-2.26	-2.26	-3.18	-2.26
24	-2.09	-2.09	-2.09	-2.09	-2.09	-2.09	-2.93	-2.09
25	-1.93	-1.93	-1.93	-1.93	-1.93	-1.93	-2.70	-1.93
26	-1.78	-1.78	-1.78	-1.78	-1.78	-1.78	-2.48	-1.78
27	-1.65	-1.65	-1.65	-1.65	-1.65	-1.65	-2.29	-1.65
28	-1.54	-1.54	-1.54	-1.54	-1.54	-1.54	-2.13	-1.54
29	-1.46	-1.46	-1.46	-1.46	-1.46	-1.46	-2.01	-1.46
30	-1.40	-1.40	-1.40	-1.40	-1.40	-1.40	-1.40	-1.40
31	-1.37	-1.37	-1.37	-1.37	-1.37	-1.37	-1.37	-1.37
32	-1.37	-1.37	-1.37	-1.37	-1.37	-1.37	-1.37	-1.37
33	-1.38	-1.38	-1.38	-1.38	-1.38	-1.38	-1.38	-1.38
34	-1.42	-1.42	-1.42	-1.42	-1.42	-1.42	-1.42	-1.42
35	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47
36	-1.53	-1.53	-1.53	-1.53	-1.53	-1.53	-1.53	-1.53
37	-1.61	-1.61	-1.61	-1.61	-1.61	-1.61	-1.61	-1.61
38	-1.69	-1.69	-1.69	-1.69	-1.69	-1.69	-1.69	-1.69
39	-1.77	-1.77	-1.77	-1.77	-1.77	-1.77	-1.77	-1.77
40	-1.85	-1.85	-1.85	-1.85	-1.85	-1.85	-1.85	-1.85

(continued next page)

Table 3.14 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
41	-1.94	-1.94	-1.94	-1.94	-1.94	-1.94	-1.94	-1.94
42	-2.02	-2.02	-2.02	-2.02	-2.02	-2.02	-2.02	-2.02
43	-2.10	-2.10	-2.10	-2.10	-2.10	-2.10	-2.10	-2.10
44	-2.18	-2.18	-2.18	-2.18	-2.18	-2.18	-2.18	-2.18
45	-2.25	-2.25	-2.25	-2.25	-2.25	-2.25	-2.25	-2.25
46	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32
47	-2.38	-2.38	-2.38	-2.38	-2.38	-2.38	-2.38	-2.38
48	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44
49	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50
50	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55
51	-2.60	-2.60	-2.60	-2.60	-2.60	-2.60	-2.60	-2.60
52	-2.65	-2.65	-2.65	-2.65	-2.65	-2.65	-2.65	-2.65
53	-2.69	-2.69	-2.69	-2.69	-2.69	-2.69	-2.69	-2.69
54	-2.74	-2.74	-2.74	-2.74	-2.74	-2.74	-2.74	-2.74
55	-2.78	-2.78	-2.78	-2.78	-2.78	-2.78	-2.78	-2.78
56	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81
57	-2.85	-2.85	-2.85	-2.85	-2.85	-2.85	-2.85	-2.85
58	-2.87	-2.87	-2.87	-2.87	-2.87	-2.87	-2.87	-2.87
59	-2.90	-2.90	-2.90	-2.90	-2.90	-2.90	-2.90	-2.90
60	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92
61	-2.93	-2.93	-2.93	-2.93	-2.93	-2.93	-2.93	-2.93
62	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94
63	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94
64	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94	-2.94
65	-2.93	-2.93	-2.93	-2.93	-2.93	-2.93	-2.93	-2.93
66	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92	-2.92
67	-2.90	-2.90	-2.90	-2.90	-2.90	-2.90	-2.90	-2.90
68	-2.87	-2.87	-2.87	-2.87	-2.87	-2.87	-2.87	-2.87
69	-2.84	-2.84	-2.84	-2.84	-2.84	-2.84	-2.84	-2.84
70	-2.80	-2.80	-2.80	-2.80	-2.80	-2.80	-2.80	-2.80
71	-2.76	-2.76	-2.76	-2.76	-2.76	-2.76	-2.76	-2.76
72	-2.70	-2.70	-2.70	-2.70	-2.70	-2.70	-2.70	-2.70
73	-2.64	-2.64	-2.64	-2.64	-2.64	-2.64	-2.64	-2.64
74	-2.58	-2.58	-2.58	-2.58	-2.58	-2.58	-2.58	-2.58
75	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50	-2.50
76	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41
77	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32
78	-2.22	-2.22	-2.22	-2.22	-2.22	-2.22	-2.22	-2.22
79	-2.12	-2.12	-2.12	-2.12	-2.12	-2.12	-2.12	-2.12
80	-2.01	-2.01	-2.01	-2.01	-2.01	-2.01	-2.01	-2.01

(continued next page)

Table 3.14 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
81	-1.90	-1.90	-1.90	-1.90	-1.90	-1.90	-1.90	-1.90
82	-1.79	-1.79	-1.79	-1.79	-1.79	-1.79	-1.79	-1.79
83	-1.68	-1.68	-1.68	-1.68	-1.68	-1.68	-1.68	-1.68
84	-1.58	-1.58	-1.58	-1.58	-1.58	-1.58	-1.58	-1.58
85	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47
86	-1.36	-1.36	-1.36	-1.36	-1.36	-1.36	-1.36	-1.36
87	-1.26	-1.26	-1.26	-1.26	-1.26	-1.26	-1.26	-1.26
88	-1.16	-1.16	-1.16	-1.16	-1.16	-1.16	-1.16	-1.16
89	-1.07	-1.07	-1.07	-1.07	-1.07	-1.07	-1.07	-1.07
90	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97
91	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89
92	-0.81	-0.81	-0.81	-0.81	-0.81	-0.81	-0.81	-0.81
93	-0.74	-0.74	-0.74	-0.74	-0.74	-0.74	-0.74	-0.74
94	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68	-0.68
95	-0.63	-0.63	-0.63	-0.63	-0.63	-0.63	-0.63	-0.63
96	-0.59	-0.59	-0.59	-0.59	-0.59	-0.59	-0.59	-0.59
97	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57
98	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57
99	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
100+[c]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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 2010–2012 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 up to the age of 30 and the same as Queensland after that. **c** 100 years and over.

Source: Estimates based on: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Life Tables, Australia,* 2010–2012, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.15 **Annual change in mortality rates by age and state in the VUMR database, females, 2009-10[a]**

Per cent per year

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
Newborns	-3.92	-3.92	-3.92	-3.92	-3.92	-3.92	-6.26	-3.92
0	-3.88	-3.88	-3.88	-3.88	-3.88	-3.88	-6.20	-3.88
1	-3.84	-3.84	-3.84	-3.84	-3.84	-3.84	-6.11	-3.84
2	-3.80	-3.80	-3.80	-3.80	-3.80	-3.80	-6.02	-3.80
3	-3.75	-3.75	-3.75	-3.75	-3.75	-3.75	-5.93	-3.75
4	-3.70	-3.70	-3.70	-3.70	-3.70	-3.70	-5.83	-3.70
5	-3.64	-3.64	-3.64	-3.64	-3.64	-3.64	-5.71	-3.64
6	-3.56	-3.56	-3.56	-3.56	-3.56	-3.56	-5.57	-3.56
7	-3.47	-3.47	-3.47	-3.47	-3.47	-3.47	-5.40	-3.47
8	-3.37	-3.37	-3.37	-3.37	-3.37	-3.37	-5.22	-3.37
9	-3.25	-3.25	-3.25	-3.25	-3.25	-3.25	-5.01	-3.25
10	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-4.80	-3.12
11	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-4.59	-3.00
12	-2.88	-2.88	-2.88	-2.88	-2.88	-2.88	-4.39	-2.88
13	-2.76	-2.76	-2.76	-2.76	-2.76	-2.76	-4.19	-2.76
14	-2.65	-2.65	-2.65	-2.65	-2.65	-2.65	-4.01	-2.65
15	-2.55	-2.55	-2.55	-2.55	-2.55	-2.55	-3.84	-2.55
16	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-3.69	-2.46
17	-2.37	-2.37	-2.37	-2.37	-2.37	-2.37	-3.55	-2.37
18	-2.30	-2.30	-2.30	-2.30	-2.30	-2.30	-3.43	-2.30
19	-2.23	-2.23	-2.23	-2.23	-2.23	-2.23	-3.31	-2.23
20	-2.17	-2.17	-2.17	-2.17	-2.17	-2.17	-3.20	-2.17
21	-2.11	-2.11	-2.11	-2.11	-2.11	-2.11	-3.11	-2.11
22	-2.07	-2.07	-2.07	-2.07	-2.07	-2.07	-3.03	-2.07
23	-2.03	-2.03	-2.03	-2.03	-2.03	-2.03	-2.97	-2.03
24	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.91	-2.00
25	-1.98	-1.98	-1.98	-1.98	-1.98	-1.98	-2.87	-1.98
26	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-2.85	-1.97
27	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-2.82	-1.97
28	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-2.81	-1.97
29	-1.97	-1.97	-1.97	-1.97	-1.97	-1.97	-2.81	-1.97
30	-1.98	-1.98	-1.98	-1.98	-1.98	-1.98	-1.98	-1.98
31	-1.99	-1.99	-1.99	-1.99	-1.99	-1.99	-1.99	-1.99
32	-2.01	-2.01	-2.01	-2.01	-2.01	-2.01	-2.01	-2.01
33	-2.03	-2.03	-2.03	-2.03	-2.03	-2.03	-2.03	-2.03
34	-2.05	-2.05	-2.05	-2.05	-2.05	-2.05	-2.05	-2.05
35	-2.07	-2.07	-2.07	-2.07	-2.07	-2.07	-2.07	-2.07
36	-2.09	-2.09	-2.09	-2.09	-2.09	-2.09	-2.09	-2.09
37	-2.11	-2.11	-2.11	-2.11	-2.11	-2.11	-2.11	-2.11
38	-2.13	-2.13	-2.13	-2.13	-2.13	-2.13	-2.13	-2.13
39	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14
40	-2.16	-2.16	-2.16	-2.16	-2.16	-2.16	-2.16	-2.16

(continued next page)

Table 3.15 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
41	-2.17	-2.17	-2.17	-2.17	-2.17	-2.17	-2.17	-2.17
42	-2.19	-2.19	-2.19	-2.19	-2.19	-2.19	-2.19	-2.19
43	-2.21	-2.21	-2.21	-2.21	-2.21	-2.21	-2.21	-2.21
44	-2.22	-2.22	-2.22	-2.22	-2.22	-2.22	-2.22	-2.22
45	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24
46	-2.26	-2.26	-2.26	-2.26	-2.26	-2.26	-2.26	-2.26
47	-2.28	-2.28	-2.28	-2.28	-2.28	-2.28	-2.28	-2.28
48	-2.30	-2.30	-2.30	-2.30	-2.30	-2.30	-2.30	-2.30
49	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32	-2.32
50	-2.34	-2.34	-2.34	-2.34	-2.34	-2.34	-2.34	-2.34
51	-2.35	-2.35	-2.35	-2.35	-2.35	-2.35	-2.35	-2.35
52	-2.36	-2.36	-2.36	-2.36	-2.36	-2.36	-2.36	-2.36
53	-2.38	-2.38	-2.38	-2.38	-2.38	-2.38	-2.38	-2.38
54	-2.39	-2.39	-2.39	-2.39	-2.39	-2.39	-2.39	-2.39
55	-2.40	-2.40	-2.40	-2.40	-2.40	-2.40	-2.40	-2.40
56	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41
57	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41
58	-2.42	-2.42	-2.42	-2.42	-2.42	-2.42	-2.42	-2.42
59	-2.43	-2.43	-2.43	-2.43	-2.43	-2.43	-2.43	-2.43
60	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44
61	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44
62	-2.45	-2.45	-2.45	-2.45	-2.45	-2.45	-2.45	-2.45
63	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46
64	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46
65	-2.47	-2.47	-2.47	-2.47	-2.47	-2.47	-2.47	-2.47
66	-2.48	-2.48	-2.48	-2.48	-2.48	-2.48	-2.48	-2.48
67	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49
68	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49
69	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49
70	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49
71	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49
72	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49	-2.49
73	-2.48	-2.48	-2.48	-2.48	-2.48	-2.48	-2.48	-2.48
74	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46	-2.46
75	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44	-2.44
76	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41
77	-2.36	-2.36	-2.36	-2.36	-2.36	-2.36	-2.36	-2.36
78	-2.31	-2.31	-2.31	-2.31	-2.31	-2.31	-2.31	-2.31
79	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24	-2.24
80	-2.15	-2.15	-2.15	-2.15	-2.15	-2.15	-2.15	-2.15

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Table 3.15 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*[b]	*ACT*
81	-2.06	-2.06	-2.06	-2.06	-2.06	-2.06	-2.06	-2.06
82	-1.95	-1.95	-1.95	-1.95	-1.95	-1.95	-1.95	-1.95
83	-1.82	-1.82	-1.82	-1.82	-1.82	-1.82	-1.82	-1.82
84	-1.68	-1.68	-1.68	-1.68	-1.68	-1.68	-1.68	-1.68
85	-1.54	-1.54	-1.54	-1.54	-1.54	-1.54	-1.54	-1.54
86	-1.39	-1.39	-1.39	-1.39	-1.39	-1.39	-1.39	-1.39
87	-1.23	-1.23	-1.23	-1.23	-1.23	-1.23	-1.23	-1.23
88	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08
89	-0.95	-0.95	-0.95	-0.95	-0.95	-0.95	-0.95	-0.95
90	-0.83	-0.83	-0.83	-0.83	-0.83	-0.83	-0.83	-0.83
91	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75	-0.75
92	-0.72	-0.72	-0.72	-0.72	-0.72	-0.72	-0.72	-0.72
93	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36
94	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18
95	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
96	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
97	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
98	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
99	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
100+[c]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[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 2010–2012 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 up to the age of 30 and the same as Queensland after that. [c] 100 years and over.

Source: Estimates based on: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Life Tables, Australia,* 2010–2012, Cat. no. 3302.0.55.001) [and state-equivalents].

Table 3.16 **NOM by age and state in the VUMR database, males, 2009-10[a]**

Thousand

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
0	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
1	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
2	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
3	0.2	0.3	0.3	0.1	0.2	…	…	…	1.1
4	0.2	0.3	0.2	0.1	0.2	…	…	…	1.1
5	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
6	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
7	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
8	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
9	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
10	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
11	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
12	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
13	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
14	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
15	1.0	0.9	0.5	0.2	0.4	…	…	0.1	3.1
16	1.0	0.9	0.5	0.2	0.4	…	…	0.1	3.1
17	1.0	0.9	0.5	0.2	0.4	…	…	0.1	3.1
18	1.0	1.0	0.5	0.2	0.4	…	…	0.1	3.2
19	1.1	1.0	0.5	0.2	0.4	…	…	0.1	3.4
20	1.4	1.1	0.8	0.2	0.5	…	…	0.1	4.1
21	1.3	1.1	0.8	0.2	0.5	…	…	0.1	4.1
22	1.3	1.1	0.8	0.2	0.5	…	…	0.1	4.2
23	1.4	1.1	0.9	0.2	0.6	…	…	0.1	4.3
24	1.4	1.1	0.9	0.2	0.6	…	…	0.1	4.3
25	0.7	0.6	0.4	0.2	0.4	…	…	…	2.3
26	0.7	0.6	0.4	0.2	0.4	…	…	…	2.3
27	0.7	0.6	0.4	0.2	0.4	…	…	…	2.3
28	0.7	0.6	0.4	0.2	0.4	…	…	…	2.2
29	0.7	0.6	0.4	0.1	0.3	…	…	…	2.1
30	0.6	0.6	0.3	0.2	0.3	…	…	…	2.1
31	0.6	0.6	0.3	0.2	0.3	…	…	…	2.1
32	0.6	0.6	0.3	0.2	0.3	…	…	…	2.0
33	0.6	0.5	0.3	0.2	0.3	…	…	…	2.0
34	0.6	0.6	0.3	0.2	0.3	…	…	…	2.1
35	0.3	0.4	0.2	0.1	0.3	…	…	…	1.4
36	0.3	0.4	0.3	0.1	0.3	…	…	…	1.4
37	0.3	0.4	0.3	0.1	0.3	…	…	…	1.4
38	0.3	0.4	0.3	0.2	0.3	…	…	…	1.5
39	0.3	0.4	0.3	0.2	0.3	…	…	…	1.5
40	0.2	0.3	0.2	0.1	0.2	…	…	…	0.9

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Table 3.16 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
41	0.2	0.3	0.1	0.1	0.2	…	…	…	0.9
42	0.2	0.2	0.1	0.1	0.2	…	…	…	0.9
43	0.2	0.2	0.1	0.1	0.2	…	…	…	0.9
44	0.2	0.2	0.1	0.1	0.2	…	…	…	0.9
45	0.1	0.1	0.1	…	0.1	…	…	…	0.6
46	0.1	0.1	0.1	…	0.1	…	…	…	0.6
47	0.1	0.1	0.1	…	0.1	…	…	…	0.6
48	0.1	0.1	0.1	…	0.1	…	…	…	0.6
49	0.1	0.1	0.1	…	0.1	…	…	…	0.5
50	0.1	0.1	…	…	0.1	…	…	…	0.2
51	0.1	0.1	…	…	0.1	…	…	…	0.2
52	0.1	0.1	…	…	0.1	…	…	…	0.2
53	0.1	0.1	…	…	0.1	…	…	…	0.2
54	0.1	0.1	…	…	0.1	…	…	…	0.2
55	…	0.1	…	…	0.1	…	…	…	0.2
56	…	0.1	…	…	0.1	…	…	…	0.2
57	…	0.1	…	…	0.1	…	…	…	0.2
58	…	0.1	…	…	0.1	…	…	…	0.2
59	…	0.1	…	…	0.1	…	…	…	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	…	…	…	…	…	…	…	…	…

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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	**26.4**	**25.3**	**16.6**	**7.1**	**14.8**	**0.8**	**0.4**	**1.5**	**92.7**

… zero or less than 50. [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: Estimates based on: ABS (*Migration Australia*, 2014, *Net Overseas Migration: Arrivals and Departures by State/territory, Age and sex,* Cat. no. 3412.0); ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001).

Table 3.17 **NOM by age and state in the VUMR database, females, 2009-10[a]**

Thousand

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
0	0.2	0.3	0.2	0.1	0.2	…	…	…	1.1
1	0.2	0.3	0.2	0.1	0.2	…	…	…	1.1
2	0.2	0.3	0.2	0.1	0.2	…	…	…	1.1
3	0.2	0.3	0.2	0.1	0.2	…	…	…	1.0
4	0.2	0.3	0.2	0.1	0.2	…	…	…	1.0
5	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
6	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
7	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
8	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
9	0.3	0.3	0.3	0.1	0.2	…	…	…	1.2
10	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
11	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
12	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
13	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
14	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1
15	1.0	0.9	0.5	0.2	0.3	…	…	0.1	2.9
16	1.0	0.9	0.5	0.2	0.3	…	…	0.1	3.0
17	1.0	0.9	0.5	0.2	0.3	…	…	0.1	3.0
18	1.0	1.0	0.5	0.2	0.3	…	…	0.1	3.1
19	1.0	1.0	0.5	0.2	0.3	…	…	0.1	3.2
20	1.6	1.2	0.8	0.2	0.4	…	…	0.1	4.4
21	1.5	1.2	0.8	0.2	0.4	…	…	0.1	4.4
22	1.6	1.2	0.8	0.2	0.4	…	…	0.1	4.4
23	1.6	1.2	0.8	0.3	0.4	…	…	0.1	4.5
24	1.6	1.3	0.9	0.3	0.4	…	…	0.1	4.6
25	1.1	0.9	0.6	0.3	0.5	…	…	…	3.4
26	1.1	0.9	0.6	0.3	0.4	…	…	…	3.4
27	1.1	0.9	0.6	0.3	0.4	…	…	…	3.4
28	1.0	0.9	0.6	0.2	0.4	…	…	…	3.4
29	1.0	0.9	0.6	0.2	0.4	…	…	…	3.3
30	0.7	0.6	0.4	0.2	0.3	…	…	…	2.4
31	0.7	0.6	0.4	0.2	0.3	…	…	…	2.3
32	0.7	0.6	0.4	0.2	0.3	…	…	…	2.3
33	0.7	0.6	0.4	0.2	0.3	…	…	…	2.3
34	0.7	0.6	0.4	0.2	0.3	…	…	…	2.3
35	0.4	0.4	0.3	0.1	0.3	…	…	…	1.5
36	0.4	0.4	0.3	0.1	0.3	…	…	…	1.6
37	0.4	0.4	0.3	0.1	0.3	…	…	…	1.6
38	0.4	0.4	0.3	0.2	0.3	…	…	…	1.7
39	0.4	0.4	0.3	0.2	0.3	…	…	…	1.6
40	0.3	0.3	0.2	0.1	0.2	…	…	…	1.1

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Table 3.17 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*[b]
41	0.3	0.3	0.2	0.1	0.2	…	…	…	1.0
42	0.3	0.3	0.2	0.1	0.2	…	…	…	1.0
43	0.3	0.3	0.2	0.1	0.2	…	…	…	1.0
44	0.3	0.3	0.2	0.1	0.2	…	…	…	1.0
45	0.2	0.2	0.1	…	0.1	…	…	…	0.6
46	0.2	0.2	0.1	…	0.1	…	…	…	0.6
47	0.2	0.2	0.1	…	0.1	…	…	…	0.6
48	0.2	0.2	0.1	…	0.1	…	…	…	0.6
49	0.2	0.2	0.1	…	0.1	…	…	…	0.6
50	0.1	0.1	0.1	…	0.1	…	…	…	0.4
51	0.1	0.1	0.1	…	0.1	…	…	…	0.4
52	0.1	0.1	0.1	…	0.1	…	…	…	0.4
53	0.1	0.1	0.1	…	0.1	…	…	…	0.4
54	0.1	0.1	0.1	…	0.1	…	…	…	0.4
55	0.1	0.1	…	…	…	…	…	…	0.3
56	0.1	0.1	…	…	…	…	…	…	0.3
57	0.1	0.1	…	…	…	…	…	…	0.3
58	0.1	0.1	…	…	…	…	…	…	0.3
59	0.1	0.1	…	…	…	…	…	…	0.3
60	0.1	…	…	…	…	…	…	…	0.2
61	0.1	…	…	…	…	…	…	…	0.2
62	0.1	…	…	…	…	…	…	…	0.2
63	0.1	…	…	…	…	…	…	…	0.2
64	0.1	…	…	…	…	…	…	…	0.1
65	…	…	…	…	…	…	…	…	…
66	…	…	…	…	…	…	…	…	…
67	…	…	…	…	…	…	…	…	…
68	…	…	…	…	…	…	…	…	…
69	…	…	…	…	…	…	…	…	…
70	…	…	…	…	…	…	…	…	…
71	…	…	…	…	…	…	…	…	…
72	…	…	…	…	…	…	…	…	…
73	…	…	…	…	…	…	…	…	…
74	…	…	…	…	…	…	…	…	…
75	…	…	…	…	…	…	…	…	…
76	…	…	…	…	…	…	…	…	…
77	…	…	…	…	…	…	…	…	…
78	…	…	…	…	…	…	…	…	…
79	…	…	…	…	…	…	…	…	…
80	…	…	…	…	…	…	…	…	…

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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	**30.8**	**28.4**	**19.2**	**7.5**	**14.1**	**0.9**	**0.8**	**1.6**	**103.3**

… zero or less than 50. [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: Estimates based on: ABS (*Migration Australia*, 2014, Cat. no. 3412.0, *Net Overseas Migration: Arrivals and Departures by State/territory, Age and sex*); ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001).

Table 3.18 **Net interstate migration by age and state in the VUMR database, males, 2009-10[a]**

Thousand

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

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Table 3.18 (continued)

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

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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	**-5.1**	**0.8**	**3.3**	**-1.4**	**2.0**	**0.2**	**-0.1**	**0.3**	**…**

… zero or less than 50. [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: Estimates based on: ABS (*Migration, Australia*, 2014, Cat. no. 3412.0, *Interstate Migration, Arrivals, Departures and Net, State/territory, age and sex*); ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001).

Table 3.19 **Net interstate migration by age and state in the VUMR database, females, 2009-10[a]**

Thousand

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

(continued next page).

Table 3.19 (continued)

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

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Table 3.19 (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	**-4.2**	**2.5**	**2.9**	**-1.3**	**0.1**	**0.4**	**-0.6**	**0.2**	**…**

… zero or less than 50. [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: Estimates based on: ABS (*Migration, Australia*, 2014, Cat. no. 3412.0, *Interstate Migration, Arrivals, Departures and Net, State/territory, age and sex*); ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001).

Table 3.20 **Labour market participation rates by age and state in the VUMR database, males, as at 30 June 2009[a]**

Per cent

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
15	20.1	26.8	38.3	41.8	29.4	5.9	36.3	29.6
16	40.1	32.3	46.1	41.4	33.8	38.2	19.4	47.7
17	45.6	42.5	64.1	65.2	68.4	57.6	52.3	45.9
18	67.4	60.9	83.2	67.2	82.4	72.2	64.6	64.2
19	72.7	72.3	79.5	77.3	79.0	76.3	87.2	82.3
20	80.2	73.1	84.3	79.7	86.9	82.1	90.0	65.4
21	80.7	75.9	81.4	83.3	94.1	88.6	81.8	78.7
22	89.4	88.9	77.7	66.2	78.3	89.1	90.0	90.0
23	86.4	80.4	89.5	80.4	87.1	78.7	90.0	83.9
24	88.6	88.6	85.5	78.5	90.0	69.3	90.0	88.7
25	88.8	90.0	90.0	88.6	90.0	87.2	87.4	89.0
26	88.8	90.0	90.0	88.6	90.0	87.2	87.4	89.0
27	88.8	90.0	90.0	88.6	90.0	87.2	87.4	89.0
28	88.8	90.0	90.0	88.6	90.0	87.2	87.4	89.0
29	88.8	90.0	90.0	88.6	90.0	87.2	87.4	89.0
30	90.0	90.0	90.0	89.3	90.0	89.7	88.7	90.0
31	90.0	90.0	90.0	89.3	90.0	89.7	88.7	90.0
32	90.0	90.0	90.0	89.3	90.0	89.7	88.7	90.0
33	90.0	90.0	90.0	89.3	90.0	89.7	88.7	90.0
34	90.0	90.0	90.0	89.3	90.0	89.7	88.7	90.0
35	90.0	90.0	90.0	89.7	90.0	87.0	90.0	90.0
36	90.0	90.0	90.0	89.7	90.0	87.0	90.0	90.0
37	90.0	90.0	90.0	89.7	90.0	87.0	90.0	90.0
38	90.0	90.0	90.0	89.7	90.0	87.0	90.0	90.0
39	90.0	90.0	90.0	89.7	90.0	87.0	90.0	90.0
40	90.0	90.0	90.0	90.0	90.0	88.8	90.0	87.1
41	90.0	90.0	90.0	90.0	90.0	88.8	90.0	87.1
42	90.0	90.0	90.0	90.0	90.0	88.8	90.0	87.1
43	90.0	90.0	90.0	90.0	90.0	88.8	90.0	87.1
44	90.0	90.0	90.0	90.0	90.0	88.8	90.0	87.1
45	88.8	90.0	90.0	87.5	90.0	84.3	88.4	89.8
46	88.8	90.0	90.0	87.5	90.0	84.3	88.4	89.8
47	88.8	90.0	90.0	87.5	90.0	84.3	88.4	89.8
48	88.8	90.0	90.0	87.5	90.0	84.3	88.4	89.8
49	88.8	90.0	90.0	87.5	90.0	84.3	88.4	89.8
50	86.1	87.8	87.2	85.4	90.0	84.4	85.7	89.0
51	86.1	87.8	87.2	85.4	90.0	84.4	85.7	89.0
52	86.1	87.8	87.2	85.4	90.0	84.4	85.7	89.0
53	86.1	87.8	87.2	85.4	90.0	84.4	85.7	89.0
54	86.1	87.8	87.2	85.4	90.0	84.4	85.7	89.0
55	78.5	77.9	79.8	77.2	83.9	71.9	84.8	79.1
56	78.5	77.9	79.8	77.2	83.9	71.9	84.8	79.1
57	78.5	77.9	79.8	77.2	83.9	71.9	84.8	79.1
58	78.5	77.9	79.8	77.2	83.9	71.9	84.8	79.1

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Table 3.20 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
59	78.5	77.9	79.8	77.2	83.9	71.9	84.8	79.1
60	58.2	61.9	58.8	61.0	66.5	51.9	68.9	62.4
61	58.2	61.9	58.8	61.0	66.5	51.9	68.9	62.4
62	58.2	61.9	58.8	61.0	66.5	51.9	68.9	62.4
63	58.2	61.9	58.8	61.0	66.5	51.9	68.9	62.4
64	58.2	61.9	58.8	61.0	66.5	51.9	68.9	62.4
65	29.4	33.8	31.2	31.1	36.2	23.6	53.0	42.4
66	29.4	33.8	31.2	31.1	36.2	23.6	53.0	42.4
67	29.4	33.8	31.2	31.1	36.2	23.6	53.0	42.4
68	29.4	33.8	31.2	31.1	36.2	23.6	53.0	42.4
69	29.4	33.8	31.2	31.1	36.2	23.6	53.0	42.4
70	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
71	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
72	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
73	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
74	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
75	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
76	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
77	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
78	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
79	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
80	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
81	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
82	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
83	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
84	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
85	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
86	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
87	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
88	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
89	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
90	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
91	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
92	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
93	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
94	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
95	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
96	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
97	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
98	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
99	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0
100+[b]	7.0	7.5	7.3	5.8	8.4	4.8	15.7	7.0

[a] Percentage of the working-age population aged 15 years and over that are engaged in the labour market (employed and unemployed). Constrained to a maximum participation rate of 90.0. [b] 100 years and over.

Source: Estimates based on ABS (*Labour Force, Australia*, Detailed Electronic Delivery, March 2010, Cat. no. 6291.0.55.001).

Table 3.21 **Labour market participation rates by age and state in the VUMR database, females, as at 30 June 2009**[a]

Per cent

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
15	30.7	25.3	49.2	27.8	39.4	50.2	24.4	38.7
16	46.8	50.6	59.5	50.0	40.4	38.1	26.3	58.3
17	49.9	52.8	63.9	63.4	58.9	56.6	51.4	39.2
18	71.3	70.8	79.3	72.0	82.3	69.6	69.3	83.7
19	72.2	66.3	68.2	80.2	68.2	59.0	76.9	88.0
20	71.8	79.9	80.1	73.6	57.7	60.8	83.8	56.9
21	74.7	72.6	67.6	74.0	83.7	69.6	87.8	61.2
22	68.3	74.1	79.9	81.1	74.6	72.5	86.0	73.1
23	85.0	76.9	73.1	68.5	69.2	75.2	38.5	77.2
24	79.7	73.5	72.9	72.7	66.2	73.6	78.4	89.3
25	74.7	75.2	72.7	73.7	74.9	72.3	70.0	84.6
26	74.7	75.2	72.7	73.7	74.9	72.3	70.0	84.6
27	74.7	75.2	72.7	73.7	74.9	72.3	70.0	84.6
28	74.7	75.2	72.7	73.7	74.9	72.3	70.0	84.6
29	74.7	75.2	72.7	73.7	74.9	72.3	70.0	84.6
30	70.3	70.5	72.3	68.0	67.8	72.8	70.7	80.6
31	70.3	70.5	72.3	68.0	67.8	72.8	70.7	80.6
32	70.3	70.5	72.3	68.0	67.8	72.8	70.7	80.6
33	70.3	70.5	72.3	68.0	67.8	72.8	70.7	80.6
34	70.3	70.5	72.3	68.0	67.8	72.8	70.7	80.6
35	71.9	70.9	74.1	74.1	71.5	74.9	74.0	82.4
36	71.9	70.9	74.1	74.1	71.5	74.9	74.0	82.4
37	71.9	70.9	74.1	74.1	71.5	74.9	74.0	82.4
38	71.9	70.9	74.1	74.1	71.5	74.9	74.0	82.4
39	71.9	70.9	74.1	74.1	71.5	74.9	74.0	82.4
40	73.8	72.8	81.0	80.0	77.1	78.4	71.1	81.4
41	73.8	72.8	81.0	80.0	77.1	78.4	71.1	81.4
42	73.8	72.8	81.0	80.0	77.1	78.4	71.1	81.4
43	73.8	72.8	81.0	80.0	77.1	78.4	71.1	81.4
44	73.8	72.8	81.0	80.0	77.1	78.4	71.1	81.4
45	76.7	80.3	82.1	79.8	81.1	78.2	84.8	84.3
46	76.7	80.3	82.1	79.8	81.1	78.2	84.8	84.3
47	76.7	80.3	82.1	79.8	81.1	78.2	84.8	84.3
48	76.7	80.3	82.1	79.8	81.1	78.2	84.8	84.3
49	76.7	80.3	82.1	79.8	81.1	78.2	84.8	84.3
50	73.9	74.9	77.7	75.2	79.4	76.7	83.8	80.5
51	73.9	74.9	77.7	75.2	79.4	76.7	83.8	80.5
52	73.9	74.9	77.7	75.2	79.4	76.7	83.8	80.5
53	73.9	74.9	77.7	75.2	79.4	76.7	83.8	80.5
54	73.9	74.9	77.7	75.2	79.4	76.7	83.8	80.5
55	61.0	64.8	63.8	64.1	68.2	63.5	72.4	71.4
56	61.0	64.8	63.8	64.1	68.2	63.5	72.4	71.4
57	61.0	64.8	63.8	64.1	68.2	63.5	72.4	71.4
58	61.0	64.8	63.8	64.1	68.2	63.5	72.4	71.4

(continued next page)

Table 3.21 (continued)

Age	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
59	61.0	64.8	63.8	64.1	68.2	63.5	72.4	71.4
60	40.3	40.4	43.4	44.0	43.3	39.7	56.1	45.3
61	40.3	40.4	43.4	44.0	43.3	39.7	56.1	45.3
62	40.3	40.4	43.4	44.0	43.3	39.7	56.1	45.3
63	40.3	40.4	43.4	44.0	43.3	39.7	56.1	45.3
64	40.3	40.4	43.4	44.0	43.3	39.7	56.1	45.3
65	18.3	16.8	16.3	16.9	18.4	12.4	27.2	16.8
66	18.3	16.8	16.3	16.9	18.4	12.4	27.2	16.8
67	18.3	16.8	16.3	16.9	18.4	12.4	27.2	16.8
68	18.3	16.8	16.3	16.9	18.4	12.4	27.2	16.8
69	18.3	16.8	16.3	16.9	18.4	12.4	27.2	16.8
70	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
71	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
72	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
73	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
74	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
75	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
76	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
77	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
78	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
79	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
80	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
81	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
82	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
83	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
84	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
85	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
86	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
87	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
88	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
89	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
90	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
91	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
92	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
93	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
94	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
95	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
96	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
97	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
98	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
99	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7
100+[b]	2.0	2.4	2.3	1.6	3.4	1.4	4.8	5.7

[a] Percentage of the working-age population aged 15 years and over that are engaged in the labour market (employed and unemployed). [b] 100 years and over.

Source: *E*stimates based on ABS (*Labour Force, Australia*, Detailed Electronic Delivery, March 2015, Cat. no. 6291.0.55.001).

3.2 Returns to capital data

Reflecting strong growth in the export price of individual mining commodities that were not driven by higher production costs (that is were driven by shifts in export demand and consequent increases in these prices), the 2009-10 VUMR database used for the reference case includes additional returns to export sales for *Coal mining* and *Iron ore mining*. The modelling of additional returns in the MMRF/VUMR model is outlined in PC (2012b).

Additional returns have been introduced into the VUMR model database by disaggregating the returns to capital in 2009-10 into:

- a transitory additional return to the owners of capital; and
- a residual 'normal' return that is more indicative of the expected long-run returns to investment.

In keeping with the foreign trade scenario outlined in chapter 8, the estimates of the additional per unit return to export sales of each commodity in the model database is estimated as the Australian dollar export price in 2009-10 relative to that in 2004-05, which is taken as being representative of the long-run trend value.

Disaggregating the returns to capital

The additional return to the owners of capital in the *Coal mining* and *Iron ore mining* industries in the 2009-10 VUMR database is estimated from the initial return to capital in the model database using the implied export prices. The average implied export prices in 2004-05 and 2009-10 ($P^{2004-05}$ and $P^{2009-10}$, respectively) are derived as the value of exports divided by the volume of exports in each year. Export volumes are denoted in physical units (rather than in terms of gross value added), and the physical units reported vary by commodity (typically tonnes). The data used are sourced from the Department of Industry's *Resources and Energy Statistics* (2014).

The value of the additional return to capital (table 3.22) is estimated as:

$$Additional\ return\ = \left(\frac{P^{2009-10} - P^{2004-05}}{P^{2004-05}}\right) \times Original\ VUMR\ return\ to\ capital$$

The residual 'normal' return is estimated as:

$$New\ VUMR\ return\ to\ capital = Original\ VUMR\ return\ to\ capital - Additional\ return$$

Table 3.22 **Additional return to export sales by VUMR industry added to the VUMR database, 2009-10**

$ million

VUMR industry	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
Coal mining	752	0	1 137	0	0	0	0	0	1 898
Iron ore mining	0	0	0	124	6 331	0	0	0	6 454
Total additional return	**752**	**0**	**1 137**	**124**	**6 331**	**0**	**0**	**0**	**8 352**

Source: Estimates based on Department of Industry (2014); VUMR model database.

4 Uprating of the model database

This chapter outlines the broad procedure used to uprate the VUMR model database from 2009-10 to 2013-14.

In each simulation year of the uprating period, shocks specific to that year calculated from published data are applied to the VUMR model database.

Most of the shocks applied in the uprating and data sources used are detailed in chapters 5 to 11. These shocks progressively bring the level and structure of the *real* economy in the initial 2009-10 VUMR database into closer alignment with the real economy in 2013-14.

In addition to these subject matter-specific shocks, the uprating of the model database also includes two further types of shocks, which are enumerated in this chapter:

- shocks to the model numeraire; and
- shocks to key macroeconomic aggregates.

4.1 Model numeraire

All prices in the VUMR model are expressed relative to the model numeraire: the price of household final consumption expenditure (HFCE) (the VUMR variable `natp3tot`).

The model numeraire was shocked to convert the values in the VUMR database from 2009-10 dollars to 2013-14 dollars. These shocks are the annual percentage changes in the implicit price deflator (IPD) implied by the published current price and chain volume values of HFCE in the ABS *System of National Accounts* (table 4.1).

The long-run average growth rate in the HFCE IPD over the period 1974-75 to 2013-14 was 5 per cent per year (figure 4.1). This reflected the higher inflationary environment that existed in the mid-1970s and 1980s. Since 1991-92 (the end of the recession), the HFCE IPD grew at an average annual rate of 2.4 per cent.

As shocks were applied to the model numeraire, the shocks applied to all other price variables in the VUMR model during the uprating period of the reference case are the percentage change in the corresponding *nominal* price. As the model numeraire is not shocked during the unwinding and projection periods, the price shocks applied during these periods are expressed in *real* terms — that is, relative to the HFCE IPD.

Table 4.1 **Model numeraire shocks to 2013-14 in the reference case[a]**

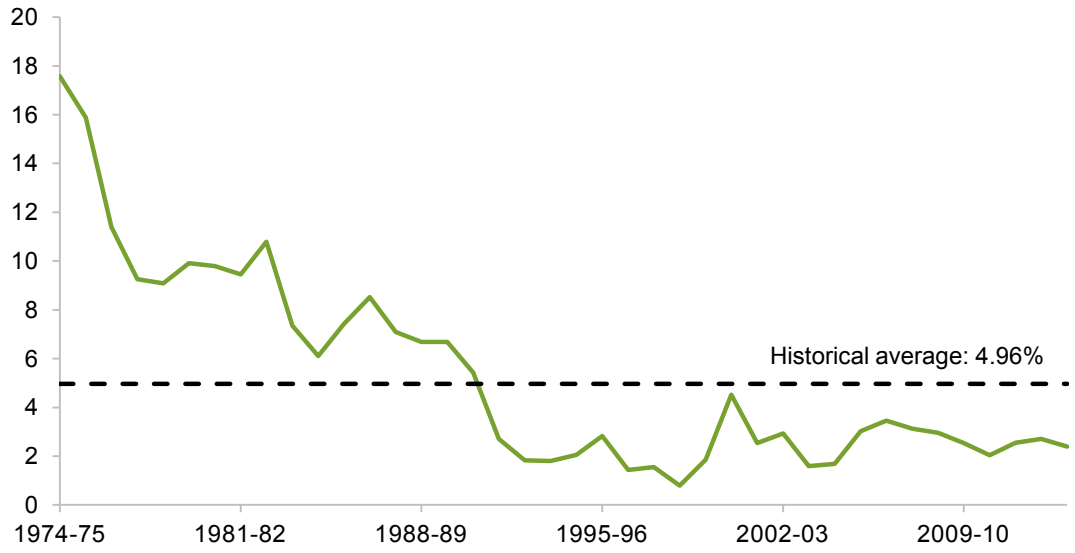
	Units	*2009-10*	*2010-11*	*2011-12*	*2012-13*	*2013-14*
Current price HFCE	$ million	719 001	761 638	801 183	835 826	878 289
Chain volume HFCE	2013-14 $ million	791 250	821 388	842 498	855 791	878 289
Implied IPD	Index	0.91	0.93	0.95	0.98	1.00
Reference case shock	Percentage change	na	2.04	2.56	2.70	2.39

na: not applicable. [a] Applied to the price of HFCE (the VUMR variable `natp3tot`).

Sources: *ABS* (*Australian System of National Accounts*, 2014-15, Cat. no. 5204.0).

Figure 4.1 **Growth in the HFCE IPD, Australia, 1974-75 to 2013-14**

Per cent



Source: *ABS* (*Australian System of National Accounts*, 2014-15, Cat. no. 5204.0).

4.2 Macroeconomic aggregates

The reference case also includes shocks to key real macroeconomic aggregates between 2009-10 and 2013-14 to ensure that the aggregates in the uprating period align with the corresponding published aggregates. These shocks also improve the alignment of the nominal exchange rate and the net balance of trade (exports less imports) with ABS statistics. These shocks are detailed in table 4.2.

Consideration was also given to including state-specific shocks to key macroeconomic aggregates to better align the reference case to actual outcomes. However, the significant year-to-year fluctuations in official state-level statistics over the uprating period made this difficult, as the VUMR model is not well suited to modelling significant short-term fluctuation.

Table 4.2 **Macroeconomic shocks to 2013-14 in the reference case**

	2009-10	*2010-11*	*2011-12*	*2012-13*	*2013-14*
Real actual activity level (2013-14$ million)[a]					
Household consumption	791 250	821 388	842 498	855 791	878 289
Investment	372 269	386 345	429 065	438 846	433 164
Government consumption:					
State & local government	156 199	159 207	164 906	166 760	168 403
Australian Government	101 293	107 164	111 979	111 902	114 305
Export volumes	279 771	282 368	296 497	313 007	331 241
Import volumes	278 676	307 251	342 973	345 165	339 062
GDP(E)	**1 422 361**	**1 456 207**	**1 509 107**	**1 545 929**	**1 584 578**
Reference case shocks (percentage change year on year)[b]					
Household consumption	na	3.81	2.57	1.58	2.63
Investment	na	3.78	11.06	2.28	-1.29
Government consumption:					
State & local government	na	1.93	3.58	1.12	0.99
Australian Government	na	5.80	4.49	-0.07	2.15
Import volumes	na	10.25	11.63	0.64	-1.77
GDP(E)	**na**	**2.38**	**3.63**	**2.44**	**2.50**

[a] As recorded in the ABS national accounts, real GDP(E) also includes changes in inventories and statistical discrepancy. [b] Applied to the VUMR model variables `natx3tot`, `natx2tot`, `natx5tot`, `natx6tot` and `natx0cif_c`, respectively.

Source: ABS (2015, *Australian System of National Accounts*, 2014-15, Cat. no. 5204.0).

5 Demography

The level and nature of economic activity in Australia out to 2060 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.

Identifying future demographic trends is, however, 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 and, if so, how many. Such factors are difficult to account for and are not normally included in stylised modelling reference cases. As such, the projections developed in this chapter generally assume a continuation of broad historical trends over the projection period.

This chapter is organised into sections that focus on the key sources of national demographic change — fertility, mortality and net overseas migration (NOM).[6] Each section commences by providing a historical perspective focusing on relevant national and, where appropriate, state trends. Each section then details the key demographic assumptions employed in:

- the latest ABS population projections contained in *Australia 2012 (base) to 2101* (Cat. no. 3222.0);
- the latest and previous *Intergenerational Reports* (Australian Government 2015b and 2010, respectively); and
- the Commission's research report on *An Ageing Australia: Preparing for the Future* (PC 2013).

Each section concludes by detailing the key demographic assumptions that the Commission has adopted in the modelling of the reference case. As VUMR models the economy of each state separately, many of the demographic assumptions in the 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.

6 Net interstate migration in the VUMR model is linked to the interstate movement of employed persons in response to differences in nominal wages by occupation across states.

Analytical framework used

The analytical framework used to assess the contributions made by demographic change to real GDP growth adopted in the reference case is based on the PPP framework detailed in chapter 2. Population growth has been an important driver of real GDP growth, while an increase in the population of working age has made a minor contribution. This chapter ascertains the contributions made by fertility, mortality, NOM and ageing to historical population growth, both at the national and state levels, and identifies recent trends to gain insights into future directions. Assumptions about future trends are then applied as shocks to the detailed demographic module in the VUMR model to provide the demographic projections outlined in chapter 12. This approach to modelling the contributions made by demographic change is based on that used in *Economy-wide Modelling of Impacts of COAG Reforms* (PC 2012b).

5.1 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 or so, reaching an estimated resident population of 23.6 million at the end of December 2014 (figure 5.1). This growth has closely followed a polynomial trend. If Australia's population were only to continue to increase in line with past trend growth, it would reach around 40 million people by 2060.

The national rate of population growth is determined by:

- the net of births and deaths (net natural increase) and;
- the net of immigration and emigration; that is, NOM.[7]

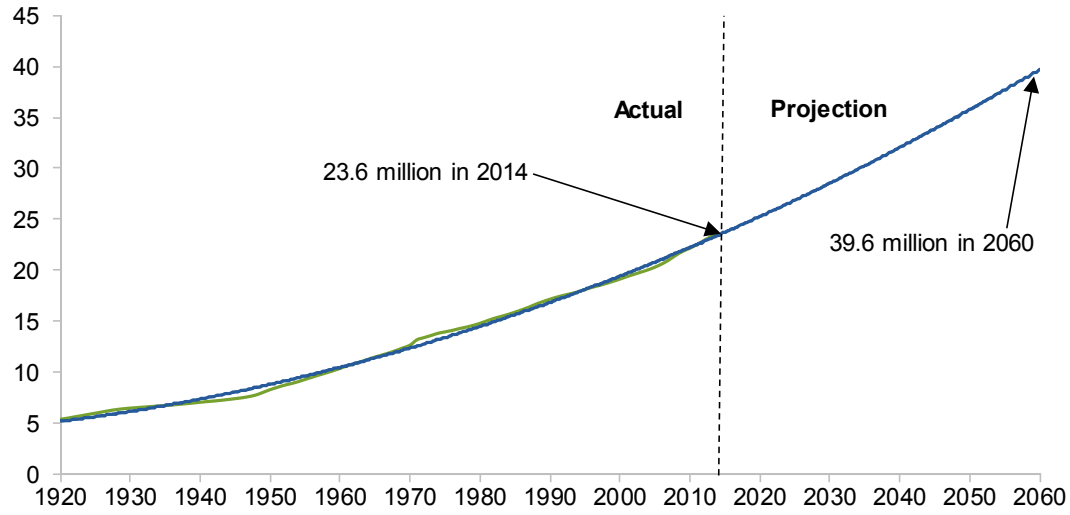
Net natural increase has historically been the main source of population growth in Australia over the last 90 years (figure 5.2). NOM increased after the end of World War II, particularly in the 1950s and 1960s, and again more recently. Historically, NOM has been more variable than net natural increase. Since 2005, NOM has greatly exceeded the rate of net natural increase, accounting for almost 60 per cent of the increase in population.

As discussed in chapter 2, the population of Australia increased at an annual average rate of 1.3 per cent between 1974-75 and 2013-14. Of this:

- net natural increase contributed 0.7 percentage points per year; and
- NOM contributed the remaining 0.6 percentage points per year.

[7] 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.

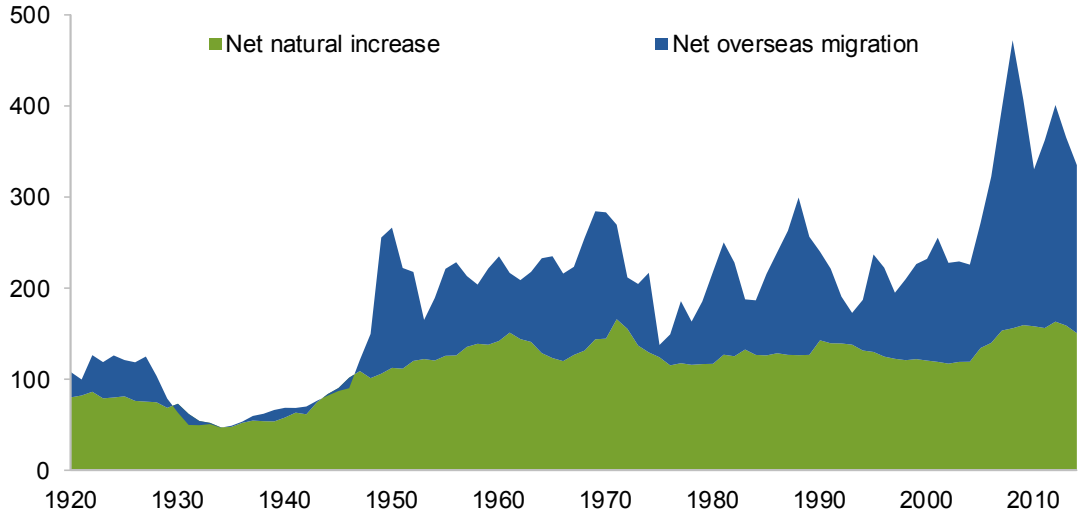
Figure 5.1 **Australian population as at 31 December, 1920 to 2060[a,b]**
Millions



a Includes Christmas and Cocos (Keeling) Islands since September 1993. **b** Actual data to 2014. Trend based on polynomial projection to 2060.

Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0).

Figure 5.2 **Components of Australian population change, 1920 to 2014**
Thousands

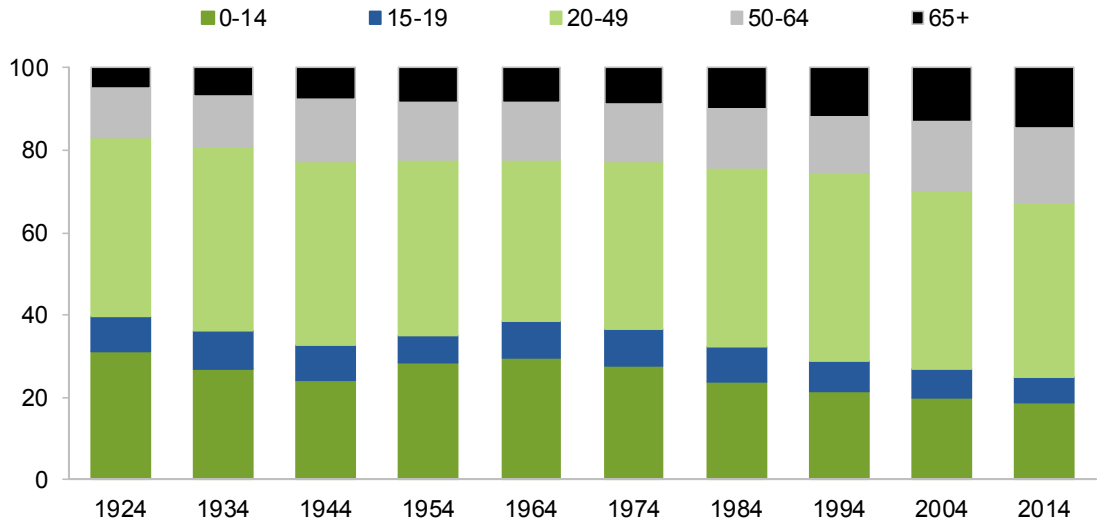


Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0); Phillips, Klapdor and Simon-Davies (2010).

Not only has the population of Australia increased over the last 90 years, its average age has increased too. Mortality rates have declined since 1920, resulting in a steady increase in life expectancy (discussed in section 5.3). Combined with periods of decreasing fertility rates (section 5.3), this has resulted in an ageing population structure (figure 5.3). That is, the proportion of the Australian population in older age groups has increased relative to younger age groups. For example, the share of Australians aged 65 years and older has steadily increased from 5 per cent of the population in 1924 to 14.7 per cent in 2014, while Australians aged 14 years and younger has declined from 31.1 per cent in 1924 to 18.8 per cent in 2014.

Figure 5.3 **Share of the Australian population by age, 1924 to 2014[a]**

Per cent



[a] Estimates are as at 30 June of the relevant year.

Source: Estimates based on ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0).

Comparison of recent projections

The recent studies reviewed in this section suggest that the Australian population will be between 37 and 48 million by 2060, with most studies having a central estimate close to 40 million in 2060 (table 5.1). These estimates are similar to a continuation of the polynomial trend rate of growth from 1920 to 2014 (figure 5.1).

Table 5.1 **Population projections to 2060, Australia**
Millions

Projection	*2020*	*2030*	*2040*	*2050*	*2060*
ABS Population projections, Australia					
High growth scenario (Series A)	26.3	31.4	36.5	41.9	47.7
Medium growth scenario (Series B)	26.0	30.1	33.9	37.6	41.2
Low growth scenario (Series C)	25.7	29.0	31.8	34.3	36.6
PC An Ageing Australia: Preparing for the Future					
Base case	25.6	29.0	32.2	35.3	38.3
Intergenerational Report					
2010 report	25.7	29.2	32.6	35.9	na
	2014-15	*2024-25*	*2034-35*	*2044-45*	*2054-55*
2015 report	23.9	28.0	32.0	35.8	39.7

na: not applicable.

Sources: ABS (*Population Projections, Australia, 2012 (base) to 2101*, Cat. no. 3222.0); Australian Government (2010, p. 5); Australian Government (2015b, p. 99); PC (2013).

ABS Population projections

The ABS has developed 18 different national population scenarios to 2101. These scenarios consist of different combination of:

- three fertility rate assumptions (labelled as 'high', 'medium' and 'low');
- two life expectancy at birth assumptions (labelled 'high' and 'medium'); and
- three NOM assumptions (labelled as 'high', 'medium' and 'low').

The key demographic assumptions underlying the ABS population projection are set out in table 5.2.

Three of these 18 scenarios are published in *Population Projections, Australia, 2012 (base) to 2101* (ABS Cat. no. 3222.0):

- 'Series A' (high growth) is based on the high assumptions for fertility rate, life expectancy at birth and NOM;
- 'Series B' (medium growth) is based on the medium assumptions for fertility rate, life expectancy at birth and NOM, and largely reflects the then 'current long-term trends' in these variables; and
- 'Series C' (low growth) is based on the low assumptions for fertility rate and NOM, and the medium assumption for life expectancy at birth.

Table 5.2 **Demographic assumptions underpinning ABS population projections to 2101 for Australia**

	High	*Medium*	*Low*
Total fertility rate	2.00	1.80	1.60
Life expectancy at birth (years)			
Males	92.1	85.2	na
Females	93.6	88.3	na
NOM (per cent of population)	0.6	0.6	0.5

na: not applicable

Source: ABS (*Population Projections, Australia, 2012 (base) to 2101*, Cat. no. 3222.0).

An Ageing Australia: Preparing for the Future (PC 2013)

PC (2013) projected a population of 38.3 million in 2060. This reflected assumptions of:

- a constant total fertility rate of 1.85 to 2060;
- life expectancies at birth in 2060 of 89.1 for males and 91.4 females; and
- NOM gradually declining to 0.5 per cent of the population.

Intergenerational Reports by the Australian Government

The Intergenerational Reports focus on the implications of demographic change for economic growth and assess the financial implications of continuing current policies and trends over the next four decades The reports are required every five years under the *Charter of Budget Honesty Act 1998* (Cwlth).

The *Intergenerational Report 2015* projected a population of 39.7 million in 2055 (Australian Government 2015b, p. 99). This updates the 35.9 million contained in the *Intergenerational Report 2010* for 2050 (Australian Government 2010, p. 5).

The 2015 report projections are based on assumptions of:

- a constant total fertility rate of 1.9 to 2054-55;
- life expectancies at birth in 2054-55 of 95.1 for males and 96.6 females; and
- NOM of 215 000 per year from 2018-19 (so that it gradually declines as a share of the resident population to just over 0.5 per cent in 2054-55, which was the average share observed between 1973 and 2006).

5.2 Fertility

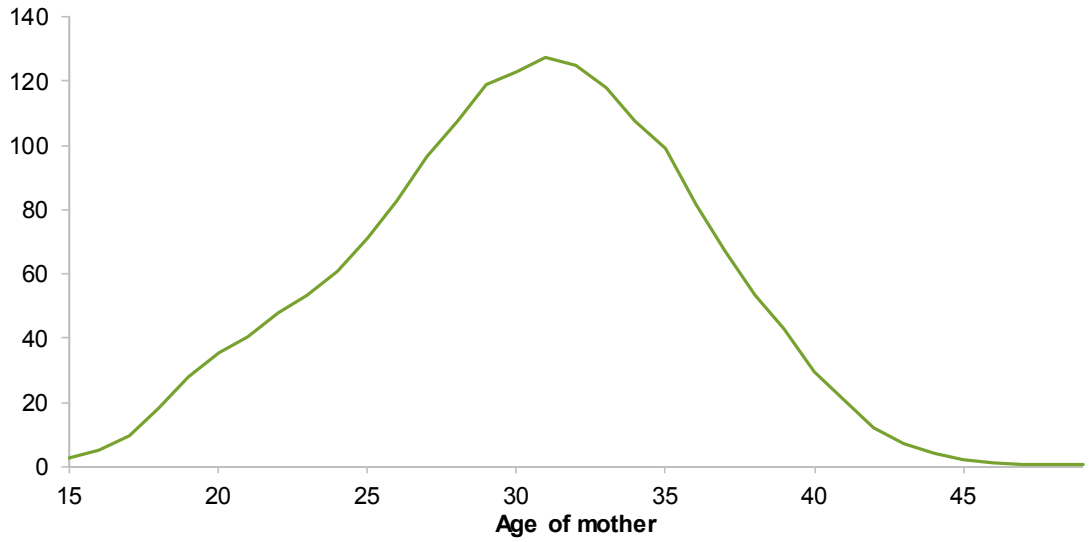
The number of births in Australia has important implications for not only the growth rate of the population, but also for its future age structure. The number of births depends on:

- the number of women of childbearing age (assumed to be between 15 and 49 years);
- their age profile (that is, the number of women at each childbearing age); and
- the fertility rate at each age (termed 'age-specific fertility rate').

The total fertility rate (TFR) is the headline fertility figure. It measures the average number of babies that each woman, currently at age 15, would be expected to have if they experienced current age-specific fertility rates (ASFR) over their reproductive life.

The national TFR was 1.83 birth per women in the financial year 2013-14. In 2014, the average number of births per woman increased more-or-less steadily with each year of age up to 127.3 births per 1000 women at the age of 31 years (figure 5.4).[8] Thereafter, the average number of births per woman declined reasonably rapidly. Over 60 per cent of all births occur when the mother is aged between 25 and 35 years.

Figure 5.4 **ASFRs, Australia, 2014**
Births per 1000 women



Source: ABS (*Births, Australia*, 2014, Cat. no. 3301.0).

8 Detailed births data are available on a calendar rather than financial year basis.

Historical perspective

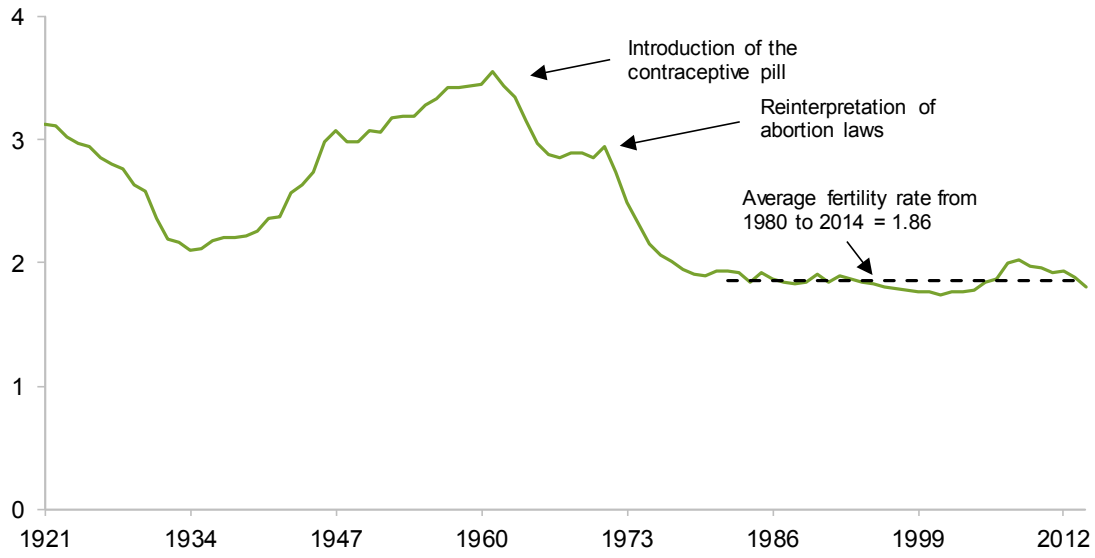
National trends

Total fertility rates

Over the last 90 years, the TFR in Australia has varied considerably (figure 5.5), 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 patterns of education, and workforce engagement of women.

Figure 5.5 **TFR, Australia, 1921 to 2014[a]**

Births per woman



[a] The TFR is defined as the sum of ASFRs (the number of live births that occurred or were registered during the financial year, according to the age of the mother, per 1000 of the female estimated resident population of the same age at 31 December) divided by 1000. It is a measure of the number of children that a female, currently at the age of 15 would bear during her lifetime, if she experienced current ASFRs.

Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat no. 3105.0.65.001); ABS (*Births, Australia*, 2014, Cat. no. 3301.0).

Within this time period, movements in the TFR can be divided into five distinct periods:

- 1920s to the early 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).
- 1934 to 1945 (World War II) — after a gentle upward movement for a few years, the TFR trended sharply upwards during World War II.

