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Looking Back on Structural Change in Australia: 2002–2012

Supplement to Annual Report 2011-12

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About this supplement

This supplement provides additional data and supportive analyses for the theme chapter of the Productivity Commission's 2011-12 Annual Report (PC 2012a). That chapter, entitled 'Structural adjustment in a "multi-speed" economy', was aimed at understanding recent structural change and adjustment in Australia, particularly adjustment pressures from the natural resources boom.

This publication extends the evidence previously presented regarding the movement of labour and capital over the period from 2002 to 2012. Examining how factors of production were reallocated to more valued uses during the boom years can shed light on the mechanisms facilitating (or impeding) the capacity of the Australian economy to adapt more broadly to economic 'shocks' from any source.

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Abbreviations and explanations

Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ANZSIC	Australian and New Zealand Standard Industrial Classification
BREE	Bureau of Resources and Energy Economics
CGE	Computable general equilibrium (analysis)
CMEWA	Chamber of Minerals and Energy of Western Australia
COAG	Council of Australian Governments
DEEWR	Department of Education, Employment and Workplace Relations
DIDO	Drive-in, Drive-out
FBT	Fringe Benefit Tax
FIFO	Fly-in, Fly-out
FMG	Fortescue Metals Group
GDP	Gross Domestic Product
GFC	Global Financial Crisis
HILDA	Household, Income and Labour Dynamics in Australia
IAC	Industries Assistance Commission
IC	Industry Commission
ICT	Information and communication technologies
IVI	Internet Vacancy Index
JVS	Job Vacancy Survey

LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
MCA	Minerals Council of Australia
MFP	Multi-factor productivity
PC	Productivity Commission
PPP	Purchasing power parity
SCI	Structural change index
RBA	Reserve Bank of Australia

Explanations

Capitalisation	Throughout this supplement, the convention is used to capitalise the names of industries (ANZSIC industry divisions A to S), but not those of sectors, in the text. For the most part, sectors are broad groupings of industries. However, in the case of agriculture, mining, manufacturing, utilities and construction, the industry and the sector are equivalent (in other words, the industry and sector cover exactly the same portion of the economy).
Natural resources sector	For the purpose of this supplement, the natural resources sector extends to, and is limited to, the production of minerals and energy, and of specialised services such as exploration. As defined, this sector aligns with the ABS Mining industry division (ABS ANZSIC industry division B — table A.1). For this reason, the terms 'natural resources sector', 'resources sector', 'mining sector' and 'Mining industry' are used interchangeably.

1 Setting the scene

1.1 What is meant by structural change and structural adjustment?

There is no simple definition of structural change. This term generally describes the fact that, whenever supply and/or demand conditions change in markets for intermediate and final goods and services produced in a country, there will be direct and indirect consequences for industry outputs and structures, as well as for the use of capital, labour and land in that country. Put another way, structural change is the process through which the sectoral composition of the economy is altered in one or more dimensions (box 1.1). Sectoral shares can change when output and/or employment decrease in absolute terms in some sectors, while they expand in others. Shares can also change when rates of growth of output and/or