- 1946 to 1961 ('Baby Boomer' period) — the TFR 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. The main increases in fertility rates occurred for women aged between 20 and 30 years, although teenage pregnancy also rose over this period (that is, on average, women started having children earlier than they had in previous decades) (figure 5.6). In part, these changes in fertility rates reflects 'tempo' effects — the influence of previously foregone childbearing.
- 1961 to 1980 — over this period, the TFR dropped steeply and the age at which women began having children steadily increased. This decline in the TFR was driven by a number of complex and interacting factors. These include:
  - *Greater control over fertility decisions*. The oral contraceptive pill became available in Australia in 1961. While access (particularly for unmarried women) was initially constrained, use of the oral contraceptive pill progressively increased among women (ABS, *Australian Social Trends*, 1998, Cat. no. 4102.0).[9] 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).[10]
  - *Increased participation by women in higher and vocational education*.
  - *Increased participation by women in the workforce*. Female labour participation increased significantly, from 33 per cent in 1964 to 44 per cent in 1977 (RBA 1996).[11] This reflected increased numbers of women entering the workforce, and a greater ability for women to re-enter the workforce following the birth of a child. For example, the Commonwealth Public Service first permitted married women to be appointed to, or remain as permanent officers in, the Commonwealth Public Service in 1966, and to return to their jobs after the birth of their children (Weston et al. 2001).
- 1980 to 2014 — the TFR has been relatively stable since the late 1970s, notwithstanding a slight increase and subsequent decrease recently. Within this time period, there were some minor variations. The TFR fell slightly during the 1990s, before rebounding slightly in the first decade of the 2000s. Many demographers have attributed this slight decline and rebound as a 'tempo' effect arising as women initially delayed the age at which they had children before having them at an older age. More recently, the TFR has reverted towards more average levels over the period.

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

10 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.

11 This trend of increasing female labour force participation has continued to the present day.

Changes in the number of births over time not only reflect trends in overall fertility (referred to as the TFR), but also reflect changes in fertility for women of different childbearing ages that are encapsulated in the TFR (referred to as ASFRs).

Age-specific fertility rates

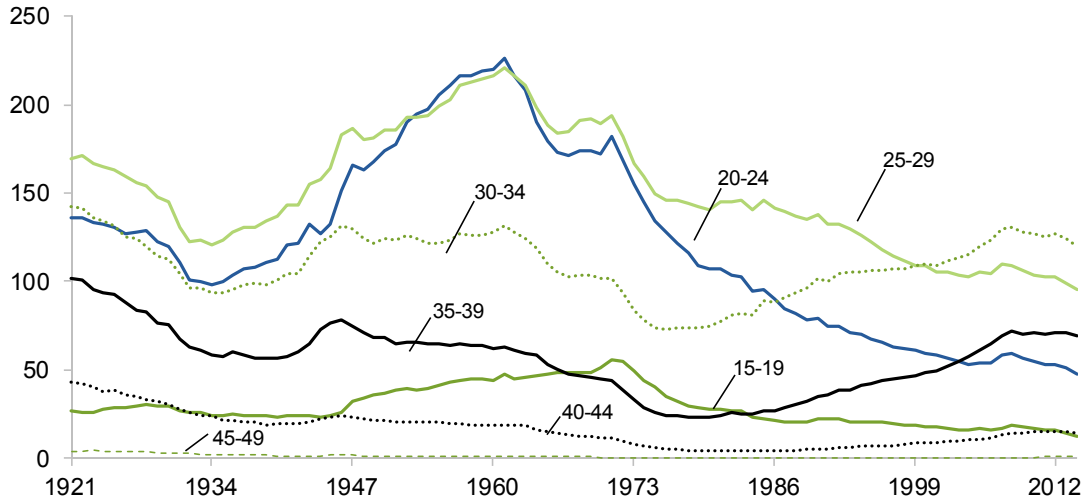
ASFRs have also varied over the last 90 years, with a generally similar pattern for most ages to that of the TFR (figure 5.6).

Although smaller in number, the ASFRs for women aged 40 years and older have declined by more than any other age group. There were also declines for women aged under 30 years of age, particular those under 25 years of age. It is interesting to note that the fertility for 15-19 year olds declined from the 1970s onwards (figure 5.6).

Since 1980, the ASFRs have continued to change with fertility rates for women under 30 year olds declining, and those over 30 year olds rising. 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).

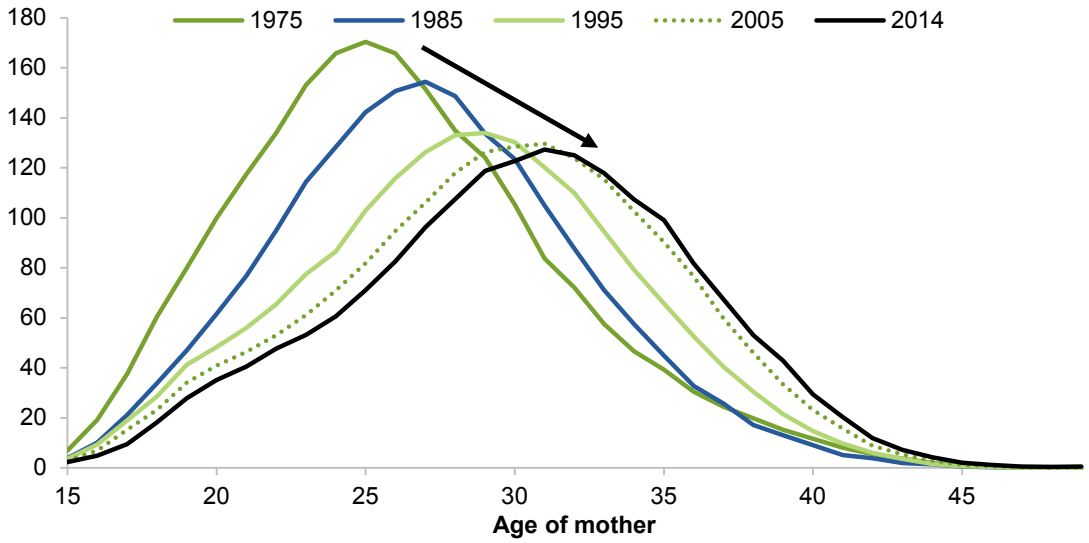
Figure 5.6 **ASFRs over time, Australia, 1921 to 2014**
Births per 1000 women



Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Births, Australia*, 2014, Cat. no. 3301.0).

The consequence of this is that woman tend to have fewer babies over their reproductive lives and, when they do, they tend to give birth at older ages than previously (figure 5.7).

Figure 5.7 **Distribution of ASFRs, Australia, 1975 to 2014**
Births per 1000 women



Source: ABS (*Births, Australia*, 2014, Cat. no. 3301.0).

Sex ratio

One factor affecting future fertility rates is the mix of male and female births, termed as the 'sex ratio'. It reflects the number of male births per 100 female births and is used in the demographic module in VUMR to determine the gender of live births. The sex ratio in Australia has fluctuated around its long-run average of 105.5 male births to 100 female births since 1921. Before 1968, the sex ratio varied more than after 1973 (the years for which data are available), with the range between 106.9 and 104.0. After 1973, the sex ratio varies between a maximum of 106.3 and a minimum of 104.8 male births per 100 female births in any one year (figure 5.8).

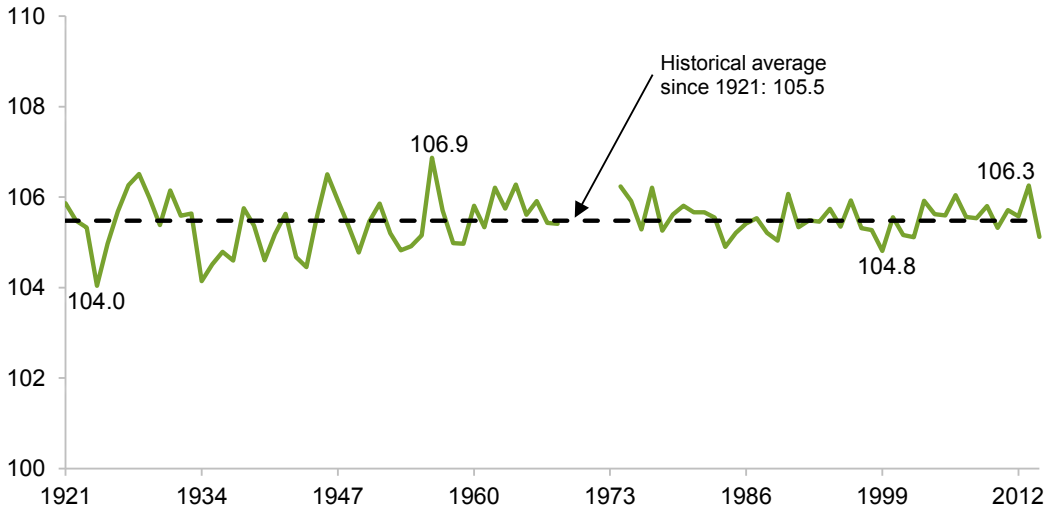
State trends

In general, state fertility rates have exhibited a similar pattern of movement to the national figures, with fertility rates declining at a decreasing rate over most of the last 40 years, but experiencing moderate increases from 2001 onwards. 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 2014, the TFR varied from 1.73 births per woman in New South Wales to 2.10 births per woman in the Northern Territory (figure 5.9).

Figure 5.8 **Sex ratio of births, Australia, 1921 to 2014[a]**

Male births per 100 female births

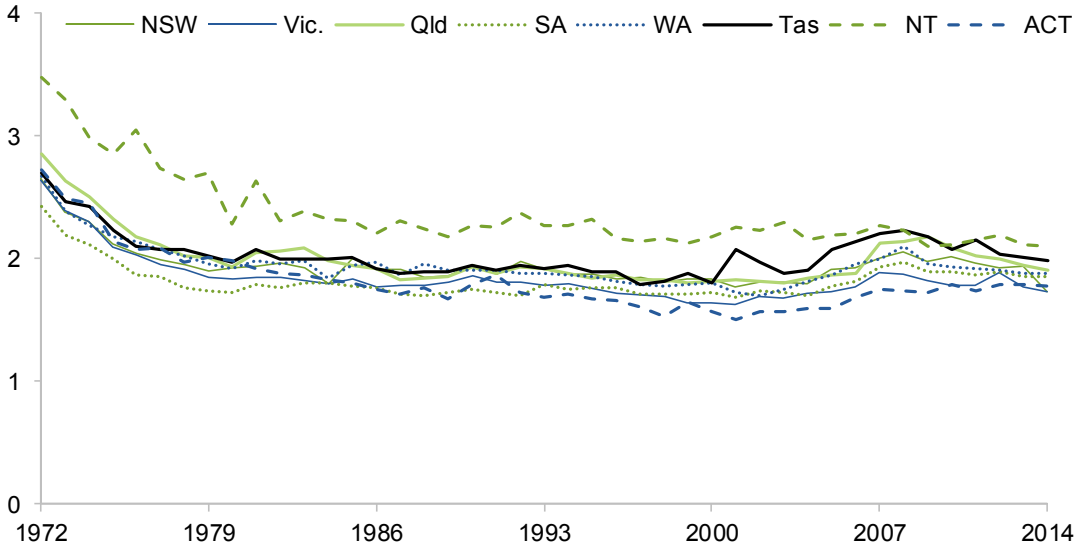


a Data not available for 1969 to 1973.

Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); *ABS (Births, Australia*, 2014, Cat. no. 3301.0).

Figure 5.9 **TFR by state, 1972 to 2014**

Births per woman



Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Births Australia*, 2014, Cat. no. 3301.0).

AFSRs vary by state (figure 5.10). In 2014:

- variability in fertility rates was more noticeable in the youngest and highest age groups — 15 to 24 and 45 to 49 — across all states. For 20 to 24 year olds, the lowest fertility rate was 29.4 births per 1000 women in the Australian Capital Territory, compared to 93.2 births in the Northern Territory. For 45 to 49 years old, the lowest fertility rate was 0.5 births per 1000 women in South Australia, compared to 1.3 births in the Australian Capital Territory;
- across all states, there was less variability in fertility rates in the 30 to 34 age group;
- the Northern Territory had a much higher fertility rate for 15 to 29 year olds than the national average, and a lower fertility rate for other age groups;
- Queensland and Tasmania also had above average fertility rates for women aged less than 30;
- women in Victoria and Australian Capital Territory delayed childbearing to older ages relative to other states, with fertility rates for under 30s below the national average, and fertility rates for over 30s are slightly above the national average; and
- New South Wales had below average fertility rates for all age groups from 15 to 39.

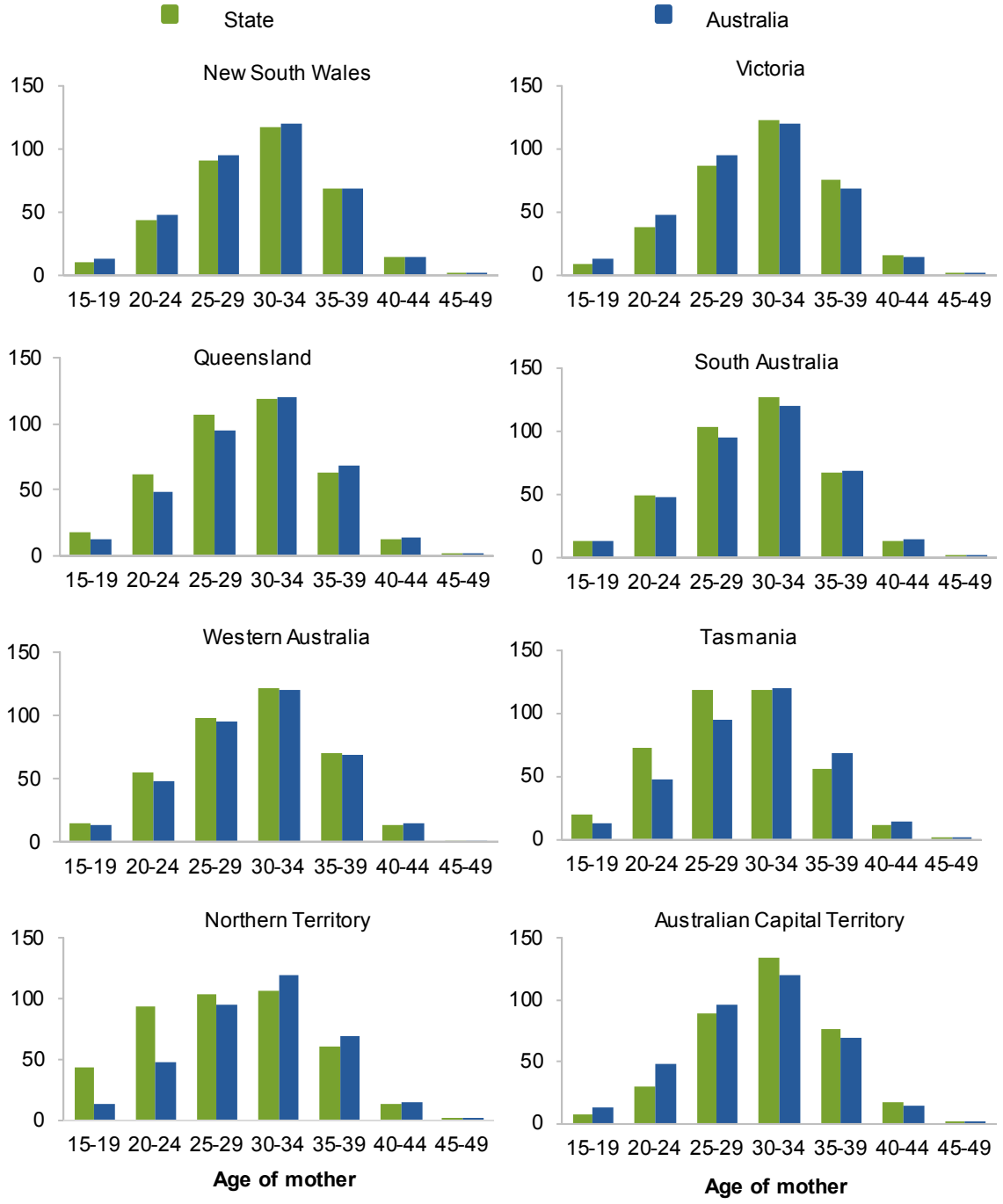
Comparison of recent projections

Projections of future fertility rates have tended to assume a continuation of the recent period of relative stability (table 5.3).

- The ABS high growth scenario (Series A) projections are based on the TFR rising to 2.0 births per woman by 2026 and remaining at that level. The medium growth scenario (Series B) projections are based on the TFR declining to 1.8 births per woman by 2026 and remaining at that level to 2101. The low growth scenario (Series C) projections are based on the TFR declining to 1.6 births per woman by 2026 and remaining at that level (ABS Cat. no. 3222.0).
- PC (2013) assumed a base case of 1.85 births per woman out to 2060.
- The *Intergenerational Reports* for both 2010 and 2015 (Australian Government 2010, p. 6, Australian Government 2015b, p. 99) assumed that the TFR will reach 1.9 births per woman by 2013 and will stay at that level to 2055.

Figure 5.10 **ASFRs by state, 2014**

Births per 1000 women



Source: ABS (*Births Australia*, 2014, Cat. no. 3301.0).

Table 5.3 **TFRs to 2060 adopted in other studies**
Births per woman

Projection	*2020*	*2030*	*2040*	*2050*	*2060*
ABS Population projections, Australia					
High growth scenario (Series A)	1.97	2.00	2.00	2.00	2.00
Medium growth scenario (Series B)	1.85	1.80	1.80	1.80	1.80
Low growth scenario (Series C)	1.73	1.60	1.60	1.60	1.60
PC An Ageing Australia: Preparing for the Future					
Base case	1.87	1.85	1.85	1.85	1.85
Intergenerational Report					
2010 report	1.90	1.90	1.90	1.90	na
2015 report	1.90	1.90	1.90	1.90	1.90

na: not available.

Sources: ABS (*Population Projections, Australia, 2012 (base) to 2101*, Cat. no. 3222.0); Australian Government (2010, p. 6); Australian Government (2015b, p. 99); PC (2013).

Towards a modelling reference case — fertility

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 downward trend in fertility observed from the 1960s to the 1980s has abated, and there are reasonable prospects that the TFR will persist within a range between 1.75 and 2 (PC 2013, p. 42; Lattimore and Pobke 2008).

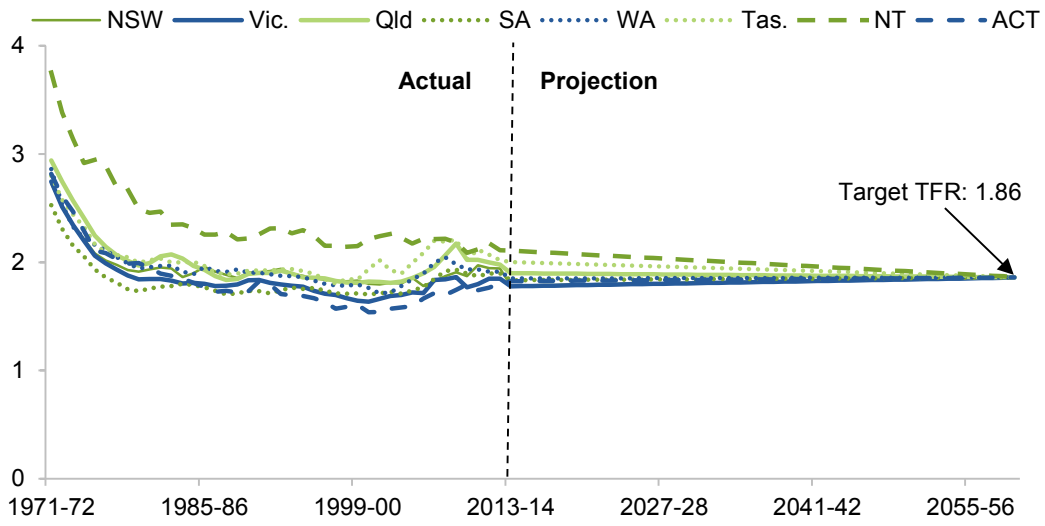
The reference case reflects this assessment. It uses the actual TFR in each state from 2009-10 to 2013-14, before assuming that the TFR in each state gradually transitions to the national average (averaged over the period 1980 to 2014) of 1.86 births per woman by 2060 (figure 5.11 and table 5.4). The state age-specific fertility rates in each simulation year are scaled to align with the target TFR in that year. The initial TFR and ASFRs in the model database are set out in chapter 3 (table 3.11).

These assumptions imply that the national TFR increases marginally from 1.83 births per woman in 2013-14 to 1.86 births per woman in 2059-60.

Where data are available (2009-10 to 2013-14), the reference case uses the actual sex ratio in each state. However, in the unwinding and projection periods, the number of male births per 100 female births in each state is assumed to be the same as the national average from 1921 to 2014 of 105.5, on the basis that the underlying probability that a baby is born male or female is determined by genetic factors that do not depend on the state of residence of the mother. This is based on the assumption that the variation evident in the historical data across states is attributable to natural statistical variation (table 5.4).

Figure 5.11 **TFR by state to 2059-60 in the reference case[a]**

Births per woman



a Actual data to 2013-14. Projection to 2059-60. Data for 1971-72 to 2004-05 are the average of calendar year TFRs. Data for 2005-06 to 2013-14 are the financial year TFRs.

Source: Estimates based on ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, June 2011 and December 2014, Cat. no. 3101.0).

Table 5.4 **TFR by state to 2059-60 in the reference case[a]**

State	*2009-10*	*2019-20*	*2029-30*	*2039-40*	*2049-50*	*2059-60*
Total fertility rate (births per woman)						
New South Wales	2.01	1.93	1.91	1.90	1.88	1.86
Victoria	1.85	1.85	1.85	1.86	1.86	1.86
Queensland	2.07	1.96	1.94	1.91	1.89	1.86
South Australia	1.90	1.89	1.88	1.88	1.87	1.86
Western Australia	1.98	1.91	1.90	1.88	1.87	1.86
Tasmania	2.14	2.00	1.96	1.93	1.89	1.86
Northern Territory	2.14	2.07	2.02	1.97	1.91	1.86
Australian Capital Territory	1.82	1.81	1.83	1.84	1.85	1.86
Australia[b]	1.97	1.91	1.90	1.89	1.87	1.86
Sex ratio (male births per 100 female births)						
New South Wales	105.4	105.5	105.5	105.5	105.5	105.5
Victoria	104.9	105.5	105.5	105.5	105.5	105.5
Queensland	105.6	105.5	105.5	105.5	105.5	105.5
South Australia	107.6	105.5	105.5	105.5	105.5	105.5
Western Australia	105.4	105.5	105.5	105.5	105.5	105.5
Tasmania	106.5	105.5	105.5	105.5	105.5	105.5
Northern Territory	108.6	105.5	105.5	105.5	105.5	105.5
Australian Capital Territory	109.8	105.5	105.5	105.5	105.5	105.5
Australia[b]	105.6	105.5	105.5	105.5	105.5	105.5

[a] In the VUMR 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. [b] Implied national change based on the state-specific shocks.

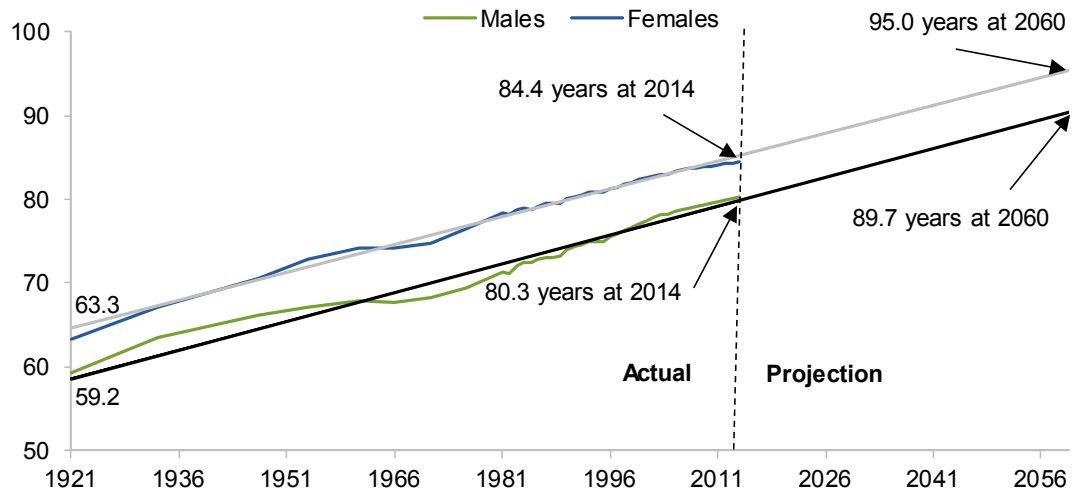
5.3 Mortality

Historical perspective

Discussions of mortality are frequently couched in terms of 'life expectancy at birth' — the estimated number of years that a newborn baby would live if current mortality patterns remained constant throughout the baby's lifetime — as it encapsulates the current mortality rate (the probability of dying) at each age of life.

Life expectancy at birth was 80.3 years for males and 84.4 years for females in 2014 (figure 5.12).

Figure 5.12 **Life expectancy at birth by gender, Australia, 1921 to 2060[a]**
Years



a Actual data to 2014. Projection to 2060. Data between 1921 and 1967 and between 1996 and 2004 have been calculated using data for the three years ending in the reference year.
Source: Estimates based on ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Deaths, Australia*, 2014, Cat. no. 3302.0).

National trends

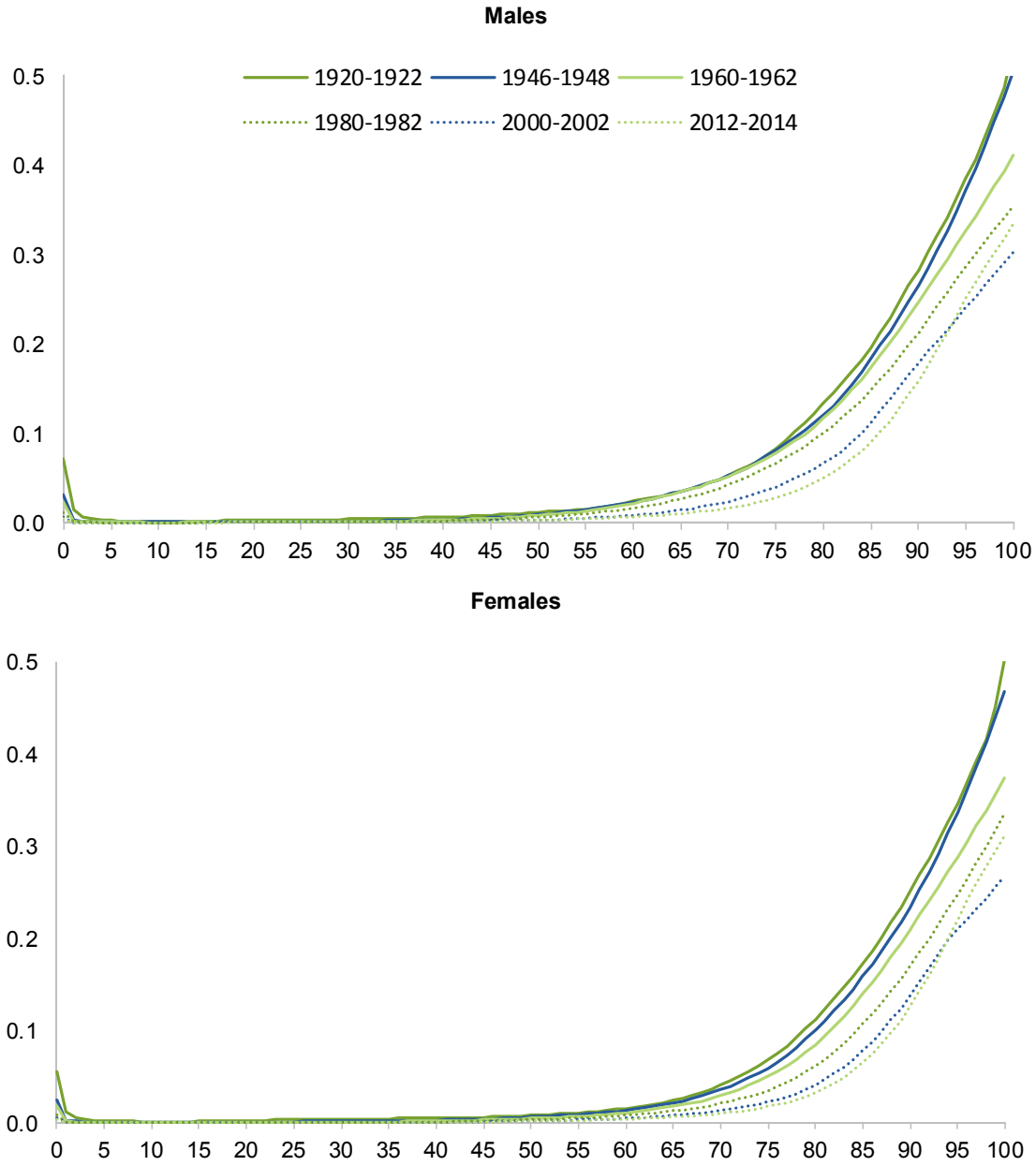
Since the 1920s, life expectancy at birth for both males and females has increased at a more-or-less linear rate. Over this period, life expectancy for females has been consistently higher than for males — although the gap widened after World War II before narrowing slightly more recently (figure 5.12). 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 5.13).

State trends

Since 1971, trends in life expectancy at birth in most states have not varied substantially from the national average (figure 5.14). 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. However, the gaps in life expectancy at birth between the Northern Territory and the rest of Australia have generally reduced over time.

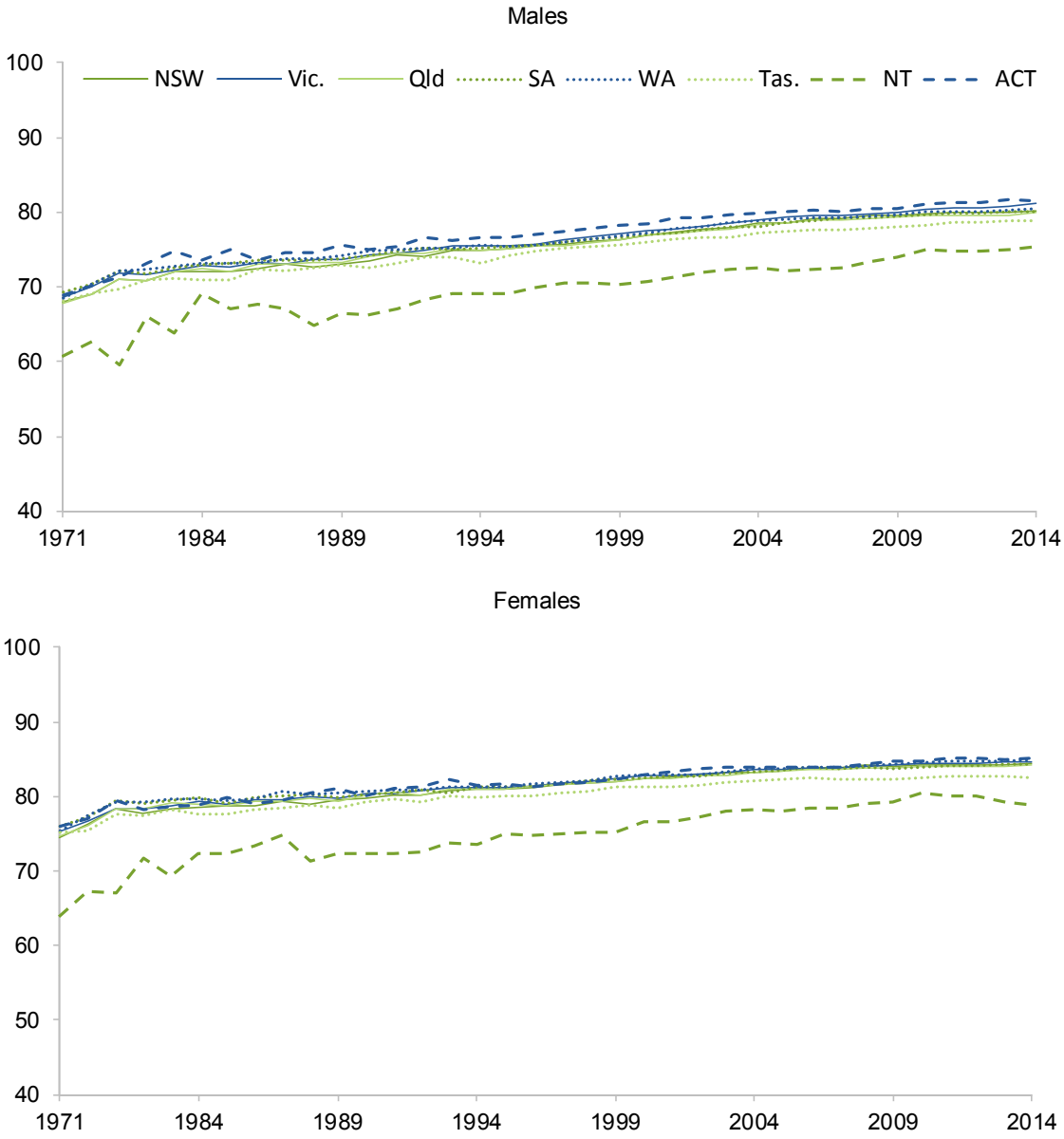
Figure 5.13 **Mortality rates by gender, Australia, 1920 to 2014**

Probability of dying in the next year



Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001), ABS (*Life Tables, States, Territories and Australia,* 2012–2014, Cat. no. 3302.0.55.001.

Figure 5.14 **Life expectancy at birth by state, 1971 to 2014[a]**
Years



[a] Data from 1995 to 2011 has been calculated using data for the three years ending in the reference year.

Sources: ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001), ABS (*Life Tables,* 2014, Cat. no. 3302.0.55.001).

Comparison of recent projections

All of the studies reviewed project life expectancy to increase over the projection period, albeit at slowing rates of growth (table 5.5). The studies also tend to incorporate a degree of convergence, with male life expectancy increasing at a slightly faster rate than females.

The ABS (*Population Projections, 2012 to 2101*, 2012, Cat. no. 3222.0) provides two possible projections for life expectancy at birth:

- *High life expectancy at birth* (constant improvement in life expectancy) — male and female life expectancy at birth will increase from 2009–2011 levels by 0.25 and 0.19 years per year, respectively, until 2060-61. Based on this assumption, male life expectancy at birth would reach 92.1 years and female life expectancy at birth would reach 93.6 years in 2060-61.
- *Medium life expectancy at birth* (declining improvement in life expectancy) — male and female life expectancy is projected to improve at a gradually declining rate from the 2009–2011 levels by 0.25 and 0.19 years per year, respectively, to 0.07 and 0.05, respectively in 2060-61.[12] Based on this, life expectancy at birth will reach 85.2 years for males and 88.3 years for females in 2060-61.

The ABS population projection Series A assumed high life expectancy and Series B and C assume medium life expectancy at birth.

Similar to ABS Series B, PC (2013) assumed a decline in the rate of increase in life expectancy at birth and projects life expectancy for males to reach 89.1 and for females 91.4 in 2060.

The two Intergenerational Reports reviewed also assumed that the rate of increase in life expectancy at birth will diminish over time. The 2010 report projects life expectancy at birth to be 87.7 years for males and 90.5 years for females in 2050 (Australian Government 2010, p. 7). The corresponding projections in the 2015 report are 95.1 years for men and 96.6 years for women in 2054-55 (Australian Government 2015b).

[12] In the declining improvement in life expectancy scenario, the annual increases in life expectancy at birth for males and females, respectively, are: 0.25 and 0.19 years per year from 2015-16; 0.20 and 0.15 years per year from 2020-21; 0.15 and 0.11 years per year from 2025-26; 0.10 and 0.08 years per year from 2030-31; and 0.07 and 0.05 years per year from 2060-61 (ABS Cat. no. 3222.0).

Table 5.5 **Life expectancy at birth to 2060 adopted in other studies**
Years

Projection	*2020*	*2030*	*2040*	*2050*	*2060*
ABS Population projections, Australia					
High growth scenario (Series A))					
Males:	82.1	84.6	87.1	89.6	92.1
Females:	86.0	87.9	89.8	91.7	93.6
Medium growth scenario (Series B)					
Males:	81.8	83.1	83.8	84.5	85.2
Females	85.8	86.8	87.3	87.8	88.3
Low growth scenario (Series C))					
Males:	81.8	83.1	83.8	84.5	85.2
Females	85.8	86.8	87.3	87.8	88.3
PC An Ageing Australia: Preparing for the Future					
Base case					
Males:	82.2	84.3	86.1	87.8	89.1
Females	85.9	87.5	88.8	90.1	91.4
Intergenerational Report					
2010 report					
Males:	82.5	84.5	86.1	87.7	na
Females	86.2	87.8	89.2	90.5	na
	2014-15	*2024-25*	*2034-35*	*2044-45*	*2054-55*
2015 report					
Males:	91.5	92.6	93.6	94.4	95.1
Females	93.6	94.5	95.3	96.0	96.6

na: not available.

Sources: ABS (*Population Projections, Australia, 2012 (base) to 2101*, Cat. no. 3222.0); Australian Government (2010, p. 7); Australian Government (2015b, p. 99); PC (2013).

Towards a modelling reference case — mortality

While genetic limitations may mean that life expectancy cannot increase indefinitely, there has, nonetheless, been a roughly linear increase in life expectancy over the last 90 years.

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 VUMR. Given this, the age-, gender- and state-specific mortality rates in the model database (detailed in tables 3.12 and 3.13 in chapter 3) are updated using the age-, gender- and state-specific growth rates (detailed in tables 3.14 and 3.15 in chapter 3). The growth rates for all states other than the Northern Territory are the average annual improvement in the mortality rates for each age and gender for Australia over the period 1970–72 to

2010-12.[13] These improvement factors for mortality 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 5.6) are generally close to those obtained by linearly extrapolating historical trends (figure 5.12).

Table 5.6 **Life expectancy at birth by state implied by the annual changes in mortality rates to 2059-60 in the reference case**
Years

	2009-10	*2019-20*	*2029-30*	*2039-40*	*2049-50*	*2059-60*
Males						
New South Wales	80.2	82.2	84.3	86.1	87.7	89.1
Victoria	81.1	82.6	84.6	86.4	87.9	89.3
Queensland	79.9	81.9	84.0	85.9	87.5	88.9
South Australia	80.1	82.1	84.2	86.0	87.6	89.0
Western Australia	80.5	82.4	84.4	86.2	87.8	89.2
Tasmania	78.8	80.9	83.1	85.0	86.7	88.2
Northern Territory	75.4	79.5	83.1	86.0	88.4	90.3
Australian Capital Territory	81.4	83.3	85.2	86.9	88.3	89.6
Females						
New South Wales	84.4	86.0	87.5	88.9	90.1	91.1
Victoria	84.7	86.2	87.6	88.9	90.1	91.0
Queensland	84.2	85.8	87.4	88.7	89.9	90.9
South Australia	84.3	85.9	87.4	88.7	89.9	90.9
Western Australia	84.9	86.4	87.9	89.2	90.4	91.3
Tasmania	82.5	84.4	86.1	87.6	88.8	90.0
Northern Territory	78.9	83.8	86.6	88.7	90.4	91.7
Australian Capital Territory	85.2	86.6	88.0	89.2	90.3	91.3

5.4 Overseas migration

NOM can directly affect the Australian economy by changing the size of the population, its age and gender structure as well as the size and composition of labour force. The effect of NOM on population growth can be amplified if it increases the proportion of population in the high fertility rate age groups (20 to 39 years old) and/or the proportion of females.

[13] Reflecting higher historical rates of improvement in life expectancy, the improvement factors applied to the Northern Territory differ by age and gender to those applied in other states. The improvement factor for babies reflects the recent higher growth rates for life expectancy at birth in the Northern Territory. The improvement factors for all other ages have been adjusted proportionately so that the improvement factors for those aged 100 years and over are identical to those in all other states. This way, the improvements in life expectancy in the Northern Territory are skewed towards younger age groups.

NOM was 205 823 in the financial year 2013-14, equivalent to 0.88 per cent of the population in that year (ABS, *Australian Demographic Statistics*, December 2014, Cat. no. 3101.0). This represents the net of 488 629 migrant arrivals to Australia and 282 806 resident departures from Australia.[14]

Historical trends

While more recent data tends to be published on a financial-year basis (the year ended 30 June), which is consistent with the VUMR model, much of the historical data on NOM is published on a calendar-year basis (the year ended 31 December).

National trends

Since 1920, NOM as a proportion of the Australian population has fluctuated substantially between -0.18 per cent (1931) and 1.86 per cent (1949) (figure 5.15, top panel). After account is taken of year-to-year variations, the long-run average has remained fairly stable at around 0.6 to 0.7 per cent of the Australian population over various sub-periods to 2014 (table 5.7). More recently, during the 1990s annual NOM tended to be below the historic average, while for each year since the mid-2000s it has been above the historic average (figure 5.15, top panel).

Historically, the number of migrants entering Australia has been largely determined by the Australian Government (table 5.8). However, over time, immigration policies have become more flexible, enabling the system to be more responsive to changes in the demand for labour, as well as the demand for student places by foreign students.

Table 5.7 **Average NOM as a share of the population, 1920 to 2014[a]**
Per cent

Time period	*Share of population*[b]
1920-2014	0.59
1955-2014	0.69
1975-2014	0.64
1990-2014	0.68

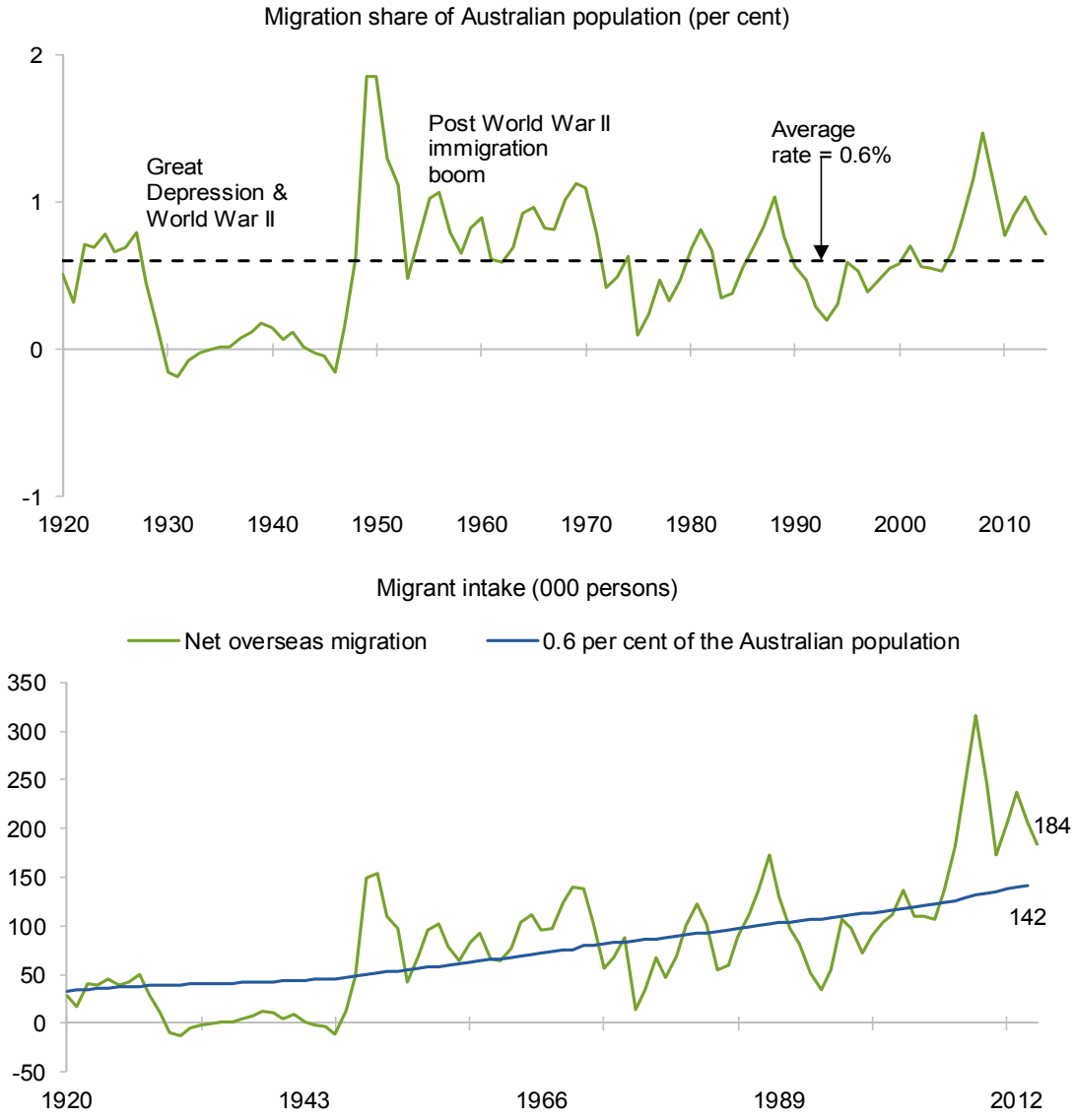
a Calendar year basis. **b** Share of Australian population as at 31 December.

Source: Estimates based on ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0); Phillips, Klapdor and Simon–Davies (2010).

14 In subsequent releases, the ABS *has* revised up NOM in 2013-14. In the 2013-14 release of *Migration, Australia*, NOM in 2013-14 was 212 695, with 492 436 migrant arrivals to Australia and 279 741 resident departures from Australia (ABS Cat. no. 3412.0).

There have also been significant changes in the level and composition of migration over the last 10 years. Between 2004 and 2008, annual NOM rose from just over 100 000 to a peak of over 315 000 in 2008, before falling back to 184 135 in 2014 (figure 5.15, bottom panel). In large part, this was driven by increases in the number of long-term temporary immigrants coming to Australia (especially international students and long-stay business visas), rather than reductions in the number of departures (figure 5.16).

Figure 5.15 **NOM, Australia, 1920 to 2014[a,b]**



[a] Calendar year basis. [b] From July 1925, figures are net permanent and long-term migration. From 1971 to 2006, 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 over a period of 16 months and the number of outgoing travellers who leave Australia for 12 months or more over a period of 16 months.

Source: ABS (Australian Historical Population Statistics, 2014, Cat. no. 3105.0.65.001); ABS (Australian Demographic Statistics, December 2014, Cat. no. 3101.0); Phillips, Klapdor and Simon–Davies (2010).

Table 5.8 **Selected changes to Australia's immigration program, 1973 to 2014**

Year	*Change*
1973	End of the White Australia policy; Introduction of the unrestricted Trans-Tasman Travel Arrangement between Australia and New Zealand; Permitting overseas students to remain when their services were sought by an Australian employer
1977	Commencement of the first tailored humanitarian program
1979	Introduction of first points-based system – points allocated to applicants' family based on, among other things, links to Australia, skills, English language proficiency
1989	Capping the level of migration through the points-tested components of the family and 'economic' streams
1992	Introduction of universal visa system – all immigrants to enter Australia under one visa system
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	Increase in residency requirement to gain citizenship from two to four years; Introduction of citizenship test; 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

(continued next page)

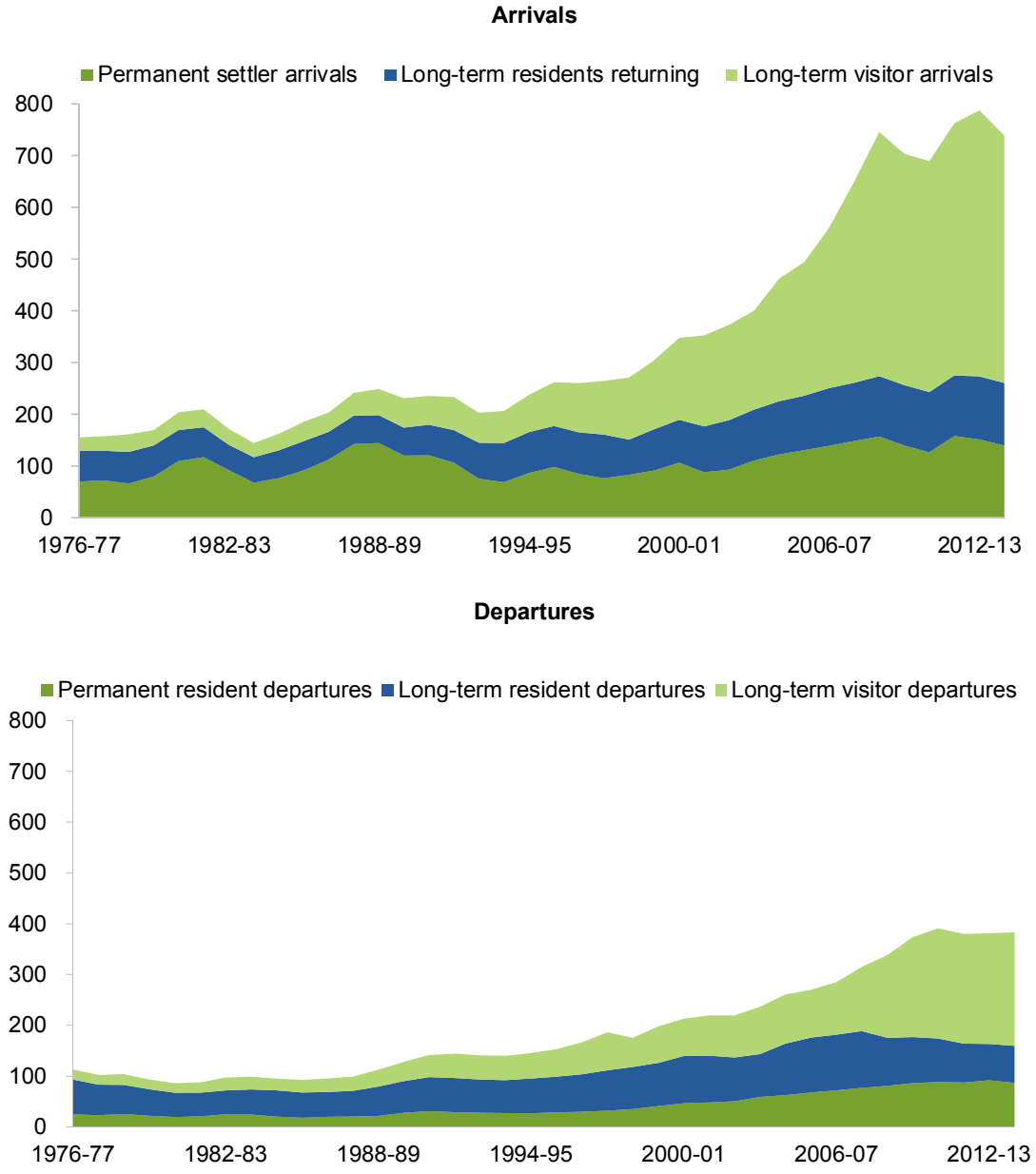
Table 5.8 (continued)

Year	*Change*
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; Introduction of rules for temporary skilled graduate visas for students studying for an occupation not on the skilled occupations list
2011-12	The introduction of streamlined visa processing for students
2012-13	Introduction of SkillSelect — a new two-step regime for skilled migration designed to allow for a greater degree of control over the level of NOM: the first 'expression of interest' step involves applicants providing information for a points test score to rank them within a nominated occupation; and a second step in which the highest ranked potential applicants in each selection round are invited to lodge a visa application; Introduction of the Business Innovation and Investment Program and the Significant Investor visa to reform business skills visa
2013-14	Introduction of the labour market testing requirement, which created a legal obligation for certain employers to provide evidence of attempts to recruit locally before nominating overseas workers under the subclass 457 programme unless exempted; Extension of streamlined visa processing to low-immigration-risk non-university higher education providers

Sources: DIAC (2011, 2013b, 2014); DIBP (2015); DIMA (2001); Evans (2008a, 2008b, 2008c, 2009, 2010); Klapdor, Coombs and Bohm (2009); Koleth (2010); Parliamentary Library (2010); Ray (1989).

Figure 5.16 **Overseas arrivals to and departures from Australia, 1976-77 to 2013-14**

Thousands

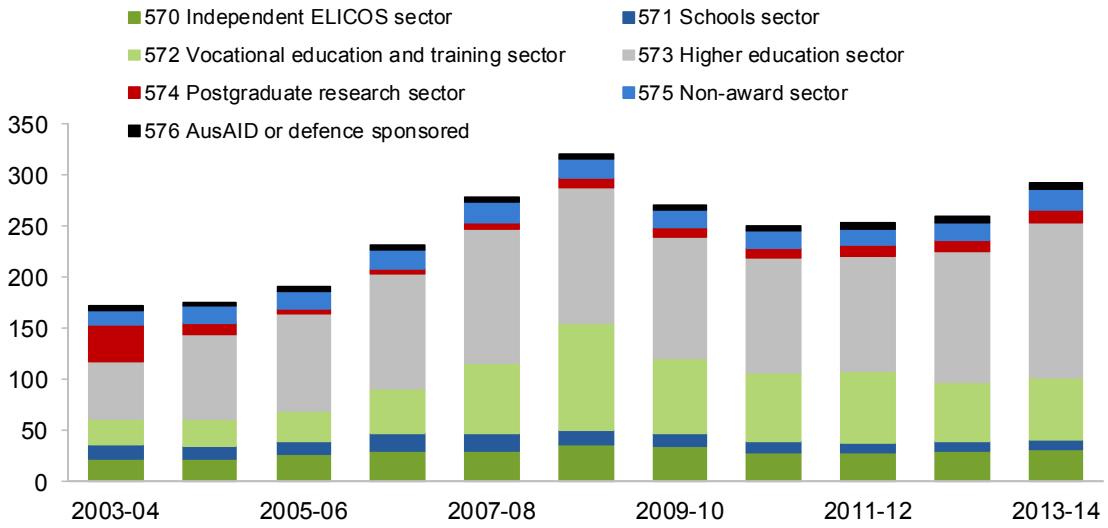


Source: ABS (*Overseas Arrivals and Departures, Australia*, January 2015, Cat. no. 3401.0).

The number of student visa grants grew by about 70 per cent over the last decade; from 172 000 in 2003–14 to 292 000 in 2013-14 (figure 5.17). The largest increases in visas were for vocational education and training (increasing by over 300 per cent, or 78 962 students) and for higher education (increasing by about 150 per cent, or 78 748 students).

Figure 5.17 **Number of student visas granted by visa subclass, Australia, 2003-04 to 2013-14**

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), DIBP (2014).

This increase in overseas students can be attributed partly to changes to the migration rules that enabled students who had successfully completed their studies at an Australian educational institution, and had skills considered to be in demand, to apply for permanent residency onshore. 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.

Student visas granted peaked in 2008-09 at almost 320 000. The subsequent decline reflects a number of factors, including:

- greater focus on integrity for applications from selected countries;
- increased financial requirements;
- global economic uncertainty;
- reforms to the Skilled Migration Program, which made the transition from international student to permanent residency more difficult; and
- the appreciation of the Australian dollar (DIAC 2013a).

In 2011, the Australian Government commissioned the independent Knight Review (Australian Government 2011) to review the student visa programme to ensure its settings were able to respond to current and future challenges. Following the recommendations of the Review, the student visa programme has since undergone significant reform. One

important reform was in the visa processing area which benefited from the introduction of streamlined visa processing. Under this program, students benefit from lower evidentiary requirements, regardless of their country of citizenship, and generally receive simpler and quicker visa processing.

There has been an upward swing in the numbers of student visas since 2011-12, and the largest increase took place in the higher education sector (figure 5.17). Analysis by the Centre for International Economics (CIE) found, after accounting for exchange rates and other factors, a significant positive impact of streamlined visa processing on student numbers (CIE 2014).

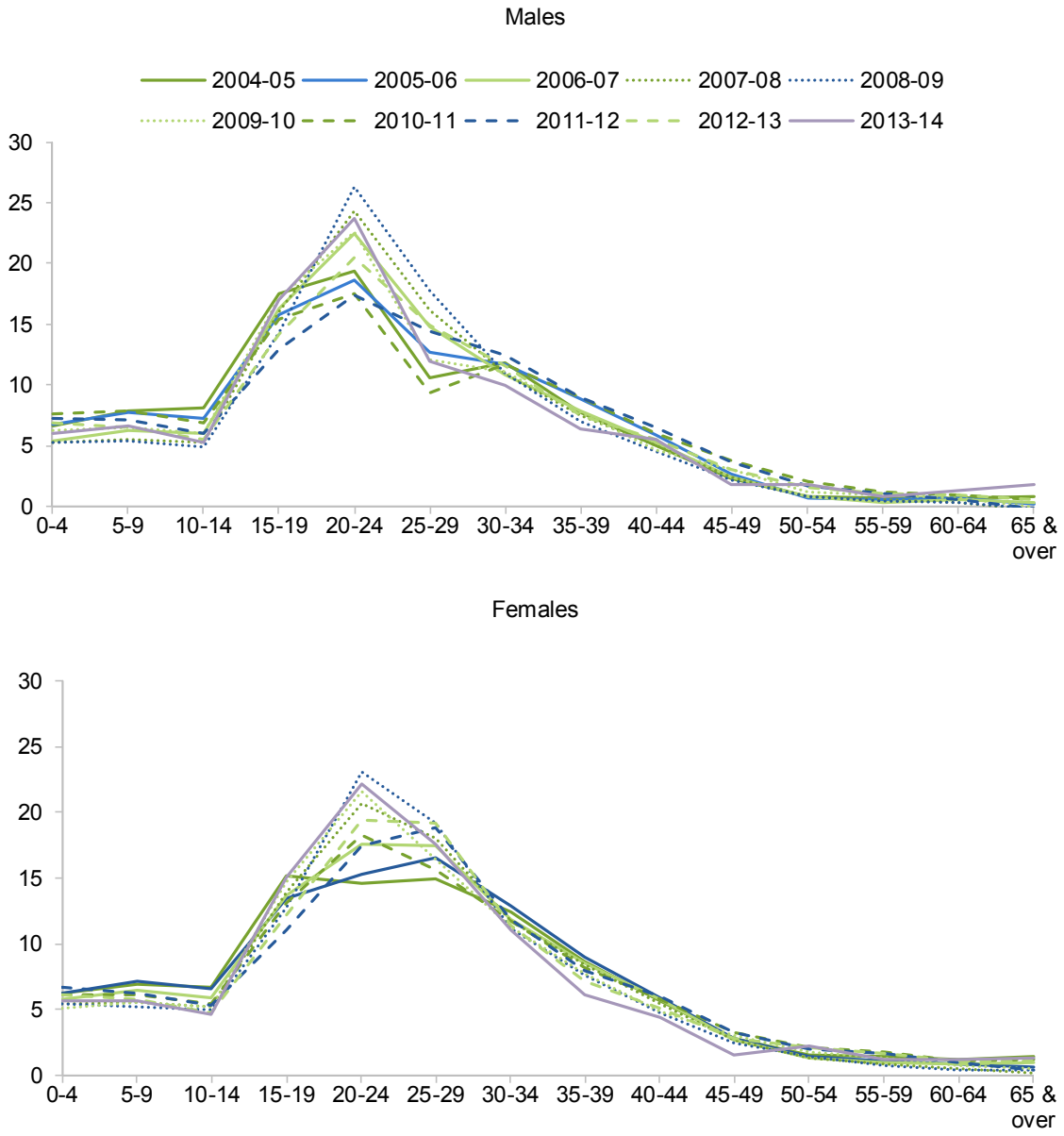
Despite the increasing trend, student visa grants have not returned to their pre-global financial crisis levels. In addition, since the path from overseas student visa to permanent residency has been restricted (PC 2015a), the number of overseas students is not expected to rise to the level prevailing in mid-to-late 2000s.

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. 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 decline in student numbers since the peak in 2008-09 has mainly been for males in the 20 to 24 and adjacent age groups (figure 5.18).

The share of NOM by age varies across time, and is particularly volatile for over 50 year olds (due to the small number of migrants in those age groups) (figure 5.19). In 2008-09, there was a net outflow of males aged 65 and over, resulting in a negative sex ratio.

Figure 5.18 **Age distribution of NOM by gender, 2004-05 to 2013-14[a]**

Per cent



a The age-specific shares sum to 100 per cent for each gender in each year.

Source: ABS (*Migration, Australia*, 2013-14, Cat. no. 3412.0).

Figure 5.19 **Sex ratio of NOM by age, 2004-05 to 2013-14 (selected years)[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 in 2008-09.

Source: ABS (*Migration, Australia*, 2013-14, Cat. no. 3412.0).

Comparison of recent projections

As NOM has varied substantially over recent decades, there are often significant differences in the level of NOM assumed in studies across time. Studies also vary in whether they use a NOM rate (share of the population) or a fixed level of NOM. In the latter case, the NOM rate declines over time.

The ABS has three assumptions regarding the level of NOM over the projection period — high, medium and low. Under the 'high' assumption, the level of NOM settles at 280 000 by 2021 and remains at that level. Under the 'medium' and 'low' assumptions, the NOM figures by 2021 are 240 000 and 200 000, respectively, remaining at those levels after that.

The medium NOM assumption used in Series B is equivalent to a decline of NOM from 0.7 per cent of the population in 2020 to 0.6 per cent in 2050 (table 5.9).

PC (2013) assumed that NOM would decline from 2012 to 180 000 by 2018 and remain at that level out to 2102.

The *Intergenerational Report 2010* projected that NOM 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 (Australian Government 2010, p. 7). As NOM is fixed at 180 000 people per year from 2012, NOM 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.

These estimates of NOM were revised up in the *Intergenerational Report 2015* to 215 000 by 2018-19 in the 'currently legislated' scenario, which was based on the then current state of play (Australian Government 2015b, p. viii). Under this scenario, NOM is projected to fall as a percentage of the population over the next 40 years, to just over 0.5 per cent, which would bring it back in line with the average of 0.5 per cent observed between 1973 and 2006.

Table 5.9 **NOM to 2060 adopted in other studies**
Per cent of the Australian population

Projection	*2020*	*2030*	*2040*	*2050*	*2060*
ABS Population projections, Australia					
High growth scenario (Series A)	1.1	0.9	0.8	0.7	0.6
Medium growth scenario (Series B)	0.9	0.8	0.7	0.6	0.6
Low growth scenario (Series C)	0.8	0.7	0.6	0.6	0.5
PC An Ageing Australia: Preparing for the Future					
Base case	0.7	0.6	0.6	0.5	0.5
Intergenerational Reports					
2010 report	0.7	0.6	0.6	0.5	na
	2014-15	*2024-25*	*2034-35*	*2044-45*	*2054-55*
2015 report	1.0	0.8	0.7	0.6	0.5

na: not applicable.

Sources: ABS (2013, *Population Projections, Australia, 2012 (base) to 2101*, Cat. no. 3222.0); Australian Government (2010, p. 7); Australian Government (2015b, p. 99); PC (2013).

Towards a modelling reference case — net overseas migration

NOM by age, gender and state in the model database are set out in chapter 3 (tables 3.16 and 3.17).

The modelling reference case uses actual NOM by age, gender and state in each financial year to 2013-14 (table 5.10).[15] The average age and gender shares over this period are shown in table 5.11.

Table 5.10 **NOM to 2013-14 in the reference case**

	2009-10	*2010-11*	*2011-12*	*2012-13*	*2013-14*
Persons	196 058	180 372	229 408	227 141	205 823
Share of population (per cent)[a]	0.90	0.82	1.03	1.00	0.89

[a] Share of beginning-of-year population.

Source: ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0).

15 The level of NOM by state was sourced from ABS (*Australian Demographic Statistics*, June 2010, Cat. no. 3101.0) 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.

It is then assumed that the NOM share of the population is linearly unwound from the level in 2013-14 (0.88 per cent) to the long-term historical average of 0.64 per cent by 2024-25 and remain at that level thereafter (table 5.12 and figure 5.20).

The age, gender and state distribution of NOM during the projection period is determined by the database shares at the beginning of each simulation year and is updated during each simulation year.

Table 5.11 **Average age and sex ratios of NOM, 2010-11 to 2013-14[a]**

Age	*Share of NOM*	*Sex ratio*
	Per cent	Male migrants per 100 female migrants
0-4	6.7	106.1
5-9	6.4	108.3
10-14	5.5	110.7
15-19	13.1	108.8
20-24	18.9	95.7
25-29	16.1	70.0
30-34	11.7	95.6
35-39	7.9	100.8
40-44	5.7	100.9
45-49	3.2	103.8
50-54	1.9	74.4
55-59	1.4	60.4
60-64	0.9	72.0
65 and over	0.7	37.1
Total	**100.0**	**93.8**

a Average of 2010-11 to 2013-14.

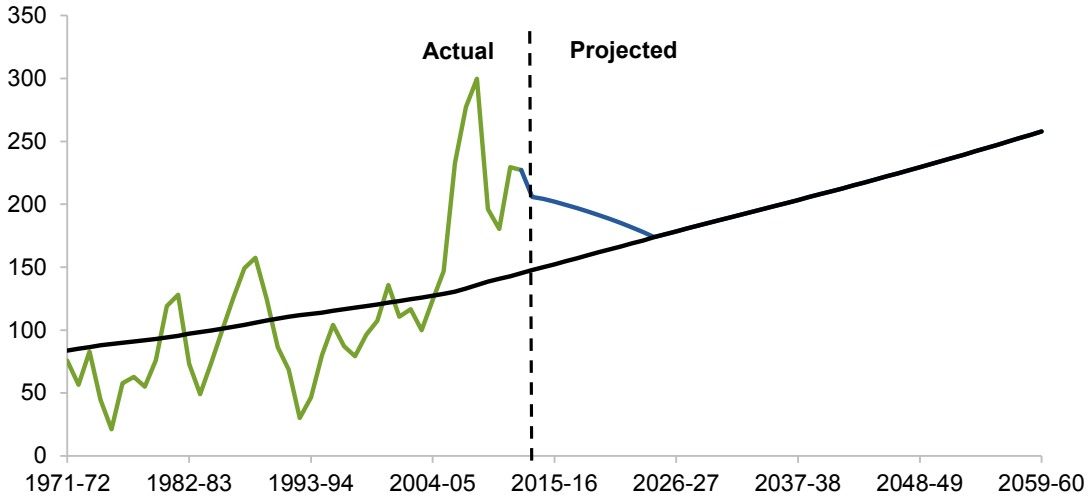
Source: ABS (*Migration, Australia*, 2013-14, Cat. no. 3412.0).

Table 5.12 **NOM projections 2014-15 to 2059-60 in the reference case**

	2019-20	*2029-30*	*2039-40*	*2049-50*	*2059-60*
Proportion of the population (per cent)	0.75	0.64	0.64	0.64	0.64
Level (persons per year)	150 404	169 863	190 672	212 829	236 335

Figure 5.20 **Actual and projected NOM in the reference case, 1971-72 to 2059-60[a]**

Thousands



[a] Actual data to 2013-14. Projection to 2059-60.

Source: Estimates based on ABS (*Australian Historical Population Statistics*, 2014, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0); Phillips, Klapdor and Simon−Davies (2010).

5.5 Summary of reference case assumptions

This section summarises the key demographic assumptions adopted in the reference case. The implications of these assumptions, including the level of population and its distribution across states, ages and gender, are set out in chapter 12.

Fertility rates

- The reference case involves specifying the annual change in the TFR for each state out to 2059-60.
- The actual annual change in the TFR for each state is applied over the uprating period (2009-10 to 2013-14). The TFR for each state is then assumed to linearly converge from their actual rate to 1.86 births per woman in 2059-60 (over the unwinding and projection periods) (details given in table 5.4).
- While determined by the model, the effect of this is that the national TFR is assumed to decline from 1.97 births per woman in 2009-10 to 1.86 births per woman in 2059-60.

- The ASFRs in each state in each simulation year are scaled to align with the target TFR for that state in that year (details given in table 5.4).
  - The initial TFR and ASFRs in the model database are set out in table 3.11 in chapter 3.
- The actual sex ratio in each state — the ratio of male births per 100 female births — is used to 2013-14, and thereafter assumed to be the historical national average of 105.5 (details given in table 5.4).

Mortality rates

- State and age-specific mortality rates in each simulation year are updated using the annual age-, gender- and state-specific improvement factors that are detailed in tables 3.14 and 3.15 in chapter 3

Net overseas migration

- NOM is modelled by age, gender and state.
- Actual NOM by age, gender and state is used to 2013-14 (summarised in tables 5.10 and 5.11).
- NOM is then modelled as unwinding linearly as a share of the population to the long-term historical average of 0.64 per cent of the beginning-of-year population by 2024-25 and remain at that level thereafter (table 5.12).
- The age, gender and state distribution of NOM is determined by the database shares at the beginning of each simulation year and is updated during each simulation year (tables 3.16 and 3.17 in chapter 3).

Net interstate migration

Interstate migration, which contributes to population distribution across states, is modelled endogenously in the reference case, and is linked to changes in the labour market, which respond to differences in nominal wage changes by occupations across states.

6 Labour market

Changes in labour supply (labour inputs) contribute to changes in the level of economic output and form an important part of any modelling reference case.

This chapter outlines the specific sources of labour market assumptions adopted in the reference case. It commences by outlining recent historical trends and changes in workforce composition (section 6.1). It then summarises key labour market projections adopted in several recent studies (section 6.2). The chapter concludes by outlining the assumptions adopted in the reference case (section 6.3).

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 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.

Analytical framework used

The analytical framework used to assess the contributions made by changes in labour market participation to real GDP growth is based on the PPP framework detailed in chapter 2. Labour inputs are expressed in terms of hours worked. The productive contribution of these labour inputs is discussed in chapter 7.

Total hours worked in any given year depends on:

- the number of people in the economy at each working age (which occurs through demographic change); and
- the annual number of hours worked by each person of working age (which reflects labour market-specific considerations).

The demographic assumptions set out in chapter 5 determine the number of people at each working age in the reference case (assumed to be 15 years and over) out to 2059-60.

The contribution made to total hours worked of this working-age population can be further decomposed into the contributions made 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 employed at each working age.

This chapter ascertains the contribution made by each of these three factors to historical real GDP growth. It uses these recent trends to gain insights into future directions for the labour market. The subsequent adjusted trends are applied as shocks to the VUMR model that determine the labour market projections set out in chapter 12. This approach to modelling the contributions made by labour market participation is based on that used in PC (2012b).

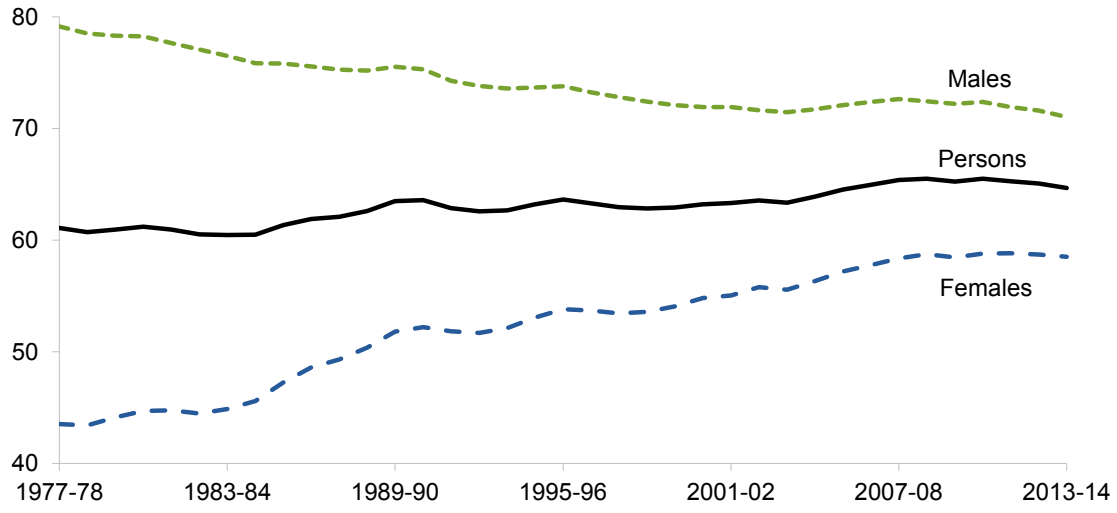
6.1 Historical perspective

Labour force participation rates

Labour force participation rates have increased slowly since the late 1970s, growing by an average of 0.16 per cent a year over the period 1977-78 to 2013-14 (figure 6.1).[16]

Figure 6.1 **Labour force participation rate by gender, Australia, 1977-78 to 2013-14[a]**

Per cent



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

Source: ABS (*Labour Force, Australia*, May 2015, Cat. no. 6202.0).

Gender-wise, labour market participation has been a mixed story.

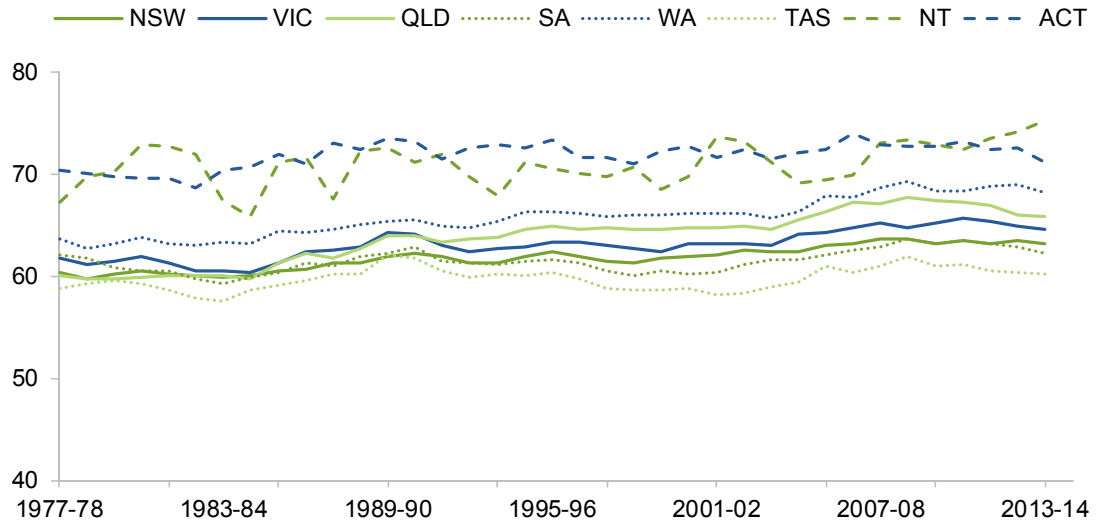
16 The time periods analysed in this chapter are generally based on data availability (typically starting in 1977-78).

- Female 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, 2015b).
- 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 a 'discouraged worker effect' associated with reductions in employment in the traditionally male dominated manufacturing and agricultural sectors and greater difficulty for men in finding employment in the expanding services sector.

The overall result has been a steady convergence of participation rates for women and men, with the overall rate increasing over time.

Participation rates have increased in all states, although there have been some substantial short-run fluctuations (figure 6.2). Aside from the Northern Territory, all jurisdictions have experienced broadly similar fluctuations, although relativities have widened for some states.

Figure 6.2 **Labour force participation rate by state, 1977-78 to 2013-14[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.

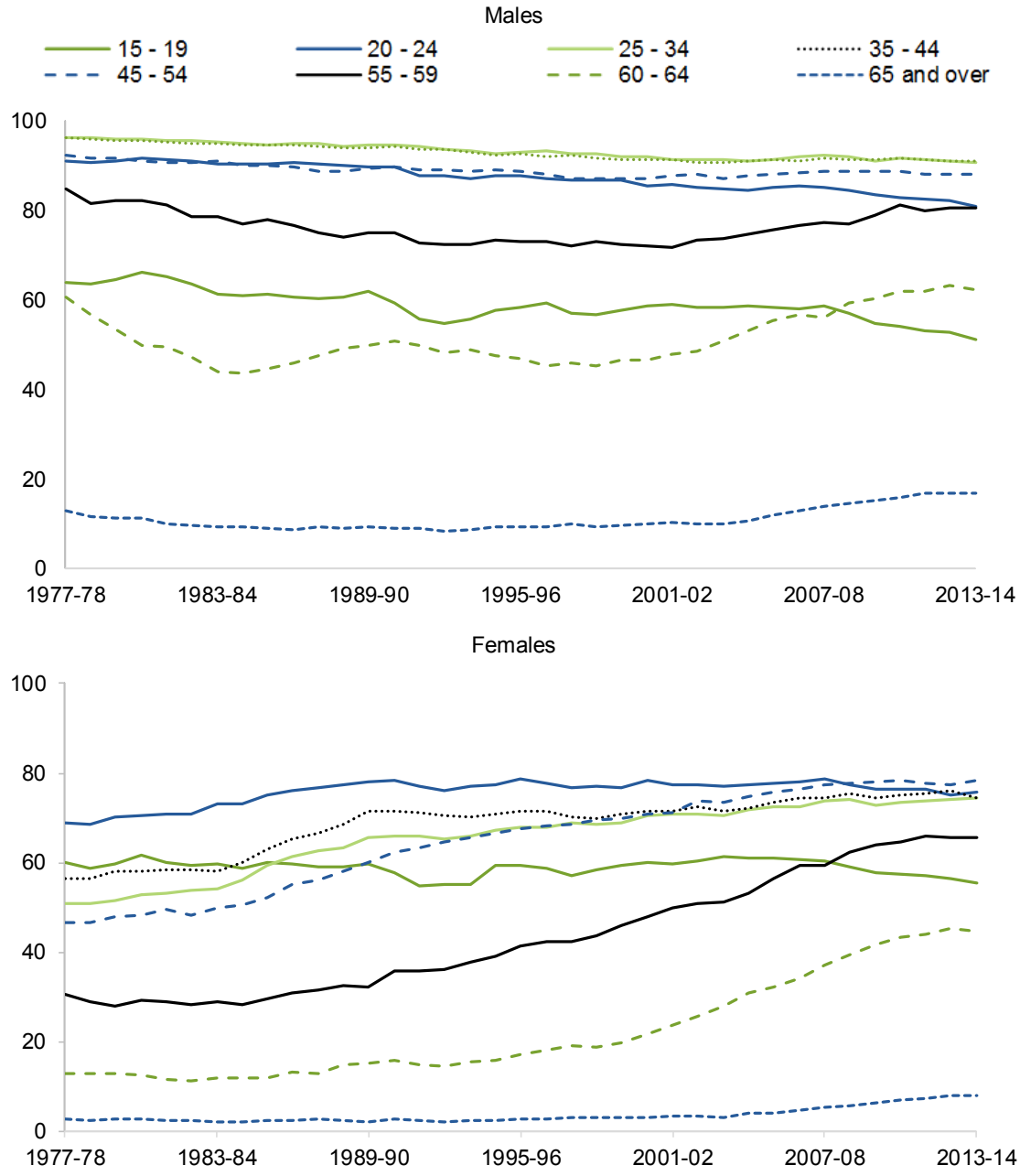
Source: ABS (*Labour Force, Australia*, May 2015, Cat. no. 6202.0).

Age-specific participation rates for both men and women have also varied between 1978 and 2014 (figure 6.3). 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 historical 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 with the decline in the 55–59 and 60–64 age groups being reversed in the decade commencing 2000.

Figure 6.3 **Age-specific national labour force participation rate by gender, 1977-78 to 2013-14[a]**

Per cent



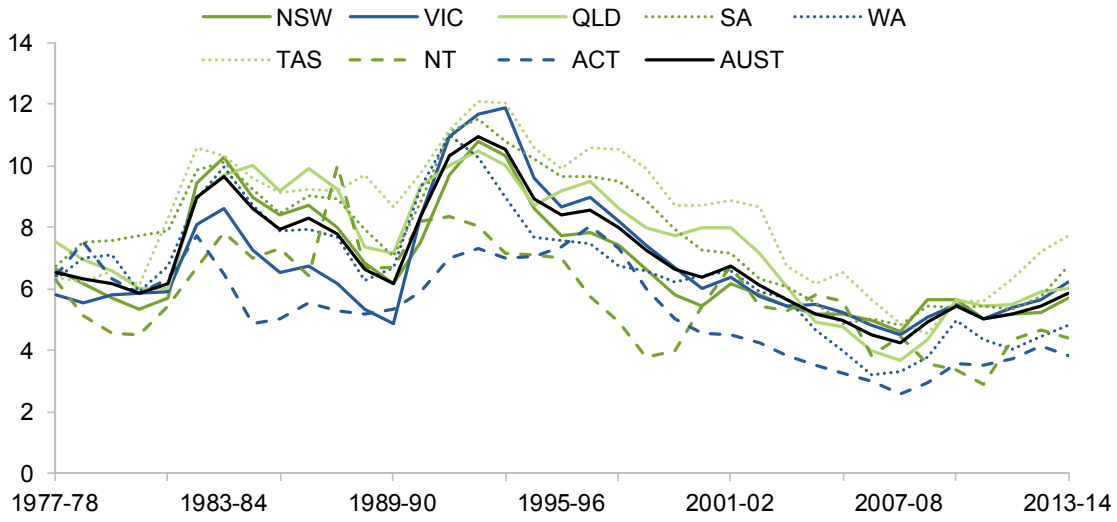
a The labour force in each age group as a share of the civilian population aged 15 years and over in that age group.

Source: ABS (*Labour Force, Australia, Detailed - Electronic Delivery*, April 2015, Cat. no. 6291.0.55.001).

Employment rates

After years of sustained economic growth in Australia, and notwithstanding temporary increases in unemployment rates during the 1980s and early 1990s, there was an increase in the share of the labour force engaged in employment (the employment rate) from the late 1970s to 2008. This trend towards increased employment meant that the share of the labour force that is unemployed (the unemployment rate) declined from 5.3 per cent in 1978 to a level of 4.2 per cent in 2008, after which the national unemployment rate has increased gradually to 5.9 per cent in 2013-14 – that is, around the level prevailing in the late 1970s (figure 6.4).

Figure 6.4 **National and state unemployment rates, 1977-78 to 2013-14[a,b]**
Per cent



[a] The number of unemployed persons expressed as a share of the labour force.[b] The unemployment rate is the converse of the employment rate.

Source: ABS (*Labour Force, Australia*, May 2015, Cat. no. 6202.0).

Over the same time period, the changes in employment and unemployment rates have been broadly consistent across all states (figure 6.4). Unemployment rates have steadily declined since the early 1990s, notwithstanding the increase around the time of the Global Financial Crisis (GFC). As of June 2014, the unemployment rates in all jurisdictions were higher than they were in 2007-08 — some jurisdictions like the Northern Territory was marginally higher at 4.5 per cent, while South Australia and Queensland were appreciably higher at 7.3 per cent and 6.8 per cent, respectively.

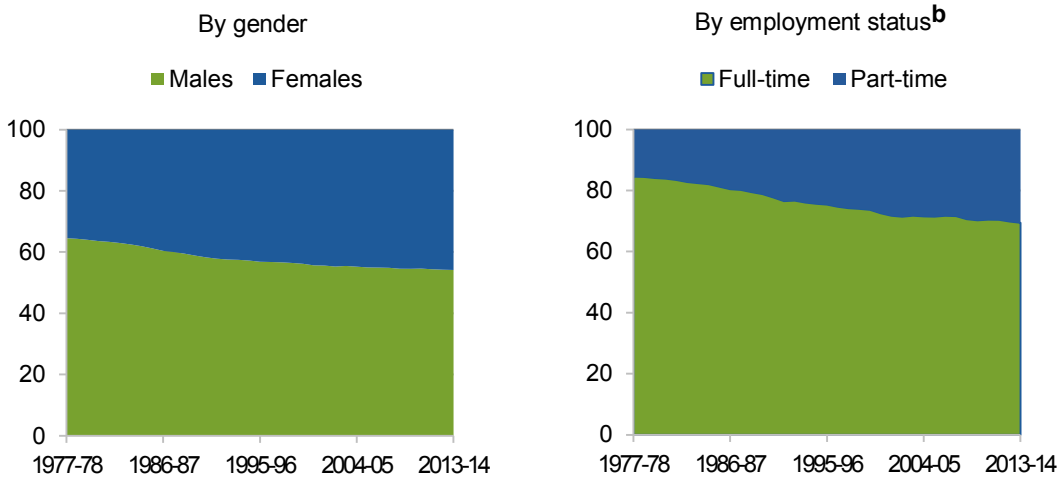
Other perceptible changes in the nature of employment in Australia over this period include:

- a marked growth in female employment reflecting their increased participation in the labour force (figure 6.5, left panel);
- an increase in relative importance of part-time employment, rising from 15 per cent of total employment in 1978 to 31 per cent in 2015 (figure 6.5, right panel); and
- 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 giving rise to more part-time employment. These trends and the associated economic changes are described in Abhayaratna and Lattimore (2007), Lattimore (2007), Abhayaratna et al. (2008) and Gilfillan and Andrews (2010).

Figure 6.5 **Employment share by gender and employment status, Australia, 1977-78 to 2013-14[a]**

Per cent



a Persons basis. **b** Part-time workers are those who usually work less than 35 hours a week in all jobs.

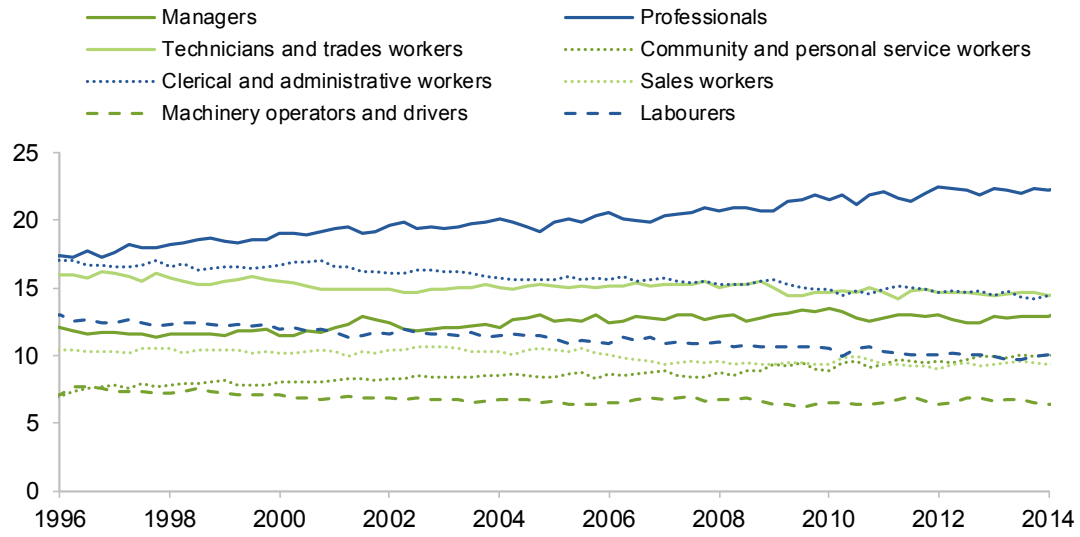
Source: ABS (*Labour Force, Australia*, May 2015, Cat. no. 6202.0).

Employment by occupation

The occupational composition of total employment has changed over time (figure 6.6). The most notable increases between 1996 and 2014 have been in the employment of *professionals*, increasing from 17 to 23 per cent, and *community and personal service workers,* increasing from 6 to 10 per cent of total employment. The employment share of *managers* also increased, albeit not as markedly. All other employment categories have decreased as a share of total employment, with the most notable declines being for the *labourers* and *machinery operators and drivers* categories.

Figure 6.6 **Occupation share of national employment, August 1996 to August 2014**

Per cent

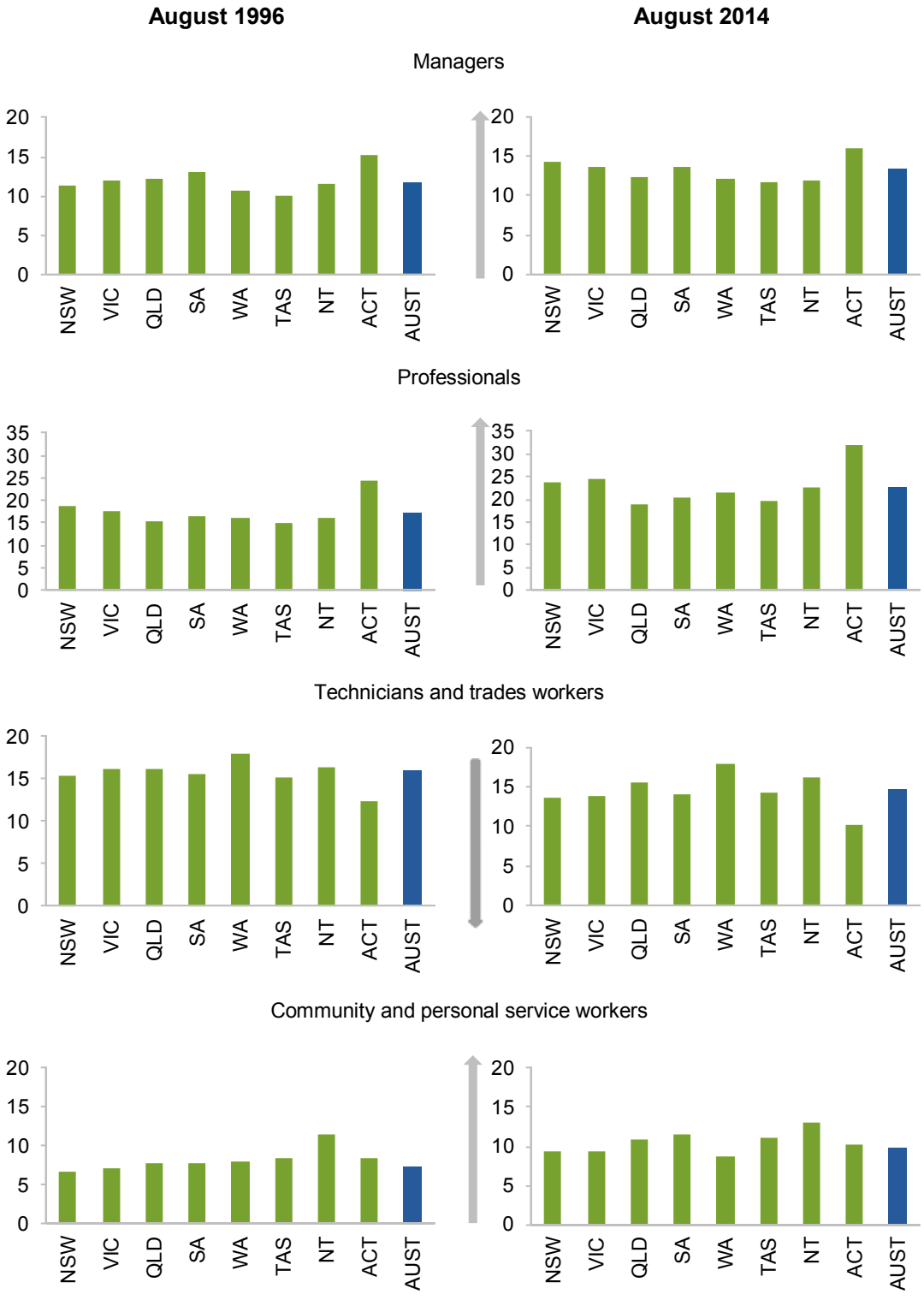


Source: ABS (*Labour Force, Australia, Detailed, Quarterly*, February 2015, Cat. no. 6291.0.55.003).

National trends in occupation shares are broadly reflected at the state level (figure 6.7). Further, occupational composition is generally similar across jurisdictions, apart from the Australian Capital Territory, where employment is skewed towards office-based occupations.

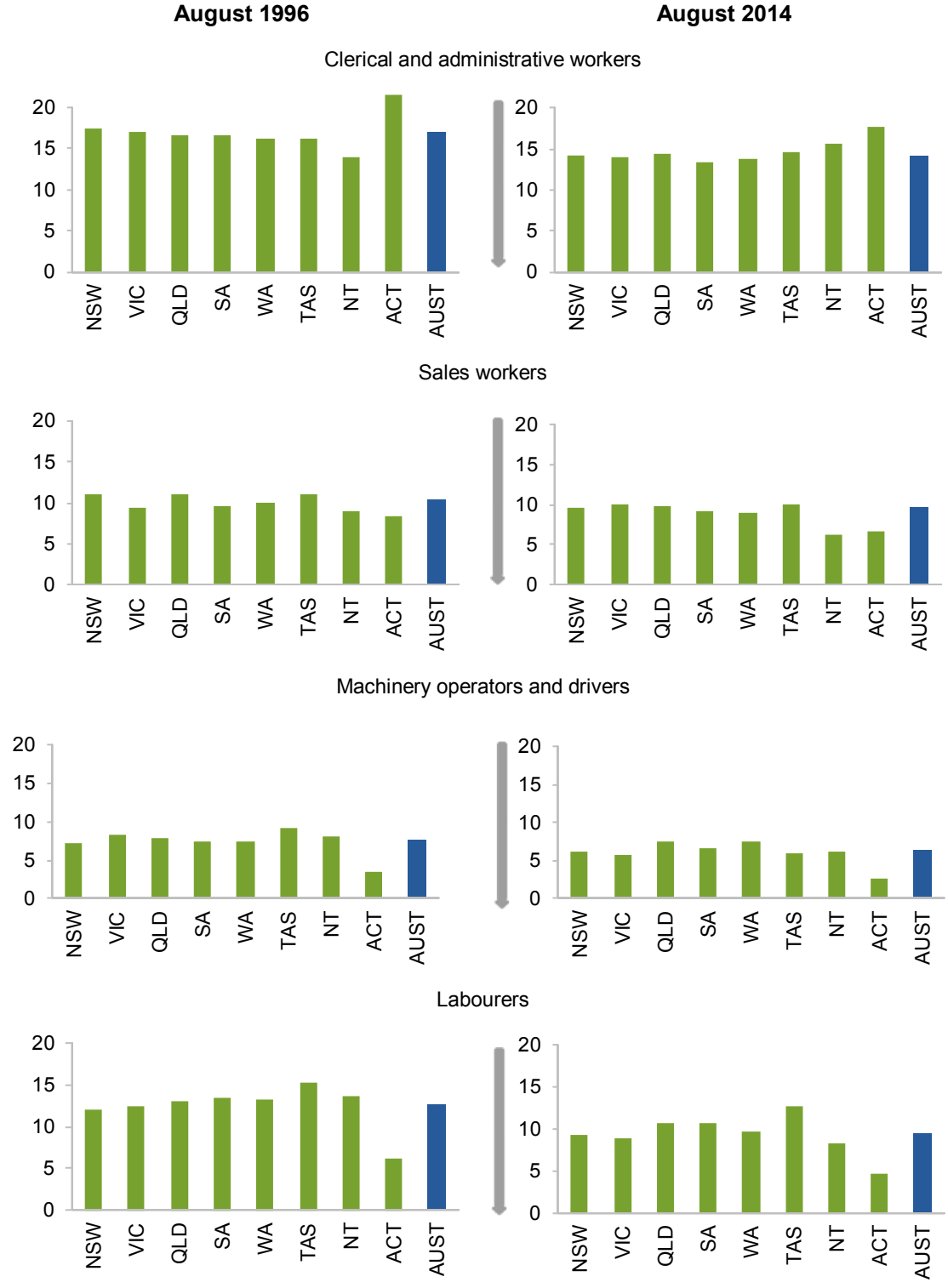
Figure 6.7 **State employment shares by occupation, August 1996 and August 2014[a]**

Per cent



(continued next page)

Figure 6.7 (continued)



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

Source: ABS (*Labour Force, Australia*, March 2015, Cat. no. 6291.0.55.001, table 09).

Average hours worked

Labour input per worker in Australia has declined since 1977-78, from an average of just over 35 to just under 33 hours per week (figure 6.8). This decline has occurred for both males and females.

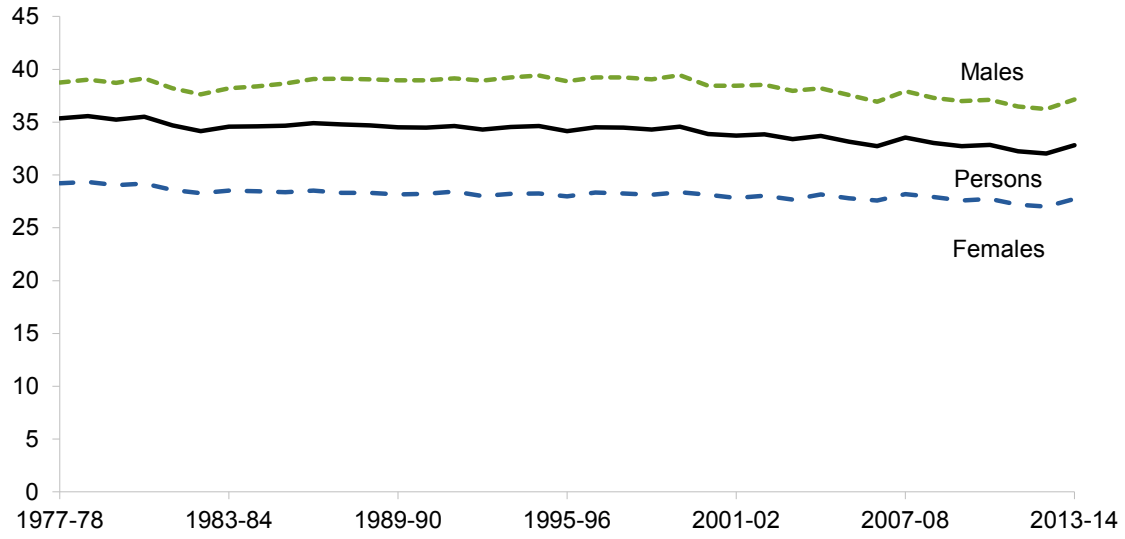
Over the same period, average hours worked increased from 15.1 to 16.4 hour per week for part-time employees and remained unchanged for full-time employees (figure 6.9).

Notwithstanding this, average hours worked across all employees decreased over the same period (figure 6.9). This decrease reflects an increase in the share of people working part-time (figure 6.5, right hand panel).

The fall in average hours worked nationally has been generally observed in all states (figure 6.10).

Figure 6.8 **Average hours worked by gender, Australia, 1977-78 to 2013-14[a]**

Hours per week

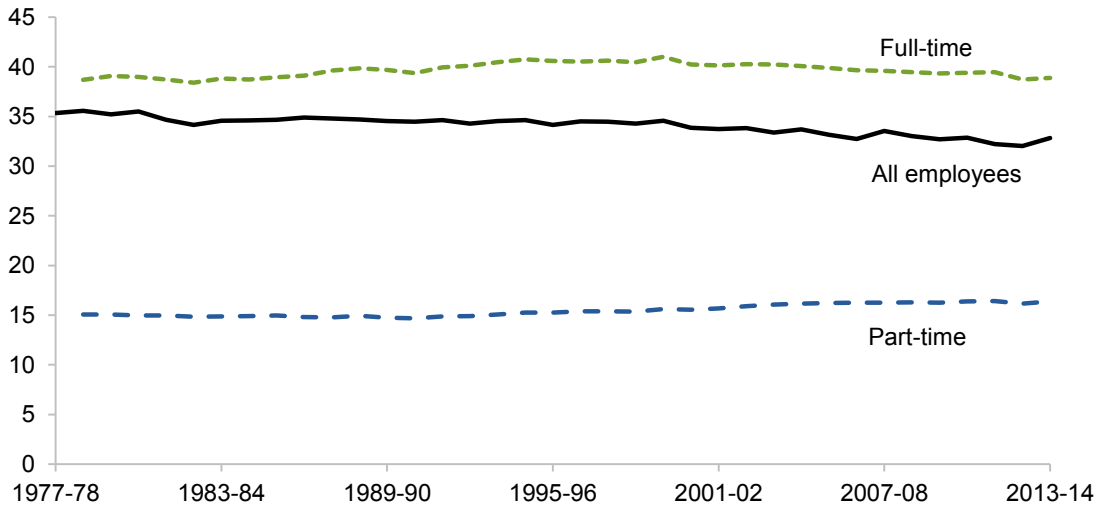


a Annual hours worked by full-time and part-time employees, expressed on a weekly basis.

Source: ABS (*Labour Force, Australia*, March 2015, Cat. no. 6291.0.55.001).

Figure 6.9 **Average hours worked by full-time, part-time and all employees, Australia, 1977-78 to 2013-14[a]**

Hours per week

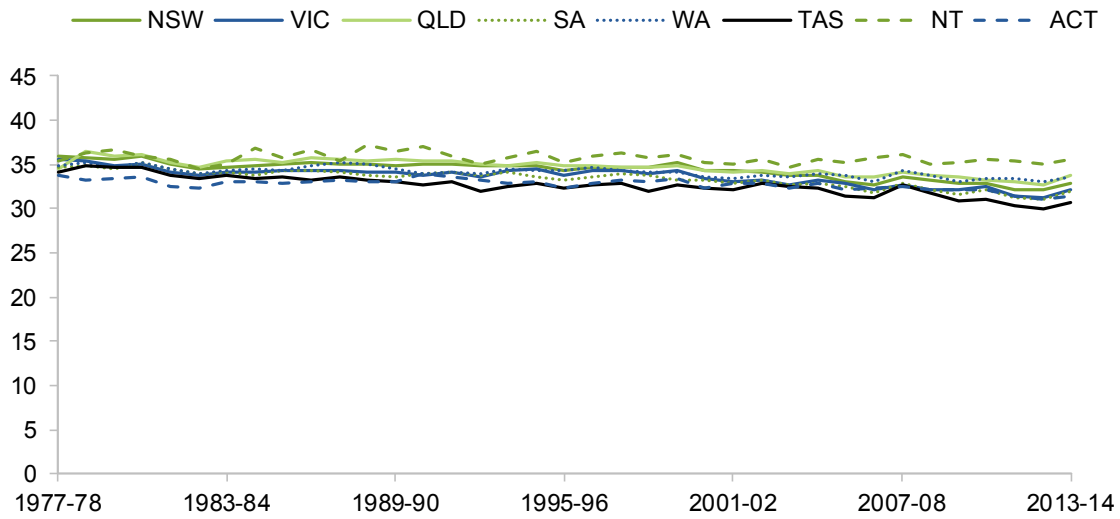


[a] Average hours worked by full-time and part-time employees on a trend basis. Part-time employees are those who usually work less than 35 hours a week (in all jobs). Trend data not available for 1977-78.

Source: ABS (*Labour Force, Australia*, March 2015, Cat. no. 6291.0.55.001).

Figure 6.10 **Average hours worked by state, 1977-78 to 2013-14[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 2015, Cat. no. 6291.0.55.001).

6.2 Projections used in other studies

The studies listed in table 6.1 use projections of labour market participation, employment (unemployment) and labour supply per person of working age. Projections from some of these studies are reviewed below.

Table 6.1 **Labour supply projections to 2060 used in other studies**

Study	*Time period*	*Participation rate*[a]	*Unemployment rate*[b]	*Average hours worked per person employed*	*Hours worked per person of working age*
		Percentage points	Percentage points	Hours per week	Hours per year
PC An Ageing Australia					
Base case	2012-13 to 2059-60	-5.3 (from 65.2 to 59.9)	-0.7 (from 5.4 to 4.7)	–1.6 (approximately from 33.9 to 32.3)	equivalent to -0.31%
Intergenerational Report					
2010 report	2010 to 2050	-4.5 (from 65.1 to 60.6)	nil (5 per cent over the period)	-0.5 (from 34.1 to 33.6)	equivalent to -0.18%
2015 report	2014-15 to 2054-55	-2.2 (from 64.6 to 62.4)	nil (5 per cent over the period)	nil (5 per cent over the period)	equivalent to -0.13%

[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: PC (2013); Australian Government (2010, 2015b).

Labour force participation rates

The Commission's *An Ageing Australia: Preparing for the Future* (PC 2013) projected that the aggregate labour market participation rate would fall from 65.2 per cent in 2012-13 to 59.9 per cent in 2059-60. These aggregate estimates reflect assumptions about future age- and gender-specific participation rates based on an analysis of historical trends up to 2012-13 (table 6.2) and ageing of the population. Although participation rates were projected to generally rise for older age groups, ageing of the population is projected to lead to more people in age groups that generally have lower labour market engagement.

The *Intergenerational Report 2015* (Australian Government 2015b) assumed that the overall labour market participation rate for people aged over 15 years would decline slightly from 64.6 per cent in 2014-15 to 62.4 per cent in 2054-55. The participation rates for men and women were assumed to fall by 2.7 percentage points and 1.7 percentage points, respectively. These declines reflect an ageing of labour market participants rather

than a fall in the participation rates for individual age groups (resulting in higher weights being placed on age groups with lower participation rates).

The 2015 report assumed higher participation rates than the previous 2010 report (Australian Government 2010) and no reduction in average hours worked.

Table 6.2 **Labour force participation rate projections by gender and age to 2060 used in An Ageing Australia[a]**

Per cent of working-age population

Age group	*2010s*	*2020s*	*2030s*	*2040s*	*2050s*
Males					
15–19	58.5	54.4	55.9	56.0	56.0
20–24	85.4	81.9	80.1	80.0	80.0
25–29	91.0	90.7	90.6	90.6	90.6
30–34	92.3	92.0	92.1	92.1	92.1
35–39	91.6	92.2	92.8	93.0	93.0
40–44	90.8	90.6	90.6	90.6	90.6
45–49	89.7	89.6	89.6	89.6	89.6
50–54	86.0	87.6	87.9	87.9	87.9
55–59	74.5	81.9	84.8	85.0	85.0
60–64	52.2	65.3	72.5	74.5	74.9
65–69	23.0	35.8	39.8	40.1	40.1
70+	6.0	8.5	10.8	11.7	11.9
Females					
15–19	60.4	57.7	58.8	58.9	58.9
20–24	77.7	75.5	75.0	75.0	75.0
25–29	74.4	75.5	75.7	75.7	75.7
30–34	69.0	72.8	74.1	74.1	74.1
35–39	70.0	74.4	76.8	77.5	77.7
40–44	75.6	78.0	79.4	79.7	79.8
45–49	77.4	79.7	79.9	79.9	79.9
50–54	70.6	78.2	81.5	82.6	82.9
55–59	53.8	68.5	74.3	74.9	75.0
60–64	29.3	48.3	56.8	58.3	58.6
65–69	10.4	22.0	31.1	34.2	34.9
70+	1.7	3.0	3.9	4.2	4.2

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

Source: PC (2013).

Employment rates

Most of the studies identified assume little change in unemployment rates (and, by implication, employment rates) over the projection period (table 6.1). PC (2013) assumed that the unemployment rate would fall from 5.4 per cent in 2012-13 to 4.7 per cent in 2059-60. The *Intergenerational Report 2015* assumed that the unemployment rate would remain at 5 per cent throughout the projection period to 2055.

Average hours worked

Most of the studies reviewed indicate a slight decline or little change in average hours worked over the projection period (table 6.1). However, one study incorporates age-specific variations, including increases for some age and gender groups.

- PC (2013) projected slight increases in average hours worked for men in the age groups between the ages 30 to 64 and slight decreases or no changes for other age groups. (table 6.3). Average hours worked by women were projected to increase slightly for many age groups (except those aged 15 to 24 years, 40 to 49 years and those aged over 70 years).

The supply of hours worked per person of working age

Collectively, the labour market assumptions in the studies reviewed here imply modest declines in the average hours of labour supplied by each person of working age over the projection period (table 6.1). These aggregate declines generally reflect the effects of lower participation rates and average hours worked notwithstanding projected reductions in the unemployment rate, which would increase the supply of labour.

6.3 Towards a modelling reference case

The historical trends and projections documented above provide a starting point to develop the labour market assumptions in the reference case.

Labour force participation rates

Participation rates have changed substantially over time, and available projections, both from the Commission and from the *Intergenerational Report 2015*, assume that they will continue to change into the near future but generally stabilise over time. Accordingly, for the reference case, some further changes in participation rates have been assumed.

The historical analysis indicates that trends in labour force participation vary by gender and by age. It is not unreasonable to suppose that differences in labour force participation by age and gender will continue into the future. Given this, the participation rates in the reference case are differentiated by age and gender (detailed in table 6.4). Notwithstanding that there are some differences between the Commission's 2013 projections and the more recent projections in *Intergenerational Report 2015*, the projections adopted in the reference case are based on those used in the earlier study owing to the greater age and gender detail.

Table 6.3 **Average hours worked projections by gender and age to 2060 used in An Ageing Australia**

Hours per week

	2010s	*2020s*	*2030s*	*2040s*	*2050s*
Males					
15–19	21.6	21.6	21.6	21.6	21.6
20–24	32.3	31.7	31.5	31.3	31.3
25–29	37.1	37.0	37.0	37.0	37.0
30–34	39.0	39.4	39.5	39.5	39.5
35–39	39.5	40.0	40.2	40.2	40.2
40–44	39.6	40.0	40.2	40.2	40.2
45–49	39.2	39.3	39.6	39.7	39.7
50–54	39.1	39.4	39.6	39.7	39.8
55–59	37.7	38.2	38.4	38.6	38.6
60–64	34.8	34.9	35.0	35.0	35.0
65–69	30.8	30.3	29.9	29.5	29.1
70+	25.2	24.3	24.0	23.8	23.5
Females					
15–19	16.6	16.5	16.5	16.5	16.5
20–24	27.4	26.2	25.6	25.4	25.4
25–29	30.6	30.6	30.7	30.7	30.7
30–34	28.7	29.5	29.8	29.9	30.0
35–39	27.2	27.6	27.7	27.7	27.7
40–44	27.5	27.4	27.4	27.3	27.3
45–49	29.0	28.9	28.8	28.8	28.8
50–54	29.0	29.2	29.4	29.4	29.4
55–59	28.3	28.9	29.1	29.2	29.2
60–64	25.1	25.4	25.4	25.5	25.5
65–69	21.4	21.6	21.8	21.8	21.8
70+	18.3	17.6	17.6	17.5	17.5

Source: PC (2013).

Table 6.4 **Labour force participation rate changes by gender and age to 2059-60 in the reference case[a]**

Average annual change, per cent

	Uprating period					*Projection period*				
Gender & age	*June 2009 to 2010*	*June 2010 to 2011*	*June 2011 to 2012*	*June 2012 to 2013*	*June 2013 to 2014*	*Rest of 2010s*	*2020s*	*2030s*	*2040s*	*2050s*
Males										
15–19	-4.0	-1.2	-2.1	-0.9	1.8	0.6	0.1	0	0	0
20–24	-1.1	-0.9	-0.4	-0.6	0	-0.3	-0.1	0	0	0
25–29	-0.8	1.1	-0.6	-1.1	0.8	0	0	0	0	0
30–34	-1.1	0.6	0	0	0	0	0	0	0	0
35–39	-0.5	1.0	-0.4	-0.6	0.5	0.1	0.1	0	0	0
40–44	0.6	-0.6	-0.1	0.1	0	0	0	0	0	0
45–49	0	-0.5	-0.2	0.1	0.2	0	0	0	0	0
50–54	0.3	0.8	-1.3	0.1	0.7	0.1	0	0	0	0
55–59	2.8	2.6	-1.5	0.8	1.4	0.5	0.1	0	0	0
60–64	1.7	2.4	-0.1	2.2	2.8	1.4	0.5	0.1	0	0
65–69	4.8	2.0	4.8	-1.4	6.7	1.5	0.2	0	0	0
70+	4.3	1.8	7.1	2.7	1.8	3.0	1.3	0.4	0.1	0
Females										
15–19	-1.7	-0.5	-0.7	-1.4	1.1	0.4	0	0	0	0
20–24	-1.3	0.1	0	-2.0	0.9	-0.1	0	0	0	0
25–29	-0.9	0.8	0.3	0.2	0.1	0	0	0	0	0
30–34	-2.8	1.2	0.7	1.0	0.4	0.2	0	0	0	0
35–39	-0.9	0.6	0.3	0.6	0.8	0.4	0.2	0	0	0
40–44	-2.2	1.2	0.5	0.9	0.1	0.2	0.1	0	0	0
45–49	-0.9	0.2	-0.7	-1.3	2.0	0	0	0	0	0
50–54	1.7	1.1	-0.8	0.7	1.9	0.5	0.2	0.1	0	0
55–59	2.2	1.2	1.6	-0.4	4.6	1.1	0.2	0	0	0
60–64	6.2	4.0	1.2	2.6	6.3	2.2	0.6	0.1	0	0
65–69	13.8	2.9	7.7	4.8	5.4	4.7	1.8	0.4	0.1	0
70+	7.6	18.0	-5.5	15.6	-1.1	4.0	1.3	0.2	0	0

[a] Applied uniformly across states.

Source: Based on PC (2013).

To align with the appropriate variable in the VUMR model (the variable `f_partrate_q`), the shocks applied in the reference case are the annual *percentage changes* in the age and gender-specific labour force participation rates. 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.

Following variations in the assumed participation rates, there is some variation in the magnitude of the changes included in the reference case for the different age/gender groups (table 6.4). The assumptions generally imply minimal change in most age and gender-specific participation rates over the projection period. The changes reported for the

years 2010-11 to 2013-14 are included to uprate the level and structure of the economy represented in the model database to 2013-14.

Employment rates

Over the period 2010-11 to 2013-14, there has been significant year-to-year variation in the ABS estimates of the unemployment rate for some states (ABS Cat. no. 6202.0). By definition, this also implies significant changes in the employment rate in those states. In some cases, there are roughly offsetting changes in subsequent years.[17] This variability may reflect high standard errors associated with estimates of unemployment arising from the relatively small sample sizes involved. This creates uncertainty surrounding the actual underlying changes. Notwithstanding these issues, the reference case includes the actual percentage change in each state's unemployment rate in each year (applied uniformly across occupations) during the *uprating* period (2010-11 to 2013-14) (figure 6.5).

Historical growth in the employment rate — the proportion of the labour force in employment — is the consequence of a range of factors, some of which are likely to change significantly, but not predictably over the projection period. For example, much of the growth in the employment rate (and decline in the unemployment rate) in Australia occurred after major microeconomic reforms and internationalisation of the Australian economy during the 1980s and 1990s.

Table 6.5 **Changes in state unemployment rates to 2013-14 in the reference case[a]**

Percentage change

State	*2009-10*	*2010-11*	*2011-12*	*2012-13*	*2013-14*
New South Wales	-19.1	0.7	-1.4	4.0	6.1
Victoria	-10.4	-15.5	18.4	6.5	11.0
Queensland	-5.4	-1.4	-0.5	22.0	0.4
South Australia	-1.5	-7.5	26.3	-6.3	22.2
Western Australia	-24.7	3.8	-18.0	31.4	7.7
Tasmania	44.1	-16.1	37.9	25.0	-16.3
Northern Territory	-21.6	25.4	26.2	36.0	-11.5
Australian Capital Territory	-10.8	27.1	-7.1	-4.5	-9.1
Australia[b]	-12.6	-4.4	4.7	10.4	6.2

a The state unemployment rates in the initial VUMR model database are as at 30 June 2009 (chapter 3). Applied uniformly across occupations. **b** Not applied to the model. For reporting purposes only.

Source: ABS (*Labour Force, Australia*, April 2015, Cat no. 6202.0).

17 The unemployment rate in Victoria, for example, is reported to have fallen 15.5 per cent in 2010-11 and risen 18.4 per cent in 2011-12. Tasmania and South Australia are reported to have experienced similar large changes, although not necessarily offsetting (ABS Cat. no. 6202.0).

Changes in the employment rate have contributed little to changes in national output over the period 1974-75 and 2013-14 (figure 2.1).

Given this, the reference case also does not include any employment rate shocks during the *unwinding* (2014-15 to 2017-18) or the *projection* periods (2018-19 to 2059-60). Changes in the mix of full-time and part-time employment over time are incorporated into the hours worked shocks in the reference case (discussed next).

Average hours worked

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

The trend towards part-time work is assumed to continue into the projection period, especially with an ageing population. Given this, it is assumed in the reference case that average hours worked per person in VUMR (which does not differentiate between full-time and part-time employment) falls by 0.3 per cent per year in the projection period. Modelled changes for the years 2010-11 to 2013-14 are based on actual changes over the period (table 6.6).

Table 6.6 **Average hours worked growth rates to 2059-60 in the reference case[a]**

Per cent per year

Uprating period				*Projection[b]*
2010-11	*2011-12*	*2012-13*	*2013-14*	*2014-15 to 2059-60*
0.36	0.26	-1.70	-0.03	-0.30

[a] Applied uniformly across industries, states and occupations. [b] Annual average growth from 1974-75 to 2013-14.

Source: Based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia*, May 2015, Cat. no. 6202.0).

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.

The reference case allows the supply of labour in each occupation to gradually adjust endogenously in response to changes in the nominal consumer wage differential for that occupation relative to the national average (see PC 2012b). As a result, the occupational composition of the workforce will adjust over time to changes in labour demand.

Demand for labour

The demand for labour in the reference case by industry, state and occupation is determined by standard labour market theory in the VUMR model. Producers minimise the cost of producing a given level of output by choosing the mix of primary factors (labour, capital and agricultural land), and the demand for labour by occupation, based on relative primary factor prices after accounting for any changes in the productivity of these factors (CoPS 2014).

Industry output responds to changes in demand by Australian households (arising from income and taste changes), changes in demand by other Australian producers and changes in demand from overseas (among other things). This, along with other primary factor prices (primarily capital), the relative productivity of those factors and industry output, drives changes in the demand for labour in the different occupations. It is assumed that wages adjust to clear the labour markets in the VUMR model, while unemployment rates remain constant.

7 Productivity

Productivity growth is an important source of change in national output and living standards over time. Over the last 40 years, growth in national output per hour worked — labour productivity — accounted for over half of Australia's real GDP growth, with the remainder mainly reflecting the growth in population (chapter 2).

This chapter reports on productivity trends in Australia. It commences by outlining historical trends from 1974-75 to 2013-14, initially for the economy as a whole and then by sector and industry (section 7.1). It then reviews productivity projections and modelling assumptions employed in other economy-wide modelling studies (section 7.2). To aid in the understanding of the model projections presented in chapter 12, this chapter also distinguishes between the contributions to historical labour productivity growth made by the deployment of additional capital per unit of labour input (termed 'capital deepening') and improvements in the use of capital and labour inputs (termed 'multifactor productivity' or MFP) (section 7.3).This section also discusses some related issues in modelling labour productivity growth. It concludes by outlining the labour productivity growth scenario applied in the reference case (section 7.4).

Analytical framework used

The analytical framework used to assess the contributions made by productivity growth to real GDP growth adopted in this chapter is based on the PPP framework detailed in chapter 2. Labour productivity growth has been the most important driver of historical real GDP growth in Australia.

Assumptions about future directions in industry labour productivity are applied to the VUMR model as shocks by allowing primary factor augmenting technical change to vary. This approach to modelling labour productivity growth is based on that used in PC (2012b).

Consistent with chapter 2, labour productivity in this chapter is expressed in terms of real GVA per hour worked. Real GVA measures the net value added in production across all industries. It is a narrower measure of economic activity than real GDP, which also includes taxes less subsidies on products and the statistical discrepancy. Unless otherwise stated, the definition of industry used in this chapter is the ABS ANZSIC Division.

7.1 Historical perspective

Economy-wide perspective

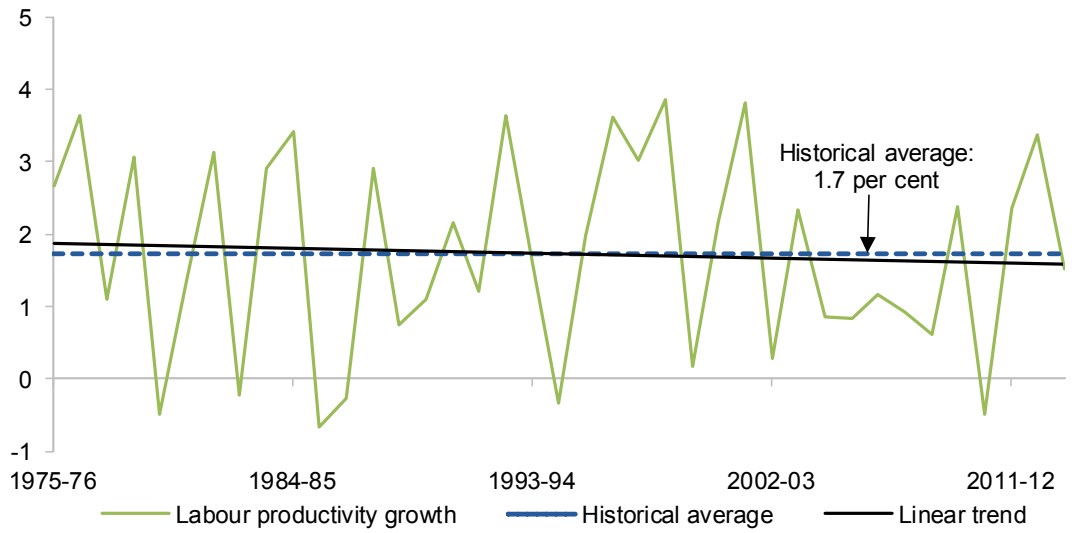
Economy-wide labour productivity in Australia grew by 1.5 per cent in 2013-14.

Annual labour productivity growth has varied considerably over the last 40 years, ranging from -0.7 to +3.9 per cent in any one year (figure 7.1). Given the cyclical nature of changes over time, labour productivity is usually analysed in terms of 'productivity cycles' rather than growth rates in individual years. The use of cycles smooths out the significant year-to-year variability that can occur in measured labour productivity.

Since 1974-75, labour productivity growth has declined gradually. The 39 year average growth rate is 1.7 per cent per year (figure 7.1).

Figure 7.1 **Growth in labour productivity, Australia, 1974-75 to 2013-14[a]**

Per cent per year



a Labour productivity is calculated as real GVA per hour worked.

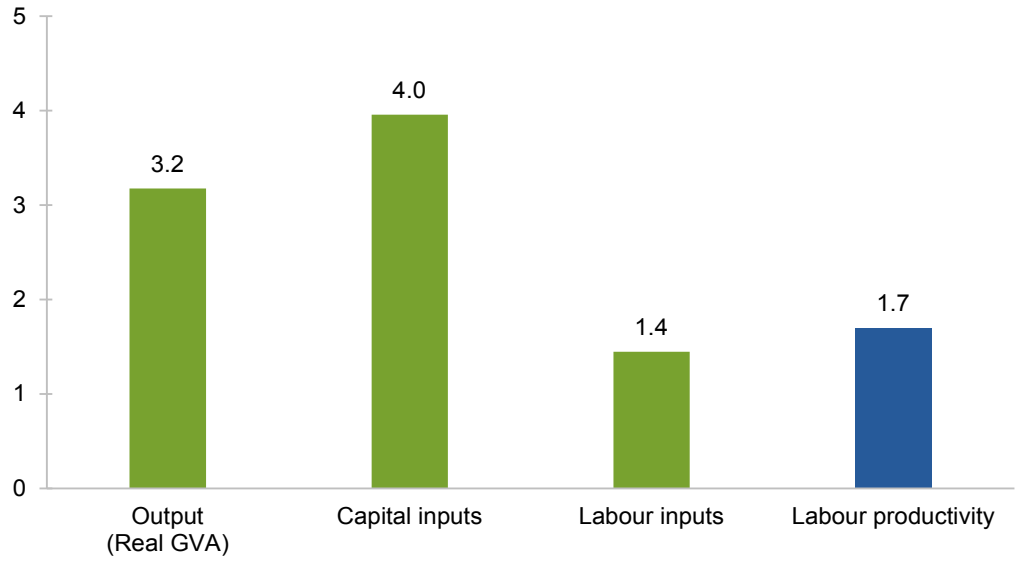
Sources: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003).

The 1.7 per cent average growth rate from 1974-75 to 2013-14 reflects:

- real GVA growth for the economy of 3.2 per cent per year; and
- labour inputs growth of 1.4 per cent per year (figure 7.2).[18]

Figure 7.2 **Growth in output, capital inputs, labour inputs and labour productivity, Australia, 1974-75 to 2013-14[a]**

Per cent per year



[a] Real GVA is real GDP less taxes less subsidies on products and the statistical discrepancy. Capital inputs for the economy are measured by weighting all industries' capital services inputs growth rates by their capital income shares (calculated using gross operating surplus). Labour inputs are measured as average hours worked per week by employed persons in each quarter multiplied by 52.14 weeks. Labour productivity is calculated as real GVA per hour worked.

Source: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003).

Over the same period, measured capital inputs grew by 4.0 per cent per year (figure 7.2). This highlights, as noted in chapter 2, that much of the growth in national output was driven by capital deepening — the increased use of capital per unit of labour.[19] That is, over time, production in Australia has become more capital-intensive per unit of output.

[18] The difference between historical output and labour input growth and labour productivity reflects the effects of rounding.

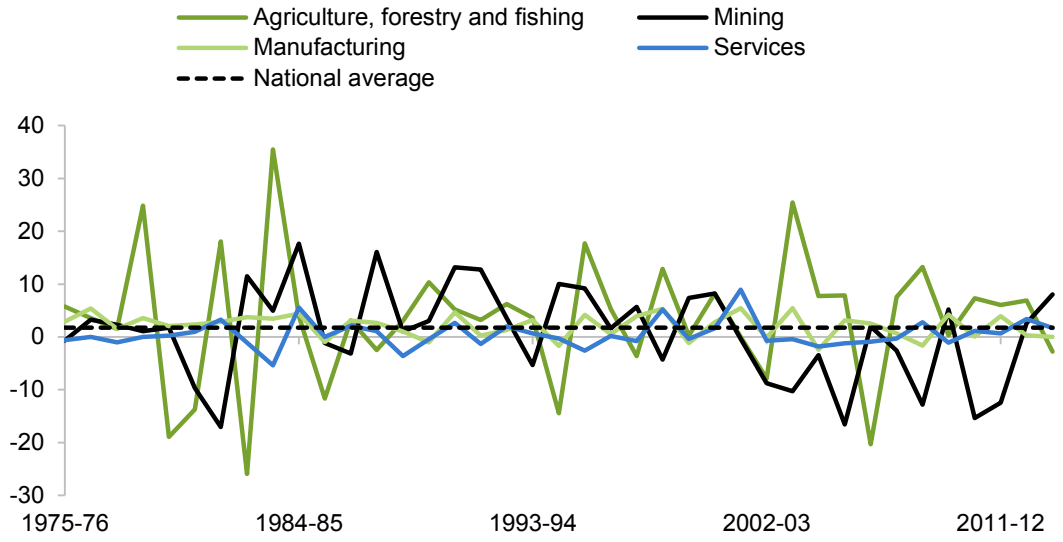
[19] The converse, where the use of capital inputs grows at a slower rate than labour inputs, is termed 'capital shallowing'. As capital deepening is more prevalent in the Australian economy over time, the use of capital deepening in the general (non-statistical) discussion that follows also applies to capital shallowing.

Sectoral perspective

Labour productivity growth at the sectoral level differs from that of the economy (figure 7.3). For example, labour productivity in the mining sector has grown below the national average for much of the last decade. This slower growth reflects, among other things, the effects of increased investment arising from the strong growth in export prices of certain mining commodities, most notably iron ore, coking coal and thermal coal (discussed in chapter 8). As a result, sectoral and industry productivity cycles frequently differ from national cycles.

Figure 7.3 **Growth in labour productivity by sector, Australia, 1974-75 to 2013-14[a]**

Per cent per year



[a] Real GVA per hour worked.

Source: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003).

Over the period 1974-75 to 2013-14, labour productivity growth averaged 3.4 per cent for agriculture, 0.7 per cent for mining, 2.1 per cent for manufacturing and 0.5 per cent for services.

Industry perspective

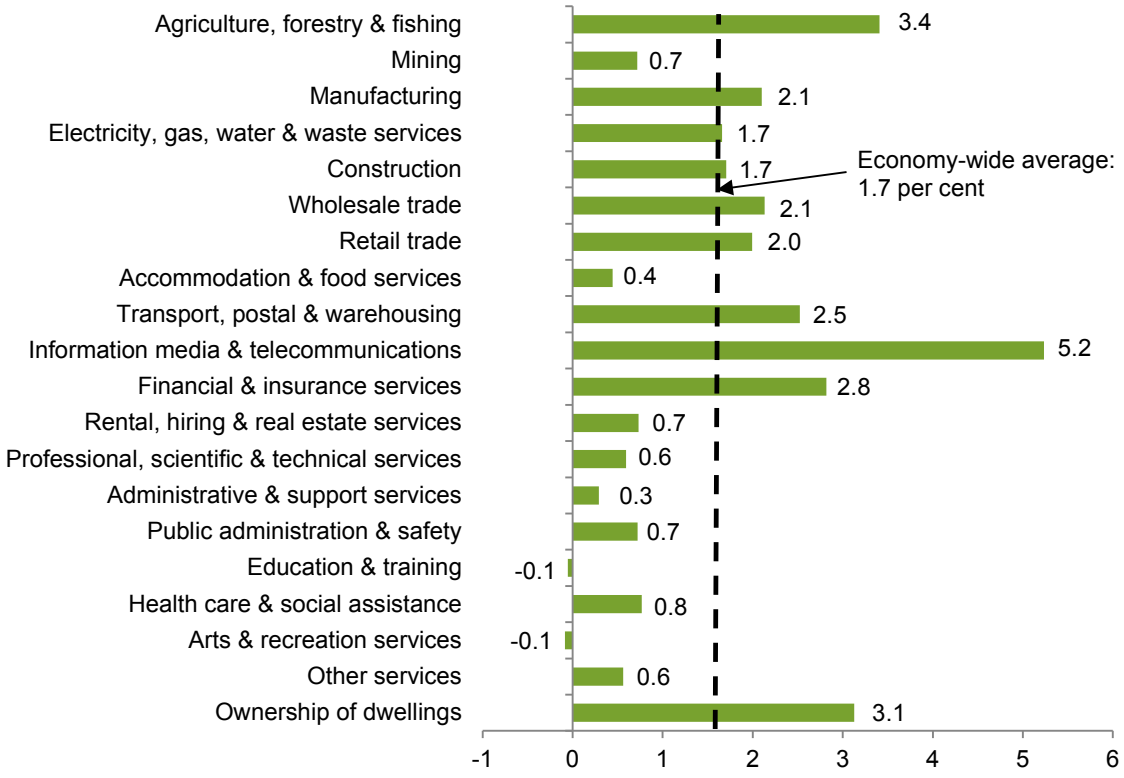
At a more detailed level, measured labour productivity for most ABS ANZSIC industry divisions grew between 1974-75 and 2013-14 (figure 7.4). Notable exceptions were the *education & training* and *arts & recreation services* industries, which recorded small declines in measured labour productivity growth.

The industry division which recorded the highest growth in measured labour productivity was *information media & telecommunications*, which grew at an average annual rate of 5.2 per cent compared to the national average of 1.7 per cent. *Agriculture, forestry, fishing & hunting* recorded the next highest growth (3.4 per cent) followed by *ownership of dwellings* (3.1 per cent). The other ANZSIC industry divisions with average or above average growth were: *financial & insurance services*; *transport, postal & warehousing*; *manufacturing*; *wholesale trade*; *retail trade; electricity, gas, water & waste services*; and *construction*.

Labour productivity growth in the remaining eight industry divisions — *mining*; *accommodation & food services*; *rental, hiring & real estate services*; *professional, scientific & technical services*; *administrative & support services*; *public administration & safety*; *health care & social assistance*; and *other services* — was less than 1 per cent per year.

Figure 7.4 **Growth in labour productivity by industry, Australia, 1974-75 to 2013-14**

Per cent per year



Source: Estimates based on ABS (*Australian System of National Accounts, 2013-14*, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003).

Measured labour productivity growth is typically lower in many service industry activities, such as health care and education. These industries are highly labour-intensive and employ relatively little capital compared to other industries. However, the measurement of productivity in these service-sector industries is complicated by the absence of an independent measure of output.[20]

Measured output grew strongly in many labour-intensive service industries such as *health care & social assistance*. These industries also typically have low measured rates of labour productivity growth, implying that employment growth has moved with output growth. Also, as much of their output is funded through government expenditure, government expenditure in these areas would be expected to grow in line with the employment and wages growth. However, available data suggest that employment and wages growth in the sector may have exceeded that in government expenditure, suggesting that patients have funded the difference.

As a first step towards better understanding this relationship, productivity growth in these industries can be inferred using an alternative approach (box 7.1). While preliminary, the Commission has applied this approach to the health care services industry to test its feasibility. The alternative approach yielded a slightly higher estimate of labour productivity growth compared to the conventional approach. However, further analysis of the sector is required to reconcile low measured labour productivity growth with historical government expenditure growth (chapter 13).

[20] Estimation of labour productivity, and its decomposition into capital deepening and MFP growth, requires independent estimates of changes in industry inputs and outputs. The ABS publishes independent output 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*.

Box 7.1 An alternative approach to measuring labour productivity in service-sector industries

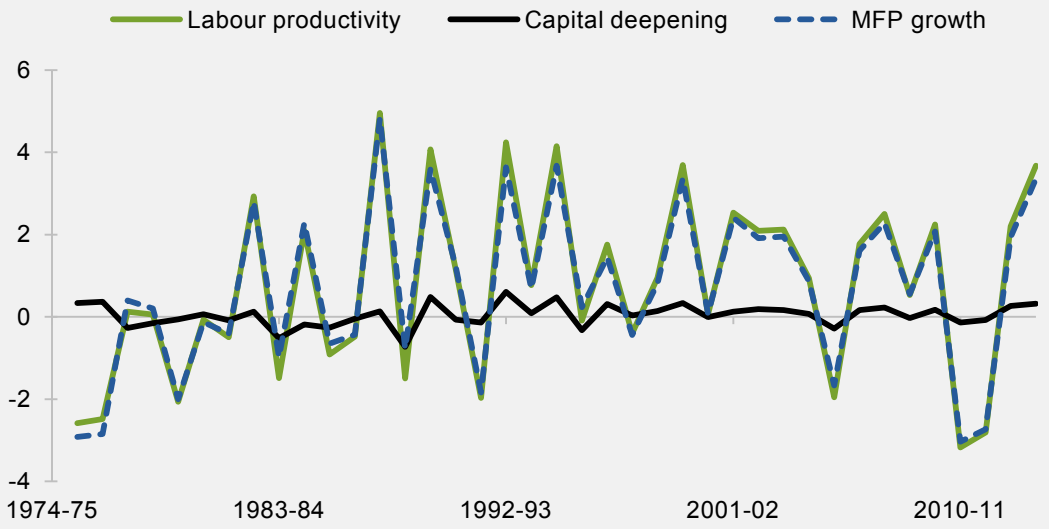
Many service sector industries, such as the provision of health care and education services, have low measured labour productivity growth compared to other industries using conventional productivity measurement techniques. Low productivity growth implies that these sectors experienced minimal capital deepening and/or MFP growth normally associated with more effective or lower cost provision of services. Such measurements may appear at odds with other related indicators such as government expenditure on these services, especially over time.

An alternate approach is to infer productivity growth using the 'dual rate of cost diminution' (DCD) approach, which relates difference between the overall growth in input costs and the growth in output price (or the cost of service provision or expenditure). Under such an approach, productivity growth can be inferred from changes in output, input usage and the prices paid for these inputs. Harris (1988) outlines an application of this approach for total factor productivity.

A preliminary application of DCD analysis for the Australian health care sector suggests that labour productivity growth averaged around 1.1 per cent per year since 1974-75, which is slightly higher than the 0.8 per cent per year based on conventional measurement techniques (table 7.3). Most of this growth appears to have come from MFP growth, rather than from capital deepening.

An alternative measure of labour productivity, capital deepening and MFP growth in health care & social assistance, Australia, 1974-75 to 2013-14

Per cent



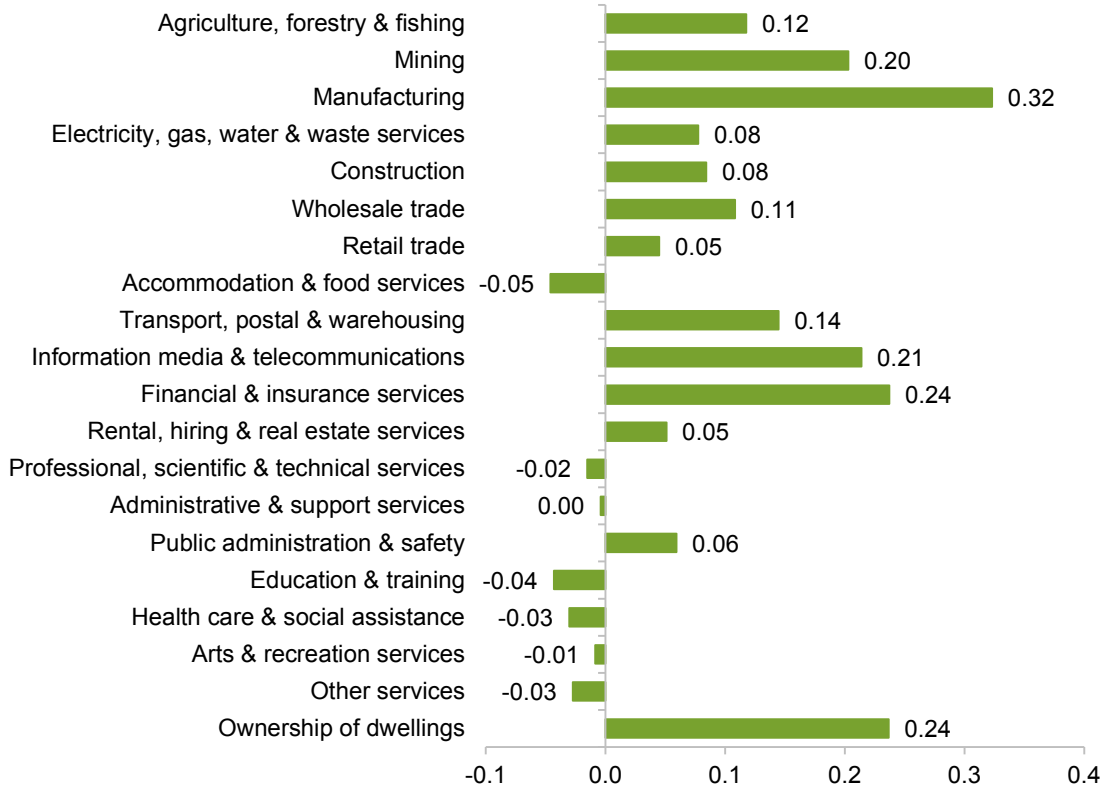
Source: Estimates based on ABS (*Australian System of National Accounts*, 2014-15, Cat. no. 5204.0).

Industry contributions to national labour productivity growth

Between 1974-75 and 2013-14, more than two-thirds of the growth in national labour productivity came from five ANZSIC industry divisions[21] — *manufacturing*; *financial & insurance services*; *ownership of dwellings; information media & telecommunications*; and *mining* (figure 7.5).[22]

Figure 7.5 **Industry contribution to aggregate labour productivity growth, Australia, 1974-75 to 2013-14[a]**

Percentage points



a Industry contribution to aggregate labour productivity growth is estimated as the difference between its contribution to aggregate output and to aggregate labour input growth.

Source: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003).

21 The contribution made by each industry to aggregate labour productivity growth depends on its share of aggregate output and labour inputs. As a result, even though some industries had higher average labour productivity growth rates, their relatively smaller shares of the economy mean that they made a lower contribution.

22 As it does not employ labour, the contribution from the *ownership of dwellings* industry reflects the contribution to national labour productivity growth made by the growth in industry output.

Seven service ANZSIC industry divisions were recorded as making small negative contributions to the growth in national labour productivity — *accommodation & food services*; *professional, scientific & technical services*; *administrative & support services*; *education & training*; *health care & social assistance*; *arts & recreation services*; and *other services*.

7.2 Projections used in other studies

Earlier 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 reference cases used in three related modelling 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*; then were updated, and in some cases revised, in *Strong Growth, Low Pollution*. All three studies used the MMRF model, which is a precursor of the VUMR model used in this study.

This section reports on the productivity projections used 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.[23] 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 included three key sources of productivity growth in their reference cases:

- 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.

[23] 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.

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

The aggregate labour productivity assumptions in *Strong Growth, Low Pollution* were imposed as labour-augmenting technical change (Treasury 2011, p. 169).[24] Treasury forecasts and budget projections for aggregate labour productivity growth were used to 2014-15. After that, it is unclear what assumptions, if any, were made regarding aggregate labour productivity growth 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 7.1), 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.

Table 7.1 **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 introduce compositional detail into the aggregate labour productivity story.[25] 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.[26] The modelling assumed 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).

The *Strong Growth, Low Pollution* modelling also allowed for changes in the use of intermediate inputs in production. These assumptions collectively imply a decline in the total use of intermediate inputs per unit of output over time.

[24] Labour augmenting and other forms of technical change used in economic modelling are discussed in the next section.

[25] 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.

[26] 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.

PC (2012b) contains further detail on the assumptions in *Strong Growth, Low Pollution*.

Intergenerational reports

Each of the four intergenerational reports published — 2002-03, 2007, 2010 and 2015 — make an assumption about future growth in national labour productivity (table 7.2). The growth in national labour productivity in each report is based on a historical average at the time of publication, The assumed growth in future national labour productivity has progressively declined from 1.75 per cent per in the 2002-03 and 2007 reports, to 1.6 per cent in the 2010 report and then 1.5 per cent in the 2015 report. This decline reflects lower measured productivity in recent years.

Table 7.2 **Aggregate labour productivity growth rate assumptions in the Intergenerational reports**

Intergenerational report	*Average over the period*	*Aggregate labour productivity growth rate assumed*
		Per cent per year
2002-03 report	Preceding 30 years	1.75
2007 report	Preceding 30 years	1.75
2010 report	Preceding 30 years	1.6
2015 report	Preceding 30 years	1.5

Sources: Australian Government (2002, 2007, 2010, 2015b).

The *Intergenerational Report 2015* (Australian Government 2015b) assumed that average annual labour productivity growth over the 40 years to 2055 would be 1.5 per cent per year and reflects the 30-year average used in the *Budget Papers 2014-15* (Australian Government 2015a) and *Mid-Year Economic and Fiscal Outlook 2014-15* (Australian Government 2014).

7.3 Some issues in modelling labour productivity growth

As noted in the previous section, there are a range of issues that are relevant to the modelling of labour productivity growth.

Some of these issues are also relevant in understanding the comparability between the model-based projections reported in chapter 12 and those based on historical data, particularly the contributions to labour productivity growth made by capital deepening and MFP growth.

These issues are addressed in this section in terms of:

- how to measure labour productivity growth and the contributions made by capital deepening and MFP growth;
- how to model labour productivity growth in economy-wide models such as VUMR; and
- how comparable are model-based projections of capital deepening and MFP growth with historical data.

Measurement of labour productivity growth

Labour productivity growth depends on how output and labour inputs are measured. The decomposition of labour productivity growth into the contributions made by capital deepening and MFP growth also depends on how capital inputs and capital income are measured.

Identifying and measuring the sources of labour productivity growth

Based on the production function that underlies the growth accounting framework used to assess labour productivity growth, growth in output can arise from:

- changes in the *quantum* of physical units of inputs used in production;[27] and
- changes in the *technical efficiency* with which those inputs are used.[28]

The economic consequences of changes in the quantum of inputs used in production may differ from changes in *technical efficiency*.

In order to gauge the effect of changes in the *quantum* of inputs used from those arising from changes in the *efficiency* with which those inputs are used, labour productivity growth is often decomposed into:

- the contribution made by capital deepening (the contribution made by growth in the capital-labour ratio — the growth in the quantity of capital inputs relative to the quantity of labour inputs); and
- the contribution made by MFP growth.

MFP growth is conventionally measured as the remainder of labour productivity not accounted for by capital deepening. It is usually calculated as a residual.

[27] Changes in the *quantum* of labour inputs will affect output and labour productivity growth, while changes in the *quantum* of capital inputs will only affect output growth.

[28] Changes in technical efficiency can be thought of as altering the 'effective' supply of physical inputs.

A common interpretation of MFP growth is that it reflects improvements in efficiency of input use and, hence, affects living standards per person over time. In contrast, capital deepening reflects changes in the capital-labour ratio and, as the additional capital has to be funded, may not give rise to improvements in living standards per person.

MFP growth may arise from technical or organizational change. Such technical change may reflect the joint effects of many other factors including the adoption of new technologies, economies of scale, managerial skill, and changes in the organization of production. If the measures of input use have not been adjusted to account for changes in input quality over time, MFP growth will also include the effect of changes in input quality. Measured MFP growth may also reflect the effect of any changes in the measurement of capital over time.

The contributions of capital deepening and MFP growth to labour productivity growth will depend on how capital and labour inputs are measured, including whether the measure of inputs adjust for changes in their 'quality' over time.

The effect of changes in input quality

In productivity analysis, capital and labour inputs represent the stream of services provided by capital and labour to production over the course of a year. Labour inputs are frequently measured in terms of hours worked, while the stream of capital services is commonly assumed to vary in proportion with the underlying stock of capital.

Changes in the quality of capital and labour inputs over time may affect the efficiency with which they can be used in production. Improvements in education, training and work experience may, for example, mean that more output can be produced from each hour worked. This may mean that an hour worked by an employee in a given occupation in the past may not have the same effect on output as an hour worked by someone in the same occupation today. Likewise, innovation and new product varieties may improve the quality of capital used in production and enable more output to be produced from each asset.

Available indicators suggest that the quality of the labour force and capital stock have indeed been improving over time (PC 2012b).

The issue of changes in input quality over time raise the issue of whether and, if so, how to adjust the measurement of inputs to account for quality changes that occur over time.

If the measures of input use are adjusted to reflect changes in quality over time, these changes alter the quantum of inputs used and, consequently, the distribution of labour productivity growth arising from capital deepening (and conversely from MFP growth). This approach is referred to here as 'embodied' technical change, as there is an aspect of technical change embodied in the measure of inputs used. Technical change embodied in the labour inputs will also affect the size of labour productivity itself.

The term 'disembodied' technical change is conventionally used to refer to the alternative of not adjusting input use for changes in quality over time.

In practice, it is not possible to fully separate changes in the *quantity* of inputs used from changes in the *technical efficiency* with which those inputs are used. This gives rise to legitimate uncertainty concerning the actual contribution to labour productivity growth from capital deepening and MFP growth.

The perpetual inventory model used by the ABS to derive its measures of capital stock takes into account changes in the mix of asset classes over time as well as some changes in asset quality for all industries. These changes in asset quality include changes in the productive efficiency of asset classes as they age (the effect of different vintages) and, in some cases, the introduction of new models.

Modelling of labour productivity growth

The modelling studies reviewed in section 7.2 involved specifying the extent of technical change to the model.

Technical change is related to, but is conceptually different from, productivity growth. Technical change relates to the efficiency with which an input or inputs are used in production, whereas productivity relates to the relationship between the growth in output and those inputs.

As economy-wide models such as VUMR do not generally contain a theory as to how technical change occurs, the technical change variables in such models are naturally fixed (referred to as being 'exogenous'). This means that the relationship between output growth and input use is typically determined by the model (referred to as being 'endogenously determined') based on the theory in the model, relative prices and the extent of any technical change that affect the effective supply of inputs used in production.

Modelling technical change in this way is conceptually different from the measures of productivity growth published by the ABS.

An alternative approach is to directly specify the extent of productivity growth. As productivity growth is a naturally endogenous variable in such models, another variable that is naturally exogenous to the model (usually a technical change variable) needs to be made endogenous so that the productivity growth can be shocked. This means that modelling productivity growth directly will result in a different modelling environment (or model closure) — the list of exogenous variables, and hence those that are endogenous — to that needed to model technical change.

Theoretically, the magnitude of the shocks applied should also differ between the two approaches.[29]

As the economic consequences will vary, an appropriate technical change or productivity variable needs to be identified regardless of which approach is used. This will determine which variable is to be shocked and, under the alternative approach, which naturally endogenous variable is to be fixed. This choice of variable should reflect a view about the underlying source of technical change.

The underlying source of technical change

Technical and organisational changes may add to the productivity of available capital and/or labour. Such changes increase the effective supply of 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' technical change;
- *capital augmenting* technical change, which increases the effectiveness of capital inputs used in production — typified by a 'Solow-Neutral' technical change; and
- *multifactor augmenting* technical change, which improves the effectiveness of more than one factor of production — primary factor augmenting technical change, for example, increases the effectiveness of both labour and capital inputs used in production — typified by a 'Hicks-Neutral' technical change.

In practice, technical change need not arise from one of these sources alone, but may instead arise from more than one (or even all) of these sources of improvement.

These concepts essentially reflect different views on whether technical change improves the efficiency with which labour, capital or both labour and capital (or other factors) are used in production.

The VUMR model used in this study contains a range of technical change variables that could be used to model labour productivity growth over time. These include:

- labour augmenting technical change;
- capital augmenting technical change;
- primary factor augmenting technical change (applying to the use of labour, capital and agricultural land);
- intermediate input augmenting technical change; and

[29] This difference is often overlooked in practice.

- all input augmenting technical change (applying to the use of primary factors and intermediate inputs).[30]

If capital deepening is determined by the model, which is usually the case, the choice of technical change variable implicitly reflects a judgment about the underlying (unobservable) source of MFP growth.

The available data were reviewed in PC (2012b) to find the extent of evidence supporting each of the key sources of technical change available in the VUMR model. That study did not find compelling evidence in support of the view of purely labour input augmenting technical change. It also did not find any evidence of intermediate input augmenting technical change. In light of this, the study assumed that projected MFP growth arises though primary factor augmenting technical change that affects the efficiency with which both capital and labour inputs are used in production. This assumption is the same as that adopted in PC (2012b).

Level at which productivity growth occurs

The level at which the productivity growth (or technical change) occurs also needs to be specified in modelling labour productivity growth.

In the VUMR model, productivity growth (or technical change) can be specified and modelled at a variety of levels in the model. The changes can be specified and modelled at the economy-wide level. In the absence of any additional shocks, this approach assumes that the changes are uniform across industries and states. Alternatively, changes can be specified and modelled at the national industry level. This approach assumes that the industry-specific changes are uniform across states. The changes can also be specified and modelled for each state industry.

Differences in the way productivity growth is specified and modelled will affect the relative competitiveness of activities and the distribution of activity across the economy. Industry-specific productivity changes will result in a different composition of economic activity to national productivity shocks or uniform shocks across industries.

All of the studies reviewed in section 7.2 specify *national* changes in labour productivity, while some also include *industry-specific* growth rates (and possibly a balancing term to ensure consistency with the national shocks being applied).

Productivity differences across states will alter the level and distribution of activity across states in an analogous way to differences in productivity growth across industries. However, reflecting the absence of state-level productivity data, productivity growth at the industry level is typically modelled as being the same across states in state-based models

[30] The VUMR model also includes a range of productivity-related variables and equations.

such as VUMR. As a result, differences across states will be influenced by differences in their industry composition.

Interpretation of model-based labour productivity results

Two issues that affect the comparability of estimates from the VUMR model with published ABS data are:

- differences in the way capital is modelled; and
- differences in the way capital income shares are modelled.

Measurement of capital inputs in the VUMR model

The measurement of capital inputs in Australia is summarised in box 7.2.

The measure of capital inputs in the VUMR model is stylistically similar to the ABS concept of 'capital services' for market-sector industries, whereby the changes in the productive capital stocks in each industry are weighted by their rental value shares to gain an overall capital input measure.

However, unlike the ABS, the measure of capital in the VUMR model does not:

- differentiate between different classes of assets used in each industry (or between assets owned by the incorporated and unincorporated sectors);[31] and
- adjust the measure of capital inputs used to reflect changes in asset class quality over time (such as the introduction of new technology).

As a result, the measure of capital used for all industries in the VUMR model is conceptually different to that used by the ABS in its assessment of labour productivity growth within the market sector. Capital growth projections from the VUMR model will not reflect any change in the mix of asset classes used within an industry, any change to the quality of those asset classes over time, the introduction of new asset vintages or any change in the productive efficiency of each asset class over their operational lives that may be incorporated into the measure of productive capital stock used by the ABS.

Consequently, even if all other things were equal, model-based projections of the contribution made by capital deepening to labour productivity from the VUMR model, both in aggregate and at the industry level, are likely to differ from those derived using the ABS methodology. The contribution of MFP growth would likewise be different, as it is estimated as a residual.

[31] The VUMR measure of capital also does not differentiate between ownership by the incorporated and unincorporated sectors.

Box 7.2 The measurement of capital inputs

In its productivity analysis, the ABS assumes that the stream of capital inputs (referred to as 'capital services') varies in proportion to changes in a measure referred to as 'productive capital stock' for all industries in the market sector. Productive capital stocks weight the growth in capital by their contribution to annual production (referred to as their rental value). Productive capital stocks are not published for industries in the non-market sector.

However, economy-wide modelling requires the use of a measure of capital inputs for all industries in the economy, including those in the non-market sector.

The only measure of capital stock published by the ABS for all industries in the economy is a measure referred to as 'net capital stock', whereby the growth in each asset class, within and between industries and over time, are weighted by their market value.

Productive capital stocks place higher weight on assets such as computers whose productive efficiency declines more rapidly over time (that is, those with higher depreciation rates) and to the introduction of new vintages than do net capital stocks.

These two different measures of capital have their own relative strengths. The key strength of productive capital stocks is that, at least conceptually, is that it more closely resembles the stream of capital services used in production that should flow through into productivity. The key strength of net capital stocks is that estimates are published for all industries and are available over longer time periods than productive capital stocks.

In aggregate, these two capital stock measures generally exhibit broadly similar growth rates (such as for the market sector). However, for some industries that are intensive users of ICT, such as *financial and insurance services*, these two capital stock measures can grow differently and, hence, can give rise to additional uncertainty concerning the extent of capital deepening and MFP growth.

The measure of capital used in this paper uses productive capital stocks for all 16 industries in the ABS market sector (rather than net capital stocks used in PC 2012b) and net capital stock for the 4 industries in the ABS non-market sector (the same as PC 2012b). Growth in each asset class are aggregated to the industry level using their share of gross operating surplus (rental value), based on a national accounting framework (which excludes taxes and unforeseen obsolescence), as weights.

The economy-wide measures of capital input growth and capital deepening reported in this paper aggregate each industry's capital growth using rental value weights.

The effects of these methodological differences could be gauged by re-computing the ABS capital service estimates by gradually imposing each of the assumptions implicit in the VUMR model and assessing their impact on the contribution of capital deepening to labour productivity growth.

However, this approach to estimating capital service inputs is not possible, as the detailed perpetual inventory model used by the ABS to estimate capital service inputs is not publicly available. Instead, inferences on the possible effects of these quality adjustments are gauged by assessing the impact of two different measures of capital inputs on the contribution made by capital deepening to labour productivity growth (box 7.3).

Box 7.3 Implications of quality adjustments to capital for measuring the contributions from capital deepening and MFP growth

To gain insights into the possible effects of quality adjustment on the components of labour productivity growth, the effects of two different measures of capital inputs are compared for the market sector (which accounts for around two-thirds of the economy).

The first measure, which is analogous to that used by the ABS, allows the weights used to aggregate different asset classes to vary over time to reflect changes in their quality. The second measure of capital inputs holds the weight of each asset class fixed *within* each industry at their initial 1989-90 share (the first year for which detailed asset data are available for most market-sector industries) to align more closely with the measure of capital in the VUMR model.

Over the period 1989-90 to 2013-14, capital deepening based on the first measure of capital contributed 1.7 percentage points to the 2.6 percentage point growth in market-sector labour productivity. In contrast, the second measure of capital contributed 1.4 percentage points.

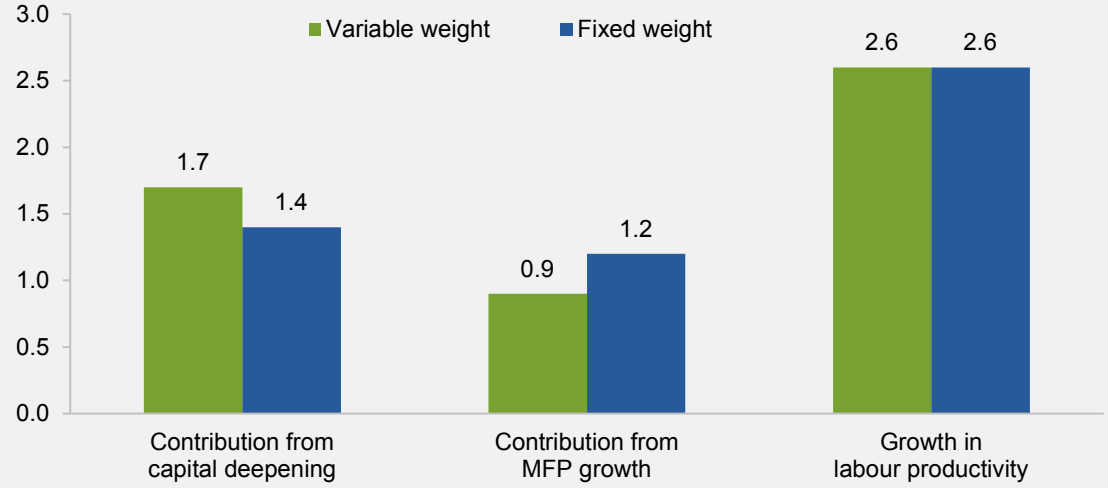
This analysis is based on the period 1989-90 to 2013-14, rather than the full historical period analysed in the wider paper. Over this longer period, capital deepening contributed 1.5 percentage points to the 2.3 percentage point growth in market sector labour productivity based on the first measure of capital. However, if the effect of this 'quality adjustment' extended uniformly back to 1974-75, the use of the second measure of capital inputs may have resulted in around 1.2 percentage points of capital deepening. This would also imply MFP growth of just over 1.1 percentage points (compared to 0.8 percentage points based on the first measure of capital).

The inclusion of the generally labour-intensive industries in the non-market sector would further reduce the contribution made by capital deepening.

These factors create some uncertainty surrounding the actual extent of capital deepening.

Contribution of capital deepening to market-sector labour productivity growth using alternative measures of capital inputs, 1989-90 to 2013-14

Per cent



Source: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003); ABS (*Estimates of Industry Multifactor Productivity Australia*, 2013-14, Cat. no. 5260.0.55.002).

Based on the analysis of the market sector (box 7.3), capital deepening may have contributed between 0.8 ('disembodied' technical change) and 1.0 percentage point ('embodied' technical change) of the 1.7 percentage point growth in economy-wide labour productivity between 1974-75 and 2013-14, with MFP growth accounting for between 0.9 and 0.7 percentage points, respectively.

This distinction between measures of capital that reflect 'embodied' and 'disembodied' technical change may matter for the reference case, as the historical data published by the ABS partially adjusts the measures of capital inputs used to account for changes in their quality over time, whereas the measure of capital in the VUMR model does not take into account changes in the quality of capital inputs over time.

The implication of this is that changes in the quality of capital inputs used in production are more likely to be reflected as:

- contributions from capital deepening in the historical estimates based on ABS data; and
- contributions from MFP growth in the projections derived from the VUMR modelling.

The distinction between 'embodied' and 'disembodied' technical change that arises from quality changes over time is also important for labour inputs (box 7.4).

Measurement of capital income

As noted, the contribution from capital deepening to labour productivity growth also depends on the share of income from production that accrues to the owners of capital (the capital income share).

In practice, the distinction between labour and capital income is unclear owing to the inclusion of people that are self-employed in national production. The earnings of the self-employed can be considered as consisting of two components:

- a notional labour income based on the hours that they work (analogous to wages paid to employees); and
- a return on capital for their investment in the business (analogous to dividends paid to the owners of capital in listed companies).

In their productivity analysis, the ABS adjusts labour income to include the notional labour income of the self-employed (to be consistent with the measure of labour inputs used). This gives rise to adjusted and unadjusted cost shares for both labour and capital.

The effect of this adjustment is to reduce the share of total factor income that goes to capital. In 2013-14, this adjustment reduced the capital income share by 4.5 percentage points (from 47.1 to 42.5 per cent) and increased the labour income cost share by the same amount (from 52.9 to 57.5 per cent). While altering the income shares, this adjustment does not materially alter their growth rates since 1974-75 (figure 7.6).

Box 7.4 Adjustment of labour inputs to account for quality changes

Labour inputs are typically combined into a single category and measured in terms of hours worked without adjustment for the relative productivity of different levels of technical skill or experience of the workforce.

However, additional education, training and work experience can lead to changes in the quality of labour inputs that increase their productive efficiency.

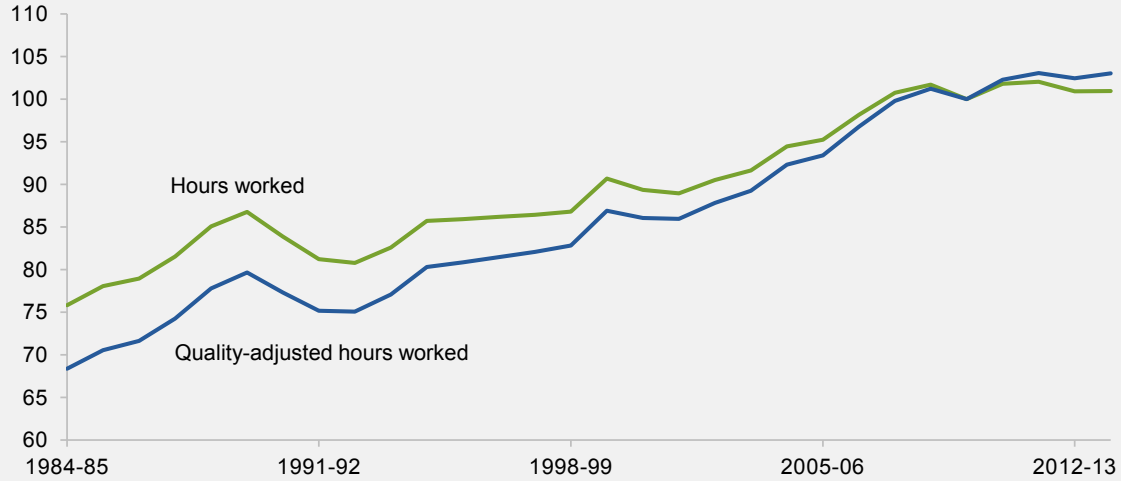
Experimental estimates by the ABS for the market sector suggest that labour inputs adjusted to take account of work experience and education increased by 1.4 per cent per year over the period 1984-85 to 2013-14. In contrast, labour inputs measured on an hours worked basis increased by 1.0 per cent per year over the same period.

As noted, the use of unadjusted labour input series in this paper means that changes in the quality of labour over time will contribute to measured MFP growth. That is, it results in disembodied technical change.

Somewhat ironically, the use of the experimental quality adjusted labour inputs leads to lower measured aggregate labour productivity growth compared to the unadjusted labour inputs typically used in Australian productivity studies (including this paper). This arises from a change in the weights used to aggregate different types of labour, as more skilled labour typically have higher wages (technically, the value of their marginal products) than less skilled labour and, hence, also attract a higher weight (discussed in PC 2012b).

Trends in labour inputs used in production, Australian market sector, 1984-85 to 2013-14[a]

Index (Reference year: 2009-10 =100)

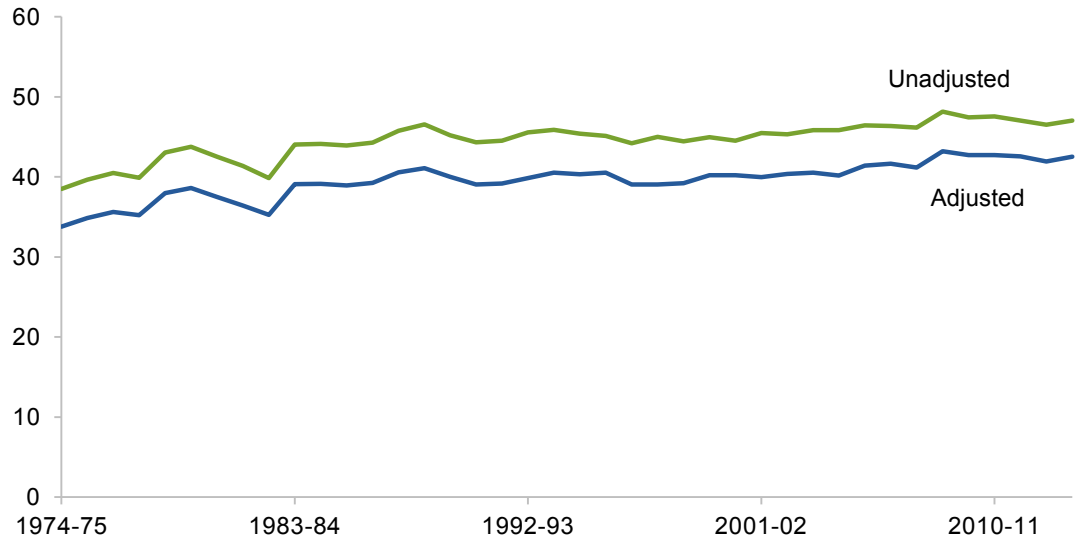


[a] Quarterly average hours worked in a week are calculated from the quarterly survey of industry hours worked in a survey week divided by the number employed quarterly. The average weekly earnings for each industry are then divided by the average weekly hours worked and corrected for inflation using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

Sources: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003); ABS (*Estimates of Industry Multifactor Productivity Australia*, 2013-14, Cat. no. 5260.0.55.002).

Figure 7.6 **Capital cost shares, before and after adjusting for the labour income of the self-employed, Australia, 1974-75 to 2013-14**

Per cent



Sources: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Estimates of Industry Multifactor Productivity Australia*, 2013-14, Cat. no. 5260.0.55.002).

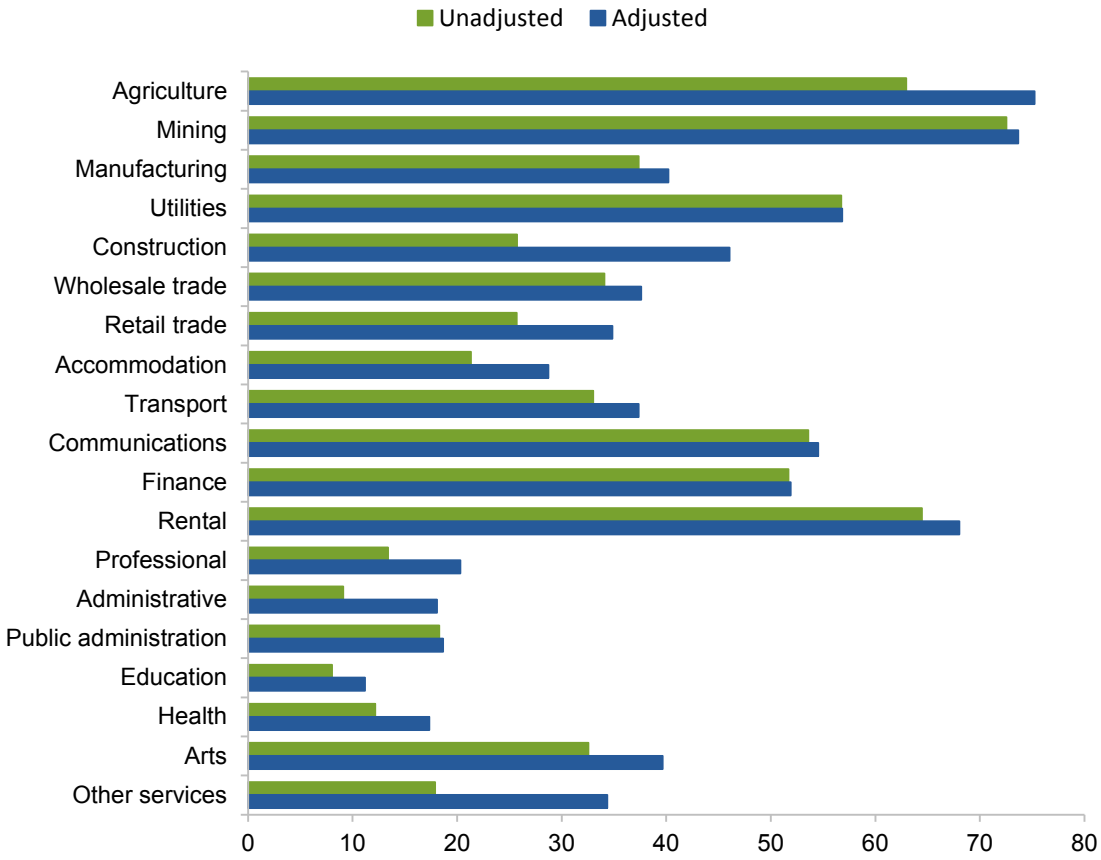
The consequence of this fall in the capital income share is to reduce the contribution made by capital deepening (and to increase the contribution made by MFP growth) to labour productivity growth. By reducing the weight applied to the growth in the capital-labour ratio, this reduction in capital income reduced the contribution from capital deepening by just over 10 per cent (0.1 percentage point) from 1974-75 to 2013-14.

The significance of this adjustment to the capital income share is more material for some industries, most notably *agriculture*, *construction* and many service industries (figure 7.7). For many industries, this adjustment is relatively modest.

The VUMR model does not distinguish the self-employed from employees and, hence, the capital income shares are not adjusted over time for changes in the fortunes of the self-employed, notwithstanding that the capital and labour income shares in the starting database have been adjusted to align with the practice used by the ABS. This may mean that VUMR-based projections may give rise to different contributions from capital deepening and MFP growth than if the income shares had been adjusted (all other things being).

Figure 7.7 **Average capital cost shares by industry, before and after adjusting for the labour income of the self-employed, Australia, 1974-75 to 2013-14**

Per cent



Source: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Estimates of Industry Multifactor Productivity Australia*, 2013-14, Cat. no. 5260.0.55.002).

7.4 Towards a modelling reference case

As discussed in section 7.3, all modelling reference cases require simplifying assumptions about how the relationship between productive inputs and outputs — that is, productivity — evolves over time and assumptions about the nature of the underlying contributions of technological and organisational change to productivity growth.

The approach to modelling labour productivity growth adopted in this paper is based on that adopted in PC (2012b). In the reference case documented here:

- labour productivity growth is modelled at the industry level;
- labour productivity growth is assumed to be uniform across states; and
- MFP growth is assumed to arise through *primary factor augmenting* technical change.

The assumption that MFP growth arises through *primary factor augmenting* technical change is different to the Australian studies reviewed in section 7.2, which assume that MFP grow arise through *labour augmenting* technological change. The reasons for this assumption are set out in PC (2012b). In short, this is because technological and organisational change can affect the productivity of capital as well as labour.

The reference case specifies the annual change in labour productivity growth at the VUMR industry level (the exogenous variable) based on recent changes and longer-term historical trends. Capital deepening is modelled endogenously on the basis of the relative returns to capital across activities. For industry activities, that part of projected labour productivity growth that is not accounted for by capital deepening is determined to be MFP growth arising from *primary factor augmenting* technical change (the endogenous variable).

Growth in aggregate labour productivity over the unwinding and projection periods is determined endogenously by the growth in labour productivity at the industry level and by the relative contribution that each industry makes to national output.

Implementation

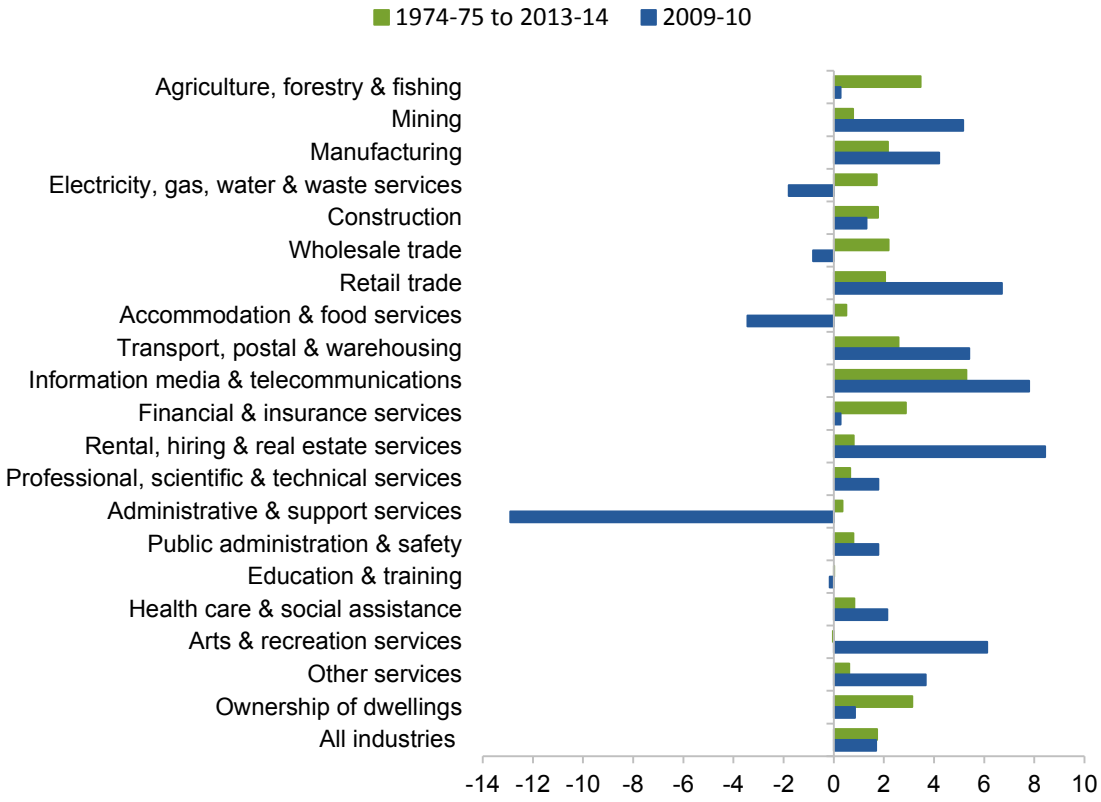
The starting database for the reference case is based on data for the 2009-10 financial year. As productivity growth in many industries in 2009-10 differed from their long-run historical average (figure 7.8), the implied productivity story in the model database is unlikely to be representative of the long-term trend for each industry. This divergence raises the question about how industry productivity should transition to their long-run historical average.

General approach

The reference case reflects a gradual reversion from current labour productivity levels (as reflected in the initial VUMR model database for 2009-10) to historical trends in measured productivity at the industry level (table 7.3 at the end of this chapter). It is generally assumed that the data for each ANZSIC industry division is the same for all component industries in the VUMR model.

Figure 7.8 **Industry labour productivity growth, Australia, average 1974-75 to 2013-14 and 2009-10[a]**

Per cent per year



[a] Labour productivity is calculated as real GVA per hour worked.

Source: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003); ABS (*Estimates of Industry Multifactor Productivity Australia*, 2013-14, Cat. no. 5260.0.55.002).

For each VUMR industry, the industry-specific labour productivity shocks applied vary over three distinct periods:

- the *uprating* period — between 2009-10 and 2013-14 — labour productivity growth is assumed to be the actual annual changes between 2009-10 and 2013-14;
- the *unwinding* period — between 2014-15 and 2017-18 (to be consistent with the terms of trade — chapter 8) — labour productivity growth is assumed to linearly converge to its long-run historical average (between 1974-75 and 2013-14); and
- the *projection* period — between 2017-18 and 2059-60 — labour productivity growth in each industry is assumed to remain constant at its long-run historical average.

For those industries where the long-run measured labour productivity growth rate is negative, the long-run labour productivity growth rate is set to zero in the reference case.[32]

Exceptions to this general approach are discussed below.

Mining industries

Measuring productivity in the mining sector is problematic for many reasons. Some of these are specific to the mining sector, while others apply more widely, particularly to infrastructure-related industries such as *electricity, gas, water & waste services*. The significant export price changes, and the subsequent investment responses, associated with the mining boom, have exacerbated these wider issues for the mining sector.

For mining productivity, some key issues that are important for the reference case are:

- the official ABS estimates of mining sector productivity over the period covered by mining boom are affected by investment activity that is unrelated to the use of resources in extracting commodities from the ground (production), especially over the long term;
- the measure of output used in the official ABS estimates of productivity — real GVA — is difficult to accurately measure in the presence of large and sudden price and volume changes; and
- the impact of the mining boom has not been uniform across mining commodities.

These issues are discussed in turn.

As measured, the official ABS estimates of productivity in the mining sector are based on the use of *all* capital and labour inputs, and do not distinguish between those used in extracting the commodities from the ground (production) from those used by mining companies to construct new mines on their own behalf (investment).[33] As a result, the official measures of mining productivity reflect the effects of *both* production and their own-account investment activities.

The significant investment that occurred in response to the mining boom led to substantial increases in the use of capital, labour and other inputs by the mining sector. However, given the long lags involved, it often takes a number of years for this increase in investment to flow through to output.

Consequently, the investment boom has been a key contributor to falls in measured labour productivity in the mining sector over recent years, as use of capital and labour inputs

[32] VUMR industries with negative measured long-run historical labour productivity between 1974-75 and 2013-14 are: *school education*; *non-school education*; and *arts & recreation services*.

[33] This is particularly an issue for the ABS *Input-Output Tables* (Cat. no. 5209.0.055.001), on which the VUMR model database is based (chapter 3).

increase ahead of the subsequent increase in output. As a result, current measures of mining productivity are unlikely to be representative of those that the sector will face over the projection period.

Notwithstanding that the effects of the investment phase of the mining boom may continue in the near term, measured labour productivity is likely to rise with the switch to the production phase as output increases and input use associated with constructing new mines abates.

These investment effects are independent of changes in efficiency associated with mining production.

This distinction between mining production and mining investment is important for the reference case as the economic effects of investment and capital deepening are different to MFP growth arising from technical or organisational change.

However, as the published data does not generally distinguish between resources used in production and investment, it is not possible to model these effects separately.

The rapid changes in export prices, in particular, has created issues in measuring real industry GVA needed to measure labour productivity in the sector. As a result, changes in measured output may not be correlated with physical production, especially for activities within the mining sector.

Modelling of labour productivity growth in the reference case

There are eight mining industries in the VUMR model: *coal mining*; *oil extraction*; *gas extraction*; *LNG processing*; *iron ore mining*; *non-ferrous metal ore mining*; *non-metallic mineral mining*; and *exploration & mining support services*.

Changes in production, investment, export prices and export volumes were not uniform across these industries. Some commodities, particularly iron ore and black coal (both metallurgical and thermal), experienced larger changes than others and the timing of these effects varied. As a result, there are likely to have been significant variations in the productivity performance across mining activities.

However, published data suitable for estimating productivity within the mining sector is patchy, inconsistent and frequently subject to significant year-to-year variability. Timeseries data on real GVA and hours worked are only published for the *coal mining* industry. Given that there is also a residual unallocated category for the available hours worked data (termed by the ABS 'not further disaggregated') that has grown substantially over time, it is not possible to meaningfully map from the published ABS categories to the industries within the VUMR model.

Even at a more aggregated level, historical mining labour productivity growth is sensitive to the time period chosen. This gives rise to significant uncertainty concerning the appropriate long-term productivity rate to project the mining sector.

Given this, and without knowing what is happening to productivity in competitor nations such as Brazil, it is assumed that productivity in all of the VUMR mining industries converge to the long-run average of 0.7 per cent for the ABS mining division to align with the projected fall in import prices expressed in Australian dollars (chapter 8).

Exceptions are the VUMR mining industries associated with the ABS *oil and gas* industry. As *oil extraction* is a mature industry, it is assumed that the long-term productivity of *oil extraction* grows at half the rate of the growth projected for the other mining industries (table 7.3). As it is combined with *gas extraction* in the ABS data, it is assumed that the long-run growth target for the *gas extraction* industry is the same as for *oil extraction*. Also, as gas is a key input into the production of LNG, the same productivity growth is applied to the capital-intensive *LNG production* industry, which employs little labour.

Table 7.3 **Labour productivity growth projections by VUMR industry to 2059-60 in the reference case**

Per cent per year

		Actual				Unwinding				Projection
VUMR Industry	*1974-75 to 2013-14*	*2010-11*	*2011-12*	*2012-13*	*2013-14*	*2014-15*	*2015-16*	*2016-17*	*2017-18*	*Long-run target*
Sheep & beef cattle	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Whole milk & dairy cattle	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Other animals	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Crops & grains	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Other agriculture	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Forestry & logging	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Fishing, hunting & aquaculture	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Agriculture, forestry & fishing support services	3.4	7.3	6.0	6.9	-2.8	-1.6	-0.4	0.8	2.0	3.4
Coal mining	0.7	-15.3	-12.5	2.6	8.1	12.3	10.9	9.8	9.0	0.7
Oil extraction	0.7	-15.3	-12.5	2.6	8.1	6.2	5.5	4.9	4.5	0.4
Gas extraction	0.7	-15.3	-12.5	2.6	8.1	6.2	5.5	4.9	4.5	0.4
Liquefied natural gas production	0.7	-15.3	-12.5	2.6	8.1	6.2	5.5	4.9	4.5	0.4
Iron ore mining	0.7	-15.3	-12.5	2.6	8.1	12.3	10.9	9.8	9.0	0.7
Non-ferrous metal ore mining	0.7	-15.3	-12.5	2.6	8.1	12.3	10.9	9.8	9.0	0.7
Non-metallic mineral mining	0.7	-15.3	-12.5	2.6	8.1	12.3	10.9	9.8	9.0	0.7
Exploration & mining support services	0.7	-15.3	-12.5	2.6	8.1	12.3	10.9	9.8	9.0	0.7
Meat products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Dairy products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Other food product manufacturing	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Beverage & tobacco product manufacturing	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1

(continued next page)

Table 7.3 (continued)

		Actual				Unwinding				Projection
VUMR Industry	*1974-75 to 2013-14*	*2010-11*	*2011-12*	*2012-13*	*2013-14*	*2014-15*	*2015-16*	*2016-17*	*2017-18*	*Long-run target*
Textiles, clothing & footwear	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Sawmill & other wood products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Pulp, paper & paper products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Printing & recorded media	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Petroleum & coal products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Basic chemical & chemical products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Polymer & rubber products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Non-metallic mineral products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Cement, lime & concrete	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Iron & steel	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Alumina	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Aluminium	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Other non-ferrous metals	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Metal products	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Motor vehicles & parts	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Other equipment	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Other manufacturing	2.1	0.1	3.9	0.3	0	0.4	0.8	1.2	1.6	2.1
Electricity generation: coal	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Electricity generation: gas	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Electricity generation: hydro	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Electricity generation: renewable	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Electricity generation: alternative	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Electricity supply	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Gas supply	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7

(continued next page)

Table 7.3 (continued)

		Actual				Unwinding				Projection
VUMR Industry	*1974-75 to 2013-14*	*2010-11*	*2011-12*	*2012-13*	*2013-14*	*2014-15*	*2015-16*	*2016-17*	*2017-18*	*Long-run target*
Water supply, sewerage & drainage	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Waste collection, treatment & disposal	1.7	-8.3	-1.8	8.5	-8.6	-6.5	-4.4	-2.3	-0.2	1.7
Residential building construction	1.7	0.5	11.4	3.8	-1.0	-0.5	0	0.5	1.0	1.7
Non-residential building construction	1.7	0.5	11.4	3.8	-1.0	-0.5	0	0.5	1.0	1.7
Construction services	1.7	0.5	11.4	3.8	-1.0	-0.5	0	0.5	1.0	1.7
Wholesale trade	2.1	1.9	6.4	-1.1	6.0	5.2	4.4	3.6	2.8	2.1
Retail trade	2.0	-1.1	3.4	4.8	2.2	2.2	2.2	2.2	2.2	2.0
Accommodation & food services	0.4	-0.6	4.1	-1.1	1.7	1.4	1.1	0.8	0.5	0.4
Road freight transport	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Road passenger transport	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Rail freight transport	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Rail passenger transport	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Pipeline transport	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Water transport	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Air transport	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Transport services nec	2.5	1.2	6.2	2.4	-1.9	-1.0	-0.1	0.8	1.7	2.5
Publishing, information & media	5.2	2.9	-2.9	-1.6	13.9	12.2	10.5	8.8	7.1	5.2
Telecommunication services	5.2	2.9	-2.9	-1.6	13.9	12.2	10.5	8.8	7.1	5.2
Banking services	2.8	2.3	-3.1	8.5	2.9	2.9	2.9	2.9	2.9	2.8
Finance services other than banking	2.8	2.3	-3.1	8.5	2.9	2.9	2.9	2.9	2.9	2.8
Insurance services	2.8	2.3	-3.1	8.5	2.9	2.9	2.9	2.9	2.9	2.8
Superannuation fund services	2.8	2.3	-3.1	8.5	2.9	2.9	2.9	2.9	2.9	2.8
Other financial services	2.8	2.3	-3.1	8.5	2.9	2.9	2.9	2.9	2.9	2.8
Ownership of dwellings[a]	3.1	1.0	1.2	3.3	2.2	2.4	2.6	2.8	3.0	3.1

(continued next page)

Table 7.3 (continued)

		Actual				Unwinding				Projection
VUMR Industry	*1974-75 to 2013-14*	*2010-11*	*2011-12*	*2012-13*	*2013-14*	*2014-15*	*2015-16*	*2016-17*	*2017-18*	*Long-run target*
Business services[b]	0.5	1.2	0.7	3.4	1.7	1.5	1.3	1.1	0.9	0.5
Public administration & regulatory services	0.7	-0.7	-2.4	5.2	-0.2	0	0.2	0.4	0.6	0.7
Defence	0.7	-0.7	-2.4	5.2	-0.2	0	0.2	0.4	0.6	0.7
School education	-0.1	-1.6	2.6	-1.6	0.3	0.2	0.1	0	-0.1	0
Non-school education	-0.1	-1.6	2.6	-1.6	0.3	0.2	0.1	0	-0.1	0
Health care services	0.8	-3.1	-2.7	4.2	1.9	1.7	1.5	1.3	1.1	0.8
Residential care & social assistance	0.8	-3.1	-2.7	4.2	1.9	1.7	1.5	1.3	1.1	0.8
Arts & recreation services	-0.1	-2.7	1.0	-0.6	8.1	6.5	4.9	3.3	1.7	0
Automotive repair & maintenance	0.6	-2.2	4.8	-1.8	-6.1	-4.8	-3.5	-2.2	-0.9	0.6
Other repair & maintenance	0.6	-2.2	4.8	-1.8	-6.1	-4.8	-3.5	-2.2	-0.9	0.6
Personal & other services	0.6	-2.2	4.8	-1.8	-6.1	-4.8	-3.5	-2.2	-0.9	0.6

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 GVA).
b Business services is the weighted-average of: *rental, hiring & real estate services*; *professional, scientific & technical services*; and *administrative & support services*.

Source: Estimates based on ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2014, Cat. no. 6291.0.55.003); Estimates.

8 Foreign trade

Being a small and open economy, Australia is significantly influenced by changes in international markets for the goods and services that it exports and imports. Such changes are, therefore, an important aspect of the economic environment 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 price and composition. It initially focuses on the longer-term trends that have shaped the level and composition of the Australian economy. However, given their likely impact on the level and composition of future economic activity, this chapter then assesses more recent changes that have occurred, particularly those pertaining to the terms of trade.

The chapter commences by reviewing Australia's interactions with the rest of the world (section 8.1). This section covers international trade, the terms of trade and the role played by exchange rates. The chapter then looks at the outlook for international markets into which Australia trades (section 8.2). It then canvasses the terms of trade projections presented in other studies (section 8.3). The chapter concludes by presenting the terms of trade projections used in the modelling reference case (section 8.4).

Analytical framework used

In formulating a modelling reference case, trade between Australia and the rest of the world would ideally be analysed and modelled in terms of the individual goods and services that Australia trades internationally. This 'bottom-up' approach would involve assessing the prospects for these commodities over the projection period in terms of world demand and future prices to develop suitable shocks for the VUMR model. The aggregate terms of trade, which relates the prices received for exports to the prices of imports (both in Australian dollars), would then be determined endogenously by VUMR from the various individual price shocks. This approach requires price and volume responses that are consistent with trends evident in the aggregate terms of trade.

This approach requires rich trade data on the price and volume of individual goods and services that are traded internationally, both exports and imports. This data would also need to be consistent with the ABS aggregate terms of trade.

In the absence of such data for the products within the VUMR model, the analytical framework used in this chapter is a 'tops-down' framework in which the primary focus is on understanding the aggregate trends in international trade between Australia and the rest

of the world. In particular, given its importance in determining national income, the primary focus is on the terms of trade. This higher level analysis is extended to some of the key commodities that have underpinned the recent terms of trade boom so that suitable shocks can be applied to the VUMR model to supplement those being applied to the domestic economy.

This 'tops-down' framework is based on that used in PC (2012b), which, in turn, was based on that used by the Treasury in its climate change modelling (outlined in section 8.3). The approach used in PC (2012b) has been extended to improve the modelling of subsequent changes in economic structure arising from the terms of trade boom.

8.1 Historical perspective

The ABS records international trade in its 'balance of trade' account, which forms part of the broader 'current account' that records income flows between Australia and the rest of the world (ABS Cat. no. 5302.0).

The balance of trade is defined as the value of exports less the value of imports (both expressed in Australian dollars). In 2013-14, Australia recorded a trade deficit of just under $7 billion (or 0.4 per cent of GDP). This reflected:

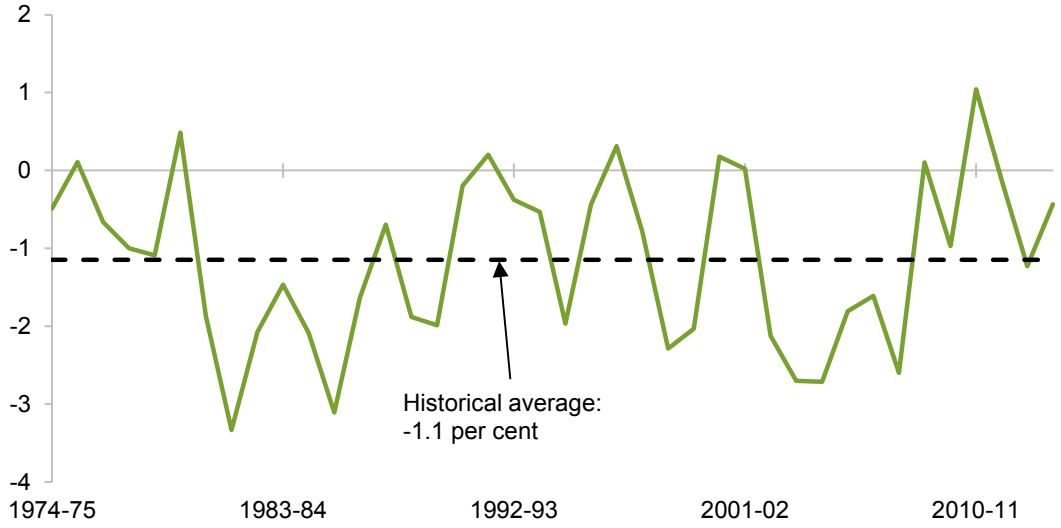
- $331 billion of exports from Australia (20.9 per cent of GDP); and
- $338 billion of imports into Australia (21.3 per cent of GDP).

Trade in goods accounted for four-fifths of Australia's international trade (83 per cent of exports and 79 per cent of imports), with trade in services accounting for the remainder.

Since 1974-75, the balance of trade has generally been in deficit, with the value of imports frequently exceeding that of exports (figure 8.1). Over this period, the trade deficit grew by 8 per cent per year in nominal terms from $0.4 million, averaging 1.1 per cent of GDP.

Figure 8.1 **Balance of trade as a share of GDP, Australia, 1974-75 to 2013-14[a]**

Per cent of GDP



[a] A positive (negative) balance of balance as a share of GDP indicates a trade surplus (deficit).

Sources: ABS (*Balance of Payments and International Investment Position, Australia*, September, 2014, Cat. no. 5302.0), ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Exports

Australia's $331 billion of exports in 2013-14 (20.9 per cent of GDP) were comprised of $274 billion in goods exports (83 per cent) and $57 billion in services exports (17 per cent).

Australia has a relatively narrow export base (table 8.1). Just two commodities accounted for over one-third of all exports by value in 2013-14 — iron ore exports were almost $75 billion (23 per cent of Australian exports by value) and black coal $40 billion (12 per cent). Even more broadly, just eight goods accounted for half the value of Australian exports in that year — iron ore, coal, LNG, crude oil, meat and meat products, wheat, alumina and copper ores. There were also significant exports of base metal ores, and the basic metals aluminium and copper.

Table 8.1 **Main exports of goods and services, Australia, 2013-14[a]**

	Exports	*Share*	*Cumulative share*
	$b	Per cent	Per cent
Good or service[b]			
Iron ore & concentrates (SITC 281)	75	22.6	22.6
Coal (SITC 321)	40	12.1	34.7
Liquefied natural gas (SITC 343)	16	4.9	39.6
Crude oil (SITC 333)	10	3.2	42.8
Meat & meat products (SITC 011)	10	3.0	45.8
Wheat (SITC 041)	6	1.8	47.6
Alumina (SITC 285)	6	1.8	49.4
Copper ores (SITC 283)	5	1.6	51.0
Sub-total	*169*	*51.0*	
All exports[c]	**330**	**100.0**	
By broad sector			
Agriculture (SITC 001–272)[d]	41	12.5	12.5
Mining (SITC 273–345)	168	50.8	63.3
Manufacturing (SITC 411–988)	64	19.4	82.6
Services	57	17.4	100.0
All exports	**330**	**100.0**	
By country			
China	107	32.4	32.4
Japan	50	15.2	47.7
Korea	22	6.7	54.4
United States	16	5.0	59.3
India	10	3.2	62.5
Other Asia	50	15.1	77.6
Europe	25	7.5	85.1
Rest of the world	49	14.9	100.0
All exports	**330**	**100.0**	

a Exports excluding those that involve a change of ownership. As a result, the value of exports presented here is less than total exports of $331 billion. **b** Based on the Standard International Trade Classification (SITC) definitions. Under the SITC, some activities that are classified as manufacturing activities in the ABS *Input-Output Tables* are included as part of the associated agriculture or mining activity. **c** Sum of all exports of each good or service reported. **d** Including meat & meat products.

Sources: ABS (*International Trade in Goods and Services*, *Australia*, September 2014, Cat. no. 5368.0), ABS (*International Trade in Services by Country, by State and by Detailed Services Category*, 2013-14, Cat. no. 5368.55.003).

At 51 per cent of exports in 2013-14, Australia is highly reliant on mining exports (table 8.1). Manufacturing and services exports were broadly similar at 19 per cent and 17 per cent, respectively. Agriculture accounted for 12 per cent of exports.[34] The high exchange rate in 2013-14 penalised all exporters, especially those in non-mining industries. The main service exports were wholesale trade, transport and education services.[35]

While exporting to more than 50 countries in 2013-14, Australia relies on a limited number of export markets (table 8.1). China accounted for about one-third of all exports in 2013-14 (32 per cent). Three countries — China, Japan and South Korea (in order) — collectively accounted for over half of total exports (54 per cent). In total, roughly 73 per cent of Australian exports by value went to countries in Asia.

Changes in Australian exports since 1974-75

Australian exports grew from $10 billion in 1974-75, representing annual growth of 9 per cent per year. This growth reflects changes in:

- the volume and composition of the goods exported; and
- the prices received for those exports.

Aggregate export volumes measured in chain volume terms grew by 5 per cent per year from 1974-75, while Australian dollar export prices grew by 4 per cent per year (figure 8.2).[36]

The share of goods and services in total exports has not changed markedly since 1974-75 (ABS Cat. no. 5302.0).

Notwithstanding this, the composition of Australian goods exports has shifted away from rural commodities, such as wool and wheat, more towards natural resources such as iron ore, coal and LNG. Since 1974-75, the share of rural exports fell from 38 per cent to less than 15 per cent, while mining exports rose from 28 per cent to more than 60 per cent (ABS Cat. no. 5368.0).

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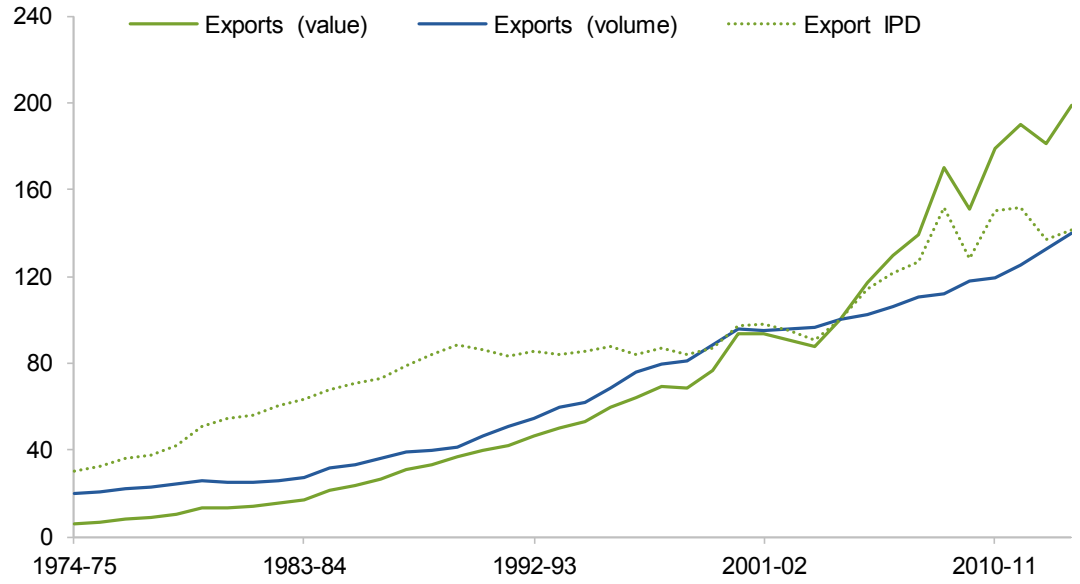
34 Exports of manufactured goods are understated, and exports of agricultural and mining goods are overstated, on a SITC basis, as the SITC does not generally classify the basic processing of agricultural and mining products as manufactured activities, as in the ABS *Input-Output Tables*.

35 Tourism is not classified as a commodity by the ABS in the *Input-Output Tables*. Instead, as inbound tourism depends on the nationality of the purchaser, tourism exports consist of shares of a range of goods and service exports, such as air transport, accommodation, food and beverages services, and education. Similarly, exports of education services also consist of shares of a range of goods and service exports.

36 Unless otherwise stated, the price changes reported in this chapter are based on Australian dollar (rather than foreign currency) prices. The aggregate export and import prices used are the implicit price deflators (IPDs) implied by dividing the value of export or imports in Australian dollars by the chain volume measure of exports or imports (both sourced from the ABS).

Figure 8.2 **Australian exports, 1974-75 to 2013-14[a]**

Index (Reference year: 2004-05=100)



[a] Export IPD is derived as current price exports divided by chain volume exports.

Sources: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

The composition of services exports has also changed. Travel services exports grew from 18 per cent of services exports in 1974-75 to 59 per cent in 2013-14 (ABS Cat. no. 5302.0) — a reflection of Australia's growing exports of education services (PC 2015a).[37]

The share of Australian merchandise exports going to Asia grew from 48 per cent in 1974-75 to 77 per cent in 2013-14. The share jointly accounted for by Europe, the United States and Canada has fallen from 30 per cent to less than 8.5 per cent over the same period (DFAT 2015).

Changes in Australian export prices since 1974-75

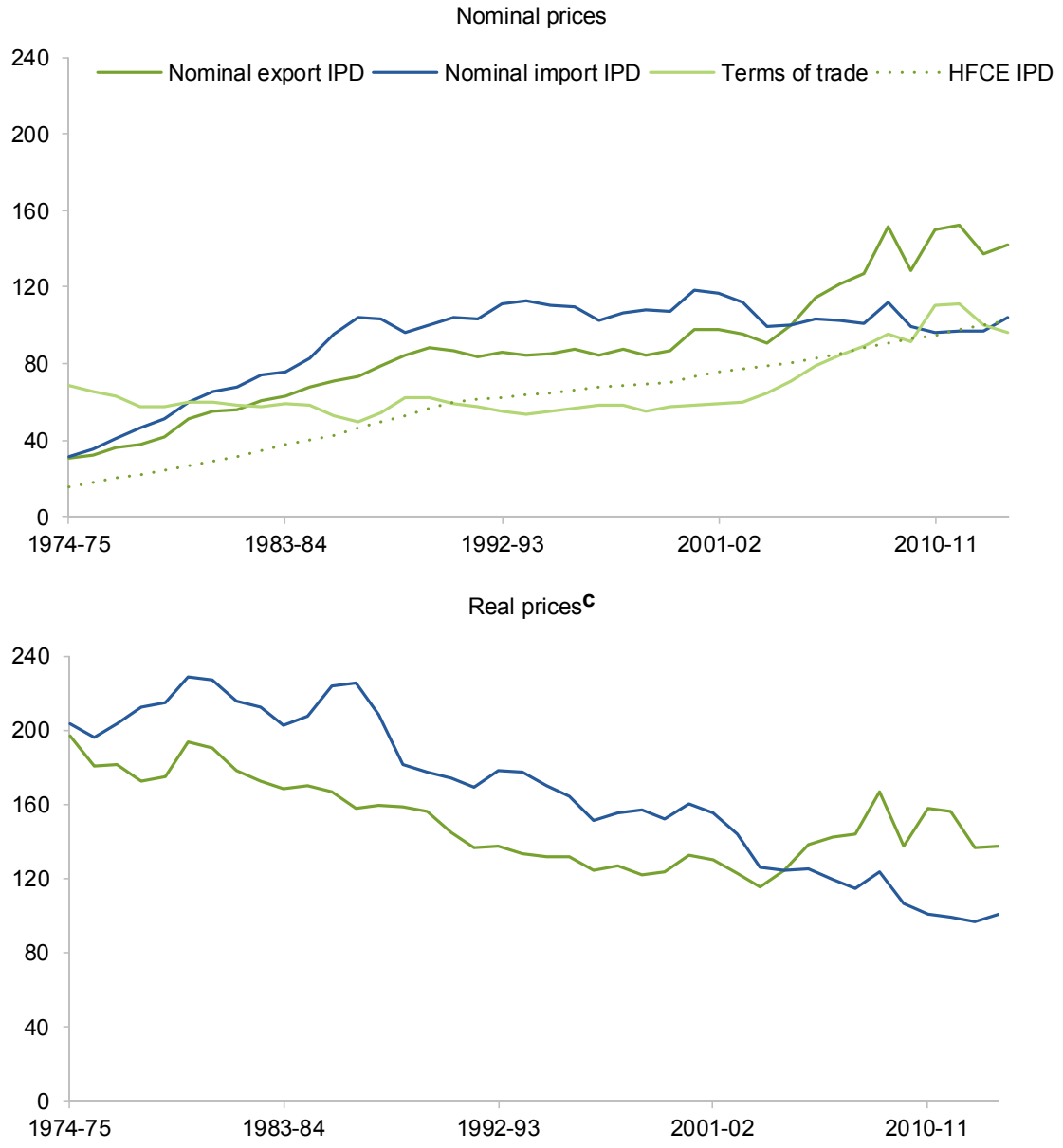
As mentioned, the export IPD grew by 4 per cent per year since 1974-75. This means that the Australian dollar price of exports *rose* by 4 per cent per year in *nominal* terms (figure 8.3, upper panel).

[37] The ABS statistics split exports of education services between 'travel services' (education services provided to non-residents studying in Australia) and 'all other exports' (exports of online and offshore education services provided to residents of other countries). These export values are gross in the sense that they do not net out the value of Australian imports of education services.

Given that the HFCE IPD (the numeraire in the VUMR model) *grew* by 5 per cent per year over this period (chapter 2 and figure 8.3, upper panel), the *real* Australian dollar price of exports *fell* by 1 per cent per year over the same period (figure 8.3, lower panel).

Figure 8.3 **Prices of goods and services exports and imports, Australia, 1974-75 to 2013-14[a,b]**

Index (Reference year: 2004-05=100)



[a] Terms of trade: Index of the ratio of goods and services export prices to import prices (both expressed in Australian dollars). [b] HFCE IPD: Household final consumption expenditure implicit price deflator (the numeraire in the VUMR model). [c] Nominal export and import IPD of goods and services deflated by the HFCE IPD.

Sources: *ABS* (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Sub-periods

This aggregate analysis masks four distinct sub-periods since 1974-75 relating to *nominal* Australian dollar export prices (figure 8.3, upper panel):

- From 1974-75 up to the mid-1980s: Australian dollar export prices grew in nominal terms (period one).
- From the mid-1980s up to 2004-05: Australian dollar export prices growth, while still positive, slowed (period two).
- From 2004-05 and 2011-12: Australian dollar export prices *rose* strongly in nominal terms, reflecting the terms of trade boom (period three).
- From 2012-13 to 2014-15, Australian dollar export prices *fell* sharply in nominal terms, reflecting the unwinding of the terms of trade boom (period four).

Relative to the HFCE IPD, real Australian dollar export prices *fell* in periods two and four, *rose strongly* in period three and remained constant in period one (figure 8.3, lower panel).

Imports

Imports into Australia totalled $338 billion in 2013-14 (21 per cent of GDP). This was comprised of $267 billion in goods imports (79 per cent) and $71 billion in services imports (21 per cent).

Australia mainly imports manufactured goods and services (table 8.2). Collectively, the five largest import groups — personal travel services, crude petroleum, refined petroleum, passenger motor vehicles and telecommunications equipment — accounted for roughly one-third of all imports. Capital and intermediate goods accounted for over half of total imports (ABS Cat. no. 5302.0).

Most of Australia's imports come from a relatively small number of countries in 2013-14, particularly China, the United States, Japan, Korea and some of the members of the Association of Southeast Asian Nations (ASEAN) — Indonesia, Malaysia, Singapore, Thailand, and Vietnam (table 8.2).

Table 8.2 **Main imports of goods and services, Australia, 2013-14[a]**

	Imports	*Share*	*Cumulative share*
	$b	Per cent	Per cent
Good or service[b]			
Personal travel (excluding education) services	25	7.9	7.9
Crude petroleum	22	6.7	14.6
Refined petroleum	19	6.0	20.5
Passenger motor vehicles	18	5.5	26.0
Telecommunications equipment	12	3.6	29.6
Medicinal & pharmaceutical products	10	3.1	32.8
Freight services	10	3.0	35.8
Office machines & automatic data processing machines	10	3.0	38.8
Clothing & footwear	9	2.8	41.5
Non-monetary gold	5	1.5	43.0
Sub-total	*139*	*43.0*	
All imports[c]	**323**	**100.0**	
By broad sector			
Agriculture (SITC 001–272)[d]	15	4.8	4.8
Mining (SITC 273–345)	45	13.8	18.6
Manufacturing (SITC 411–988)	192	59.4	78.0
Services	71	22.0	100.0
All imports	**323**	**100.0**	
By country			
China	52	16.1	16.1
United states	39	12.2	28.3
Japan	21	6.5	34.8
Korea	12	3.7	38.5
India	4	1.3	39.9
Other Asia	67	20.6	60.5
European Union	67	20.9	81.3
Rest of the world	60	18.7	100.0
All imports	**323**	**100.0**	

[a] Imports excluding those that involve a change of ownership. As a result, the value of imports presented here is less than total imports of $338 billion. [b] Based on SITC definitions. Under the SITC, some activities than are classified as manufacturing activities in the ABS *Input-Output Tables* are included as part of the associated agriculture or mining activity. [c] Sum of all imports of each good or service reported. [d] Including meat & meat products.

Sources: ABS (*International Trade in Goods and Services*, *Australia*, September 2014, Cat. no. 5368.0), ABS (*International Trade in Services by Country, by State and by Detailed Services Category*, 2013-14, Cat. no. 5368.55.003).

Changes in Australian imports since 1974-75

Imports into Australia grew from $11 billion in 1974-75 to $338 billion in 2013-14, representing annual growth of 9 per cent per year (the same as for exports). This growth reflects changes in:

- the volume and composition of the goods imported; and
- the prices paid for those imports.

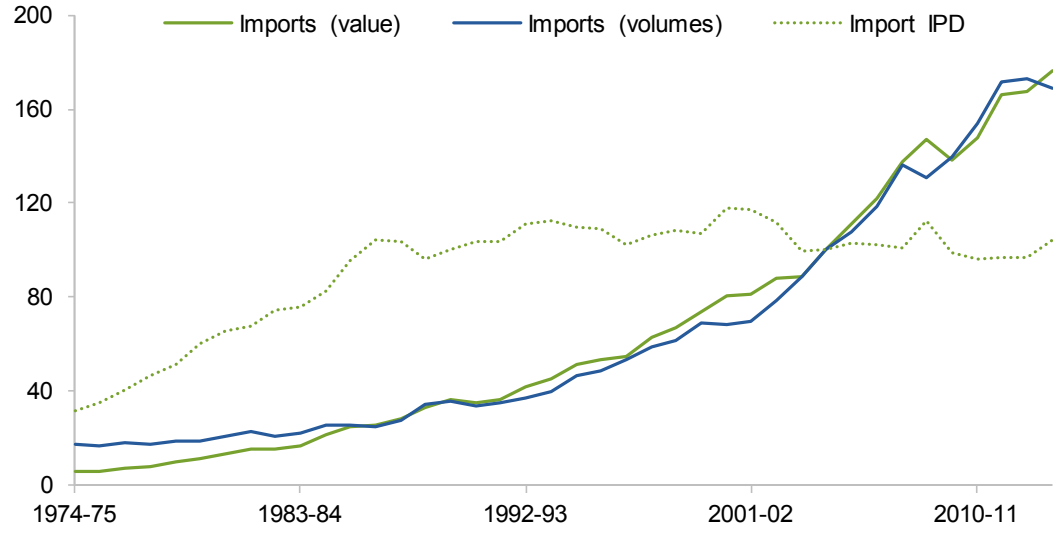
Aggregate import volumes measured in chain volume terms grew by 5.9 per cent per year from 1974-75, while import prices grew by 3.1 per cent per year (figure 8.4).

Like exports, the share of goods and services in total imports has not changed markedly since 1974-75 (ABS Cat. no. 5302.0).

Nonetheless, while less dramatic than for Australian exports, the broad composition of goods imported into Australia has changed. The relative importance of intermediate goods imports has declined, while consumption goods have increased (ABS Cat. no. 5368.0). Capital goods form an important input into investment, which has increased in recent years in response to the mining boom (chapter 7). Among other things, the growth in consumption goods reflects the development of new products (such as computers, mobile phones and televisions) and lower cost production costs overseas (leading to lower import prices). Lower-cost manufactured goods imports have primarily come from emerging economies in Asia in general, and China in particular.

Figure 8.4 **Australian imports, 1974-75 to 2013-14[a]**

Index (Reference year: 2004-05=100)



[a] Import IPD is derived as current price imports divided by chain volume imports.

Sources: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

As with exports, the sources of Australia's imports have also undergone noticeable changes. In 1974-75, 60 per cent of Australia's merchandise imports came from the North America and Europe; by 2013-14, 55 per cent of Australia's merchandise imports came from Asia (DFAT 2015).

Changes in Australian import prices since 1974-75

As mentioned, the import IPD grew by 3.1 per cent per year since 1974-75. This means that the Australian dollar price of imports *rose* by 3.1 per cent per year in *nominal* terms (figure 8.3, upper panel).

Given that the HFCE IPD (the numeraire in the VUMR model) *grew* by 5 per cent per year (chapter 2 and figure 8.3, upper panel), the *real* Australian dollar price of imports *fell* by 1.9 per cent per year over the same period (figure 8.3, lower panel).

Sub-periods

This aggregate analysis masks two distinct sub-periods relating to import prices (figure 8.3, upper panel):

- Following the oil price shocks of the 1970s, nominal Australian dollar import prices grew strongly up to the mid-1980s. This period also coincided with high rates of inflation in developed economies. For Australia, the period also coincided with a fixed exchange rate (a managed trade weighted peg), which saw periodic depreciations as Australia's rate of inflation tended to exceed that of our major trading partners. The progressively flexible exchange rate was floated in 1983, which resulted in a significant depreciation of the Australian dollar.
- From the mid-1980s, despite some year-to-year variation, nominal Australian dollar import prices have remained generally flat. This reflects the more benign global inflation environment over this period.

Relative to the HFCE IPD, *real* Australian dollar import prices, respectively, rose and fell over these two periods.

Terms of trade

Aggregate movements in trade volumes and prices are reflected in the terms of trade.

The terms of trade is the ratio of the weighted-average of Australian export prices relative to the weighted-average of Australian import prices (both expressed in Australian dollars), where the weights are equal to each good or service's share of the total value of exports or imports, respectively.

Movements in the terms of trade reflect the effects of short- and long-run factors. Short-term factors that may influence the terms of trade include:

- temporary imbalances between global demand and supply of particular commodities, which cause price spikes and falls;
- the effects of the business cycles in different countries, which affect patterns in demand more generally; and
- geopolitical considerations that affect market stability and global perceptions of risk and return, which can lead to international capital flows that affect the Australian dollar.

The longer-term factors that influence the terms of trade include: changes in the type and source of goods and services traded internationally; broad trends in relative rates of productivity growth; and global trends in the prices of the products that Australia trades internationally.

The terms of trade since the end of the 2000s has been very high by historical standards. Given the role of the terms of trade in driving trade and income for Australia, this warrants a longer-term analysis.

Long term trends

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 8.5).

In a Reserve Bank of Australia discussion paper, Atkin et al. (2014, pp. 3–4) identify five major *upswings* in Australia's terms of trade since 1869-70:

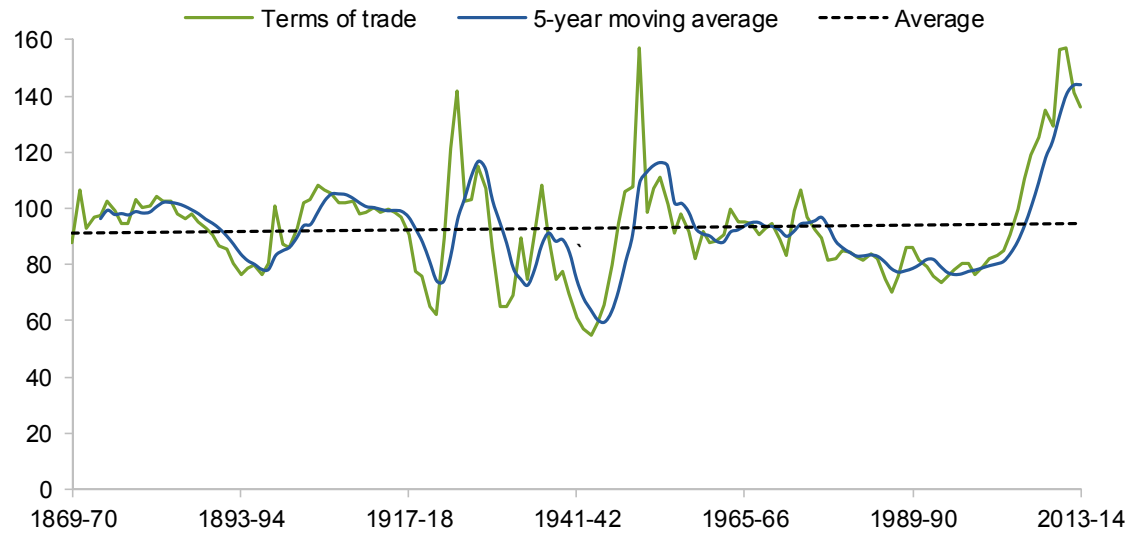
- 1894–1905: primarily reflecting higher wool prices, caused by the recovery from the global depression of the 1890s, together with the continued industrialisation of North America, Western Europe and Japan.
- 1922–1925: primarily reflecting a significant decline in Australia's import prices arising from falls in the prices of manufactured goods from the United States and the United Kingdom augmented by higher world prices for wool and grains.
- 1944–1951: primarily reflecting higher wool prices, caused by a surge in the demand for wool arising from the Korean War, and higher prices for a range of rural goods and resource commodities as a consequence of higher demand from post-World War II reconstruction, higher population growth, and the resumption of world trade.
- 1968–1974: primarily reflecting higher wool and other rural commodity prices, such as cereals and meat, associated with, among other things, supply disruptions caused by adverse weather in major grain producing regions and buoyant mineral prices associated with growth in the Japanese economy.

- 1994–2011: primarily reflecting higher mineral prices, especially iron ore and coal, due to a surge in demand from China and India, resulting from the rapid industrialisation and urbanisation in these countries.[38]

In almost all cases, the major upswings in Australia's terms of trade were driven by strong growth in export prices. The only exception was in the early 1920s, where a decline in import prices was the major contributor to the upswing in the terms of trade.

The first four upswings were either driven by, or included, upswings in the prices of rural commodities. Only the most recent upswing was primarily driven by resource commodities such as iron ore and coal.

Figure 8.5 **Terms of trade, Australia, 1869-70 to 2013-14[a]**
Index (Reference year: 2004-05=100)



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

Sources: Gillitzer and Kearns (2005); ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

The most recent boom

As noted, the recent boom reflected strong growth in the demand for Australian exports from China and India, both rapidly industrialising economies with large populations (Gruen 2011; Stevens 2011). This increase in demand resulted in sharp increase in iron ore

38 Data published after Atkin et al. (2014) indicate that the latest terms of trade cycle upswing extended for an additional year to 2011-12.

and coal prices in particular. It also resulted in a much higher level of the exchange rate than has generally been seen since the currency was floated in 1983.

The latest upswing in the terms of trade peaked at an index value of 157.0 in 2011-12, which is marginally below the highest ever financial year peak of 157.3 in 1950-51 during the Korean War boom. On a five-year moving average basis, the most recent boom reached its highest level in history in 2011-12, 75 per cent above the average since 1869-70, and 57 per cent above the average over the 20th Century.

However, there is uncertainty concerning the starting point of the latest upswing. The latest upswing could have started in:

- 1994, when the terms of trade turned upwards from its most recent longer-term low at an index of 55.0 (1993-94) — this would make the duration of the most recent boom 17 years. Atkin et al. (2014) attribute the starting point of the upswing to 1994.
- 1995-96, when the five-year moving average turned up — this would make the duration of the most recent boom 15 years.
- 1998-99, when the terms of trade once again turned up at an index of 57.1 following a modest downturn — this would make the duration of the most recent boom 12 years.
- 2002-03, when the growth in five-year moving average accelerated appreciably — this would make the duration of the most recent boom eight years.

The first three possible starting points would make the most recent upswing the longest in the last 140 years. As a result, the most recent upswing is sometimes referred to as a 'super cycle' given the magnitude of the upswing and its length.

However, much of this early growth reflected recovery from the then relatively low historic levels to the longer-term average (taken here to be the level in 2004-05).

Since 2004-05, the terms of trade grew by 57 per cent over the six years, with average growth of 6.4 per cent per year.[39] This rise to its peak in 2011-12 reflects:

- a 6 per cent per year *increase* in export prices (expressed in Australian dollars); and
- a 0.4 per cent per year *decrease* in import prices (expressed in Australian dollars).

Thus, similar to many previous upswings, the rise in the recent terms of trade was driven almost entirely by increases in the Australian dollar price of exports rather than by decreases in import prices.

[39] Based on the Atkin et al. (2014) starting point of 1994, the most recent boom is the longest upswing in the last 140 years (lasting 18 years from its trough in 1993-94 to its peak in 2011-12) and reached the second highest annual level ever recorded. The peak of 157.0 in 2011-12 is marginally below the highest ever financial year peak of 157.3 recorded in 1950-51 during the Korean War boom. On a five-year moving average basis, the most recent boom reached its highest level in history in 2011-12, 75 per cent above the average since 1869-70, and 57 per cent above the average over the 20th Century.

The terms of trade subsequently fell to 141.8 in 2012-13 and 136.6 in 2013-14.[40] Despite these declines, the terms of trade in 2013-14 remained 43 percentage points above the level in 2004-05.

Contribution of exchange rates to export and import price changes

Up to this point, the discussion has focused on the changes in the *Australian dollar* prices of exports and imports and the terms of trade. As well as reflecting Australian economic conditions, these prices also reflect changes outside of Australia, including the effect of exchange rate changes.

The prices paid on world markets reflect the interaction of global demand and global supply. Global demand depends on factors such as income levels, wealth and consumer preferences, while global supply reflects factors such as global production, resource availability and productivity.

While Australian trade occurs with many countries, and is designated in many different currencies, most of the mining commodities in which Australia trades are generally traded in United States (US) dollars.

The Australian dollar has fluctuated widely against the US dollar over the last forty years (figure 8.6). The Australian dollar traded around 136 US cents in 1974-75.[41] At the time the dollar was floated by the Hawke Government in December 1983, the Australian dollar had fallen to around 90 US cents. Notwithstanding some interim fluctuations, the Australian dollar fell to 52 US cents in 2001-02. Reflecting the rise in the terms of trade, the Australian dollar rose throughout most of the 2000s, reaching a recent peak of 103 US cents in 2011-12 and 2012-13. As the terms of trade came off its recent highs, the dollar subsequently fell to around 82 US cents in December 2014. The Australian dollar is generally correlated with the terms of trade — appreciating as the terms of trade rises and depreciating when it declines (figure 8.6).

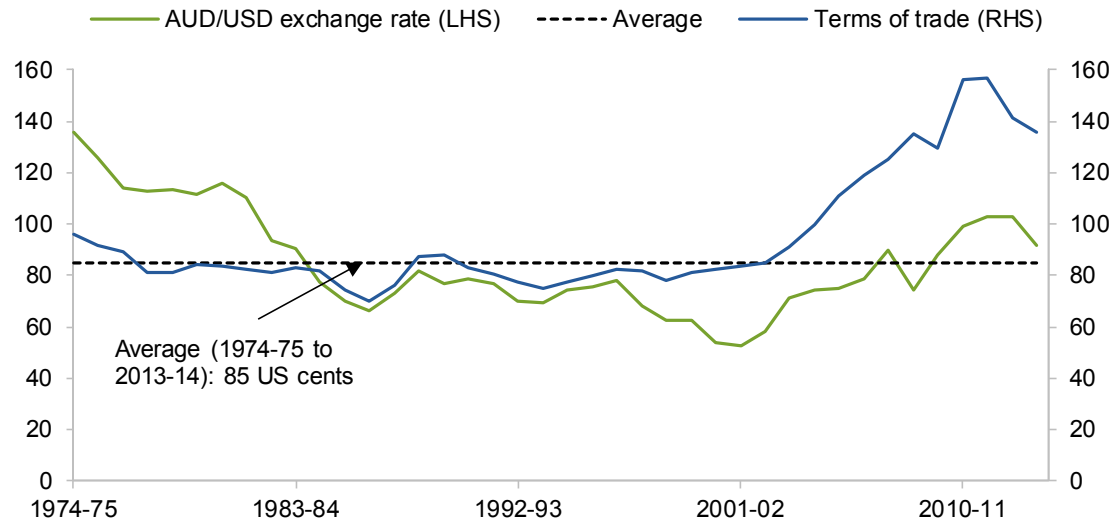
Reflecting higher historical levels, the Australian dollar has fallen by 1 per cent per year against the US dollar since 1974-75. This suggests that changes in the exchange rate contributed around one quarter of the 4 per cent annual nominal growth in Australian dollar export prices (25 per cent) and around one-third of the 3.1 per cent annual increase in import prices (32 per cent).

40 The terms of trade fell again in 2014-15 to 122.5.

41 Australia had a fixed exchange rate regime in 1974-75, under which the Reserve Bank of Australia (RBA) fixed the exchange rate, first against the US dollar (until September 1974) and then against a basket of currencies known as the trade-weighted index (TWI) (until December 1983).

Figure 8.6 **Australian dollar/US dollar exchange rate and the terms of trade, 1974-75 to 2013-14[a]**

US cents (LHS); Index (Reference year: 2004-05=100) (RHS)



[a] Exchange rate: US cents per Australian dollar. 1974-75 to 1977-78: Average of RBA monthly data. 1978-79 to 2013-14: ABS financial year average.

Sources: ABS (*Balance of Payments and International Investment Position, Australia*, June 2015, Cat. o. 5302.0); RBA (Exchange Rates – Monthly – July 1969 to December 2009XLS); *ABS* (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Exchange rate movements have clearly been an important contributor to historical changes in the terms of trade. Movements in the exchange rate help offset, at least partially, changes in global prices. As a result, the terms of trade and exchange rate are effectively jointly determined.

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

The outlook for Australia's terms of trade will depend on the prospects for:

- movements in trade volumes; and
- prices.

Prospects for movements in trade volumes

The prospects for Australian export volumes over the period covered by the reference case, both in aggregate and for individual goods and services, will depend on many factors.

Some factors affecting the international competitiveness of Australian firms are influenced by domestic considerations, which, at least in part, are within Australia's sphere of influence. These factors include productivity growth, the nature and extent of innovation and the international competitiveness of local factor and product markets.

However, many of the factors affecting the prospects for Australian export volumes are outside of Australia's direct control. One such factor is the growth prospects for Australia's major trading partners.

Growth prospects for Australia's major trading partners

Reflecting long-term trends in the global location of economic activity, and the decline in the influence of historical political relationships, the destination for Australian exports has shifted away from Europe towards Asia. Australian exports to its Asian neighbours grew from 48 per cent in 1974-75 to just over 77 per cent of in 2013-14. Over this period, China has grown from less than 3 per cent of Australian exports to 32 per cent. China also accounted for 16 per cent of Australia's imports in 2013-14 (table 8.2).

Many Asian economies have developed rapidly since the end of the World War II, starting first with Japan, then Korea, and now China and India. Future movements in Australia's terms of trade will depend more on the rate and pattern of growth of these Asian economies than those in Europe and the United States.

Real economic growth in China, for example, averaged 10 per cent per year over the past decade. This growth was driven by manufacturing export industries, the provision of domestic infrastructure and housing investment. As a result, China has been the largest export market for Australian iron ore since 2004 (Australian Trade Commission 2015).[42]

The *Australia in the Asian Century* White Paper (Australian Government 2012) characterise the 21st century as 'the Asian century', stating that the region as a whole will account for almost half the world's output by 2025. It goes on to state that:

> Asia's rise is changing the world. This is a defining feature of the 21st century — the Asian century. These developments have profound implications for people everywhere.
>
> Asia's extraordinary ascent has already changed the Australian economy, society and strategic environment. The scale and pace of the change still to come mean Australia is entering a truly transformative period in our history.
>
> Within only a few years, Asia will not only be the world's largest producer of goods and services, it will also be the world's largest consumer of them. It is already the most populous region in the world. In the future, it will also be home to the majority of the world's middle class.

[42] In December 2015, Australian iron ore accounted for close to 60 per cent of China's total iron ore imports by volume (DIIS & Westpac 2016).

> The Asian century is an Australian opportunity. As the global centre of gravity shifts to our region, the tyranny of distance is being replaced by the prospects of proximity. Australia is located in the right place at the right time — in the Asian region in the Asian century.
>
> For several decades, Australian businesses, exporters and the community have grown their footprint across the region. Today, for Australia, the minerals and energy boom is the most visible, but not the only, aspect of Asia's rise. As the century unfolds, the growth in our region will impact on almost all of our economy and society.
>
> An increasingly wealthy and mobile middle class is emerging in the region, creating new opportunities. They are demanding a diverse range of goods and services, from health and aged care to education to household goods, and tourism, banking and financial services, as well as high-quality food products. (p. 1)

This positive outlook for Asia is also shared by the IMF in its *World Economic Outlook* (IMF 2016), which forecasts the trend of above average economic growth to continue for most Asian countries to 2021. Real GDP is forecast to grow in countries in the 'emerging and developing Asia' region by an average of around 6 per cent over the period 2016 to 2021 compared to a world average of 3.4 per cent.

Australia is well positioned to benefit from this growth, given its close proximity and well-developed and relatively open service sector (Plumb, Kent and Bishop 2013). Australia has also recently signed Free Trade Agreements with China, Japan and Korea that may provide further opportunities for Australian exports.

More specifically, the White Paper identifies opportunities for Australia:

- in mining and resource related sectors — continued economic development in the region will drive demand for energy and mineral resources;
- in tourism, sport, education, the arts and creative industries, professional, banking and financial services, and science and technology — thanks to growing affluence in Asia;
- in agriculture — rising food demand, connected to rising populations and an expanding middle class in Asia, offers an opportunity for Australia to be an important supplier of high-value food, requiring greater investment by agribusinesses to boost output and research, adapt to regulatory change and build capacity;
- in manufacturing and services — as Australian businesses join regional and global value chains and over time become increasingly integrated and specialised, they will offer high-value and innovative products and services; and
- in environmentally sustainable growth, natural resource management, infrastructure development, urban design and health and aged care — as Australians leverage their expertise to do business with their neighbours (p. 8).

Future falls in the export prices of mineral commodities may lead to further exchange rate depreciations. This should enhance the international competitiveness of Australian exporters. This may benefit agricultural, manufacturing and other trade-exposed service exporters who were adversely affected by the appreciation of the dollar that accompanied the mining boom.

A potential risk factor going forward is the level of concentration in Australia's export base, both in terms of being highly reliant on exports of iron ore, coal and LNG as well as being highly reliant on a small number of export markets (China, Japan and Korea). This makes Australia more exposed to adverse changes in international circumstances than many countries. Moreover, any rebalancing of the Chinese economy away from investment towards household consumption orientated growth has the potential to switch Chinese demand away from resources towards consumer items such as food, education and tourism (Kelly 2014). Higher income growth in Asia is likely to add to this shift. Such changes present opportunities for some Australian exporters and may be detrimental to others.

The global trading landscape is also changing in ways that create both opportunities and threats for future Australian trade, including:

- increasing economies of scale in production that lead to fewer, larger manufacturing plants (such as petroleum refining and passenger motor vehicle manufacturing);
- increasing intra-industry trade and the development of globalised production chains that spread production across countries;
- increasing trade in services (such as education, health and business services);
- the increasing role played by multinationals, which may manage their global operations in ways that do not necessarily align with Australia's national interest;
- the increasing importance of embedded knowledge and intellectual property in trade (such as in the development of pharmaceuticals, and patents and royalties in manufacturing); and
- increasing global competition from a wider range of countries.

These changes are likely to affect future Australian trade, some positively and others not.

Prospects for movements in prices

Research by Harvey et al. (2010), among others, has suggested that countries like Australia, 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, commodities have dominated Australian exports (about four-fifths), while manufactured goods comprised the majority of Australian imports (Gillitzer and Kearns 2005).

The strong rise in the terms of trade that Australia experienced in the 2000s reflects growth in global demand for minerals (particularly iron ore and coal), especially from China, in excess of growth in global supply (Plumb, Kent and Bishop 2013). Coupled with capacity constraints in the short-run, the Australian dollar export prices of many mining exports rose strongly.

Reflecting the effects of past mining investment in response to higher world prices, the global supply of many mining commodities is gradually increasing relative to demand and putting downward pressure on world prices. Mineral prices have declined since their peak in late 2011, and are forecast to decline further over time as global supply increases. For example, investments in major coal exporting countries, such as Indonesia, Colombia and South Africa, have already entered into the production phase. Similarly, supplies of iron ore from both Australia and Brazil, the world's two largest producers, have increased and are projected to increase further (Department of Industry 2014). Global copper production has also grown, driven in large part by increases in Peru, but also from Australia, the United States, Africa and Chile. Given the considerable time between discovering new deposits, undertaking investment and developing a fully operational mine, past investments will continue to feed through into increased global supply and lower world prices for some time.

At the same time as production is expanding, growth in demand has been slowing. This is in large part due to falling demand growth for steel in China as their infrastructure and housing construction growth has slowed. The future trends in demand growth will depend on the rate of growth in other large economies, most notably India. While there is an infrastructure deficit in Asia, the timing of major investments is highly uncertain.

Projections in a Treasury research paper show price declines relative to the aggregate import prices for all broad export categories until around 2017-18 (Bullen, Kouparitsas and Krolikowski 2014, p. 31). Thereafter, export prices are assessed as remaining roughly constant over the remainder of their projection period to 2054-55. The relative price of non-rural commodity exports is expected to experience the largest fall, before settling at levels somewhat above the start of the resources boom (pre 2003-04) (Bullen, Kouparitsas and Krolikowski 2014, pp. 29 & 31). However, in aggregate, Australia's terms of trade is expected to fall to 2017-18 and to remain reasonably constant thereafter at a level roughly equal to that recorded in 2006-07.

Although there is broad consensus that the terms of trade is likely to fall further, before stabilising; this raises questions about the time period over which this decline will occur and the longer term level to which it will return.

8.3 Terms of trade projections used in other studies

Terms of trade assumptions have formed an important part of a number of studies that help form a view of its longer term trends:

- *Australia's Low Pollution Future* (Australian Government 2008);
- *Intergenerational Report 2010* (Australian Government 2010);
- *Strong Growth, Low Pollution* (Treasury 2011);
- *Long-run Forecasts of Australia's Terms of Trade* (Bullen, Kouparitsas and Krolikowski 2014); and

- *Intergenerational Report 2015* (Australian Government 2015b).

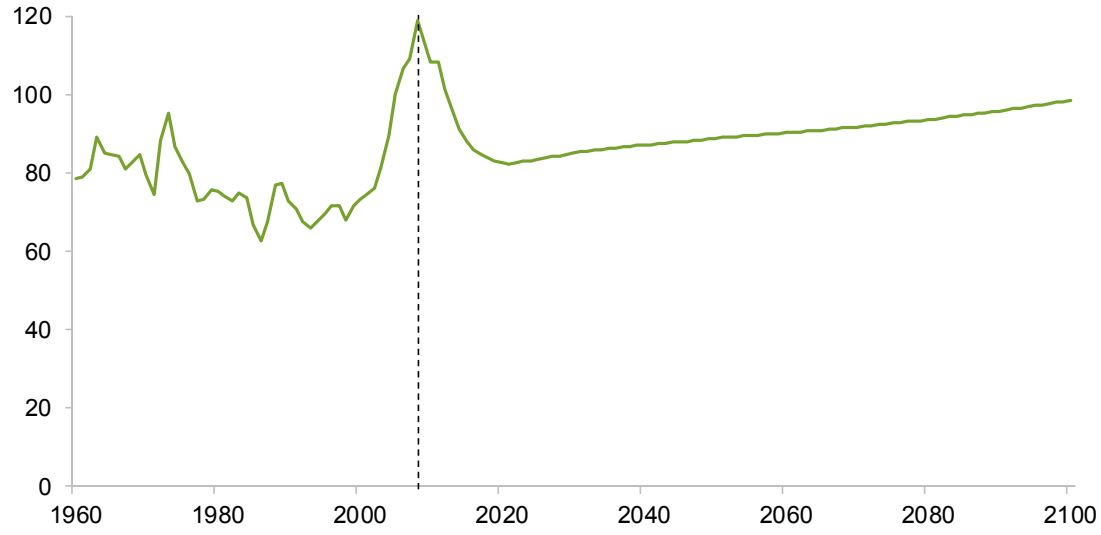
These reference cases also include some commodity-specific shocks that explicitly target the external sector. These are usually comprised of export price and export volume shocks for selected export commodities such as coal, oil and gas. Aggregate and industry-specific labour productivity shocks (discussed in chapter 7) will also indirectly affect the external sector.

Australia's Low Pollution Future

Australia's Low Pollution Future published in 2008 provided terms of trade projections to 2100 (figure 8.7). In this paper, forecasts from the then current federal budget were imposed on the MMRF model, followed by a step-down approach until 2020-21. 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 8.7 **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 Global Trade and Environment Model (GTEM)).

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.

The modelling also imposed energy supply constraints which had been identified by 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).

In addition, the modelling also included the development of LNG facilities in Queensland, leading to a convergence with international gas prices by 2029-30.

The terms of trade assumptions adopted in *Australia's Low Pollution Future* were also used in the *Garnaut Climate Change Review* (Garnaut 2008).

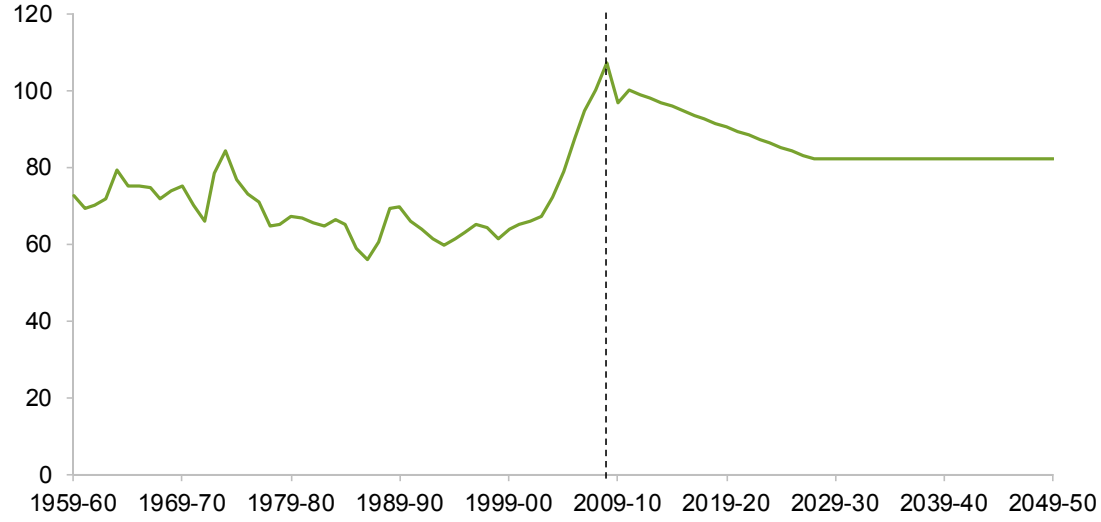
Intergenerational Report 2010

The *Intergenerational Report 2010* assumed that the terms of trade would decline gradually from their then current level through until 2027-28, and stabilise thereafter until the end of the projection period in 2049-50 (figure 8.8). This is consistent with the Australian Government's projection in the 2009-10 *Mid-Year Economic and Fiscal Outlook* (MYEFO) (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 8.8 **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

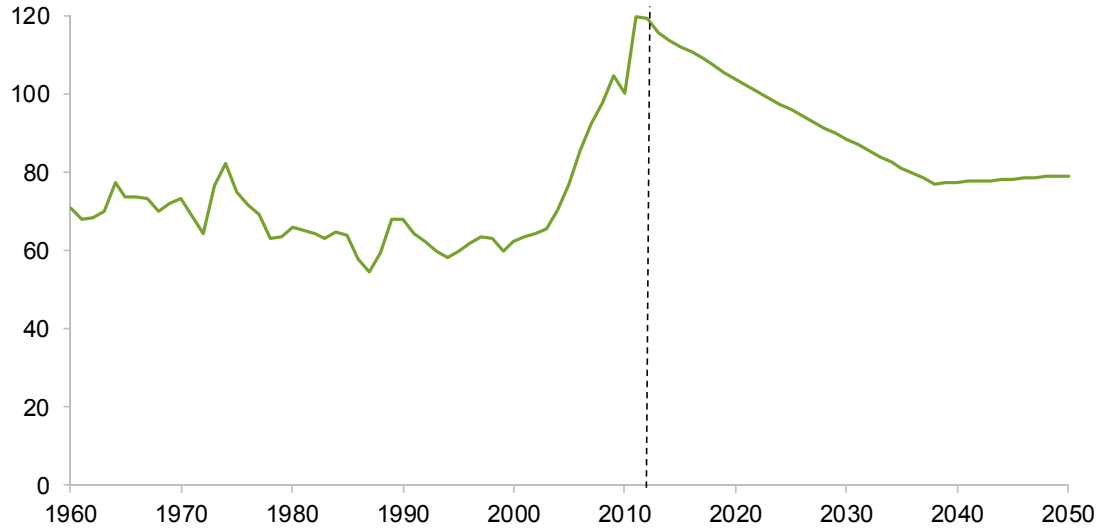
Strong Growth, Low Pollution (Treasury 2011) updated *Australia's Low Pollution Future*. The modelling used the same medium-term path for the terms of trade as the then current budget — a projected decline of around 20 per cent over a 15-year period. The terms of trade was then assumed to continue declining until 2037-38. In later years, it was projected to grow modestly, reflecting the long-term expectations of world demand and supply for Australia's key exports, as modelled within GTEM (figure 8.9).

The main differences from the earlier climate change 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 included projections for real prices of oil, gas and coal. Based on IEA projections, oil and gas prices rise strongly in real terms to 2035 and remain constant thereafter (figure 8.10). 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 8.9 **Terms of trade projections to 2050 in Strong Growth, Low Pollution[a,b,c]**

Index (Reference year: 2010=100)

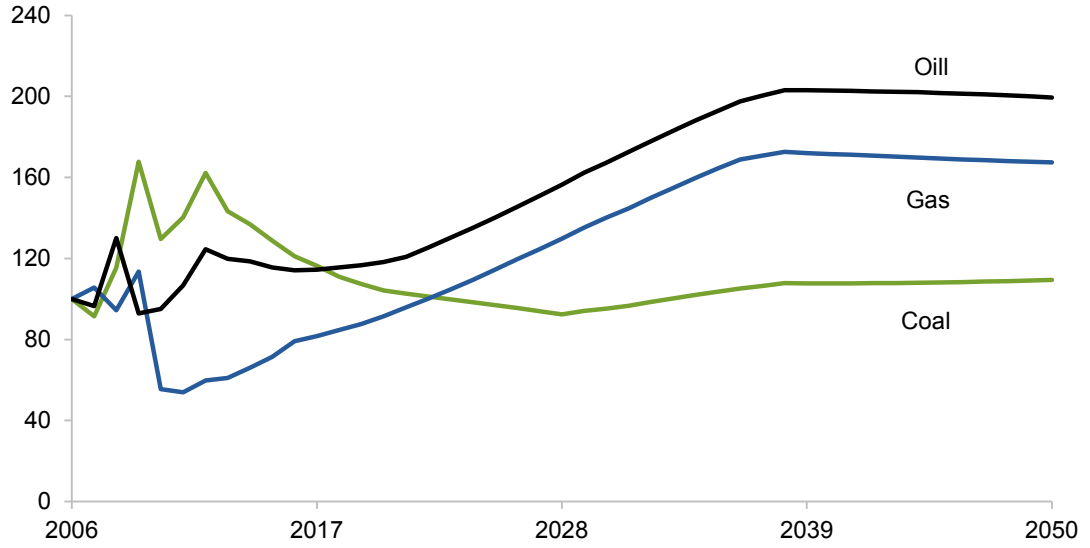


[a] Index of the ratio of export prices to import prices. [b] Medium term global action. [c] Actual data to 2011. Projections to 2050.

Source: Treasury (2011, p. 166).

Figure 8.10 **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).

Long-run Forecasts of Australia's Terms of Trade

A Treasury working paper by Bullen, Kouparitsas and Krolikowski (2014) details the projection methodology underlying the terms-of-trade projection assumption in the 2013-14 MYEFO. Its approach to modelling the terms of trade is based on:

> … detailed price and volume forecasting modules for Australia's major export categories, including global demand and supply models for the three major bulk commodities (iron ore, metallurgical coal and thermal coal).

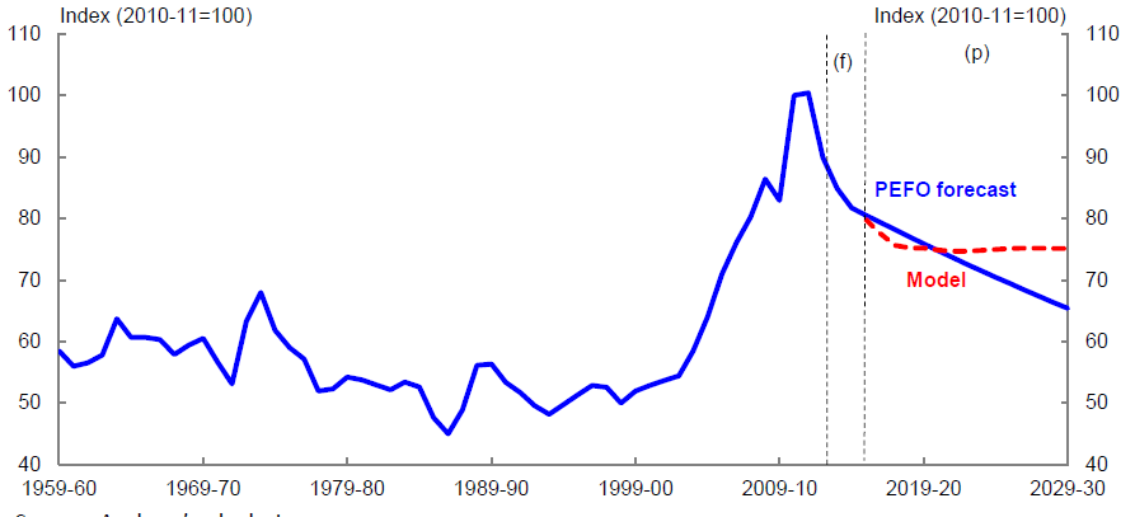
Their modelling projected a more rapid decline in the terms of trade than in the 2013-14 Budget, with the terms of trade projected to unwind to a level roughly equal to that recorded in 2006-07 by 2017-18 and remaining reasonably constant thereafter (figure 8.11).

However, the authors settle on a slightly longer unwinding to a lower level:

> Applying prudent judgement to the model's outcome results in a long−run terms of trade that settles at the level observed in 2005-06 by 2019-20.

Figure 8.11 **Terms of trade projections to 2029-30 in Long-run Forecasts of Australia's Terms of Trade[a,b,c]**

Index (Reference year: 2010-11=100)



[a] Index of the ratio of export prices to import prices. [b] Actual data to 2011-12. Projections to 2029-30. [c] PEFO: Pre-election Economic and Fiscal Outlook.

Source: Bullen, Kouparitsas and Krolikowski (2014, p. 31).

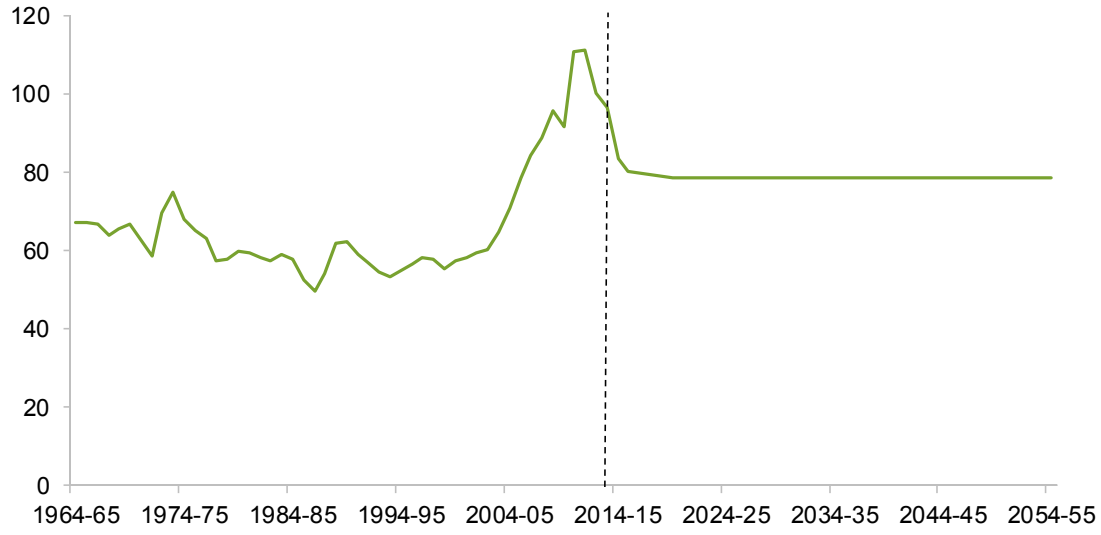
Intergenerational Report 2015

Consistent with assumptions in the 2014-15 MYEFO (Australian Government 2014), the *Intergenerational Report 2015* assumed that the terms of trade would decline from their then peak in 2010-11 to reach 2005-06 level by 2019-20, and then would remain at that level until 2054-55 (figure 8.12).

This contrasts with the 2010 report, which allowed the terms of trade to unwind and stabilise over an additional 10 years.

Figure 8.12 **Terms of trade projections to 2054-55 in Intergenerational Report 2015[a,b]**

Index (Reference year: 2012-13=100)



a Index of the ratio of export prices to import prices. **b** Actual data to 2013-14. Projections to 2054-55.

Source: Australian Government (2015b, p. 109).

8.4 Towards a modelling reference case

International trade will continue to play an important role in shaping the Australian economy and the composition of its economic activity.

Consequently, assumptions about international trade are an important part of any modelling reference case, especially in single country models, such as VUMR, that do not explicitly model changes in international demand, supply and trade.[43] Without these

[43] The standard VUMR model explicitly models international demand for Australian goods and services (based on changes in the foreign currency prices of Australian exports) and Australian demand for goods and services produced by the rest of the world (based on changes in the Australian dollar prices of

assumptions, domestic considerations alone would determine model projections of the structure of the Australian economy.

Such assumptions are often arbitrary and may need to be re-assessed in light of future developments, as highlighted by the evolution of the assumptions in the studies reviewed.

Terms of trade

The terms of trade and external sector assumptions are particularly important for the current reference case for a number of reasons.

First, the 2009-10 starting VUMR database is unlikely to be representative of the long-term structure of the Australian economy, as the official economic statistics used to construct the database reflect the effects of the mining boom. For example, mining industries such as iron ore and coal accounted for a relatively larger share of national activity in 2009-10 than they have done historically.

Second, the reference case runs through the rise and subsequent partial fall in the actual terms of trade and beyond. These changes, together with any further unwinding of the terms of trade to lower long-run levels, will also affect the projected structure of economic activity (as they did on their way up).

Ideally, the reference case would, at least stylistically, reflect changes in the terms of trade that have occurred since 2009-10 and any future unwinding, both for the economy as a whole, and for key products traded internationally (such as black coal, crude oil, LNG, iron ore, gold, meat products, air travel, business services and education services). This involves identifying the speed at which the terms of trade may unwind, the level to which it unwinds, and the relative contribution made by each product traded (both exports and imports).

Full implementation of this approach requires the ability to decompose aggregate changes in the terms of trade published by the ABS into the contributions made by changes in the price of individual export and import products in the VUMR model (or for suitable proxies).

As published, the ABS terms of trade can be decomposed into the price changes for broad product groupings based on the SITC that is used by the ABS in its *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* (Cat. no. 5209.0.55.001), on which the VUMR model is based. For example, the prices of mining products are reported for: *Coal, coke and briquettes*; *Other mineral fuels*; *Metalliferous ores and metal scrap*; and

imports relative to domestically produced goods and domestic incomes). Unless imposed externally or by assumption, VUMR does not take into account other factors that may affect international demand for Australia's exports, or supply of goods and services by foreign exporters (such as growth in population, productivity, income and taste changes in the rest of the world).

Petroleum, petroleum products and related materials. Most of these SITC groups span more than one VUMR 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 VUMR database). As a result, it is not possible to identify specific contributions made by, for example, 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 its *Input-Output Tables*, as the concordance (mapping) used by the ABS is confidential.

Consequently, it is not possible to 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 VUMR model.

Given this, the approach used to model foreign trade in the current reference case has been guided by that used in PC (2012b), which, in turn, was based on that used by the Treasury in its MMRF climate change modelling (Australian Government 2008, Treasury 2011).

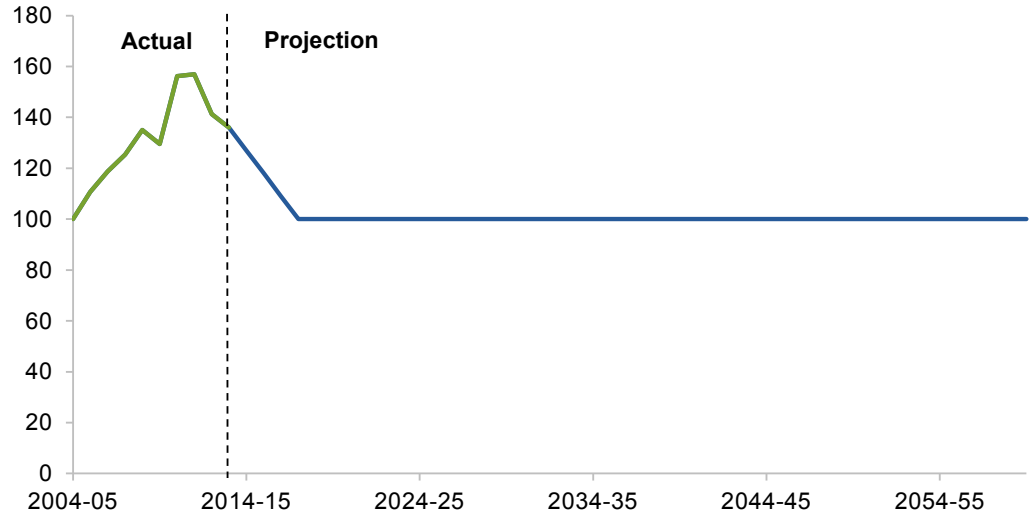
This approach involves:

- imposing an aggregate terms of trade shock for each simulation year;
- applying commodity-specific shocks to key export commodities (covering export prices and, in some instances, export volumes); and
- allowing the model to adjust export prices for all remaining export commodities to ensure that the aggregate terms of trade change by the required amount.

Aggregate terms of trade

The modelling reference case consists of the actual terms of trade to 2013-14 (figure 8.13). The terms of trade is then assumed to be linearly unwound to reach 2004-05 levels (taken to be broadly indicative of the long-term historical average) by 2017-18 (the unwinding period), and assumed to remain constant at this level to 2059-60 (the projection period). 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 7).

Figure 8.13 **Terms of trade to 2059-60 in the reference case[a,b,c]**
Index (Reference year: 2004-05=100)



[a] Index of the ratio of export prices to import prices for Australia. [b] Actual data to 2013-14. Projection: 2014-15 to 2059-60. [c] The model shocks are expressed as annual percentage changes.

Sources: ABS (*Australian System of National Accounts*, 2014-15, Cat. no. 5204.0); Estimates.

Commodity and industry-specific shocks

As noted, growth in world demand between 2004-05 and 2013-14 resulted in higher Australian dollar export prices (both in nominal and real terms) and export volumes for many mining commodities, particularly iron ore and black coal.

These increases in demand led to significant investment in some states (most notably Western Australia, Queensland and, to a lesser extent, New South Wales). Over time, this increase in investment (the 'investment' phase) translates into increased productive capacity, and, with it, production and export volumes (the 'production' phase). The increased use of capital, labour and other inputs associated with investment led to marked falls in measured labour productivity in these industries during the investment phase (chapter 7).

These different sources of economic change should ideally be modelled in ways that reflect their differing economic impacts. This would, for example, enable the economic impacts of a transitory increase in investment to be identified separately from permanent changes in productive efficiency. Mining investment would *increase* the use of construction-related (and other) inputs, while an increase in productive efficiency may *decrease* input use if it is input augmenting or have *no effect* on input use if it is output augmenting.

However, it is not possible for the Commission to disentangle the effects of these different sources of change in the official data for individual mining industries. Furthermore, it is

difficult to identify the underlying causal relationships needed to appropriately model each source of change separately, such as the extent to which measured changes in MFP growth reflect organisational and technological change in extraction activities, changes in the utilisation of existing capital and labour, changes in the use of inputs associated with investment and the influence of other factors (such as measurement error). Even where data are available, differences may exist across sources, particularly for individual years.[44]

The reference case includes changes in export prices and volumes for specific commodities (discussed below). Investment is allowed to vary in line with changes in industry rates of return based on the investment theory in the VUMR model.

Coal and iron ore

The export price and volume shocks for *coal* and *iron ore* in the reference case are sourced from the Department of Industry's *Resources and Energy Statistics* (2014). One point of difference is that the volume data relates to physical measures (such as millions of tonnes) while the ABS uses chain volume measures.

The approach used to model the export price changes for *coal* and *iron ore* is similar to that used for the aggregate terms of trade shocks: actual data are used during the uprating period to 2013-14, before being unwound to reach 2004-05 real price levels by 2017-18 (table 8.3 and figure 8.14). The export prices for the remainder of the projection period are determined by the model thereafter.

Reflecting the uprating of the database to 2013-14 dollars, the price changes applied to 2013-14 were expressed in nominal terms. After that, the price changes were expressed in real terms.

[44] For example, the value of production in 2009-10 for key mining commodity groupings (such as coal and iron ore) in the ABS *Input-Output Tables* (Cat. no. 5209.0.55.001) differs from that in ABS *Mining Operations, Australia*, 2011-12 (Cat. no. 8415.0).

Table 8.3 **Coal and iron ore export price and volume shocks to 2017-18 in the reference case[a]**

Per cent

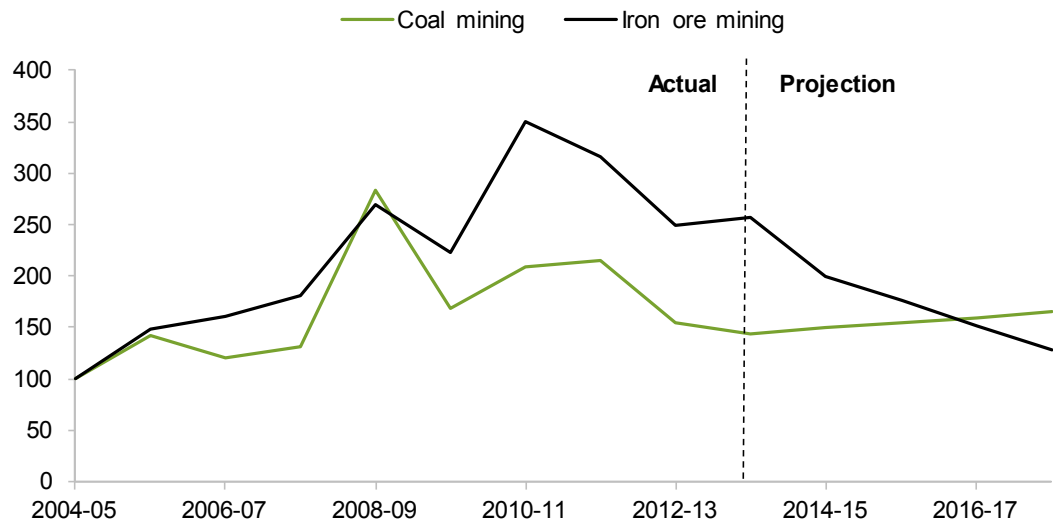
		Export prices		*Export volumes*	
Period	*Year*	*Coal[d]*	*Iron ore*	*Coal[d]*	*Iron ore*
Uprating[b]	2010-11	23.74	59.51	-2.90	4.36
	2011-12	2.85	-7.05	6.01	15.52
	2012-13	-27.67	-18.81	11.64	12.12
	2013-14	-7.28	5.91	11.68	23.60
Unwinding[c]	2014-15	-2.81	-15.11	na	na
	2015-16	-2.89	-17.79	na	na
	2016-17	-2.98	-21.64	na	na
	2017-18	-3.07	-27.62	na	na

[a] Model shocks applied to the purchasers' price of exports (expressed in Australian dollars) (the VUMR variable `p4a`) by allowing the change in the markup on export sales to vary (the VUMR variable `p4markup`). [b] Actual percentage change in the nominal export price to 2013-14.[c] Assumed percentage change in the real export price (discussed in text). [d] Exports of the VUMR commodity coal from New South Wales and Queensland only.

Sources: Department of Industry (2014); Estimates.

Figure 8.14 **Export price shocks to 2017-18 in the reference case[a]**

Index (Reference year: 2004-05=100)



[a] Actual data to 2013-14. Projection: 2014-15 to 2017-18.

Sources: Department of Industry (2014); Estimates.

Export volumes

The modelling reference case includes actual export volume shocks for *coal* and *iron ore* to 2013-14 (table 8.3), allowing export volumes and prices to move differently for particular commodities where actual data are available.

Recent investment in key mining industries will increase future productive capacity when the facilities being built become operational. The extent to which increases in productive capacity translate into actual output will depend on many factors, such as domestic operating costs and future global prices at the time, which are difficult to gauge.

Increased production should lead to future improvements in measured labour productivity in mining industries from their current low levels (chapter 7). To stylistically reflect the shift from the investment phase to the production phase of the mining boom, the reference case includes export volume shocks in the unwinding period. The increases modelled are based on the assumptions that: the level of measured productivity in these industries linearly reverts to the pre-boom level of labour productivity (taken here to be the level in 2004-05); and that half of this increase in productivity is assumed to arise through an increase in output. The subsequent increases in industry output will lead to additional investment in the VUMR model by initially increasing the rate of return to capital in those industries.

The export volume data used was sourced from the Department of Industry's *Resources and Energy Statistics* (2014) and targeted key exporting (rather than all producing) states.

Development of the LNG processing industry

The LNG industry liquefies natural gas (methane) for export. This involves chilling the gas to -161 degrees Celsius in processing facilities referred to as 'LNG trains'. Without liquefaction, it would not be economically viable to export natural gas.

The industry commenced production in Australia in 1989, with development of the North West Shelf off the coast of Karratha in north-western Western Australia. In 2006, production commenced at Darwin in the Northern Territory. In 2014, production commenced at Curtis Island in Queensland.[45]

Production has grown strongly since 2009-10, especially in 2010-11 and 2012-13.

Significant investment has also occurred in all three LNG producing states. Reflecting the time taken to gain approval for, and to construct, new LNG trains, this investment will expand future productive capacity. The extent to which increased future productive capacity will translate into additional industry output, and hence export volumes, will

[45] Prior to 2014, Queensland produced natural gas but lacked the required processing facilities needed to export LNG.

depend on many factors, including world prices and Australia's international competitiveness at the time.

LNG production currently occurs in three states: Western Australia (the main producer); the Northern Territory; and Queensland.

Modelling of the LNG industry in the reference case

The Australian natural gas industry consists of three separate grids: one in Western Australia that supplies Perth (the western grid); one supplying Darwin (the northern grid); and one that links production and consumption in Queensland, South Australia, New South Wales and Victoria (the eastern grid). Interstate trade is only possible between states on the eastern grid. Even then, interconnection constraints may limit trade between states. These separate systems mean that the price of gas varies between states.

The standard VUMR model does not model these grids separately. Instead, it models gas extraction in the same manner as other industries. As a result, the VUMR model is likely to overstate the extent of interstate trade in gas and to result in a similar price story. This is particularly an issue for states such as South Australia and Victoria that produce gas primarily for the domestic market.

Modelling of the LNG industry in the VUMR model is further complicated by the interconnectedness between the export-orientated LNG industry, the natural gas extraction industry that supplies gas domestically as well as to the LNG industry and the domestic gas supply and pipeline industries. Changes in output, prices and productivity in one industry or state can easily affect the viability of these other industries.

Reflecting actual production in 2009-10, Western Australia and the Northern Territory were the only states that produced LNG in the starting VUMR model database.

However, to enable subsequent development of an LNG industry in Queensland, the model database also includes a 'latent' LNG industry in Queensland that has an embryonic cost and sales structure that can be grown.

The modelling reference case would ideally reflect the growth in price and export volumes associated with the development of the LNG industry on a state-by-state basis.

This approach could not be achieved for a number of reasons. First, as noted, the standard VUMR model does not realistically model the three separate regional gas grids. Second, there was insufficient state-level export price and volume data for the Northern Territory. Third, reflecting different data sources, export value data for the Northern Territory and Western Australia differed from national data. Fourth, the external price and volume

projections implied much more elastic supply responses for LNG than would the VUMR model.[46]

In light of these constraints, Australian dollar export price shocks were applied to 2017-18 (to the VUMR variable p4a). During the uprating period to 2013-14, the shocks applied to Western Australia and the Northern Territory are the actual percentage changes in LNG export prices (table 8.5). The shocks applied to Western Australia, the Northern Territory and Queensland in the unwinding period from 2014-15 to 2017-18 reflect the annual growth projections in Department of Industry and Science (2015). It is assumed that these price changes arise from shifts in global demand (by allowing the VUMR variable f4q to vary).

During the uprating period (2009-10 to 2013-14), it is assumed that the capital stock in the latent Queensland LNG industry is held fixed by allowing the rate of return to vary.[47]

Table 8.4 **LNG export price shocks to 2017-18 in the reference case**
Per cent

Period	*Year*	*Export price*[a]
Uprating[b]	2010-11	19.96
	2011-12	21.11
	2012-13	-9.39
	2013-14	17.51
Unwinding[c]	2014-15	7.00
	2015-16	-22.10
	2016-17	2.00
	2017-18	0.70

[a] Applied to the export price in Australian dollars (the VUMR variable p4a) by allowing world demand for Australian exports to vary (the variable f4p).[b] Applied to Western Australia and the Northern Territory. [c] Applied to Western Australia, the Northern Territory and Queensland.

Sources: Department of Industry and Science (2015); Estimates.

Import prices

The reference case includes the actual changes in the *nominal* Australian dollar price of imports in each year during the uprating period to 2013-14 (table 8.7).[48]

46 Applying price and quantity data based on different implicit supply curves to the VUMR model may give rise to dynamic investment responses arising from different rates of return and rental prices for capital.

47 This is achieved by making the VUMR variables cap_t1 and d_r1cap exogenous by allowing the VUMR variables d_feeqror and f_x1cap2 to vary.

48 To enable the Australian dollar price of imports to be shocked in the VUMR model, the following two equations were added: natp0cif_aud(c) = natp0cif(c) + phi; and. natp0cif_aud(c) = *f_natp0aud_c* + f_natp0aud(c). The first equation defines the percentage change in the Australian dollar price of imports of each commodity (natp0cif_aud) as the foreign currency price of each commodity (natp0cif) plus the nominal exchange rate (phi). The second equation allows a

The reference case then assumes that, in aggregate, the *real* price of imports in Australian dollars *falls* by 1.4 per cent per year over the unwinding period to 2017-18.

As indicated in section 8.1, historical Australian dollar import prices:

- *rose* in nominal terms by 3.1 per cent per year (figure 8.3, upper panel); and
- *fell* in real terms (relative to the HFCE IPD) by 1.9 per cent per year (figure 8.3, lower panel) between 1974-75 and 2013-14.

However, these import price changes are clouded by the changes to Australia's exchange rate regime over the period analysed. This makes it difficult to disentangle the long-term underlying trends in Australian dollar import prices from those factors that are unlikely to reoccur during the projection period.

Given this uncertainty, the modelling reference case assumes that the *real* price of imports in Australian dollars remains flat to 2059-60.

Table 8.5 **Import price shocks to 2017-18 in the reference case[a]**
Per cent

Period	*Year*	*Australian dollar import prices*[d]
Uprating[b]	2010-11	-2.91
	2011-12	+0.94
	2012-13	-0.10
	2013-14	+7.52
Unwinding[c]	2014-15	+5.66
	2015-16	+5.36
	2016-17	+5.09
	2017-18	+4.84

[a] Average annual growth in the implicit price deflator for imports of goods and services [b] Actual percentage change in the nominal import price to 2013-14, which was derived as the value of imports divided by the chain volume value of imports. [c] Percentage change in real import prices to return the import price IPD to 2004-05 levels (so that the terms of trade returns to 2004-05 levels). [d] Applied to the Australian-dollar import price shift variable (the new variable f_natp0cif_c), which is naturally exogenous.

Source: Estimates based on *ABS* (*Australian System of National Accounts*, 2014-15, Cat. no. 5204.0); ABS (*Balance of Payments and International Investment Position, Australia*, June 2015, Cat. no. 5302.0).

single shock to be applied to all Australian dollar import prices by applying a shock to the naturally exogenous variable f_natp0aud. This requires the shift term f_natp0aud to be exogenous.

9 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 that accrue to Australians as 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 (section 9.1). The chapter then outlines the foreign investment component of the reference case (section 9.2). The associated changes in foreign trade with the rest of the world are discussed in chapter 8.

Analytical framework used

The analytical framework used in this paper to assess the economic impacts of changes in foreign investment and income flows is based on the foreign income accounts in the VUMR model (CoPS 2014). These accounts stylistically reflect many of the key international flows recorded in the ABS *Balance of Payments* (Cat. no. 5302.0).

The primary focus of the foreign income accounts in the VUMR model is on modelling the flows of income into and out of Australia that arise from:

- foreign trade (discussed in chapter 8);
- after-tax claims on domestic production arising from foreign ownership of the stock of capital used in domestic production (discussed in this chapter); and
- interest payments on the stock of net foreign liabilities (discussed in this chapter).

Collectively, these flows constitute the bulk of the 'current account' in the ABS *Balance of Payments*.[49] The VUMR model exploits the converse relationship between income flows recorded in the 'current account' and international capital flows recorded in the 'capital account' of the *Balance of Payments* to model changes in foreign ownership and net foreign liabilities.

[49] The VUMR model includes the third component on the current account, 'current transfers', which relate to net international income flows such as remittances and foreign aid. These do not involve changes in ownership and are generally held fixed in the model unless shocked. While the model database also implicitly includes stock of foreign assets owned by Australians and foreign liabilities owned by Australians, these are not modelled as VUMR does not model changes in the rest of the world.

9.1 Australia's foreign investment and income flows in a balance of payments context

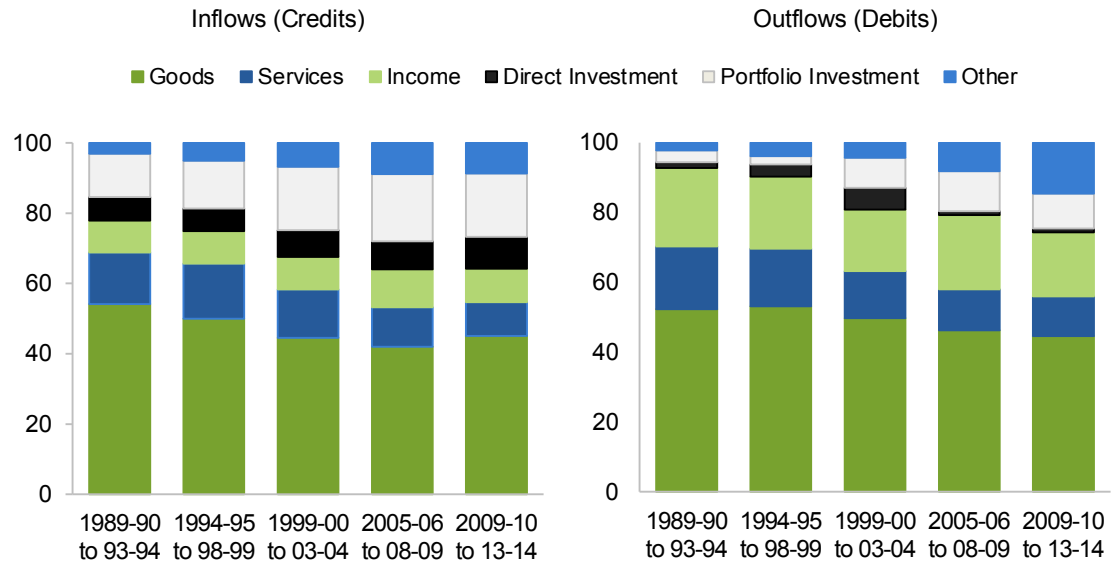
Merchandise imports and exports are the largest transactions by value in Australia's balance of payments, accounting for 41 per cent of both credits and debits in 2013-14 (figure 9.1).

The shares of merchandise imports and exports in Australia's balance of payments have declined since 1989-90, when both accounted for around 50 per cent of all transactions. 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, also declined over the period 1989-90 to 2013-14.

In contrast, international capital flows (reflecting direct and portfolio investment) have increased in relative importance over this period, notwithstanding the global financial crisis in 2008-09 (figure 9.1). Inflows of portfolio investment increased as a share of balance of payments total inflows, from an average of 13 per cent in the 1990s to 19 per cent in the 2000s, and direct investment increased slightly from 7 to 8 per cent over this period. Australia's investment overseas also increased during this period, with portfolio investment outflows increasing as a share of balance of payments outflows from 3 to 10 per cent, and Australian direct investment abroad from 3 to 4 per cent.

Figure 9.1 **Balance of payments inflows and outflows, Australia, 1989-90 to 2013-14**

Per cent

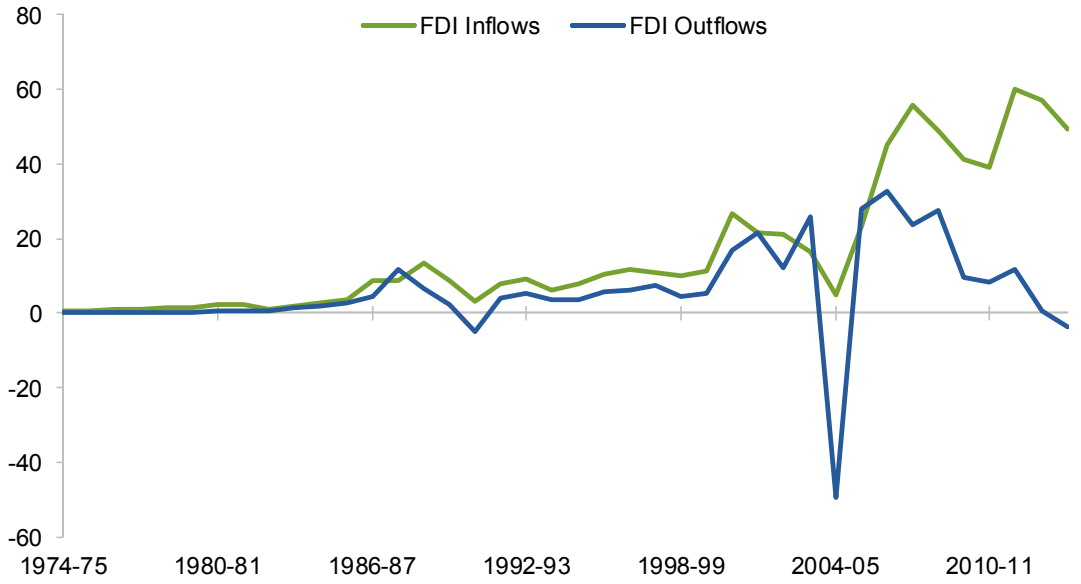


Source: ABS (*Balance of Payments and International Investment Position, Australia*, June 2014, Cat. no. 5302.0).

Trends in Australia's direct investment

Foreign direct investment (FDI) is one of the less volatile forms of capital inflow because it typically involves a substantial commitment from the investor. 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, FDI in Australia (inflows) were on average six times greater than Australian direct investment abroad (outflows). Since that time, FDI outflows have moved more or less in line with inflows. Recently, the growth in foreign investment associated with the mining boom has seen direct investment inflows grow ahead of outflows (figure 9.2).

Figure 9.2 **FDI inflows and outflows, Australia, 1974-75 to 2013-14[a]**
$ billion



[a] The temporary decline in outflows in 2004 05 reflects the relocation of News Corporation from Australia to the United States.

Source: ABS (*Balance of Payments and International Investment Position, Australia*, June 2014, Cat. no. 5302.0).

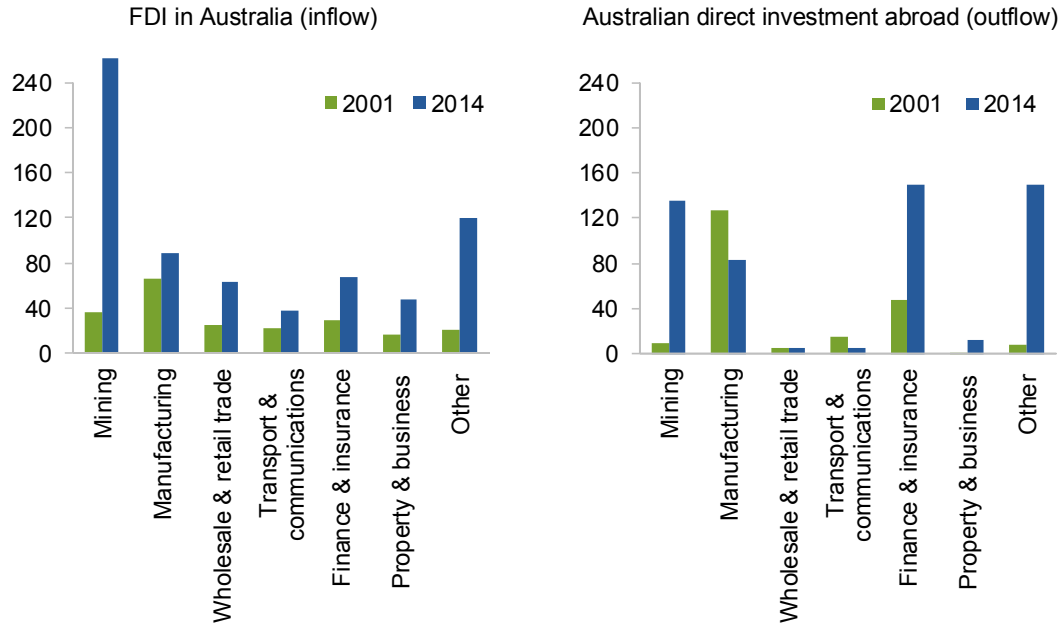
Traditionally, FDI in Australia had been concentrated in the *manufacturing* sector (figure 9.3, left-hand panel).[50] Since the early 2000s, however, FDI in other sectors has increased in importance. In particular, the level of inward investment in *mining* has increased more than seven times and now exceeds manufacturing investment by three times. The level of inward investment in services activities, including *wholesale & retail trade* and *finance & insurance*, has also increased substantially.

50 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 abstracts from the substantial year to year variation that occur in annual 'flow' data.

With respect to investment outflows, *finance & insurance*, *mining* and *manufacturing* remain the three largest sectors, although *mining* experienced the largest growth (figure 9.3, left-hand side panel).

Figure 9.3 **Industry composition of the stock of FDI, Australia, 2001 and 2014**

$ billion (current year dollars)



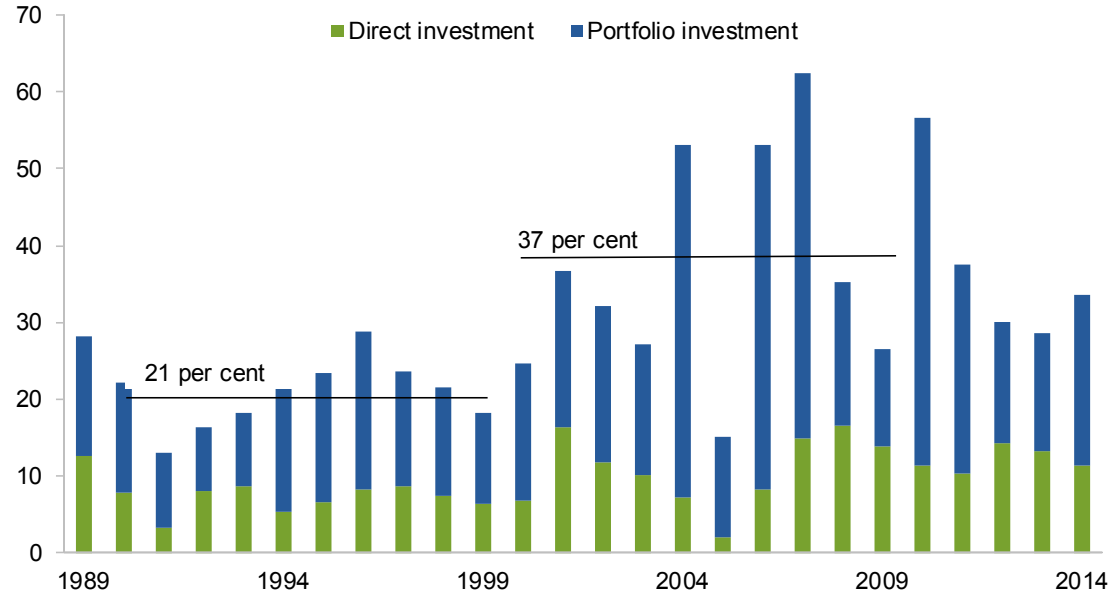
Source: ABS (*International Investment Position, Australia: Supplementary Statistics*, 2014, Cat. no. 5352.0).

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 investment share of industry capital formation averaged around 20 per cent over the 1990s. This share has increased in recent years, averaging about 37 per cent during the 2000s. Portfolio investment, which can be recalled relatively quickly and comes with no effective restriction on the movement of funds or necessarily lasting commitment by lenders or borrowers, has accounted for a varying share of this foreign investment, ranging between 48 to 87 per cent (figure 9.4).

Figure 9.4 **Share of FDI and portfolio investment in gross fixed capital formation, Australia, 1989 to 2014**

Per cent



Sources: ABS (*Balance of Payments and International Investment Position, Australia*, June 2014, Cat. no. 5302.0); ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

9.2 Towards a modelling reference case

Net national income in Australia depends on:

- the income from Australian production that flows to Australian residents; plus
- foreign-sourced income that flows to Australian residents; minus
- depreciation of the capital stock.

The VUMR model accounting implicitly includes all three of these income flows, the first two in net terms. *Net* income from Australian production that flows to Australian residents is calculated as the residual of income from Australian production that does not flow to foreign residents[51].Depreciation of the capital stock is calculated for each state industry by applying pre-specified depreciation rates.

Given this, it is important for any modelling that:

- claims on Australian production held by non-residents (arising as a result of foreign ownership or foreign financing) are accounted for; and

[51] As it is a single country model, VUMR does not model changes in foreign-sourced income that flows to Australian residents.

- changes in investment are fully funded, either from: local savings or borrowing; or foreign investment that results in changes in the foreign ownership of the domestic capital stock or from foreign borrowings.

This requires data or assumptions on the initial distribution of income generated in production that flows to domestic and foreign investors (which depends on assumptions about capital ownership and returns on non-equity (debt) investments). Changes in the funding of investment over time will influence the distribution of these claims over time.

The approach used in the VUMR model to modelling foreign investment and income flows is set out in box 9.1 using the foreign ownership shares in table 9.1.

This raises the issues of whether the dynamics of these processes are modelled appropriately in the VUMR model and in the reference case, and whether the approach used in the VUMR model provides a suitable approximation to model the effects of economic change on national income.

The available data indicate that the level of foreign investment — both inwards and outwards — has increased over time. It also indicates that, except for the late 2000s, where inflows associated with the mining boom exceeded outflows, changes in inflows and outflows have been broadly similar over the last 40 years.

Given this relatively stable long-term trend between foreign investment inflows and outflows, changes in foreign investment in the reference case use the standard relationships in the VUMR model: net foreign investment changes over time with the net current account balance. Local investment not funded by domestic savings is assumed to be funded by net foreign investment inflows.

The relative level of funding of domestic capital through foreign equity investment is determined by (exogenous) 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).

Box 9.1 Modelling of foreign investment and net international income flows in the VUMR model

The modelling of foreign investment in the Australian economy, Australian investment abroad, and the associated financial flows is highly stylised in the VUMR model.

To support this stylised modelling, the model database distinguishes between stock of 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.

VUMR models the changes in these stocks arising from net flows of foreign investment and income into Australia from the rest of the world.

Net foreign investment in Australia

The aggregation of equity and debt investment 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 and remittances (net current transfers).

The level of foreign investment in VUMR is denominated in Australian dollars. The modelling does not take into account the effect of exchange rate changes and revaluation effects. Equity investment is assumed to account for 35 per cent of the current account balance, with changes in debt investment accounting for the remaining 65 per cent. These changes are used to update the level of foreign equity and debt investment in the model database.

Chapter 8 discusses the modelling of the income flows associated with the trade account.

Changes in net income from foreign investment in VUMR are modelled as:

- the gross flow of after-tax profit remitted overseas for equity investment, which is determined by applying foreign ownership shares (table 9.1) to non-labour income for each VUMR industry, less any withholding and other taxes paid by non-residents; and
- by applying an exogenous real interest rate (assumed to be 4 per cent) to the opening stock of net debt for debt investment.

Unless shocked, the VUMR model does not model changes in international transfers such as foreign aid and remittances.

Table 9.1 **Foreign equity ownership shares by industry in the VUMR model database, 2009–10**

Per cent

VUMR industry	*Share*	*VUMR industry*	*Share*
1 Sheep & beef cattle	20	41 Electricity generation: renewables	20
2 Whole milk & dairy cattle	20	42 Electricity generation: alternative	20
3 Other animals	20	43 Electricity supply (retail & wholesale)	20
4 Crops & grains	20	44 Gas supply	20
5 Other agriculture	20	45 Water supply, sewerage & drainage	20
6 Fishing, hunting & aquaculture	20	46 Waste collection, treatment & disposal	20
7 Forestry & logging	20	47 Residential building construction	20
8 Agriculture, forestry & fishing support services	20	48 Non-residential building construction	20
9 Coal mining	40	49 Construction services	20
10 Oil extraction (includes condensate)	50	50 Wholesale trade	20
11 Gas extraction	50	51 Retail trade	20
12 Liquefied natural gas production	50	52 Accommodation & food services	20
13 Iron ore mining	20	53 Road freight transport	20
14 Non-ferrous metal ore mining	30	54 Road passenger transport	20
15 Non-metallic mineral mining	30	55 Rail freight transport	20
16 Exploration & mining support services	20	56 Rail passenger transport	20
17 Meat products	20	57 Pipeline transport	20
18 Dairy products	20	58 Water transport	20
19 Other food products manufacturing	20	59 Air transport	20
20 Beverage & tobacco product manuf.	20	60 Transport services nec	20
21 Textiles, Clothing & footwear	20	61 Publishing, information & media	20
22 Sawmill & other wood products	20	62 Telecommunication services	20
23 Pulp, paper & paper products	20	63 Banking services	10
24 Printing & recorded media	20	64 Finance services other than banking	10
25 Petroleum & coal products	40	65 Insurance services	10
26 Basic chemicals & products	30	66 Superannuation fund services	10
27 Polymer & rubber products	20	67 Other financial services	10
28 Non-metallic mineral products	20	68 Ownership of dwellings	0
29 Cement, lime & concrete	20	69 Business services	10
30 Iron & steel	40	70 Public admin. & regulatory services	0
31 Alumina	60	71 Defence	0
32 Aluminium	60	72 School education	0
33 Other non-ferrous metals	30	73 Non-school education	0
34 Metal products	30	74 Health care services	0
35 Motor vehicles & parts	50	75 Residential care & social assistance	0
36 Other equipment	50	76 Arts & recreation services	0
37 Other manufacturing	50	77 Automotive repair & maintenance	20
38 Electricity generation: coal	20	78 Other repair & maintenance	20
39 Electricity generation: gas	20	79 Personal & other services	20
40 Electricity generation: hydro	20		

Source: VUMR database.

10 Government finances

Government expenditures — which are concentrated on government administration, defence and the provision of services such as transport, education, health and social assistance — account for over a third of GDP. These expenditures, as well as the government taxation and other measures, 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 modelling reference case.

This chapter commences by setting out some key historical trends in government revenue raising, expenditure and financial balances (section 10.1). It then reviews the longer-term fiscal assumptions adopted in other studies (section 10.2), before concluding by outlining the assumptions adopted in the VUMR modelling reference case (section 10.3). In focusing on the longer-term trends, the VUMR modelling reference case abstracts from short- to medium-term fiscal considerations associated with macroeconomic management of the business cycle and related matters.

Analytical framework used

The analytical framework used in this chapter to assess the contributions made by government financial transactions to economic activity is based on that used in the ABS *Government Finance Statistics* (Cat. no. 5512.0), as represented in the government financial accounts module in the VUMR model.

The VUMR model details revenue collections, expenditure and finance balances for the Australian Government and the eight state and territory governments (local government is included in the state and territory accounts). Given this, the analysis presented in this chapter focuses, where appropriate, on all three tiers of government. The absence of comprehensive and consistent historical time-series data on government revenues and expenditures items for different levels of government in Australia constrain the time period over which historical analysis can be undertaken (box 10.1).[52]

[52] The analysis presented in this chapter does not take into account developments that have occurred since the 2013-14 financial year. It generally reports on the longest periods for which consistent data are available from the different sources used. While many of the measures reported in the different sources used are not strictly comparable or consistent with each other (for example, some measures reported are on a cash basis while others are on an accrual basis), the different sources used nevertheless provide insights into broad trends in Australian government finances and relationships over time.

The historical trends identified in this chapter are used to inform the modelling reference case reported in chapter 12.

Box 10.1 What constitutes government and government finances?

The ABS *Government Financial Statistics* (Cat. no. 5512.0) provide a consistent summary of the financial position of governments in Australia on an annual basis. The financial position of each government is summarised in three tables:

- the 'operating statement' — detailing government revenue, expenses and fiscal balances;
- the 'cash flow statement' — detailing the source and use of cash; and
- the 'balance sheet' — detailing the assets, liabilities and net worth of government.

A key point of difference is that the first two are statements of the *flow* of funds that occur within a financial year, whereas the balance sheet provides information on *stocks* at the end of each financial year (representing the cumulative consequence of past flows of funds including the latest financial year).

Financial details are provided for each tier of government — the Australian Government, state and territory governments and local government — individually and in various aggregations (such as all governments and state, territory and local government combined).

The ABS *Government Financial Statistics* also provide alternative definitions of 'government', depending on whether public non-financial and financial corporations are also included. The narrowest measure of government is 'general government', which relates to 'functions of government departments and authorities that are financed primarily from taxation'. The broadest measure is the 'total public sector', which also includes publicly owned non-financial and financial corporations. Data for the total public sector as well as aggregations across tiers of government consolidate out transfers between arms or tiers of government to provide a net view (Cat. no. 5514.0).

A second ABS publication — *Taxation Revenue, Australia* (Cat. no. 5506.0) — provides additional detail on taxation revenue collected by each level of government. However, unlike *Government Financial Statistics*, *Taxation Revenue, Australia* does not consolidate out transfers between arms or tiers of government (mainly payments of payroll tax). As a result, the amount of taxation revenue collected varies slightly between publications.

Reflecting different objectives or reporting conventions, other publications use a variety of definitions of government and measures of government revenue and expenditure.

A key source of time-series information on aggregate government finances is the ABS *Australian National Accounts* (Cat. no. 5204.0). Among other things, this publication distinguishes between *Government Final Consumption Expenditure* and *Government Gross Fixed Capital Formation* (investment). The ABS *Input-Output Tables* (Cat. no. 5209.0.55.001) also differentiate government expenditure in this way. Government non-financial trading corporations are included with their private sector counterparts in the industry in which they operate rather than as part of government final consumption expenditure.

10.1 Historical perspective

Government revenue

Australian governments collectively raised, through a variety of means, just over $605 billion in 2013-14 — equivalent to 38 per cent of GDP (figure 10.1).

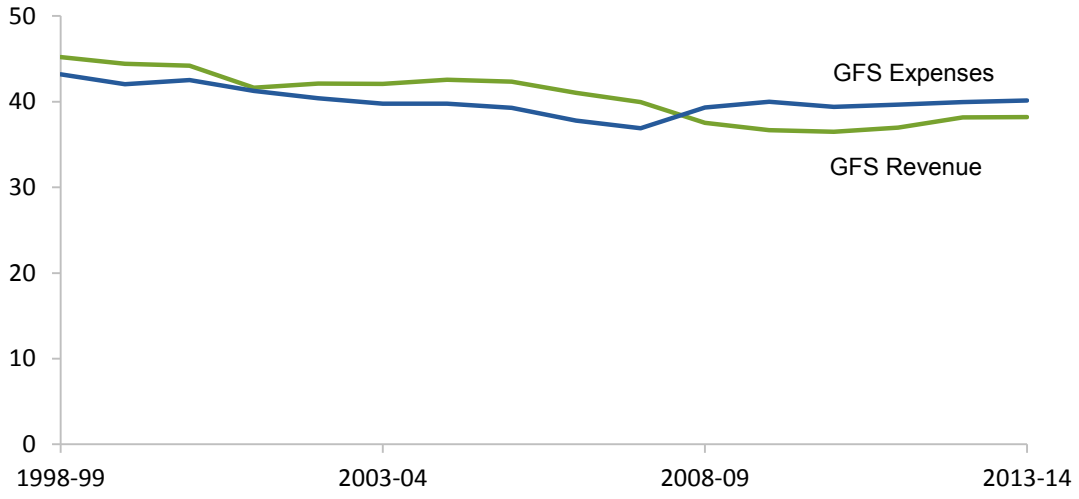
Government revenue has declined by just over one percentage point a year from 45 per cent of GDP in 1998-99 to 37 per cent in 2010-11. Since then, it has increased by 7 percentage points (figure 10.1).

This revenue falls into two broad groupings:

- revenue raised through the taxation; and
- revenue raised from other sources (such as the sale of goods and services, interest earned on investments and, for state and local governments, grants from another level of government, typically the Australian Government).

Figure 10.1 **Revenue by all levels of government as a share of GDP, Australia, 1998-99 to 2013-14[a,b]**

Per cent of GDP



a Total public sector. **b** Australian Government: GFS Revenue. State, territory & local governments: GFS Revenue less Revenue from current grants and subsidies (own-source revenue).

Sources: ABS (*Government Finance Statistics, Australia*, 2004-05 and 2013-14, Cat. no. 5512.0); ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Taxation revenue

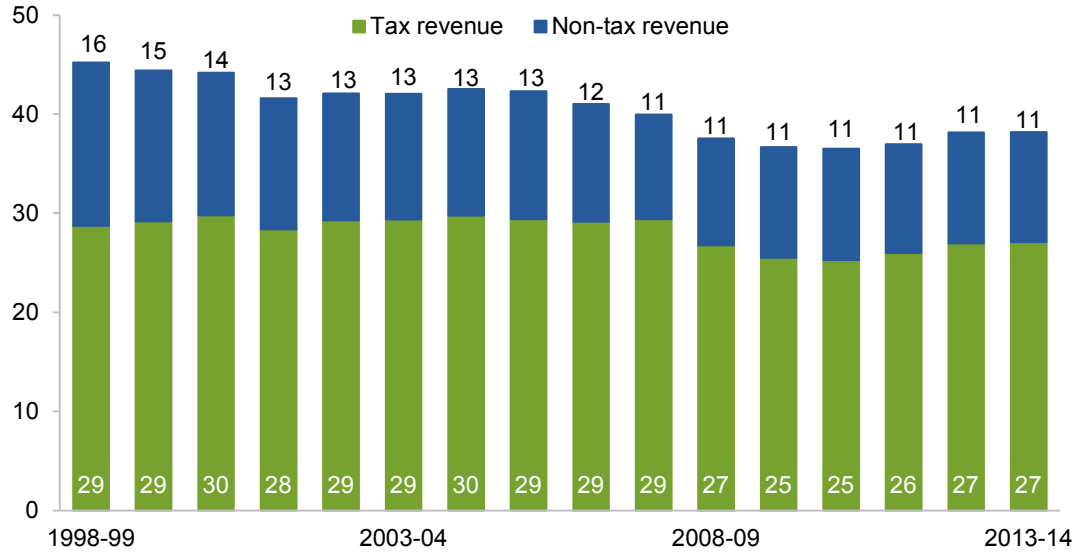
Australian governments collectively raised $429 billion in taxation revenue in 2013-14, equivalent to 27 per cent of GDP (figure 10.2).

Taxation revenue as a share of economic activity varies somewhat over recent history. From the period 1998-99 to 2007-08, the collective tax take by all Australian governments remained relatively stable at around 29 per cent of GDP. With the fall in income and economic activity following the GFC, taxes as a share of GDP fell to 27 per cent in 2008-09 and 26 per cent in 2011-12, before subsequently rising marginally to its current level of 27 per cent (figure 10.2).[53]

The Australian Government raises the majority of taxation revenue in Australia. In 2013-14, the Australian Government raised $352 million (81 per cent) of all taxation revenue (on a gross basis), with state and territory governments collecting $69 million (16 per cent) and local governments $15 million (3 per cent). These are also similar to the average share for each level of government over the period from 1998-99 (figure 10.3).

Figure 10.2 **Taxation and non-taxation revenue by all levels of government as a share of GDP, Australia, 1998-99 to 2013-14**[a]

Per cent of GDP



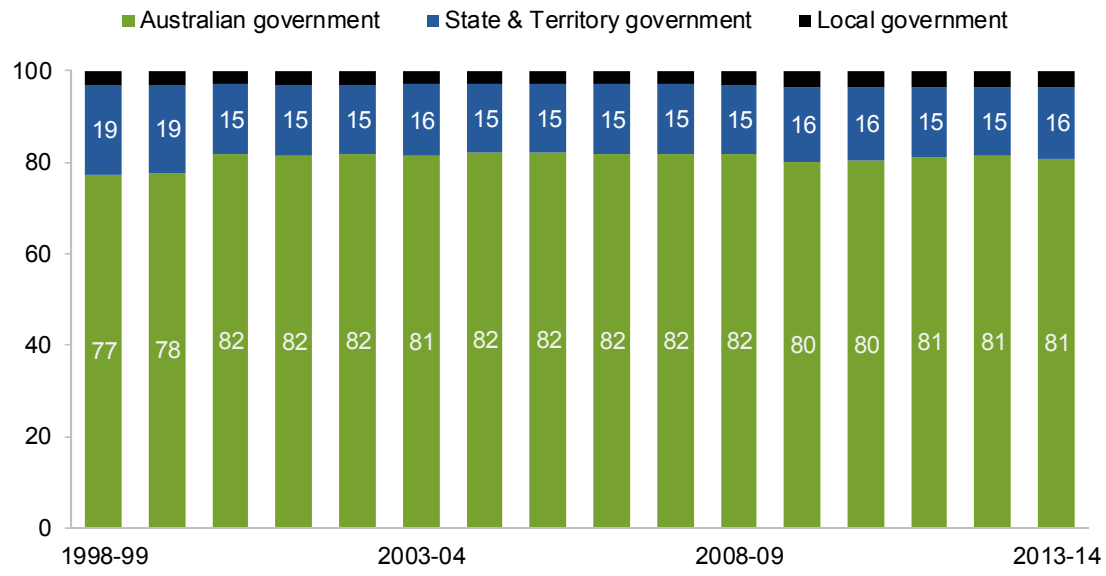
[a] Total public sector.

Sources: ABS (*Government Finance Statistics, Australia*, 2004-05 and 2013-14, Cat. no. 5512.0); ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

[53] The GFC can be considered as commencing in February 2007, when Freddie Mac announced that it would no longer buy the most risky subprime mortgages and mortgage-related securities (Federal Reserve Bank of St Louis 2016). The initial impacts of the GFC on the Australian economy occurred in the 2007-08 and 2008-09 financial years. Global quantitative easing, which occurred in response to the GFC, continues to impact on world markets.

Figure 10.3 **Share of taxation revenue by level of government, Australia, 1998-99 to 2013-14[a]**

Per cent



[a] General government.

Sources: ABS (*Government Finance Statistics, Australia*, 2004-05 and 2013-14, Cat. no. 5512.0).

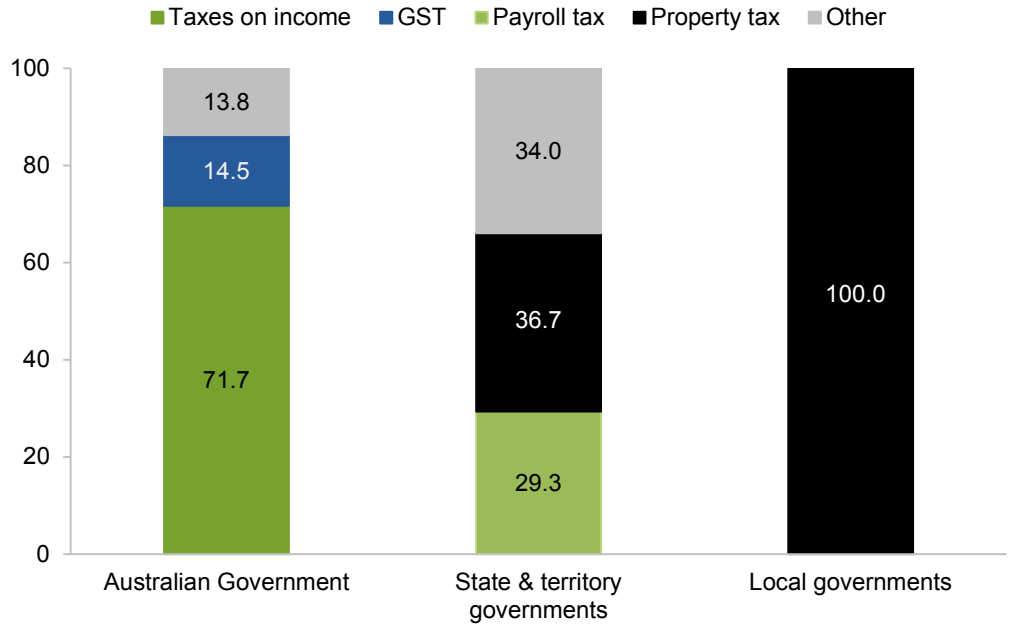
Over the period 1998-99 to 2013-14, the main taxes levied by each level of government were:

- *Australian Government* — taxes on income (personal and company) and the goods and services tax (GST) accounted for 72 and 15 per cent, respectively, of their tax revenue;[54]
- *State and territory governments* — payroll tax, property taxes, and taxes on gambling, insurance and motor vehicles each accounted for roughly one-third of their tax revenue; and
- *Local government* — property taxes accounted for all of their tax (and total) revenue (figure 10.4).

54 Since its introduction on 1 July 2000, the GST has been levied by the Australian Government on behalf of the state governments. The Australian Government distributes GST revenue collections to state and territory governments each year through grant payments (which forms an expense of the Australian Government).

Figure 10.4 **Average composition of taxation revenue by level of government, Australia, 1998-99 to 2013-14[a,b]**

Per cent (annual average)



[a] Excludes taxes collected by public sector corporations which accounted for, on average, around 1 per cent of total taxation revenue. [b] For the Australian government, 'other' primarily denotes the remaining (non-GST) taxes on the provisions of goods and services. For state and territory governments, 'other' primarily denotes taxes on the provision and use of goods and services (mainly gambling, insurance and motor vehicles).

Sources: ABS (*Taxation Revenue, Australia*, 2007-08 and 2013-14, Cat. no. 5506.0).

Non-taxation revenue

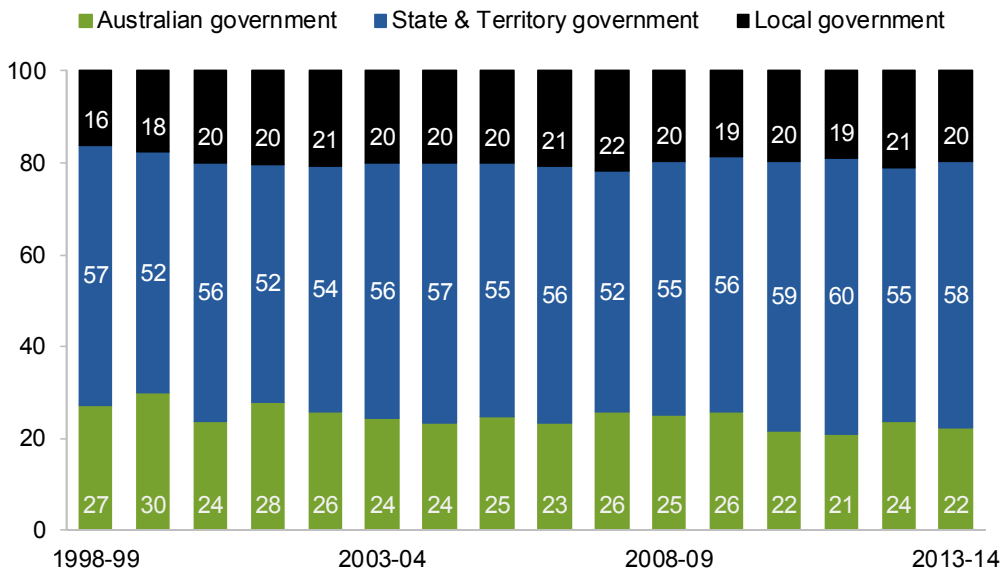
Australian governments raised $107 billion in non-taxation revenue in 2013-14, primarily from the sale of goods and services, interest, dividends, royalties and seigniorage from circulating note and coin production (ABS Cat. no. 5512.0). More than half of this revenue is collected by state and territory governments (58 per cent in 2013-14).

Since 1998-99, total non-taxation revenue has accounted for, on average, 12 per cent of GDP (figure 10.2). This share fell to 10.6 per cent in 2007-08, the year of the GFC, before rebounding slightly to around its current level of around 11 per cent.

Over this period, non-taxation revenue increased in importance for local governments (from 16 to 20 per cent) and state and territory governments (rising from 57 to 58 per cent). Accordingly, the share of the Australian Government declined from 27 to 22 per cent over the period (figure 10.5).

Figure 10.5 **Composition of non-taxation revenue by level of government, Australia, 1998-99 to 2013-14[a,b]**

Per cent



[a] General government. [b] State & territory and local governments exclude revenue received from grants and subsidies.

Sources: ABS (*Government Finance Statistics, Australia*, 2007-08 and 2013-14, Cat. no. 5512.0).

Between 1998-99 and 2013-14, sales of goods and services, interest income and dividend income together accounted for two-thirds of general government non-taxation revenue on average. Compositionally, within this, the share accounted for by dividend income has almost halved, while there has been a slight increase in the share of the sales of goods and services and the share of interest income (figure 10.6). The decrease in the share accounted for by dividend income partially reflects the privatisation of some government business enterprises. All other sources of income, which includes among other things fines and penalties and insurance premiums, account for roughly one-third of non-taxation GFS income.

Government expenditure

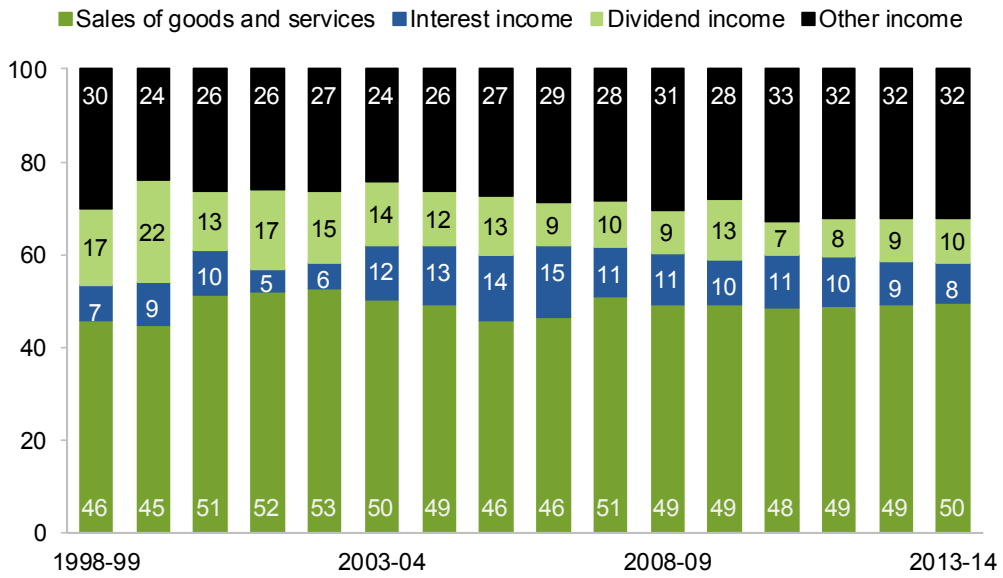
Australian governments collectively spent $636 billion in 2013-14, equivalent to 40 per cent of GDP (figure 10.1).

Government expenditure has declined from 43 per cent of GDP in 1998-99 to 37 per cent in 2007-08. Since then, it has increased by 3 percentage points (figure 10.1).

The share of total general government expenditure by each level of government has remained fairly stable between 1998-99 and 2013-14 (figure 10.7). On average, the Australian Government accounted for 56 per cent of total expenditure, with state and territory and local governments accounting for 37 and 6 per cent, respectively.

Figure 10.6 **Composition of non-taxation revenue by source of income, Australia, 1998-99 to 2013-14[a]**

Per cent

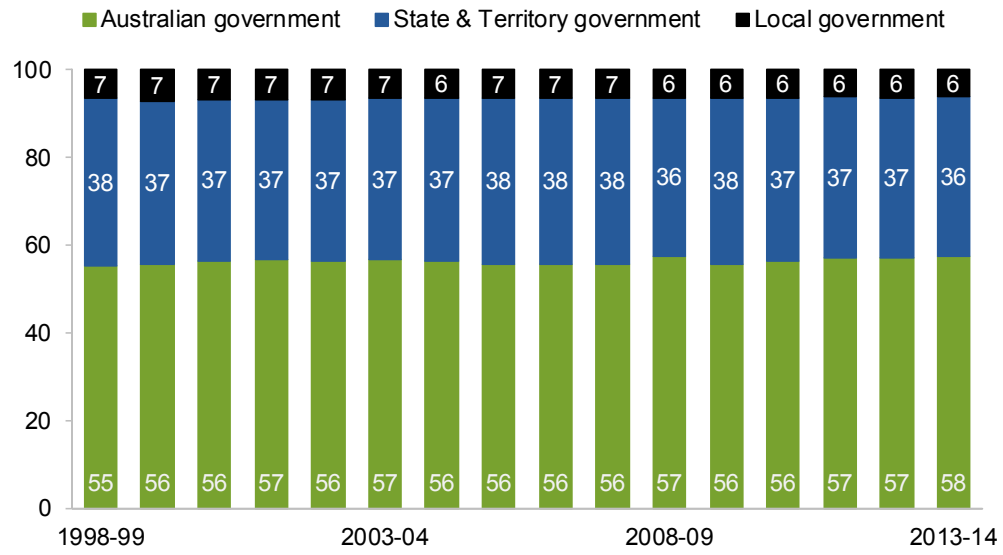


[a] General government.

Sources: ABS (*Government Finance Statistics, Australia*, 2007-08 and 2013-14, Cat. no. 5512.0).

Figure 10.7 **Government expenditure share by level of government, Australia, 1998-99 to 2013-14[a]**

Per cent



[a] General government.

Sources: ABS (*Government Finance Statistics*, 2007-08 and 2013-14, Cat. no. 5512.0).

The composition of government expenditure has remained relatively stable since 1998-99. However, there has been change over a longer timeframe. Since 1959-60, the main areas where the share of government expenditure increased are:

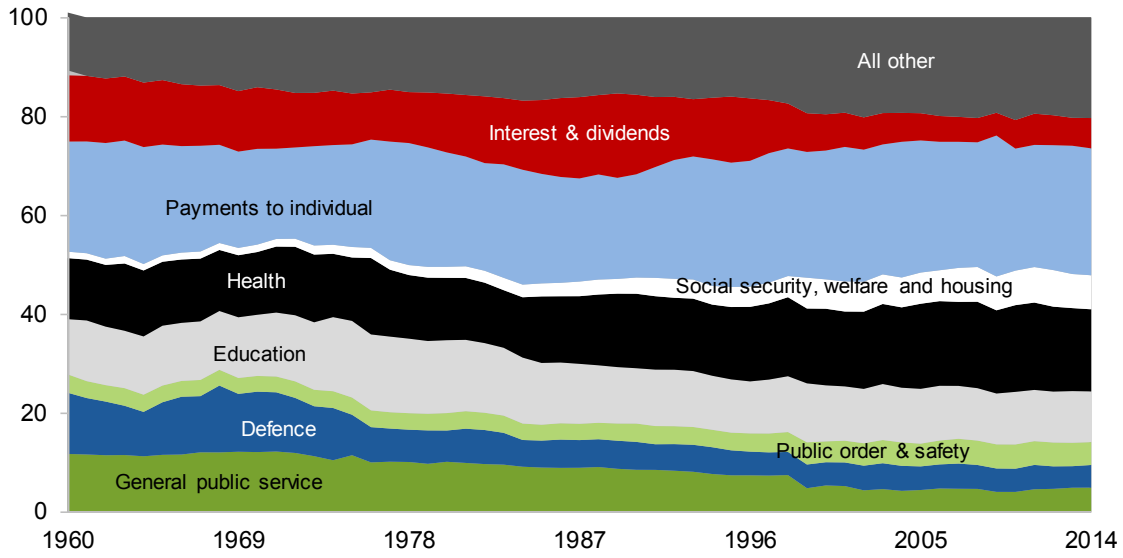
- *Social security, welfare and housing* and *Payments to individuals* — increasing collectively by 10 percentage points from 23 to 33 per cent; and
- *Health* — increasing by 5 percentage points from 12 to 17 per cent.

In contrast, the share of government expenditure decreased for:

- *Defence* and *General public service* — decreasing by 7 percentage points each from 12 to 5 per cent; and
- *Interest and dividends* — decreasing by 7 percentage points from 13 to 6 per cent (figure 10.8).

Figure 10.8 **Government expenditure share by sector, Australia, 1959-60 to 2013-14[a]**

Per cent



[a] Share of general government final consumption expenditures.

Source: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Net budget balance

There are two measures of government budget balance in the VUMR model:

- *net operating balance*, which is the difference between government revenue and government expenditure. This measure is equivalent to the change in the net worth of governments arising from their revenue and outlay activities.

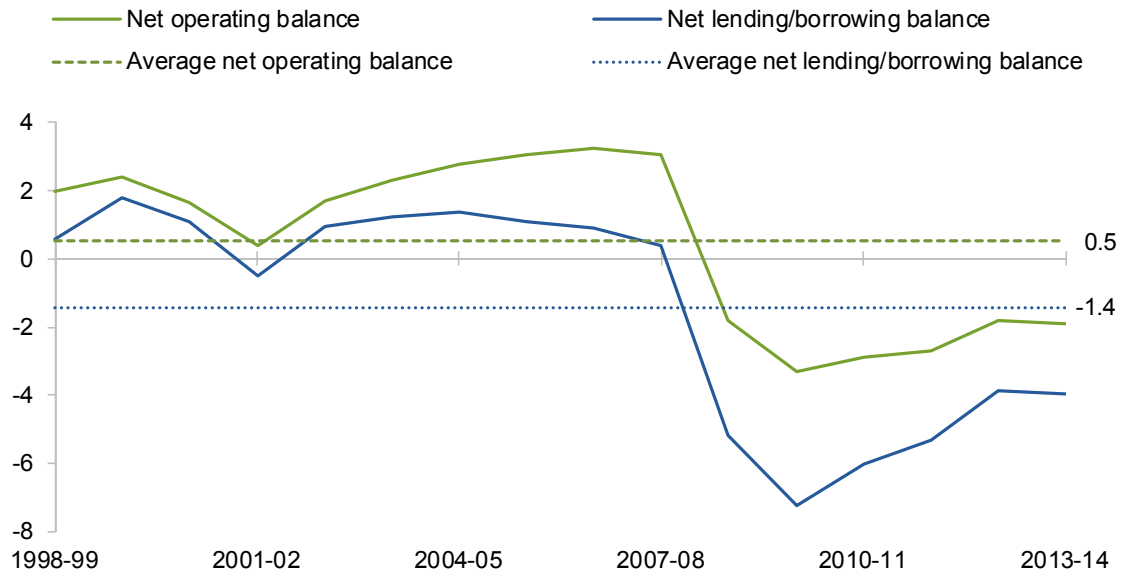
- *net lending/borrowing balance*, which is obtained by deducting the net acquisition of non-financial assets from the net operating balance. This measure shows the financing requirements of government — a positive balance reflects a net lending position and a negative balance reflects a net borrowing position. This concept is also known as the change in net financial worth due to transactions.

Notwithstanding some recent improvement, the collective net operating balance across all Australian governments deteriorated between 1988-89 and 2013-14. Up to 2007-08, the net operating balance was in surplus. However, since the GFC in 2008-09, this collective surplus has turned into a collective deficit. Despite reductions in the deficit since 2010-11, the net operating balance remained in deficit up to 2013-14. Given the small size of the net operating balance relative to government revenue and expenditure, its share of GDP has varied widely between + 3 and - 3 per cent from 1988-89 to 2013-14, averaging 0.5 per cent (figure 10.9).

The average net lending/borrowing balance across all governments between 1998-99 and 2013-14 was -1.4 per cent of GDP — that is, a net borrowing deficit equivalent to 1.4 per cent of GDP (figure 10.9). Over this period, this measure has gradually diverged from that of the net operating balance as a result of increased use of government borrowing (albeit from a small base).

Figure 10.9 **Net operating balance and net lending/borrowing balance across all levels of government as a share of GDP, 1998-99 to 2013-14[a]**

Per cent



a Total public sector.

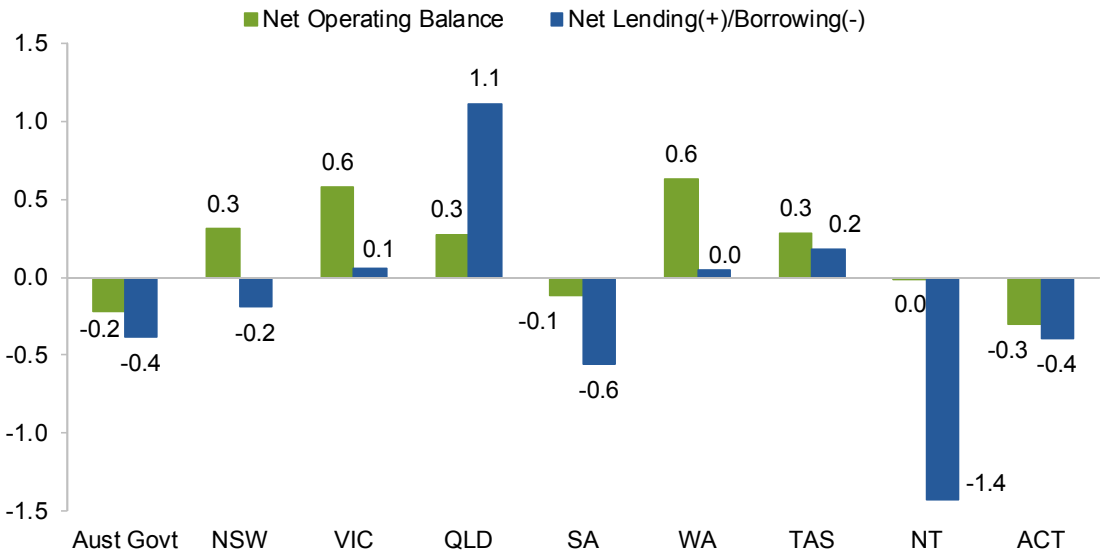
Sources: ABS (*Government Finance Statistics*, 2004-05 and 2013-14, Cat. no. 5512.0).

The budget balance of individual governments varied over this period. The average net operating balance for the Australian Government and the governments of South Australia and the two Territories were in deficit, as were their net borrowing/lending balance (figure 10.10). The Victorian, Queensland, Western Australian and Tasmanian Governments maintained, on average, surpluses for both budget balance measures over this period.

The magnitude of the averages also varies across jurisdictions, with the Northern Territory government having the largest negative net lending/borrowing balance relative to the size of its economy, followed by South Australia (figure 10.10).

Figure 10.10 **Average net budget balance as a share of state/territory GSP, 1998-99 to 2013-14[a]**

Per cent



[a] General government.

Sources: ABS (*Government Finance Statistics*, 2004-05 and 2013-14, Cat. no. 5512.0).

Vertical fiscal imbalance

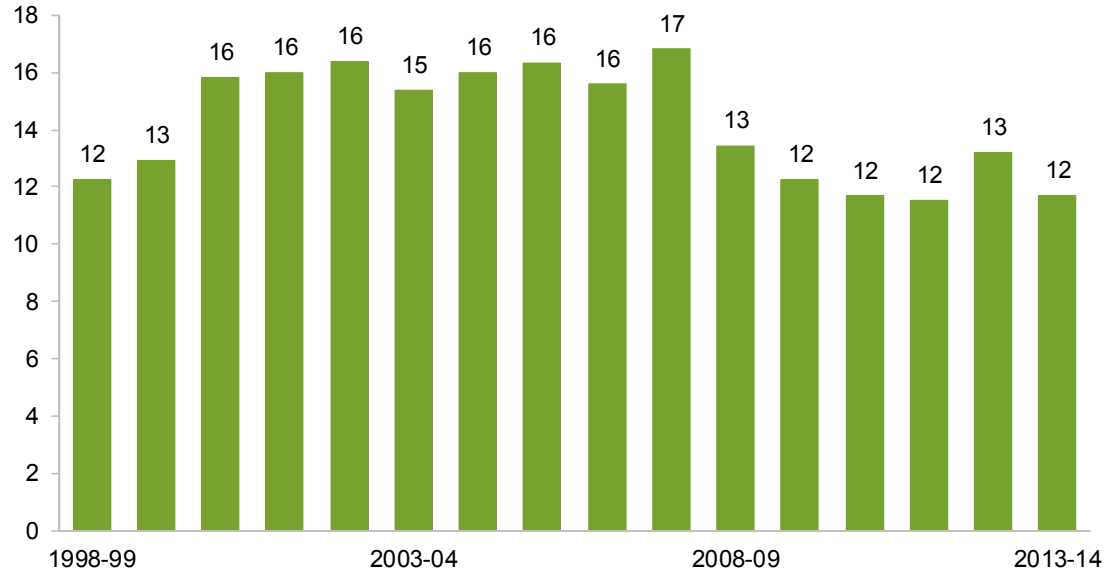
The collective net budget balances of all governments mask a feature of government finances in Australia — that is one of 'vertical fiscal imbalance', which reflects the difference in own-source revenue and expenditure between different tiers of government.

In short, state, territory and local governments are responsible for more expenditure than they raise in revenue, with transfers from the Australian Government making up the shortfall.

This vertical fiscal imbalance has been a characteristic of government finances in Australia since Federation. The shortfall funded by the Australian Government accounted for 37 per cent of collective state, territory and local government expenditure in 1901-02. This vertical fiscal imbalance fell to less than 15 per cent in the late 1930s, before rising again to more than 60 per cent in late 1950s (National Commission of Audits 2014, p. 145). Between 1998-99 and 2013-14, the average fiscal imbalance has been around 14 per cent. In recent years, especially since the GFC, this imbalance has fallen below 13 per cent (figure 10.11).

Figure 10.11 **Australian Government transfers as a proportion of state, territory and local government expenditure, 1998-99 to 2013-14[a,b]**

Per cent



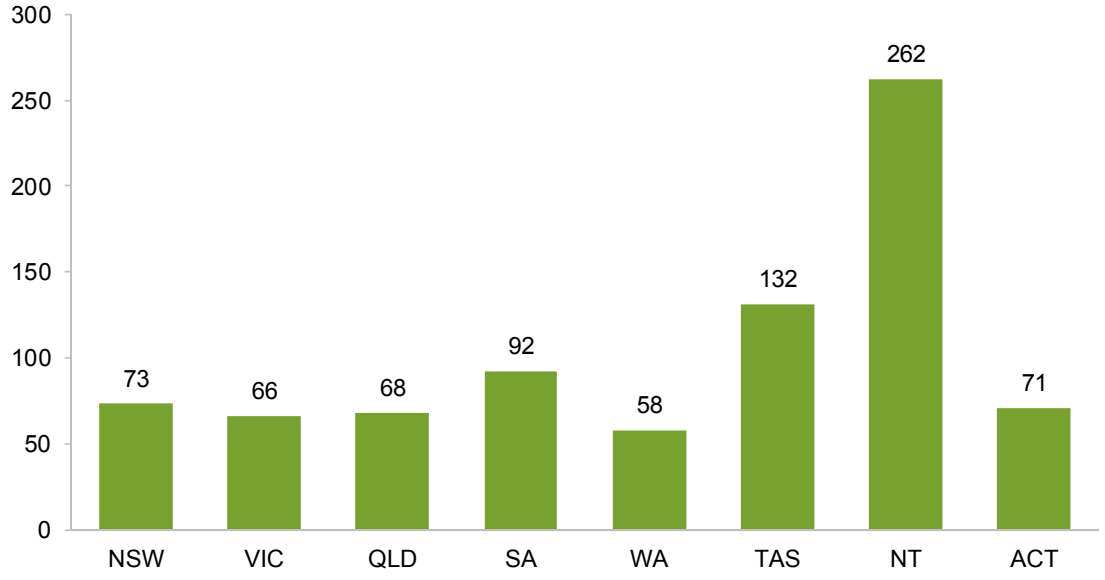
a Total public sector. **b** Each column is the difference between: the share of state, territory and local government expenditure in total expenditure (where Australian Government expenditure excludes grants and subsidies to state, territory & local governments); and the share of revenue raised by state, territory and local governments in total revenue (where state, territory & local government excludes grants and subsidies received from the Australian Government).

Sources: ABS (*Government Finance Statistics*, 2007-08 and 2013-14, Cat. no. 5512.0).

Between 1998-99 and 2013-14, the extent of vertical fiscal imbalance varied widely across states and territories (figure 10.12). The Northern Territory government's average expenditure surpassed its revenue raising capabilities by more than two and a half times. Tasmania also relied on Australian government grants for more than 1.3 times of its own source revenue over this period. All other states and the Australian Capital Territory maintained a share between 30 and 50 per cent, with an average share around 67 per cent across all jurisdictions.

Figure 10.12 **Average Australian Government transfers as a proportion of government expenditure by jurisdiction, 1998-99 to 2013-14[a,b]**

Per cent



[a] General government. [b] The difference between average own-source revenue and expenditure as a ratio of average own-source revenue.

Sources: ABS (*Government Finance Statistics*, 2007-08 and 2013-14, Cat. no. 5512.0).

Balance sheet

A non-zero net operating balance for any government has implications for its balance sheet, by affecting the value of assets held or the liabilities owed (commonly referred to as the level of government debt).[55] Where a government spends more than its total revenue — that is, when it incurs a net operating deficit — that excess expenditure needs to be funded. Such deficits are typically financed through government borrowing (such as issuing bonds) or through the sale of assets. Where governments raise more revenue than they spend (a net operating surplus), the question arises as to what governments do with the excess revenue. There are a myriad of ways that any excess funds could be used, such as being retained to fund future expenditure, being used to procure assets or being used to retire existing debt.

Balance sheet transactions give rise to intertemporal effects that may have implications for the financial position of governments in future years. Assets owned by a government may earn income (such as earning dividends or interest received) or changes in value over time

[55] The balance sheet denotes the stock of assets and liabilities held at a point in time (usually as at 30 June), while the net operating statement indicates the net inflow or outflow of funds in a given financial year.

(resulting in a notional capital gains or losses). Income from such assets would flow back into government revenue at some point in time (such as when the capital gains are realised). Liabilities need to be repaid and interest paid on the stock of debt. Repayments of liabilities require government expenditure. The level of government indebtedness and the government's perceived ability to finance its debt may affect its credit rating and the rate of interest that it can borrow at.

In 2013-14, Australian governments held assets of just under $3000 billion (145 per cent of GDP), and liabilities of $972 billion (67 per cent of GDP). The net worth of Australian governments was $2016 billion (127 per cent of GDP) (ABS Cat. no. 5402.0).

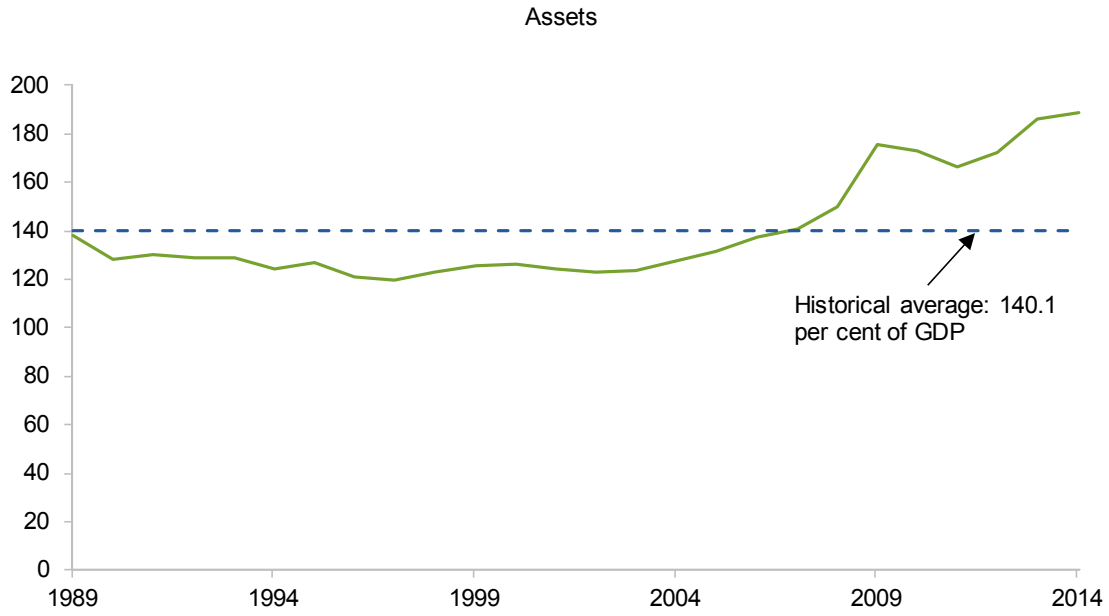
Consistent ABS data on the balance sheet across all levels of government extends back to 1988-89. From then until 2013-14, on average, Australian governments held:

- assets amounting to 140.1 per cent of GDP; and
- liabilities amounting to 48.7 per cent of GDP (figure 10.13).

Australia's level of government debt is low by international standards (figure 10.14).

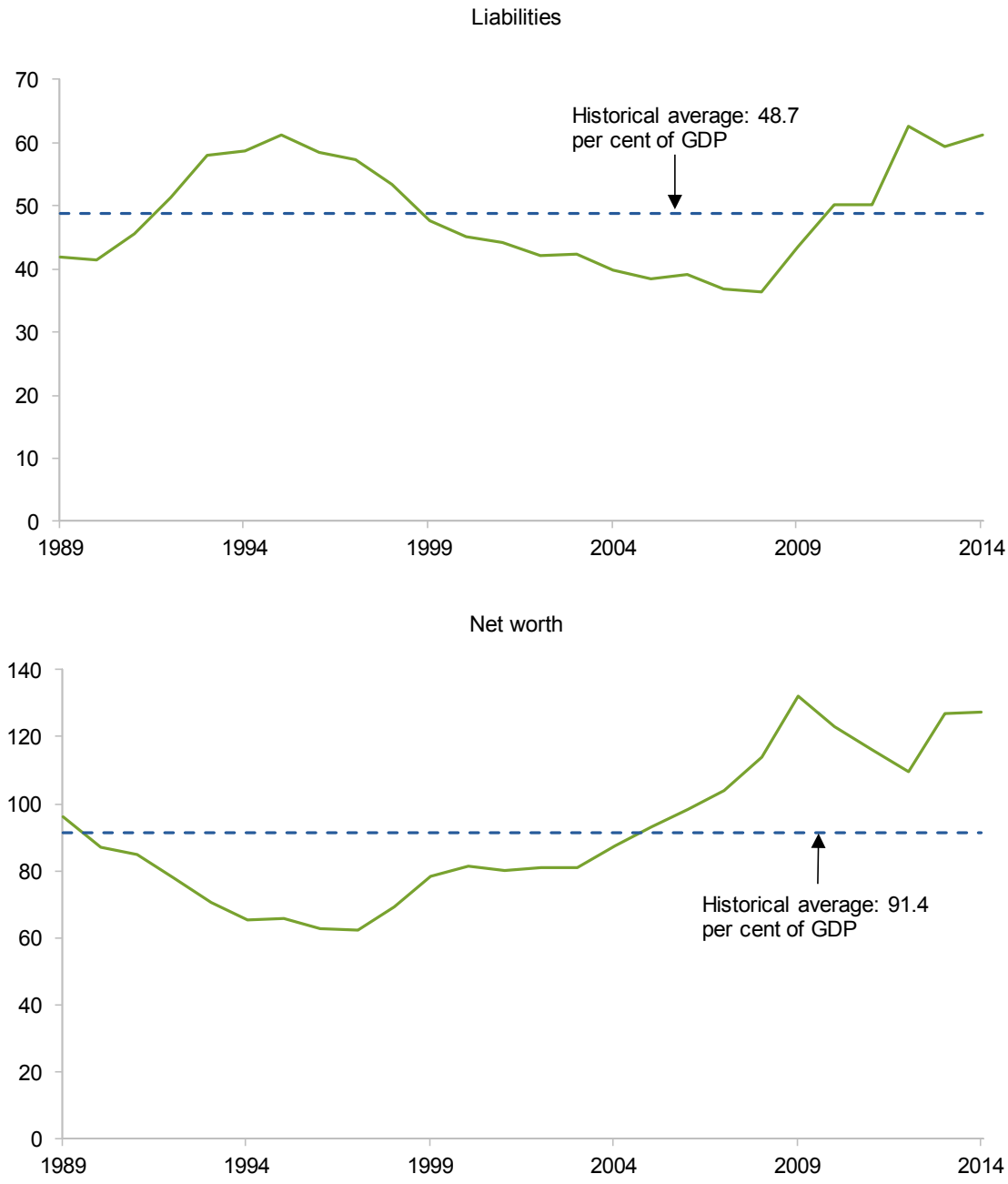
Figure 10.13 **Assets, liabilities and net worth of all levels of government, Australia, 1988-89 to 2013-14**

Per cent of GDP



(continued next page)

Figure 10.13 (continued)

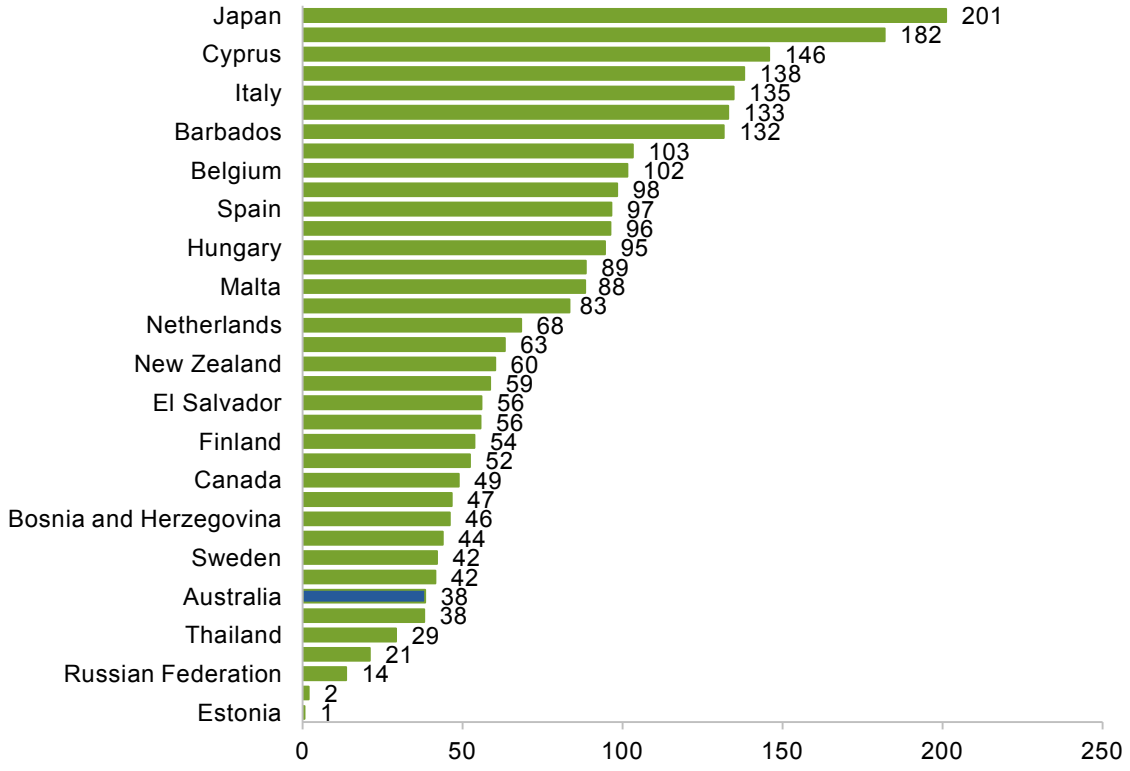


a General government.

Source: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Figure 10.14 **International comparison of central government debt as a share of GDP, 2013[a]**

Per cent of GDP



[a] Debt is the stock of direct government fixed-term contractual obligations to others outstanding on a particular date. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans. It is the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government. Because debt is a stock rather than a flow, it is measured as of a given date, usually the last day of the fiscal year.

Source: World Bank (DataBank http://data.worldbank.org/indicator/GC.DOD.TOTL.GD.ZS).

10.2 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 midyear economic forecasts. However, the Australian Treasury also produces projections over longer timeframes in its *Intergenerational Reports*.

Budget and midyear economic forecasts

Medium-term forecasts by the Australian and state and territory government treasuries

show a continuation of current revenue raising and expenditure patterns. Revenues and expenditures are projected to remain around one-third of GDP over the medium term (table 10.1).[56]

Table 10.1 **Medium-term estimates of government revenues and expenditures, 2014-15 to 2017-18**

2014-15 budget and midyear estimates

Government		2013-14	2014-15(e)	2015-16(e)	2016-17(f)	2017-18(f)
Australian	Revenue ($ million)	374 267	391 348	419 612	449 840	480 394
	Expenses ($ million)	415 294	414 845	431 118	453 806	475 447
NSW	Revenue ($ million)	66 005	67 113	70 041	73 559	74 942
	Expenses ($ million)	64 757	67 396	69 640	72 463	73 903
VIC	Revenue ($ million)	51 094	52 902	54 980	56 740	58 995
	Expenses ($ million)	50 159	51 575	51 950	53 581	55 665
Qld	Revenue ($ million)	46 734	50 120	52 951	54 510	56 270
	Expenses ($ million)	46 115	49 933	49 873	51 390	53 259
SA	Revenue ($ million)	15 254	16 067	17 258	18 090	18 659
	Expenses ($ million)	16 487	16 547	16 852	17 315	17 776
WA	Revenue ($ million)	27 970	28 683	29 901	31 159	32 162
	Expenses ($ million)	27 787	28 508	29 896	31 109	31 879
TAS	Revenue ($ million)	4 792	4 964	5 086	5 130	5 257
	Expenses ($ million)	5 059	5 249	5 211	5 255	5 375
NT	Revenue ($ million)	5 084	5 370	5 502	5 657	5 605
	Expenses ($ million)	5 115	5 307	5 403	5 588	5 604
ACT	Revenue ($ million)	4 245	4 412	4 654	4 912	5 178
	Expenses ($ million)	4 586	4 858	4 895	5 071	5 242
Total	**Revenue ($ million)**	**595 445**	**620 978**	**659 985**	**699 597**	**737 462**
	Expenses ($ million)	**635 359**	**644 219**	**664 838**	**695 578**	**724 151**
Grants to states & territories	($ million)	97 834	101 146	108 070	115 389	116 695
Share of GDP[a]	Revenue (per cent)	31	32	33	33	33
	Expenses (per cent)	34	34	33	33	33

(e) estimate. (f) forecast. [a] Totals excluding grants to states & territories.

Sources: ACT Government (2014); Australian Government (2014, 2015a); Government of South Australia (2014); Government of Western Australia (2014); Northern Territory Government (2014); NSW Government (2014); Parliament of Tasmania (2014); Queensland Government (2014); State Government of Victoria (2014); ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

56 The analysis does not take into account any subsequent revisions or updates in those jurisdictions that have handed down their budget for 2014-15 financial year.

Intergenerational Report 2010

The *Intergenerational Report 2010* (Australian Government 2010) contained a number of longer-term projections of government revenue raising and expenditures. The key projections and assumptions included:

- that the Australian Government maintains a tax-to-GDP ratio of 23.5 per cent out to 2049-50; and
- that 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 expenditure projections relative to revenue raising imply that the Australian Government would run a series of budget deficits over this period.

A key factor driving the projected increases in expenditure relative to revenue is ageing of the population, which is expected to further shift the composition of government expenditure over time towards the areas of health care and aged pensions (table 10.2).

Table 10.2 **Expenditure projections to 2049-50 in the Intergenerational Report 2010**
Per cent of GDP

	2014-15	*2019-20*	*2029-30*	*2039-40*	*2049-50*
Health	3.9	4.1	4.8	5.9	7.1
Aged care	0.8	0.9	1.2	1.6	1.8
Age and service pensions	2.7	2.8	3.3	3.7	3.9
Disability Support pension	0.9	0.9	1.0	1.0	1.0
All other payments to individuals	2.9	2.9	2.5	2.2	2.0
Education	1.7	1.8	1.9	1.9	1.9
Public sector superannuation	0.4	0.4	0.3	0.2	0.2
Other	9.3	9.2	9.2	9.1	9.2
Total payments (excluding interest)	**22.6**	**23.0**	**24.2**	**25.6**	**27.1**

Source: Australian Government (2010, p. 118).

Intergenerational Report 2015

Given the many uncertainties inherent in longer-term projections, the *Intergenerational Report 2015* (Australian Government 2015b) reports fiscal projections under three alternative scenarios:

- the 'previous policy' scenario, which shows the fiscal projections associated with the set of policies in place prior to the 2014-15 budget;

- the ‘currently legislated’ scenario, which shows the fiscal projections based on those policies in the 2014-15 budget that had been implemented; and
- the ‘proposed policy’ scenario, which shows the fiscal projections based on the full implementation of the policies announced in the 2014-15 budget and all outstanding measures.

The scenarios involve projections of expenditure and underlying cash balances on the basis that the then current tax-to-GDP ratio of 23.9 per cent is maintained over the 40 years to 2054-55.

Australian Government spending as a share of GDP in 2054-55 is assumed to rise to:

- 37.0 per cent under the ‘previous policy’ scenario;
- 31.2 per cent under the ‘currently legislated’ scenario; and
- 25.9 per cent (25.1 per cent excluding interest payments) under the ‘proposed policy’ scenario.

A key factor driving the projected increase in health and aged care expenditure in the 2015 report (and also in the 2010 report) is ageing of the population (table 10.3).

Table 10.3 **Expenditure projections to 2054-55 in the Intergenerational Report 2015**[a]

Per cent of GDP

	2014-15	*2024-25*	*2034-35*	*2044-45*	*2054-55*
Health	4.2	3.9	4.0	4.6	5.5
Aged care	0.9	1.1	1.3	1.4	1.7
Age and service pensions	2.9	2.5	2.5	2.6	2.7
Disability Support pension	1.1	0.9	1.0	1.0	1.0
All other payments to individuals	3.5	2.7	2.6	2.3	2.1
Education	1.7	1.6	1.4	1.2	1.0
Public sector superannuation	0.4	0.4	0.3	0.3	0.2
Other	10.3	11.0	10.8	10.8	10.9
Total payments (excluding interest)	**25.0**	**24.1**	**23.9**	**24.2**	**25.1**

[a] Based on ‘proposed policy’ scenario.

Source: Australian Government (2015b, p. 100).

Starting from an estimated deficit of 2.5 per cent in 2014-15, the underlying cash balance as a share of GDP in 2054-55 is projected to:

- deteriorate under the ‘previous policy’ scenario to 11.7 per cent of GDP;
- deteriorate under the ‘currently legislated’ scenario to 5.8 per cent of GDP; and
- improve under the ‘proposed policy’ scenario to a surplus to 0.5 per cent of GDP.

10.3 Towards a modelling reference case

Formulating a reference case for the VUMR model 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 paper 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 reference case makes the simplifying assumptions that all tax rates remain fixed (at their initial levels) and that real government expenditures (in 2013-14 dollars) move in line with changes in the underlying drivers contained in the VUMR model (such as changes in real economic activity, unemployment and population growth).[57] The modelling of government finances in the VUMR model is summarised in box 10.2.

It is also assumed that the net real budget balance in each jurisdiction 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). This is achieved through the use of lump-sum transfers to, or from, households in the respective jurisdictions. This maintains the real net lending/borrowing ratio in the base year of the VUMR model database (2009-10) for each jurisdiction out to 2059-60 (table 10.4). Among the state and territory governments, only Queensland had a budget deficit in 2009-10 (and in the model database) comparable to that of the Australian Government. The projected real budget deficit remains low for all other state and territory governments.

As recognised in the *Intergenerational Reports 2010* and *2015* (and mentioned in chapter 11), expenditure on health care and health-related commodities are 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, real government expenditure on health in the VUMR model increases proportionately with the share of the population aged 65 years and over. The reference case also adopts the *Intergenerational Report 2015* 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 through increased household expenditure. The fiscal closure used assumes that this additional government expenditure is funded through lump-sum transfers from households. These lump-sum transfers feed through into household income and expenditure in the VUMR model.

[57] The annex at the end of this chapter contains a full listing of the government revenue and expenditure items included in the model and the economic drivers associated with each one.

Box 10.2 The modelling of government finances in the VUMR model

The government financial accounts in the VUMR model are based on the ABS's operating statement in the ABS's *Government Financial Statistics* (Cat. no. 5512.0). This statement records the revenue and expenses for all levels of government in Australia (including local government) on a consistent basis (box 10.1).

The VUMR model distinguishes a range of government taxes, non-taxation sources of revenue and expenses for:

- the Australian Government; and
- each of the eight state and territory government (including any local government).

The drivers of each item of revenue and expenditure are listed in the annex to this chapter.

While not modelled explicitly in the VUMR government financial accounts, government investment forms part of aggregate investment, which also includes investment by the private sector. Aggregate investment is explicitly modelled in the core of the VUMR model as responding to changes in disequilibrium rates of return at the regional industry level.

Government liabilities are not modelled in the VUMR government financial accounts. However, transactions between Australia and the rest of the world, implicitly including government liabilities, form part of net foreign liabilities in the model core. Interest is payable on the debt component of net foreign liabilities.

The government financial accounts in the VUMR model do not, however, contain a funds statement or balance sheet, the two other statements relating to the financial position of governments in ABS's *Government Financial Statistics* (Cat. no. 5512.0).

As a result, the VUMR model provides a partial coverage of changes in the financial position of governments over time. A key limitation is that it does not explicitly model balance sheet related transactions of government, such as the acquisition, use, retirement and changes in the valuation of the stock of assets and liabilities held. That said, the cumulative net operating balance in the model provides information on some of the changes in liabilities over time.

Consequently, there is no mechanism to ensure that the model's financial position is fiscally sustainable.

The VUMR projection for health expenditure in 2059-60 is 5.3 per cent of GDP (chapter 12), which aligns closely with the *Intergenerational Report 2015* projection of 5.7 per cent of GDP in 2054-55 under the 'currently legislated' scenario.

The VUMR model does not explicitly model the balance sheet of governments so the ongoing fiscal deficits in the projection period do not have any feedback effects that could arise in the real economy (such as an increase in the cost of borrowing). It is recognised that the modelling reference case is unlikely to be fiscally sustainable in the long term.

Table 10.4 **Real net lending/borrowing balance by level of government to 2059-60 in the reference case[a]**

Per cent of GDP/GSP

Government	*2009-10*
Australian Government	-4.72
New South Wales	-1.60
Victoria	-1.95
Queensland	-5.06
South Australia	-2.31
Western Australia	-2.18
Tasmania	-2.30
Northern Territory	-1.87
Australian Capital Territory	-1.04

a A positive share indicates net lending and a negative share indicates net borrowing.

Source: VUMR database based on ABS (*Government Finance Statistics*, 2013-14, Cat. no. 5204.0).

Annex

Table A.1 **Drivers of government revenue in the VUMR model, by ABS *Government Finance Statistics* revenue item**

Type of revenue	*Model 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.

Table A.2 Drivers of government expenditure in the VUMR model, by ABS *Government Finance Statistics* expenditure item

Type of expenditure	*Model 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; share of the population aged over 65 years; 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.

11 Household expenditure

Household consumption is the single largest component of national expenditure in Australia, accounting for 55 per cent of national production in 2009-10. Accordingly, household expenditure decisions influence the aggregate level of economic activity and can have important flow-on effects on the distribution of economic activity between industries and regions. Consequently, household expenditure is an important component of reference case.

This chapter commences by outlining the factors that influence household expenditure (section 11.1). It then outlines trends in household consumption (section 11.2), before reporting on approaches used to model future household demand adopted in recent studies (section 11.3). Drawing on past trends and recent approaches, the chapter concludes by outlining the approach adopted in the reference case (section 11.4).

Analytical framework

The analysis of household expenditure in this chapter focuses on changes in the level and composition of aggregate household consumption over time based on data from two ABS publications: *Australian National Accounts* (Cat. no. 5204.0) and *Household Expenditure Survey* (Cat. no. 6530.0). It does so to guide the formulation of the household consumption component of the reference case.

11.1 Factors influencing patterns of household expenditure

Expenditure patterns of households change over time for many reasons, including changes in: disposable income; financial circumstances; relative prices; demographic characteristics; health status; and consumer preferences (tastes). Patterns of household expenditure may also be influenced by changes in the provision of government services, 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).

In an economy-wide model such as VUMR, the level and composition of household consumption spending through time would be determined by future levels of income (aggregate household expenditure), 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, have to be determined outside the model and applied exogenously.

Assessing the importance of these drivers of household consumption is important for developing a reference case, particularly if projection period is relatively long or the scale of such changes are large.

11.2 Historical perspective

This section provides a historical perspective of trends in aggregate household expenditure and changes in its composition. It illustrates changes in household expenditure shares over time and highlights some differences in expenditure shares across different household types.

Trends in aggregate household expenditure

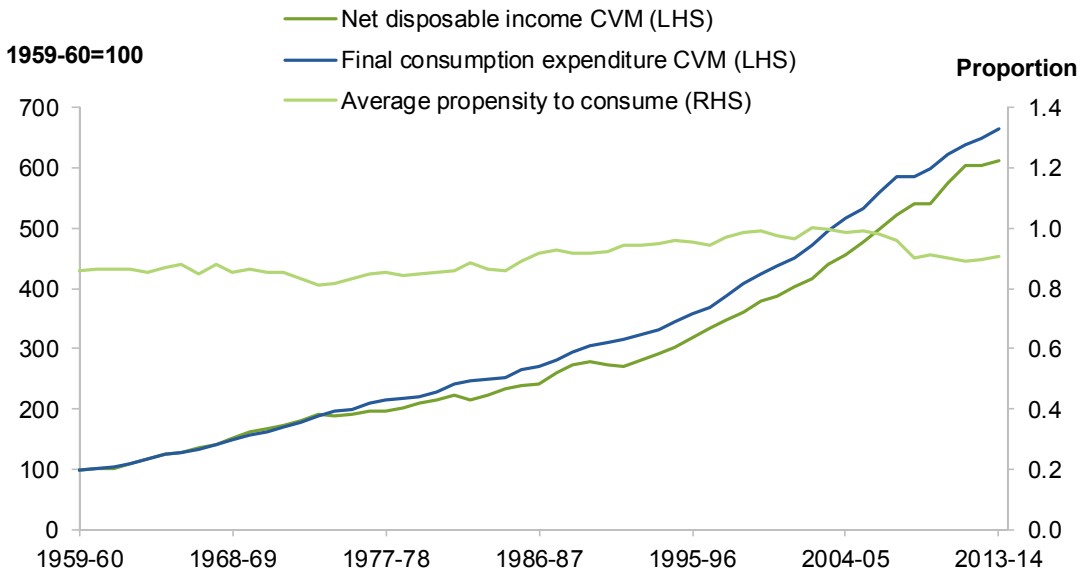
In 2013-14, household final consumption expenditure totalled $878 billion out of a net disposable income of $972 billion. Household consumption was the single largest component of expenditure in the Australian economy, accounting for almost three-fifths of GDP (55 per cent).

Household expenditure and income grew at similar rates in real (volume) terms from 1959-60 to 1973-74, after which expenditure grew at a higher rate than income by 0.2 percentage points per year (figure 11.1). As a result, the average propensity to consume — the fraction of income spent on consumption expenditure rather than on saving — increased from 81 per cent in mid-1970 to 99 per cent in 2003-04. Since then, the average propensity to consume started to fall before settling around its longer-term value of 90 per cent by 2013-14.

Change in household expenditure shares

There has been some change in the composition of household expenditure (in current prices) over time (table 11.1). Drawing on the ABS *Australian National Accounts*, there have been decreases in the shares of expenditure accounted for by *food*, *alcoholic beverages & tobacco*, *clothing & footwear*, *furnishing & household equipment* and *hotels, cafes & restaurants*. Conversely, the shares of expenditure accounted for by housing (*rent & other dwelling services*), *health*, *communication* and *education services* have increased. Some categories, such as *recreation*, *transport* and *electricity, gas & other fuel*, have remained relatively stable as a share of expenditure.

Figure 11.1 **Aggregate household disposable income and final consumption expenditure, Australia, 1959-60 to 2013-14**



Source: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Table 11.1 **Nominal household final consumption expenditure shares in the ABS National Accounts, 1959-60 to 2013-14[a]**

Per cent

Expenditure group	*1959-60*	*1969-70*	*1979-80*	*1989-90*	*1999-00*	*2009-10*	*2012-13*	*2013-14*
Food	17.8	14.8	13.4	11.5	10.4	10.3	10.1	10.0
Alcoholic beverages & tobacco	6.6	5.6	4.6	3.8	4.1	3.6	3.5	3.5
Clothing & footwear	10.0	8.0	6.5	5.4	3.9	3.7	3.2	3.2
Rent & other dwelling services	8.6	11.9	16.0	18.2	17.9	20.3	21.1	21.3
Electricity, gas & other fuel	2.3	2.0	1.8	2.0	1.8	2.1	2.6	2.6
Furnishings & household equipment	9.1	7.9	7.5	6.9	5.6	4.6	4.2	4.1
Health	3.8	4.5	5.1	4.4	4.9	5.7	6.2	6.2
Transport	12.5	13.8	13.2	12.9	12.1	10.6	10.7	10.5
Communication	0.6	0.8	1.2	1.4	2.3	2.5	2.4	2.3
Recreation & culture	8.9	8.8	9.4	10.1	11.7	10.5	10.0	9.7
Education services	0.9	1.3	1.4	2.4	3.1	3.9	4.4	4.5
Hotels, cafes & restaurants	9.4	8.7	7.9	6.7	7.4	6.8	6.6	6.6
Miscellaneous goods & services	9.5	12.1	12.0	14.4	14.9	15.3	15.0	15.4

[a] Categories are not the same as those in the ABS *Household Expenditure Surveys*.

Source: ABS (*Australian System of National Accounts*, 2013-14, 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* and *alcoholic beverages & tobacco* have decreased as a share of consumption in both nominal and real terms, whereas the shares accounted for by *furnishing & household equipment* and *clothing & footwear* have remained relatively stable in real terms (table 11.2). Another deviation between the two sets of figures is for *recreation & culture*, which has remained relatively constant as a share of nominal expenditure over the last two decades, but has risen by almost 50 per cent in volume-share terms.

Table 11.2 **Real household final consumption expenditure shares in the ABS National Accounts, 1959-60 to 2013-14[a]**

Per cent

Expenditure group	*1959-60*	*1969-70*	*1979-80*	*1989-90*	*1999-00*	*2009-10*	*2012-13*	*2013-14*
Food	16.5	14.4	13.8	12.0	10.5	9.9	10.1	10.1
Alcoholic beverages & tobacco	15.1	12.8	10.5	7.6	5.3	4.0	3.5	3.4
Clothing & footwear	5.0	4.5	3.6	3.2	2.8	3.4	3.2	3.3
Rent & other dwelling services	17.4	17.7	20.6	22.2	22.3	21.2	21.1	21.1
Electricity, gas & other fuel	2.9	3.4	3.5	3.4	3.3	3.0	2.6	2.5
Furnishings & household equipment	4.9	4.8	4.8	4.5	4.0	4.2	4.2	4.2
Health	np	5.3	6.0	5.0	4.6	5.6	6.2	6.3
Transport	np	10.7	10.4	10.2	10.8	10.4	10.7	10.4
Communication	0.3	0.3	0.5	0.8	1.8	2.3	2.4	2.4
Recreation & culture	np	5.7	6.2	6.9	8.7	9.8	10.0	9.8
Education services	np	3.6	3.4	5.0	4.6	4.3	4.4	4.4
Hotels, cafes & restaurants	10.2	9.6	9.1	7.8	7.8	6.8	6.6	6.6
Miscellaneous goods & services	np	np	np	14.8	14.9	15.2	15.0	15.4

np not published. **a** Categories are not the same as those in the ABS *Household Expenditure Surveys*.

Source: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0).

Another source of data on changes in household expenditure over time is the ABS *Household Expenditure Survey* (table 11.3). While the categories are not directly comparable with those from the *National Accounts*, they paint a similar picture of trends. Over the period from 1984 to 2009-10[58]:

- the share of expenditure on *food & non-alcoholic 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; and
- expenditure on *housing* and *medical care & health* expenses have increased.

Some categories, such as *domestic fuel & power*, *transport* and *recreation*, have remained relatively constant as a share of the value of household expenditure, in common with national income relativities.

Table 11.3 **Nominal household expenditure shares in the ABS 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 ABS *National Accounts*.

Source: ABS (*Household Expenditure Survey, Australia: Summary of Results*, 2009-10, Cat. no. 6530.0).

58 2009-10 is the most recent year for which the survey is available.

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. The *Household Expenditure Survey*, which allows disaggregation of expenditure patterns by household characteristics, provides an insight into this.

Differences by age

Expenditure shares for some categories varied considerably across age groups in 2009-10 (table 11.4). The most notable variation is in *current housing cost*, which decreases markedly as a share of expenditure as age increases. Conversely, *medical care & health expenses* are reported as increasing with age. There is some increase in the share accounted for by food across older age groups.

Table 11.4 **Nominal household expenditure shares by age group in the ABS 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).

Differences by household income

The shares of expenditure accounted for by many categories of household expenditure decrease as household incomes rise (table 11.5). The largest falls are in categories such as *current housing costs*, *food & non-alcoholic beverages*, *domestic fuel & power*, *household services & operation* and *medical care & health expenses*. The largest reported increases in relative shares as incomes increase occur in categories such as *clothing & footwear*, *recreation*, *transport* and *miscellaneous goods & services*.

Table 11.5 **Nominal household expenditure shares by gross income quintile in the ABS 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

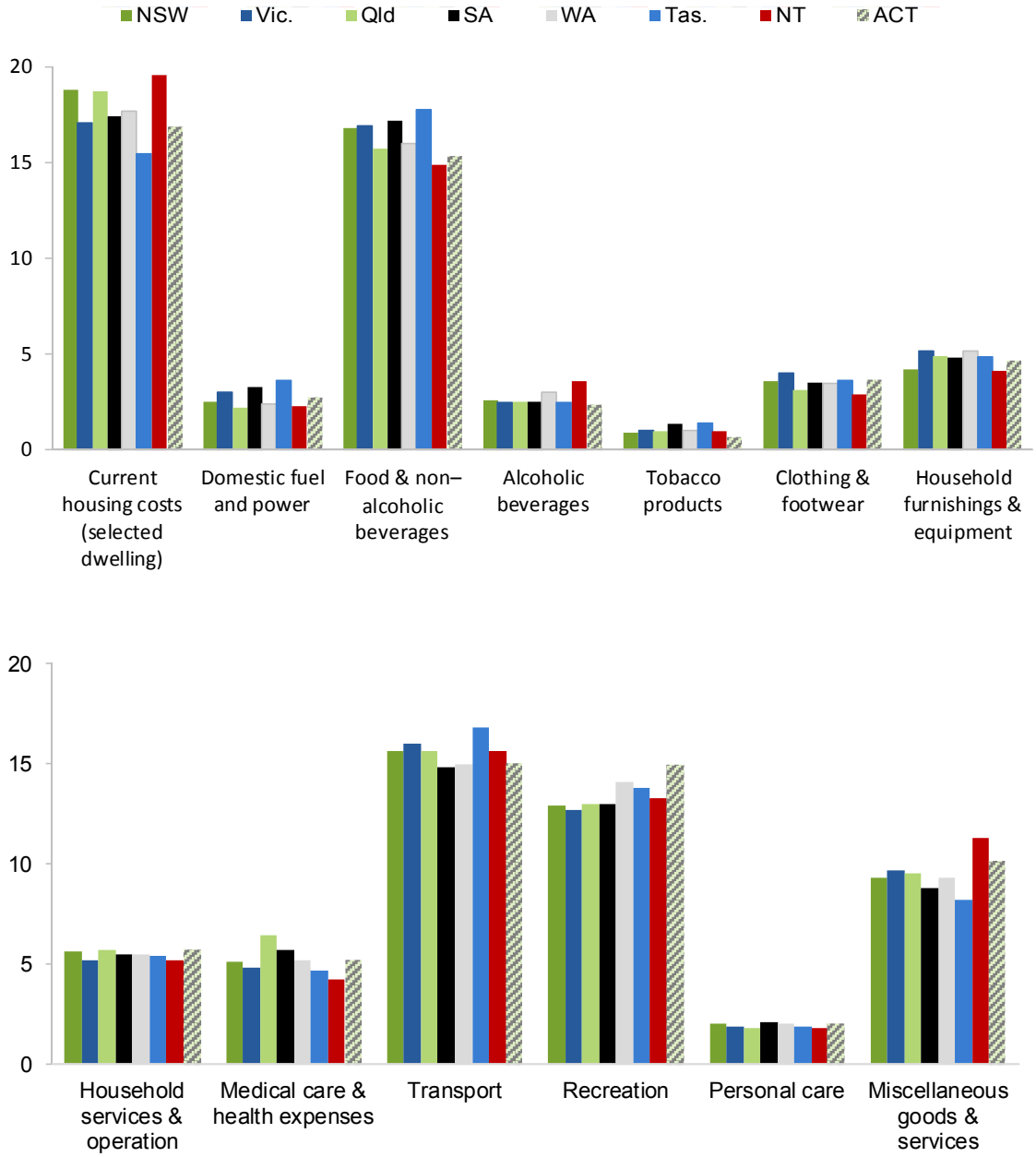
Source: ABS (*Household Expenditure Survey, Australia: Summary of Results*, 2009-10, Cat. no. 6530.0).

Differences by state of residence

There do not appear to be large differences in household expenditure shares across states (figure 11.1). Some notable differences include relatively less spending on housing in Tasmania, and relatively more spending in the Northern Territory. Conversely, the share of household expenditure on food is highest in Tasmania and lowest in the Northern Territory.

Figure 11.2 **Household expenditure shares by state of residence in the ABS Household Expenditure Survey, 2009-10**

Per cent



Source: ABS (*Household Expenditure Survey, Australia: Summary of Results*, 2009-10, Cat. no. 6530.0).

11.3 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) and 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 studies incorporate changes in household tastes into their projections.

Strong Growth, Low Pollution

Strong Growth, Low Pollution (Treasury 2011) included a range of household taste shocks in its reference case (table 11.6). 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 11.1 and 11.3) owing to differences in the commodity classifications used.[59]

Intergenerational Reports

The Australian Government's Intergenerational Reports (Australian Government 2010; 2015b) are another source of projections. Of particular note is the projected increase in government spending on health services from:

- 4 per cent of GDP in 2009-10 to 7.1 per cent in 2049-50 in the 2010 report; and
- 4.2 per cent of GDP in 2014-15 to 5.5 per cent in 2054-55 in the 2015 report.

The increase in spending is driven by a combination of an ageing population and an assumed increase in demand for health services. While these projections deal with government spending, it is possible that similar trends could be expected in terms of household expenditure on health services.

[59] 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 11.6 **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).

11.4 Towards a modelling reference case

The reference case assumes that actual changes in aggregate household consumption apply during the uprating period (2010-11 to 2013-14), with the average propensity to consume allowed to vary (table 11.7).

Table 11.7 **Changes in real household consumption to 2013-14 in the reference case**

	2010-11	*2011-12*	*2012-13*	*2013-14*
Real actual activity level (2013-14$m)	821 388	842 498	855 791	878 289
Reference case shocks (per cent)[a]	3.81	2.57	1.58	2.63

[a] Applied by allowing the average propensity to consume to vary.

Source: ABS (*Australian System of National Accounts*, 2014-15, Cat. no. 5204.0).

The average propensity to consume is held fixed in the unwinding and projection periods.

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 reference case does not include household taste change shocks. Nevertheless, under the parametrisation of the VUMR model, the share of outlays on services such as housing, health, education and communications would be projected to increase as incomes rise over time. This would be broadly consistent with the trends in table 11.2.

Further, adjustments have been made in the reference case with respect to expenditure on the VUMR commodities *Health care services* and *Residential care & social assistance*. As recognised in the *Intergenerational Report* 2015, 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, the future increase in health expenditure is modelled through an increase in government expenditure (discussed in chapter 10).

12 Modelling reference case

This chapter reports on the projected level and structure of the economy out to 2059-60 implied by the analysis in the previous chapters. It commences by reporting on the level of economic activity — initially focusing on population and then on production (section 12.1). It then reports on the structure of the economy (section 12.2). The chapter then explores differences in the projected sources of labour productivity growth compared to the period 1974-75 to 2013-14 (section 12.3). The chapter concludes by summarising the reference case and the key issues involved (section 12.4).

This reference case is intended to provide a starting point against which the impacts of different policy and other economic changes can be assessed. It is intended for use as a 'modelling counterfactual' so that the impacts of different policies or external shocks (the proposed changes) can be determined by their effect on the level and composition of economic activity. As noted in chapter 2, the reference case is not intended as a forecast of the economy into the middle of the century and reflects the assumption outlined in the previous chapters.

The reference case presented in this chapter is based on the 2009-10 VUMR database (described in chapter 3) supplied by the Centre of Policy Studies (CoPS 2015). The use of this updated VUMR database, coupled with refinement of the assumptions outlined in chapters 4 to 11, mean that the results presented in this reference case may differ from those presented in the 2012 reference case supplement (PC 2012b).[60]

12.1 Level of economic activity

The level of economic activity in the reference case reflects the assumed changes in population, participation and productivity (outlined in chapters 5, 6 and 7, respectively).

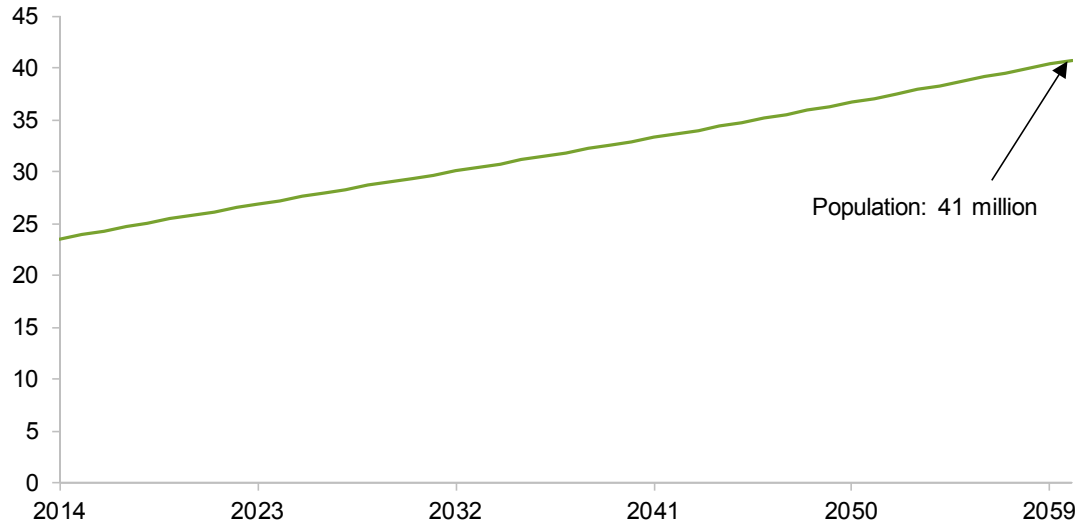
Population

Collectively, the assumptions concerning fertility, mortality and migration (chapter 5) imply that the population of Australia will reach 41 million in June 2060 (figure 12.1).

[60] The starting database for the 2012 reference case had a reference year of 2005-06 and aligned with the ABS *2005-06 Input-Output Tables*.

Figure 12.1 **Projected population, Australia, June 2014 to June 2060[a]**

Million, as at 30 June



[a] Excluding residents of *other territories* (Jervis Bay, Christmas Island and Cocos (Keeling) Islands).

Source: Estimates based on the VUMR model.

This compares to 23.4 million in June 2014 (ABS, *Australian Demographic Statistics*, December 2014, Cat. no. 3101.0). The average growth in population over the reference case is 1.2 per cent per year to June 2060.

This population projection lies within the range of 37 to 48 million covered by the ABS population projections, and is essentially identical to their medium growth scenario (Series B) projection of 41 million (chapter 5). The wide range in the ABS estimates reflects the implication of different assumptions about total fertility, life expectancy and net overseas migration.

The long-run population projections in the reference case are also broadly similar to those in the *2015 Intergenerational Report* — the projected population for June 2055 in the reference case is 39 million compared to 39.7 million for 2054-55 in the *Intergenerational Report* (chapter 5). The slightly lower population in the current paper primarily reflects the use of a lower total fertility rate — 1.86 used in this paper compared to the 1.9 used in the *2015 Intergenerational Report*.

Net overseas migration is projected to account for 56 per cent of the 1.2 per cent per year growth in population to June 2060, with net natural increase (the net of births and deaths) accounting for the remaining 44 per cent. Net overseas migration is projected to account for just over 60 per cent of population growth in the financial year 2059-60.

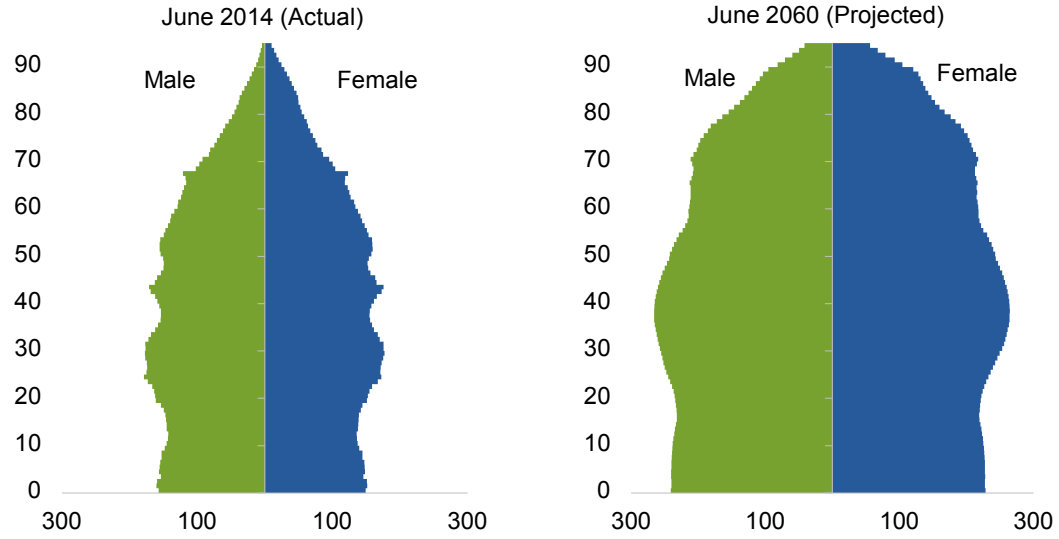
The modelling indicates a clear increase in the age profile of the Australian population ('ageing' of the population), both for males and females to 2059-60 (figure 12.2). The

share of the population aged 65 years and over — the 'dependency ratio' — is projected to rise from roughly 15 per cent in June 2014 to 24 per cent by June 2060. Conversely, the share of the population aged less than 15 years is projected to decline from 19 to 17 per cent.

The proportion of women of childbearing age (those aged 15 to 45 years) is projected to fall from 43 to 37 per cent in 2059-60 (or from 21 to 19 per cent of the entire population).

Figure 12.2 **Actual and projected age profile of the population by gender, Australia, June 2014 and June 2060[a]**

Persons ('000)



[a] Excluding residents of *other territories* (Jervis Bay, Christmas Island and Cocos (Keeling) Islands).

Sources: ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0); Estimates based on the VUMR model.

State population and its growth

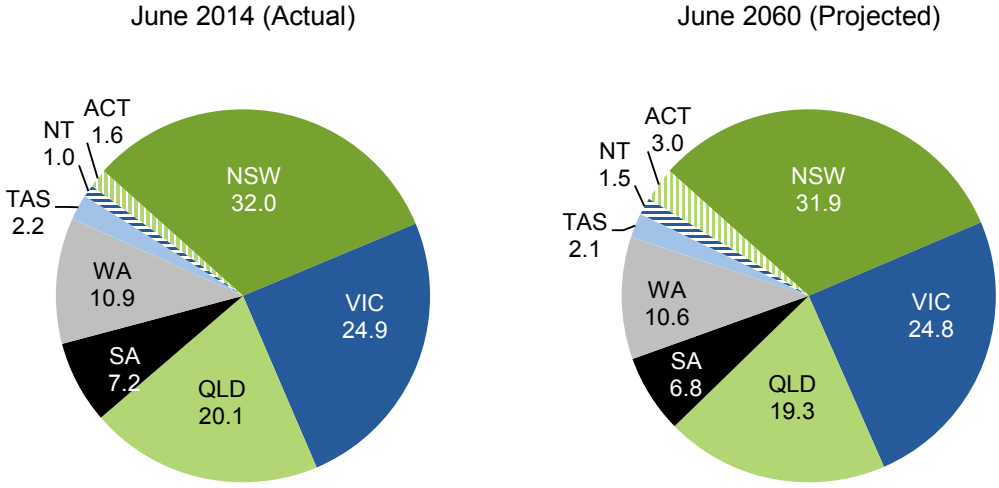
The distribution of population across states in June 2060 is projected to be similar to the current distribution (figure 12.3).

The Australian Capital Territory is projected to grow from 1.6 to 2.7 per cent of the population, and New South Wales from 32.0 to 32.3 per cent. A small increase in the population is also projected for the Northern Territory. The shares for the remaining states decline slightly, except Victoria, which is projected to remain at 24.9 per cent.[61]

[61] These model-based projections do not take into account the effects of geographical and other considerations that may constrain future population growth in some states or cities.

Figure 12.3 **Actual and projected distribution of population by state, June 2014 and June 2060[a]**

Per cent



[a] Excluding residents of *other territories* (Jervis Bay, Christmas Island and Cocos (Keeling) Islands).

Sources: ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0); Estimates based on the VUMR model.

These state demographic differences reflect, among other things, state differences in:

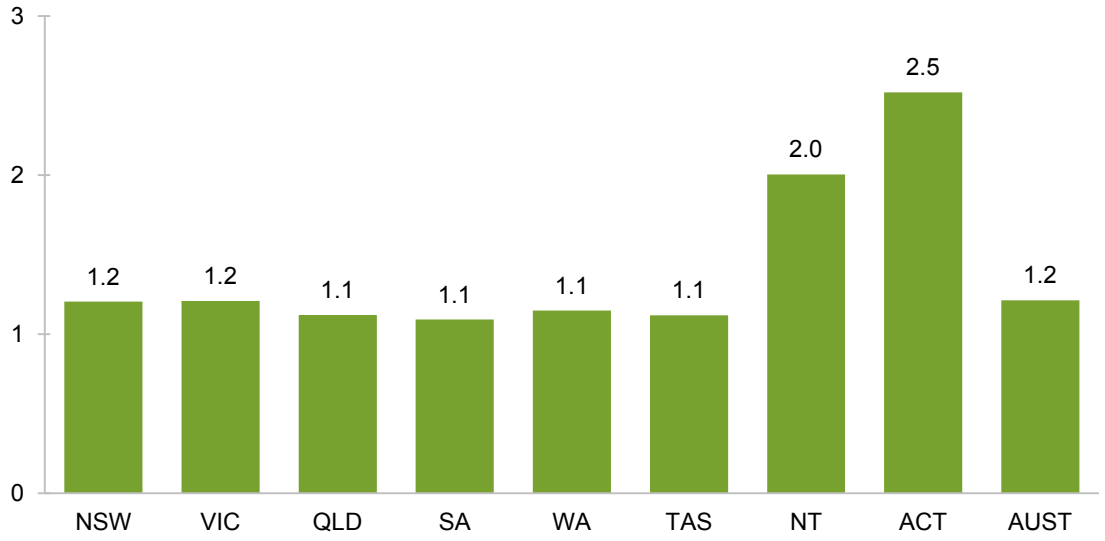
- the age and gender profiles of the initial population (chapter 3);
- variations in the demographic assumptions adopted (chapter 5); and
- net interstate migration arising from differences in nominal wage growth in each jurisdiction relative to the national average (discussed below).[62]

The Australian Capital Territory and the Northern Territory are projected to have the highest average annual population growth rates of 2.5 and 2.0 per cent, respectively (figure 12.4). In contrast, South Australia, Tasmania, Queensland and Western Australia (all 1.1 per cent) are projected to grow more slowly than the national average of 1.2 per cent.

62 As noted in chapter 5, the modelling does not take into account the effect of factors such as changes in property values or the effects of congestion on interstate migration.

Figure 12.4 **Projected average annual growth in population by state, June 2014 to June 2060**

Per cent per year



Source: Estimates based on the VUMR model.

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 to slow across most states towards 2059-60 from current levels (table 12.1).

Table 12.1 **Actual and projected average annual changes in population by state and decade to 2059-60**

Per cent per year

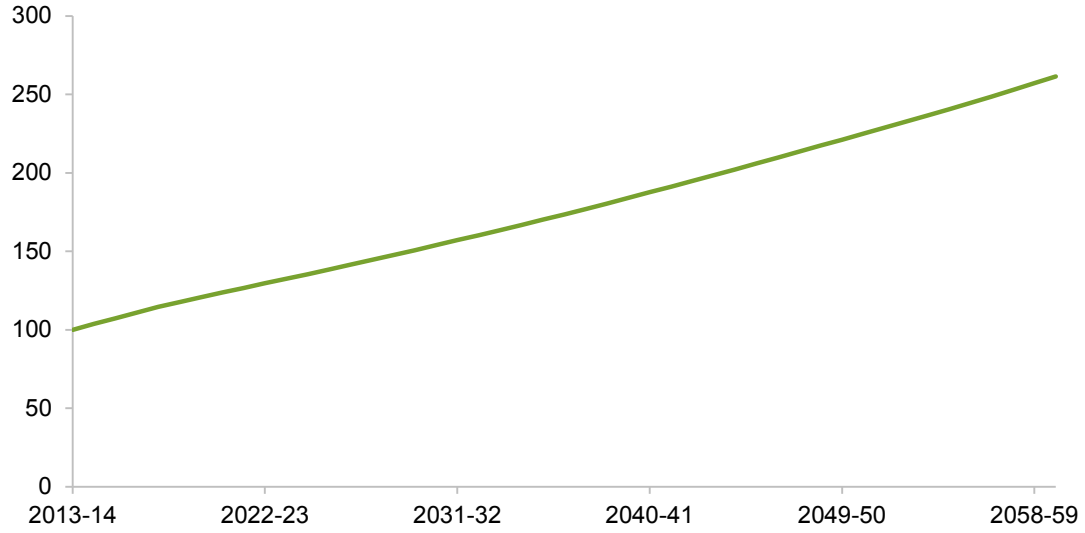
Decade	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*	*AUST*
2000s (actual)	1.1	1.6	2.4	0.9	2.0	0.7	1.6	1.3	1.5
2010s	1.1	1.6	1.8	1.7	2.5	1.7	3.0	2.3	1.6
2020s	1.3	1.2	1.2	1.1	1.5	1.4	2.8	2.7	1.3
2030s	1.2	1.1	1.1	1.0	1.2	1.1	1.6	2.4	1.2
2040s	1.2	1.1	0.9	0.8	1.0	0.6	1.6	2.8	1.1
2050s	1.2	1.0	0.9	0.8	0.9	0.9	1.4	2.6	1.1
Average	1.2	1.2	1.1	1.1	1.1	1.1	2.0	2.5	1.2

Sources: ABS (*Australian Demographic Statistics*, December 2014, Cat. no. 3101.0); Estimates based on the VUMR model.

Production

Reflecting the assumptions adopted, the economy in 2059-60 is projected to be roughly 2.5 times larger in real terms than it was in 2013-14 (figure 12.5). Real GDP is projected to grow at an average rate of 2.1 per cent per year to 2059-60, or by 0.9 per cent per person.

Figure 12.5 **Projected growth in real GDP, Australia, 2013-14 to 2059-60**
Index (Reference year: 2013-14=100)



Source: Estimates based on the VUMR model.

In terms of the PPP framework outlined in chapter 2, this 2.1 per cent per year growth in real GDP reflects:

- +1.2 percentage points from population growth;
- -0.4 percentage points from labour force participation; and
- +1.3 percentage points from labour productivity growth. [63]

That is, population and labour productivity growth are projected to increase national output growth to 2059-60, while falling workforce participation is projected to reduce it.

This projected growth in real GDP to 2059-60 is 1 percentage point less than the +3.1 per cent per year growth that occurred between 1974-75 and 2013-14 (figures 12.6).

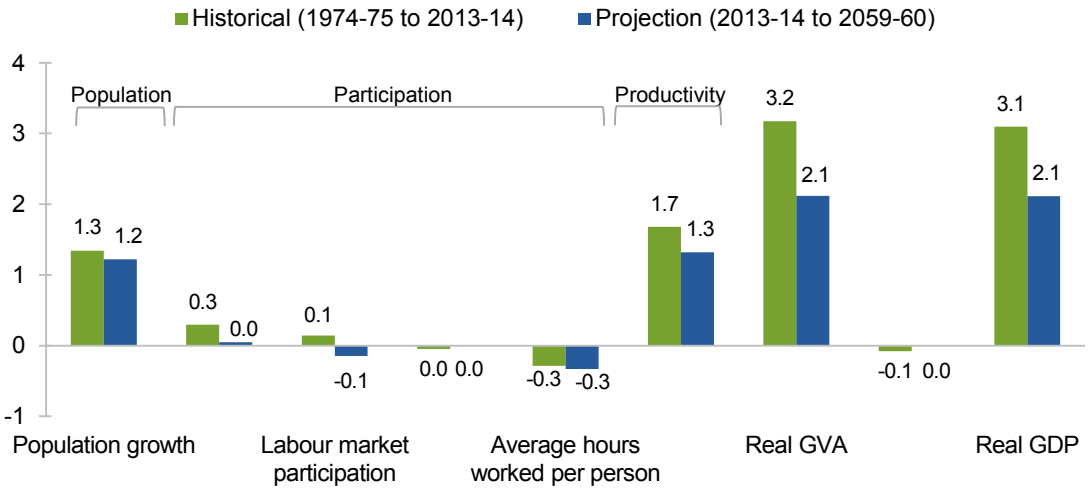
63 The numbers reported in this chapter have been rounded. As a result, the contributions may not add to corresponding total reported.

This lower projected GDP growth compared to the historical period analysed reflects lower projected contributions from:

- population growth (0.1 percentage point);
- labour force participation (0.5 percentage points); and
- labour productivity growth (0.4 percentage points) (figures 12.6).

Figure 12.6 **Actual and projected contributions to the growth in real GDP, Australia, 1974-75 to 2013-14 and 2013-14 to 2059-60[a]**

Per cent per year



Source: 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); Estimates based on the VUMR model.

Population

The projected contribution from population growth to real GDP growth to 2059-60 is marginally lower than the historical average from 1974-75 to 2013-14 (+1.2 percentage points compared to +1.3 percentage points).

This 0.1 percentage point lower projected contribution from population growth primarily reflects relatively fewer births due to a projected fall in the proportion of women of childbearing age, which falls from 21 to 19 per cent of the overall population.

Participation

The projected contribution from labour force participation to real GDP growth to 2059-60 is lower than the historical average from 1974-75 to 2013-14 (-0.4 percentage points compared to +0.1 percentage point).

This lower projected contribution primarily reflects a fall in aggregate labour force participation arising from ageing of the population — older people typically are less likely to be engaged in the labour market than younger people and, when they do, work less hours per week on average.

The 0.5 percentage point lower contribution from labour force participation reflects:

- lower growth in the share of the population of working-age (0.2 percentage points); and
- lower growth in the labour market participation rate (0.3 percentage points).

Productivity

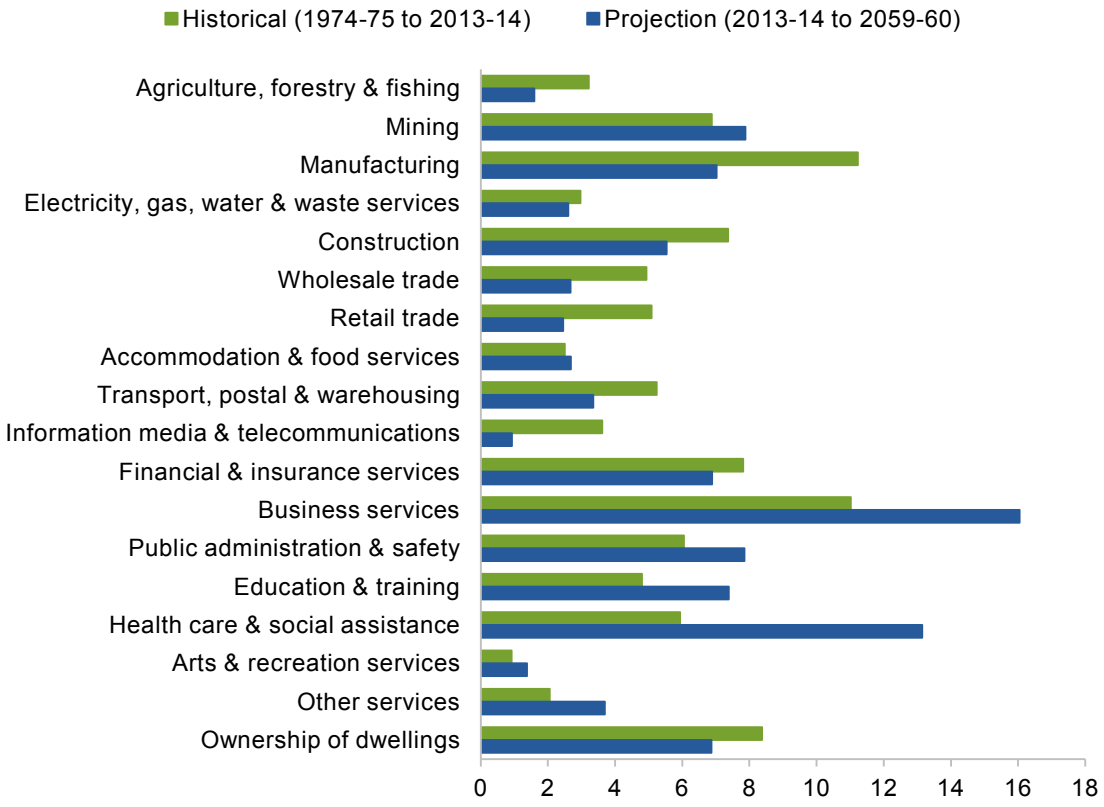
The projected contribution from aggregate labour productivity to real GDP growth to 2059-60 is lower than the historical average from 1974-75 to 2013-14 (+1.3 percentage points compared to +1.7 percentage points).

This lower projected contribution primarily reflects compositional change in the structure of the economy at the industry level (figure 12.7), as the labour productivity shocks applied to each VUMR industry during the projection period are the same as the historical growth rate for the ABS ANZSIC division to which they belong (chapter 7).

The projected fall in labour productivity growth reflects a continuation of the long-term trend away from industries in the traded-goods sector, which have higher measured labour productivity, towards those in the non-traded service sector, which have lower measured labour productivity. Thus, over time, industries with lower measured labour productivity growth account for more economic activity and, hence, attract a relatively higher weight.

Figure 12.7 **Average labour productivity weights, Australia, 1974-75 to 2013-14 and 2013-14 to 2059-60[a]**

Per cent



[a] Average industry share of total GVA.

Sources: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); Estimates based on the VUMR model.

12.2 Structure of the economy

The projected structure of the economy out to 2059-60 is inherently sensitive to the reference case assumptions adopted, especially those concerning changes in (relative) labour productivity by industry (chapter 7) and foreign trade (chapter 8). These 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).

Population and labour supply

Change in labour supply over the course of the reference case can be assessed in terms of changes in population, working-age population, labour supply, employment and average hours worked using the PPP framework outlined in chapter 2.

This section assesses the changes in these underlying contributors to total hours worked (figure 12.8). The most obvious change is the reduction in the aggregate unemployment rate during the uprating period (2010-11 to 2013-14). While less pronounced, the changes over the projection period — chiefly arising from ageing of the population — are collectively more significant in terms of their economic implications.

Working-age population (15 years and over)

The modelling indicates that the population of working age (aged 15 years and over) is projected to grow by 1.3 per cent per year. This growth reflects:

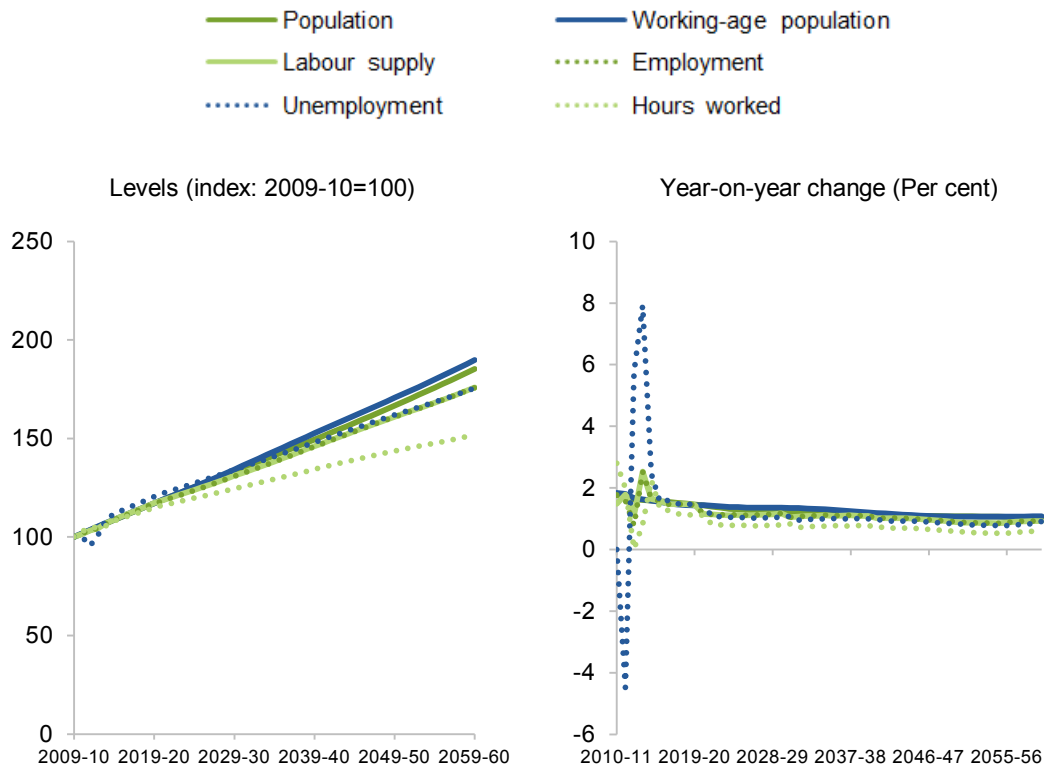
- population growth of 1.2 per cent; and
- an increase in the share of the population of working age, which is projected to grow from 81 to 83 per cent.

The number of people in this aged group is projected to rise from 19 million in June 2014 to 34 million by June 2060. Annual growth in this working-age population gradually declines over the projection period, from 1.6 per cent in 2014-15 to 1.1 per cent by 2059-60.

The number of people aged 65 years and over grows from 3 million in June 2014 (15 per cent of the total population) to 10 million by June 2060 (24 per cent of the total population). This represents an increase of 1.7 per cent per year.

The share of the working-age population that is aged 65 years and over is projected to grow from 18 per cent in June 2014 to 21 per cent in June 2060.

Figure 12.8 **Projected level and annual growth in population, working-age population, labour supply, employment, unemployment and hours worked, Australia, 2009-10 to 2059-60**



Source: Estimates based on the VUMR model.

Labour force (persons)

The number of people engaged in the labour force is projected to grow by 1.1 per cent per year in the reference case. This growth reflects:

- growth in the population of working age of 1.3 per cent; and
- a decrease in the participation rate, which is projected to fall from 65 to 60 per cent, reflecting the growth in the share of the working-age population over 65 years.

As a result, the number of people in the labour force (the labour supply) is projected to increase from over 12 million in June 2014 to over 20 million by June 2060. Ageing of the population means that the supply of labour grows at a slightly slower rate than the population as a whole (which grew by 1.2 per cent per year).

The annual growth in the supply of labour is projected to steadily decline over the course of the reference case from 2.5 per cent in 2014-15 to 0.9 per cent in 2059-60.

Employment (persons)

By assumption, projected growth in the number of people employed is the same as the supply of labour (1.1 per cent per year). This reflects:

- growth in the labour force of 1.1 per cent; and
- no change in the employment rate (by assumption).

As a result, employment is projected to rise from 12 million in June 2014 (95 per cent of the labour force) to 19 million by June 2060 (95 per cent of the labour force). Over the projection period, annual growth is projected to steadily decline from 2.5 per cent per year in 2014-15 to 0.9 per cent per year in 2059-60.

Hours worked

The number of hours worked is projected to grow by 0.8 per cent per year over the reference case. This growth reflects:

- growth in employment of 1.1 per cent; and
- a decrease in average hours worked per person employed by 0.3 per cent.

In part this reflects the assumption adopted that, reflecting the trend towards an increased share of part-time work, average hours worked per person are expected to continue their historical decline (chapter 6). This also reflects the projected decrease in the proportion of the population engaged in full-time employment (which is projected to fall from 50 to 48 per cent).

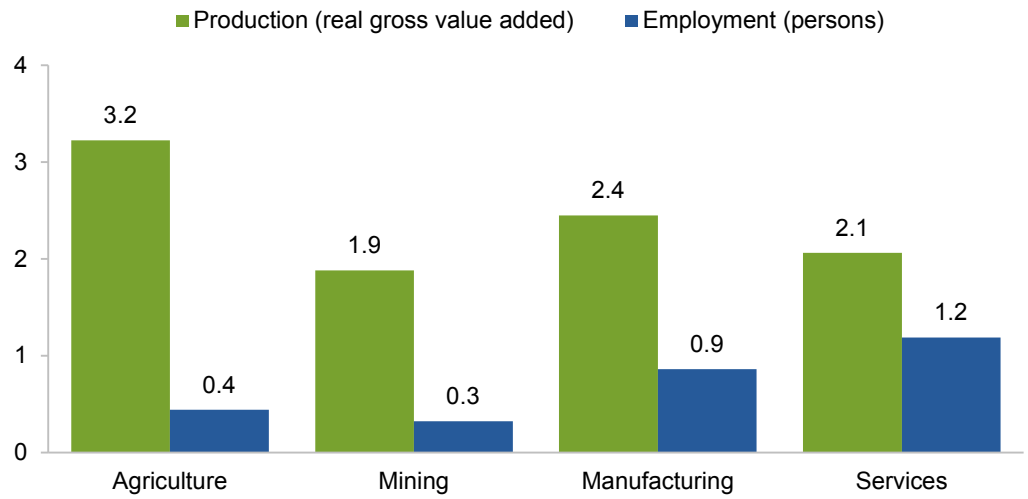
The growth in annual hours worked is projected to steadily decline from 2.2 per cent in 2014-15 to 0.6 per cent in 2059-60.

Production

Output and employment are projected to grow in all sectors to 2059-60 (figure 12.9). Employment growth is projected to be higher in the services sector, while real output growth is higher in the tradable goods sector in general and agriculture in particular. Notwithstanding a projected increase in its output, employment in agriculture is projected to grow more slowly than other sectors, continuing the long-term decline in its share of total employment.

Figure 12.9 **Projected average annual production and employment growth by sector, Australia, 2013-14 to 2059-60**

Per cent per year



Source: Estimates based on the VUMR model.

The growth in industry output primarily reflects the assumed continuation of higher historical rates of productivity growth. This accounts for the stronger projected growth in real agricultural output. The reasons for this growth are explored in box 12.1.

On the other hand, real output prices are projected to fall in the traded-goods sector and rise in the non-traded sector. Reflecting the higher historical rates of labour productivity growth, real output prices in the agricultural sector are projected to decline by 1.7 per cent per year. Real mining prices are projected to fall by 0.5 per cent per year, and manufacturing by 0.9 per cent per year. In contrast, real output prices for the service sector are projected to rise by 0.6 per cent per year.

Box 12.1 **Projected growth in agricultural production**

This box explores the reasons why the agricultural sector is projected to grow strongly in the reference case. While the discussion focuses on agricultural production, the issues raised also apply more broadly to other industries and, potentially, to other modelling reference cases.

This higher projected production reflects a number of factors.

First, the agricultural sector has higher measured labour productivity growth since 1974-75 than most industry sectors in the Australian economy — +3.4 per cent per year compared to the economy-wide average of +1.7 per cent (chapter 7). This higher historical growth reflects average annual output growth of +2.4 per cent and labour input growth of -1.1 per cent.

Second, unlike the *information, media & telecommunications* industry sector which is the other sector that experienced high historical productivity growth (chapter 7), agricultural industries are generally export-orientated. That is, exports account for a relatively higher share of their sales. This enables the above average productivity growth to translate into higher export sales in the VUMR model.

A third possible factor is that, while the reference case does not include productivity changes in the rest of the world, it could be that the implied productivity differential between Australia and the rest of the world is overstated for industries in the agricultural sector, as historical world productivity growth for agriculture may also have been higher than in other sectors (chapter 8). That is, like Australia, historical world productivity growth in the agriculture sector may have been higher, on average, than in other sectors of the world economy.

If the implied productivity differential in Australia is indeed overstated, the long-run productivity growth for agriculture in the reference case should translate into:

- larger falls in production costs;
- higher export volumes; and
- higher output growth (than otherwise).

This is indeed what is projected to occur in the reference case. This suggests that the implied productivity differential (between Australian and world agriculture) is likely to be overstated.

Further research is needed in this area as to how productivity growth at the industry level varies across countries and over time. However, such an analysis of global productivity growth is beyond the scope of this paper.

In terms of the structure of the economy in 2059-60, the services sector is projected to account for a larger share of both the value of output and employment. This growth occurs at the expense of the agricultural, mining and manufacturing sectors (figure 12.10). This represents a continuation of long-term trends of structural change at the sectoral level.

Figure 12.10 **Actual and projected distribution of production and employment by sector, Australia, 2013-14 and 2059-60**

Per cent

Sources: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0); ABS (*Labour Force, Australia, Detailed, Quarterly*, November 2011, Cat. no. 6291.0.55.003); Estimates based on the VUMR model.

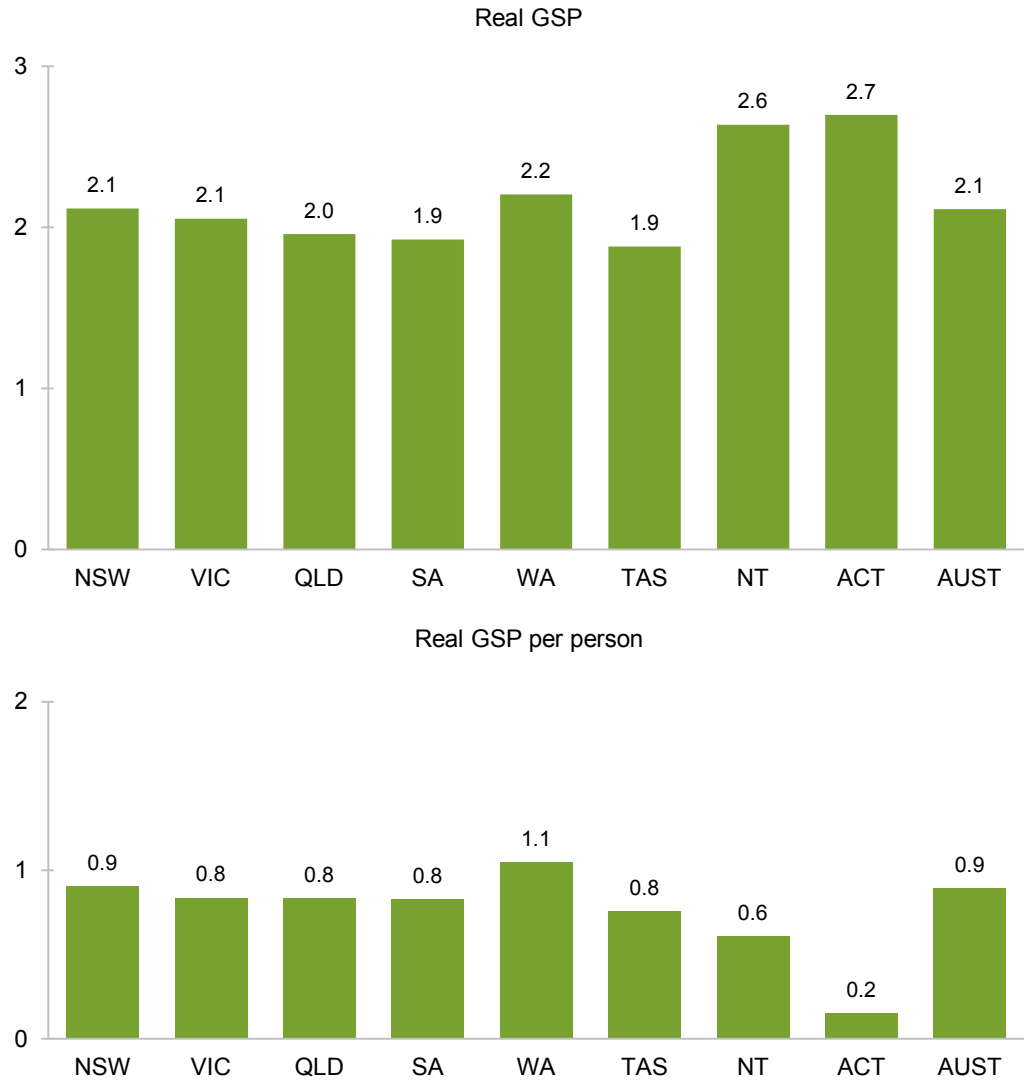
State production

Production (real GSP) is projected to increase in all states to 2059-60 by between 1.9 and 2.7 per cent per year (figure 12.11, upper panel). Growth in output is projected to be relatively stable in individual states over the projection period (table 12.2). State

production per person is similarly projected to increase in all jurisdictions (figure 12.11, lower panel). The difference between the projected real GSP and real GSP per person primarily reflects the assumption of diminishing marginal productivity of labour embodied in the VUMR model and interstate migration, which is modelled endogenously in VUMR.

Figure 12.11 **Projected average annual growth in state production, 2013-14 to 2059-60**

Per cent per year



Source: Estimates based on the VUMR model.

Table 12.2 **Actual and projected average annual changes in real GSP to 2059-60**

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	2.4	2.7	2.7	2.9	4.7	2.7	5.6	2.5	3.0
2020s	2.2	2.0	2.0	1.8	2.6	1.9	4.0	2.8	2.2
2030s	2.1	2.0	1.9	1.8	1.9	1.8	1.3	2.8	2.0
2040s	2.0	1.9	1.7	1.6	1.5	1.6	1.3	2.8	1.8
2050s	1.1	1.6	1.8	1.7	2.5	1.7	3.0	2.3	1.6
Average	2.1	2.1	2.0	1.9	2.2	1.9	2.6	2.7	2.1

Sources ABS (*Australian National Accounts: State Accounts*, 2013-14, Cat. no. 5220.0); Estimates based on the VUMR model.

While there is some variability across states, the broad sectoral picture at the national level also largely holds across all states (figure 12.12). Unsurprisingly, given the uneven distribution of mining activities in Australia, the main sectoral differences at the state level relate to the relative growth in mining activity and employment.

National expenditure

There are four main categories of final demand:

- household final consumption expenditure (household consumption);
- government final consumption expenditure (government consumption);
- gross fixed capital formation (investment); and
- exports.

The first three of these categories make up gross national expenditure (GNE). The inclusion of the balance of trade (exports less imports) gives GDP on the expenditure side.[64]

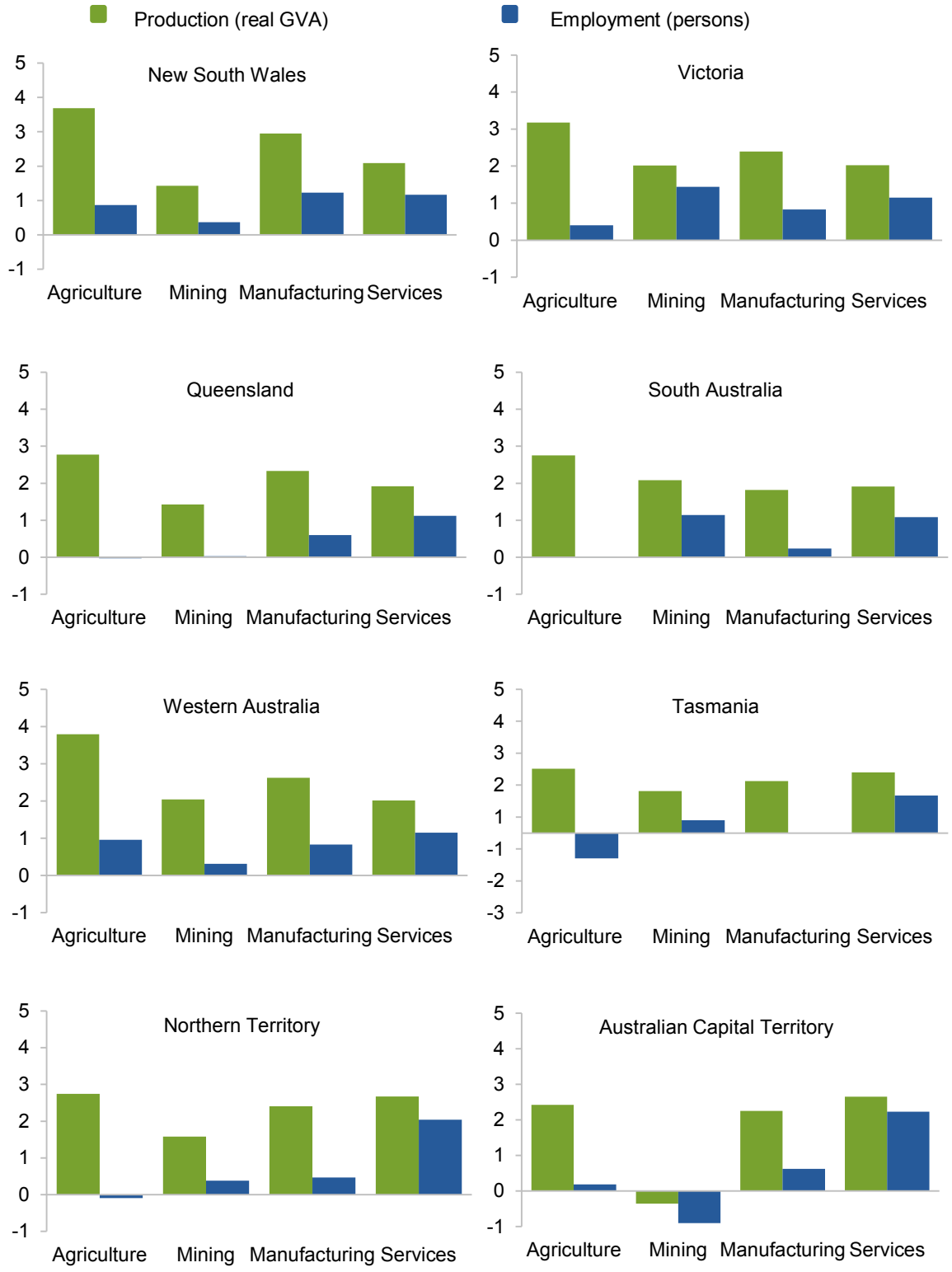
In real terms, the volume of gross national expenditure in the reference case is projected to rise by 1.9 per cent year, slightly slower than the projected 2.1 per cent per year increase in the volume of GDP (production). The 0.2 percentage point difference reflects growth in the real balance of trade.

However, in real value terms (relative to the model numeraire), there is no projected growth in the balance of trade.

64 The definition of GDP on the expenditure side also includes *changes in inventories* and the *statistical discrepancy*. In the VUMR modelling, the change in *changes in inventories* is small and there is no *statistical discrepancy*.

Figure 12.12 **Projected average annual production and employment growth by sector and state, 2013-14 to 2059-60**

Per cent per year



Source: Estimates based on the VUMR model.

Most areas of final demand in the reference case move in line with gross national expenditure in real value terms. The two exceptions are aggregate investment and the government consumption.

Each of these components in real GDP on the expenditure side is discussed in turn.

Household consumption

Household consumption expenditure is the single largest contributor to final demand and GDP on the expenditure side in Australia (accounting for 55 per cent of GDP in 2013-14).

In the VUMR model, as changes in savings behaviour need to be imposed exogenously on the model, household consumption moves in line with household income in the reference case after 2013-14. Up to 2013-14, the average propensity to consume, the converse of the savings rate, adjusts to enable the targeting of real national consumption.

Real household consumption is projected to grow by 1.9 per cent year in the reference case to 2059-60 (compared to 3.1 per cent historically). As it is the numeraire in the VUMR model, the household consumption IPD does not change from 2013-14 in the reference case. The main driver of projected household income in the reference case is growth in labour income (discussed under government consumption).

Government consumption

Government final consumption expenditure in the VUMR model moves in line with household consumption, prices and, in the case of *health care services* and *residential care & social assistance*, the share of the population aged 65 years and over.[65]

Real government consumption is projected to rise by 2.4 per cent per year over the reference case, with the government consumption IPD projected to rise by 1.6 per cent (compared to the historical averages of 3.2 and 0.1 per cent, respectively).

Part of the projected growth in government expenditure arises from ageing of the population in the reference case (section 12.1).

The projected growth in government consumption also arises from the assumption adopted that, in nominal terms, the budget balance remains fixed as a share of GDP or GSP (chapter 10). As government budget balances were in deficit in 2009-10 (chapters 3 and 10), this assumption effectively implies that government expenditure increases with economic growth. The projected increases in real government expenditure are similar for the Australian Government and for state, territory and local governments (2.3 and 2.5 per cent per year, respectively).

[65] Government final consumption expenditure in 2009-10 accounted for just over 38 per cent of all government expenditure in the VUMR model database (chapter 3).

The growth in government expenditure is projected to increase the demand for labour by government, and drive up the price of labour in the reference case. Real wages are projected to grow by 2.2 per cent per year compared to 1.1 per cent over the period 1974-75 to 2013-14. This projected growth in real wages underpins the 2.0 per cent per year annual increase in the government price index (that is, their costs).

The low rates of measured productivity growth in many industries where government expenditure is concentrated (particularly *public administration & safety*, *health care & social assistance* and *education & training*) suggest that there is limited scope for productivity improvements to allay this projected increase in expenditure.

Collectively, the growth in real government consumption (2.4 per cent) coupled with the costs faced by government (1.6 per cent) imply larger increases in nominal expenditure in the reference case than have typically occurred historically(4.0 per cent compared to 3.3 per cent).

Yet the factors that underpin this projected growth in government expenditure should also have underpinned historical government expenditure growth. The exploratory DCD analysis of historical health sector productivity discussed in chapter 7 is a first step towards better understanding the inter-relationship between government expenditure, input use, factor prices and measured productivity growth in these sectors.

Investment

Investment in the VUMR model responds to changes in the rates of return in each state industry according to the investment theory in the model (essentially responding to deviations in the actual rate of return from its long-run equilibrium rate of return). The rate of return to capital responds to changes in the demand for capital, which, in turn, reflects:

- changes in the demand for the output of that industry;
- changes in the per unit rental price of capital relative to labour;
- changes in the productivity of capital relative to labour; and
- changes in the cost of creating new units of capital.

Real investment is projected to rise by 1.2 per cent per year over the reference case, with the investment IPD rising by 0.1 per cent. This projected volume growth is slower than history (which grew by 4.6 per cent). Among a range of factors, this primarily reflects more subdued growth prospects for key capital-intensive industries such as mining and manufacturing. The factors that give rise to this slower projected growth for investment, capital and capital deepening are explored further in section 12.3. The lower historical growth in IPD compared to the reference case reflects the effect of cheaper imported capital goods.

Balance of trade

In the VUMR model, the nominal exchange rate adjusts the balance of trade to equate GDP on the expenditure side with GDP on the income side, which is effectively determined by the PPP framework outlined in chapters 2 to 11.[66]

The contributions made by exports and imports to the required changes in the balance of trade reflect the effect of the productivity assumptions (chapter 7), the external sector assumptions (chapter 8) and the nominal exchange rate.

In real value terms (relative to the model numeraire):

- the balance of trade in the reference case is projected to make no net contribution to the growth in GDP;
- exports are projected to grow by 2.1 per cent per year (compared to 4.1 per cent historically), which reflects:
  - volume growth of 2.6 per cent (compared to 5.0 per cent historically); and
  - price growth of -0.5 per cent (compared to -0.9 per cent historically); and
- imports are projected to grow by 1.6 per cent per year (compared to 4.1 per cent historically)), which reflects:
  - volume growth of 1.6 per cent (compared to 5.8 per cent historically); and
  - no price growth (compared to -1.8 per cent historically).

The limitations in modelling international trade flows in single country models such as the VUMR model are discussed in chapter 8. These limitations are likely to affect projected trade flows compared to those which occurred historically.

Composition of GDP on the expenditure side

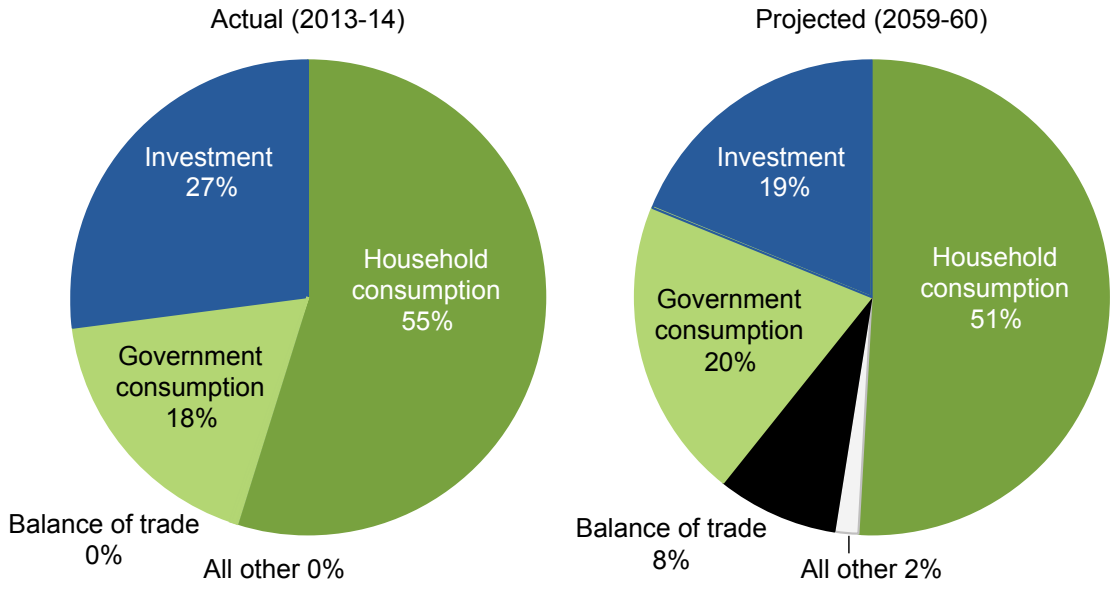
The composition of the real economy projected in 2059-60 differs from that in 2013-14, partially reflecting the end of the mining boom present in the 2013-14 data (figure 12.13).

The main differences in the projected shares of real activity are:

- a decrease in investment (down to 19 from 27 per cent in 2013-14);
- a decrease in household consumption (down to 51 from 55 per cent);
- an increase in the balance of trade — exports less imports (moving from a deficit of -0.5 per cent to a surplus of 8 per cent); and
- an increase in government consumption (up to 20 from 18 per cent).

[66] GDP on the income side measures the economy-wide income generated from production. It is calculated as the net income paid to the owners of primary factors used in production (including any taxes or subsidies levied on those factors) plus taxes less subsidies levied on the goods and services produced.

Figure 12.13 **Actual and projected composition of real GDP on the expenditure side, Australia, 2013-14 and 2059-60**



Source: ABS (*Australian System of National Accounts*, 2013-14, Cat. no. 5204.0; Estimates based on the VUMR model.

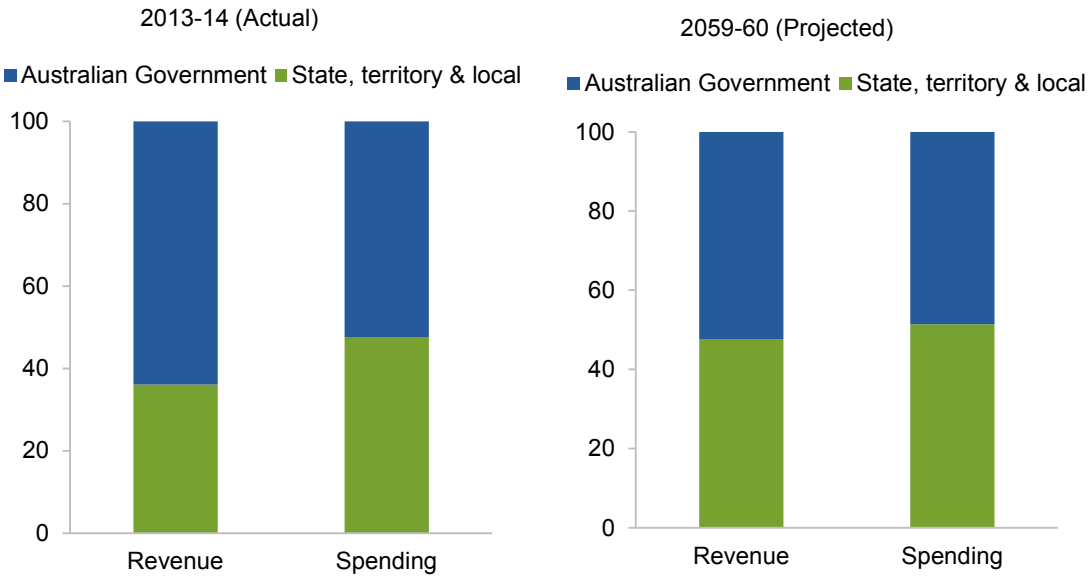
Government finances

The fiscal assumptions in the reference case (chapter 10) result in broadly similar projected growth in real government expenditure across the Australian and state, territory and local governments to 2059-60 (2.3 per cent and 2.5 per cent per year, respectively).

While the levels are projected to increase, the own-source revenue and expenditure shares for the Australian Government and state, territory and local governments are projected to remain broadly in line with current relativities (figure 12.14). That is, the Australian Government is projected to continue to raise approximately three-fifths of all government revenue to 2059-60, with the states continuing to undertake just over half of all government expenditure. Governments are assumed to maintain a fixed level of budget deficit, so any expenditure above that is funded by a lump sum transfer from households. To keep the model tractable, any excess of revenue beyond expenditure is returned in a lump sum to households and not used to reduce the budget deficits.

Figure 12.14 **Actual and projected revenue and expenditure shares by level of government, 2013-14 and 2059-60[a,b]**

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*, 2013-14, Cat. no. 5512.0); Estimates based on the VUMR model.

12.3 Exploring the sources of labour productivity growth

As flagged in section 12.2, investment growth in the reference case is projected to be lower than that which occurred from 1974-75 to 2013-14.

This section explores the apparent differences in project investment, capital and capital deepening in the reference case compared to that which occurred historically. It does so by analysing the actual and projected contributions made to labour productivity growth.

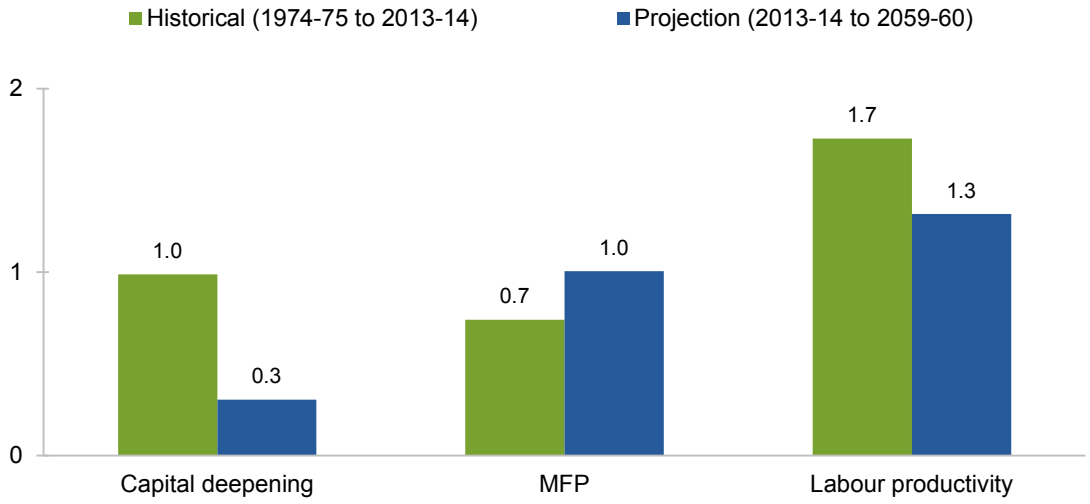
Contributions made to labour productivity growth

As discussed, annual labour productivity growth of +1.3 per cent per year is projected in the reference case to 2059-60. This growth reflects:

- a +1.0 percentage point contribution from MFP growth; and
- a +0.3 percentage points contribution from capital deepening (figure 12.15, right hand columns).

Figure 12.15 **Actual and projected average annual sources of labour productivity growth, Australia, 1974-75 to 2013-14 and 2013-14 to 2059-60**

Per cent per year



Source: Estimates based on the VUMR model.

At face value, both of these projected contributions are noticeably different from their contribution to the +1.7 per cent annual growth in labour productivity over the last 39 years, where capital deepening contributed +1.0 percentage point and MFP growth +0.7 percentage points (figure 12.15, left hand columns).

These apparent differences in the contribution from capital deepening (and from MFP growth) primarily reflect projected differences in the use of capital.

It is also worth noting that the historical contribution from capital deepening has been boosted by the significant investment activity that accompanied the recent mining boom. This investment contributed +0.1 percentage points of the historical contribution from capital deepening.

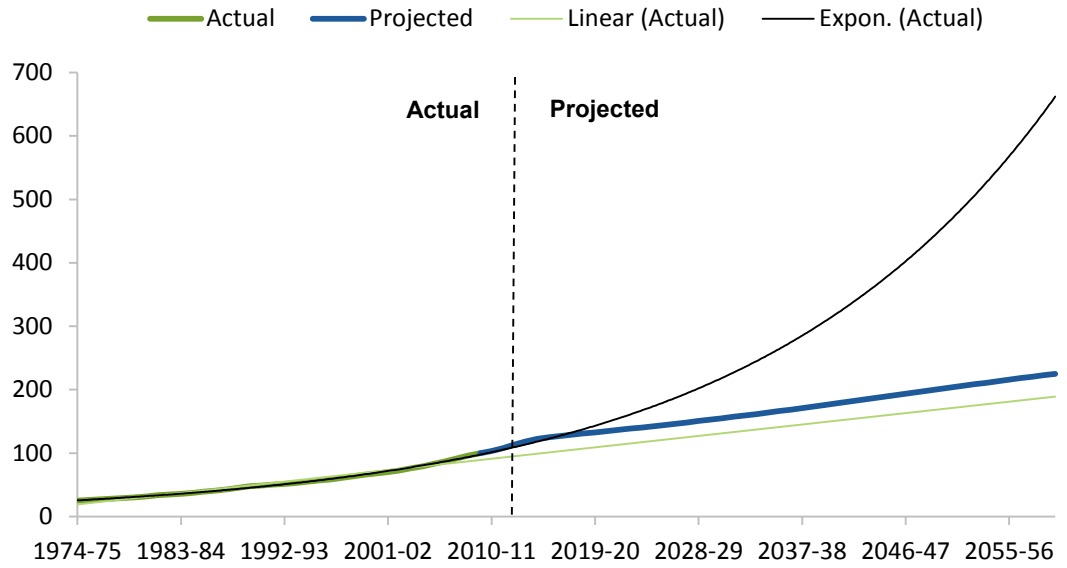
Capital input growth

The use of capital inputs is projected to grow by 1.5 per cent per year to 2059-60. This is much lower than the 4 per cent per year which occurred between 1974-75 and 2013-14.

While this difference appears large, it is worth noting that the VUMR model projections for capital input growth are above a linear extrapolation of the historic data, but significantly below an exponential trend (both figure 12.16).

Figure 12.16 **Actual, linear projection, exponential projection and modelled projection of capital input use, Australia, 1974-75 to 2059-60**

Index (Reference year: 2009-10=100)



Source: Estimates based on the VUMR model.

There are a range of issues that relate to the projected use of capital inputs and, with it, to measured capital deepening. Some of these issues relate to the historical benchmarks to which the projections are being compared and others relate to the model-based projections. These issues are discussed in turn in the remainder of this section.

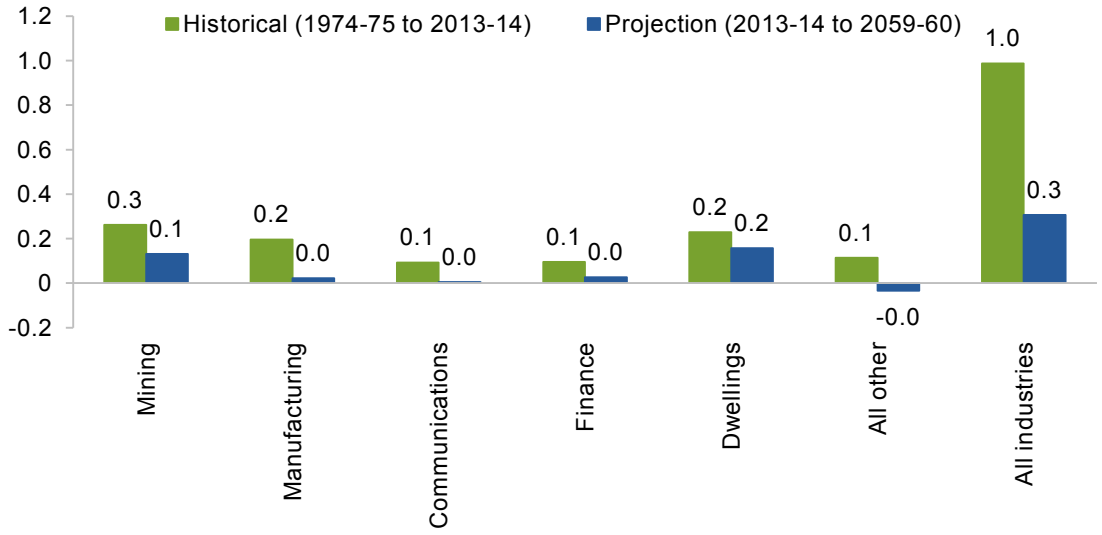
Historical capital deepening

In order to understand why the model-based projections differ from the historical estimates, an understanding is needed of the capital deepening that occurred in the Australian economy.

Most of the measured capital deepening that occurred in the Australian economy between 1974-75 and 2013-14 came from a handful of industries (figure 12.17, left hand columns).

Figure 12.17 **Actual and projected industry contribution to capital deepening in the Australian economy, 1974-75 to 2013-14 and 2013-14 to 2059-60[a]**

Percentage points



[a] Industry contribution to the aggregate contribution from capital deepening to labour productivity growth.

Source: Estimates based on the VUMR model 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).

Three ANZSIC divisions — *mining*, *ownership of dwellings* and *manufacturing* — accounted for just under 0.7 percentage points (or 70 per cent) of the historical contribution. Two more divisions — *financial & insurance services* and *information media & telecommunications* — contributed just under an additional 0.2 percentage points (20 per cent). The remaining 15 industry divisions in the economy collectively contributed the remaining 0.1 percentage point (10 per cent) to historical capital deepening.

It is worth noting that, the +1 percentage point historical contribution from capital deepening (figure 12.15) has been boosted by the significant investment activity that accompanied the recent mining boom. This investment contributed +0.1 percentage points to the historical contribution.

Prospects for this handful of industries are likely to play an influential role in determining projected capital deepening in the reference case.

Projected capital deepening

Capital deepening in the reference case is jointly determined by the closure used, the shocks applied (discussed in chapters 5 to 10), the production and investment theory in the VUMR model, the model database and the model parametrisation.

Capital deepening in the VUMR model is determined, among other things, by:

- the demand for capital and other factors of production (such as labour and land) in the VUMR model based on changes in industry output, productivity and relative factor prices (the rental prices of capital and land relative to the cost of labour); and
- investment in the model is largely driven by changes in rates of return in each state industry (which, in turn, reflects the effects of changes in industry output, productivity, the demand for factors by other industries and factor prices).

Differences between historical and projected capital deepening reflects:

- more subdued growth prospects for capital-intensive industries; and
- the effect of some conceptual and practical differences in the way that capital is measured and modelled in the VUMR model compared to that used by the ABS statistics on which the historical estimates are based (discussed in chapter 7).

Industry prospects

Growth prospects for four of the five industries that were responsible for the majority of historical capital deepening — *mining*, *manufacturing*, *financial & insurance services* and *information media & telecommunications* — are projected to be more subdued over the reference case and, as a consequence, contribute less capital deepening than they did historically (figure 12.17, right hand columns). Collectively, these four industries are projected to account for one-third of capital deepening (compared to over two-thirds historically). The exception is the *ownership of dwellings* industry, which is projected to experience broadly comparable growth.

Prospects for mining going forward are projected to be more subdued as the decline in the terms of trade creates a more muted environment for investment over the projection period than that which occurred historically.

The forthcoming closure of the passenger motor vehicle assembly industry in Australia contributes to the projected decline in capital intensity in Australian manufacturing. Moreover, the subdued prospects projected for the *oil extraction* industry is projected to subdue growth in the VUMR *petroleum & coal products* industry (which primarily engages in petrol refining).

As a result, the contribution made by *mining* and *manufacturing* to capital deepening is projected to fall from just 0.45 percentage points to 0.15 percentage points.

The effects of the model database

There are also notable differences in the industry capital stock shares in the 2009-10 VUMR database compared to those in the historical period analysed.

Two VUMR industries have materially higher shares of the aggregate capital stock in the model database than they did historically:

- *mining* accounts for 13 per cent of the VUMR capital stock compared to its historical average of 6 per cent; and
- *business services* accounts for 16 per cent of the VUMR capital stock compared to its historical average of 6 per cent.[67]

In contrast, the *ownership of dwellings* industry accounts for 25 per cent of the capital stock in the model database compared to its historical average of 33 per cent.

Projected investment growth in the VUMR mining industries in the reference case is more subdued than that which occurred historically. This means that the reference case attaches a higher weight to industries with relatively lower capital input growth. This gives rise to a much lower contribution from capital deepening by the mining sector than occurred historically.

Likewise, the contribution from the VUMR *ownership of dwellings* industry is also lower than that which occurred historically for the opposite reason, as the relatively stronger capital growth projected in this industry attracts a lower weight than it did historically.

Furthermore, despite a much higher weight in the model database, *business services* contributes little to overall projected capital deepening as its output growth is slightly below the national average.

In addition, the long-run rates of capital growth in the VUMR database that drive steady-state capital growth (the VUMR coefficient `TREND_K`) are lower those which occurred over the last 39 years (3 per cent for all state industries in the database compared to the economy-wide average capital growth of 4 per cent over the last 39 years).

Measurement issues

The relatively low level of capital deepening projected in the reference case also reflects differences between the way capital is measured by the ABS in the *National Accounts* and their productivity estimates and the measure incorporated in the VUMR model.

As discussed in chapter 7, the ABS adjusts the quantity of capital inputs used in production to reflect changes in the *quality* of that capital over time (reflecting, among other things,

[67] As its asset value is not included in the VUMR database, the capital stock shares reported do not include the asset values of land.

changes in the age-efficiency profiles of individual asset groups and the hedonic price adjustments made to control for changes in computing functionality). This gives rise to *embodied* technological change and results in changes in the quantity of capital inputs used in production rather than in MFP growth.

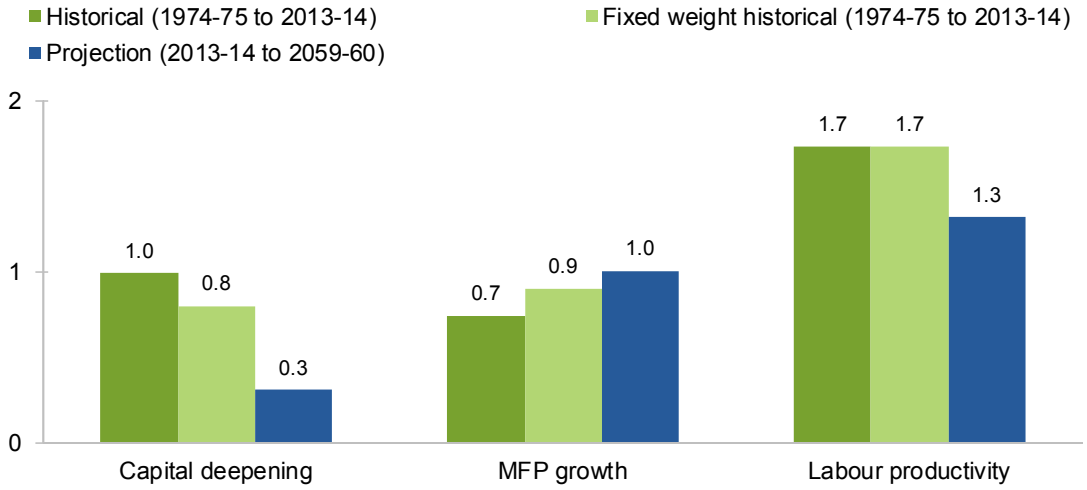
In contrast, the measure of capital in the VUMR model does not adjust for changes in the *quality* of capital used in production over the *projection* period. This gives rise to *disembodied* technological change and results in MFP growth rather than changes in the quantity of capital inputs used in production.

To the extent that the changes in input quality flow through into measured output, these changes would be expected to flow through into MFP growth in the VUMR model and into capital deepening in the historical ABS estimates. This means that these 'quality changes' would give rise to *disembodied* technical change in the VUMR model and *embodied* technical change in the historical ABS estimates.

As discussed in chapter 7, it is not possible to ascertain the extent of this effect without recourse to the detailed perpetual inventory model used by the ABS. The proxy measure of capital outlined in chapter 7 that holds each industry's mix of assets fixed to crudely approximate this effect suggests that the quality adjustments to capital inputs may have accounted for 0.2 percentage points of the difference between projected and historical capital deepening (figure 12.18).

Figure 12.18 **Actual and projected average annual sources of labour productivity growth adjusted for changes in the quality of capital, Australia, 1974-75 to 2013-14 and 2013-14 to 2059-60[a]**

Per cent per year



a Fixed weight historical: historical capital input growth holding industry weights fixed to proxy for changes in the quality of assets over time (discussed in chapter 7).

Source: Estimates based on the VUMR model.

The distinction between embodied and disembodied technical change gives rise to legitimate uncertainty concerning both historical and projected measures of capital services input use and the extent of capital deepening.

Further work needs to be done to better understand capital service use in the Australian economy and the drivers of capital deepening, both historically and into the future, and their incorporation into modelling reference cases.

Underlying source of MFP growth

The growth in capital-intensive industries will depend on the assumption concerning the underlying non-observable source of MFP growth. The modelling assumes that this growth arises from primary factor augmenting technical change. To the extent that the source of this growth is not primary factor augmenting in nature, this may give rise to some additional capital deepening at the industry level as well as affecting the level and composition of economic activity.

12.4 Summary

Projections of the level and structure of the economy are sensitive to the assumptions adopted, particularly those concerning industry labour productivity (chapter 7) and the external sector (chapter 8).

The assumptions adopted in the reference case (chapter 4 to 11) suggest that the real economy to 2059-60 may grow at a slower rate than has occurred over recent history. Additional sources of growth may be needed to maintain historical averages and to maintain living standards.

Reflecting a continuation of past trends and the assumptions adopted, the service sector is projected to grow as a share of the economy, both in terms of output and employment.

Further work is needed to project the *nominal* level of economic activity into the future. This would also require a better understanding of historical sources of price changes.

13 Areas for further research

The modelling reference case presented in this paper updates the reference case developed to assess the impacts of COAG reforms (PC 2012b). The main extensions involved the inclusion of additional macroeconomic detail.

The experience of developing the two modelling reference cases has highlighted some areas for further research that may assist in undertaking any similar exercises in the future. These research areas include:

Initial model database (2009-10)

- assessing the appropriateness of the default export demand and import substitution parameter values in the VUMR model; and
- undertaking a comparative assessment of the 2005-06 and the 2009-10 database updates and make recommendations about the selection of the next update year and recommendations for uprating between update years;

Historical estimates (1974-75 to 2013-14)

- understanding the historical drivers of capital deepening and the role played by embodied technical change (which give rise to measured increases in capital input usage) in the Australian economy and their relevance for modelling reference cases;
- identifying the underlying sources of historical MFP growth, particularly whether technical change has been primary factor-augmenting (Hicks-Neutral), labour-augmenting (Harrod-Neutral), or capital-augmenting (Solow-Neutral);
- identifying how best to incorporate state differences within a modelling reference case, especially given the high standard errors associated with published statistical measures; and
- developing the 'dual rate of cost diminution' (DCD) approach for analysing the historical source of service price change and over the projection period;

Base year to the current year (2009-10 to 2013-14)

- identifying the contribution that individual export and import commodities make to changes in the aggregate terms of trade;

- ascertaining the underlying drivers of the strong growth in import volumes, including: the role played by real price changes, changes in tastes and consumer preferences, and any other relevant drivers; and the relationship with investment;
- measuring productivity in mining industries and assessing the prospects for key export industries;
- validating and improving the National Income Accounting;

Unwinding period (2013-14 to 2024-25)

- analysing and validating of the economy-wide rate of return on capital;

Projection period (2024-25 to 2059-60)

- establishing the best approach to modelling analogous developments in the rest of the world within single country models such as VUMR;
- exploring the longer-term dynamics of government expenditure and revenue;
- giving further consideration to the timing and duration of the transition from current levels to longer-term trends, including the appropriate longer-term trends; and
- ascertaining the most appropriate ways to model substantive changes in economic activity — year-to-year changes, annual averages and how the best way to calculate these changes (discrete or continuous growth rates).

A Model closure

Table A.1 **Details of the closure used for the modelling reference case**

	VUMR variable	*Uprating (2010-11 to 2013-14)*	*Unwinding (2014-15 to 2017-18)*	*Projection (2018-19 to 2059-60)*
Model numeraire				
Household consumption price index	natp3tot	Exogenous & shocked	Exogenous	Exogenous
(a) Demography				
Total fertility rate in the next simulation year	nexttfr	Exogenous & shocked	Exogenous & shocked	Exogenous & shocked
Sex ratio (ratio of male to female births x 100)	nextpopalpha	Exogenous & shocked	Exogenous & shocked	Exogenous & shocked
Net overseas migration	f_nom	Exogenous & shocked	Exogenous	Exogenous
Change in the ratio of net overseas migration to population	d_nom2pop	Endogenous	Exogenous & shocked[a] (swapped with f_natnom)	Exogenous & shocked (swapped with f_natnom)

(continued next page)

Table A.1 (continued)

	VUMR variable	*Uprating (2010-11 to 2013-14)*	*Unwinding (2014-15 to 2017-18)*	*Projection (2018-19 to 2059-60)*
(b) Labour market				
Labour force participation rate by state	r_pop_wpop	Exogenous & shocked (swapped with f_partrate_xg)	Endogenous	Endogenous
Labour force participation rate shift term by working age and gender	f_partrate_q	Exogenous & shocked	Exogenous & shocked	Exogenous & shocked
Unemployment rate by state and occupation	unemp	Exogenous & shocked (swapped with d_unro)	Endogenous	Endogenous
Average hours worked by industry, state and occupation	r_x1lab_x1emp	Exogenous & shocked	Exogenous & shocked	Exogenous & shocked
(c) Labour productivity				
All industries (except those listed below)	x1labprod	Exogenous & shocked (swapped with a1prim) (uniform across states)	Exogenous & shocked (swapped with a1prim) (uniform across states	Exogenous & shocked (swapped with a1prim) (uniform across states
Mining industries	x1labprod	Endogenous (a1prim exogenous) [all mining industries]	Exogenous & shocked (swapped with a1prim) [Oil, NonFeOres, NonMetMins, MiningSrv]	Exogenous & shocked (swapped with a1prim) [all other than LNG]
			Endogenous [Coal; Gas; LNG; IronOre]	Endogenous [LNG]
Motor vehicles & parts; other transport	x1labprod	Endogenous (a1prim exogenous)	Endogenous	Endogenous
Electricity generation: alternative	x1labprod	Endogenous (a1prim exogenous)	Endogenous	Endogenous

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Table A.1 (continued)

	VUMR variable	*Uprating (2010-11 to 2013-14)*	*Unwinding (2014-15 to 2017-18)*	*Projection (2018-19 to 2059-60)*
(d) External sector				
Australian dollar terms of trade	nattot_aud	Exogenous & shocked (swapped with natf4p_c)	Exogenous & shocked (swapped with natf4p_c)	Exogenous & shocked (swapped with natf4p_c)
Export prices (Coal[b]; IronOre)	p4a	Exogenous & shocked (swapped with p4markup[c])	Exogenous & shocked	Endogenous
Export volumes (Coal[b]; IronOre)	x4r	Exogenous & shocked (swapped with f4q)	Endogenous	Endogenous
Australian dollar price of imports	f_natp0aud_c	Endogenous	Exogenous & shocked	Endogenous
(e) Macroeconomic				
Real national household consumption expenditure	natx3tot	Exogenous & shocked (swapped with natapc)	Endogenous	Endogenous
Real national investment expenditure	natx2tot_i	Exogenous & shocked (swapped with d_feeqror_iq)	Endogenous	Endogenous
Real government consumption expenditure:				
State, territory & local	natx5tot	Exogenous & shocked (swapped with matf5tot)	Endogenous	Endogenous
Federal	natx6tot	Exogenous & shocked (swapped with matf6tot)	Endogenous	Endogenous
Real national import volumes	natx0cif_c	Exogenous & shocked (swapped with nattwistsrc_c)	Endogenous	Endogenous
Real GDP	X0gdpexp	Exogenous & shocked (swapped with natta1prim_i)	Endogenous	Endogenous

(continued next page)

Table A.1 (continued)

	VUMR variable	*Uprating (2010-11 to 2013-14)*	*Unwinding (2014-15 to 2017-18)*	*Projection (2018-19 to 2059-60)*
(f) Other				
Non-export coal producing states[e]				
End-of-year capital stock	cap_t1	Exogenous (swapped with d_feeqror)	Endogenous	Endogenous
Change in the rate of return on capital	d_r1cap	Exogenous (swapped with f_x1cap2)	Endogenous	Endogenous
LNG production				
End-of-year capital stock	cap_t1	Exogenous & shocked[c] (swapped with d_feeqror)	Exogenous & shocked (swapped with d_feeqror)	Exogenous & shocked (swapped with d_feeqror)
Change in the rate of return on capital	d_r1cap	Exogenous (swapped with f_x1cap2)	Endogenous	Endogenous
Australian dollar export price	p4a	Exogenous & shocked[d] (swapped with f4q)	Exogenous & shocked (swapped with f4q)	Exogenous & shocked (swapped with f4q)
Motor vehicle assembly				
End-of-year capital stock	cap_t1	Exogenous (swapped with d_feeqror)	Exogenous (swapped with d_feeqror)	Exogenous (swapped with d_feeqror)
Change in the rate of return on capital	d_r1cap	Exogenous (swapped with f_x1cap2)	Exogenous (swapped with f_x1cap2)	Exogenous (swapped with f_x1cap2)

[a] Unwinding of net overseas migration to long-term trend occurs over the period to 2024-25. [b] New South Wales and Queensland. [c] Enables changes in export prices to feed into additional returns from export sales (positive or negative). [d] Western Australia and the Northern Territory only. [e] Victoria, Western Australia, South Australia and Tasmania.

B Index of boxes, tables and figures

Table B.1 List of boxes

Table B.2 List of figures

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Table B.2 (continued)

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Table B.3 **List of tables**

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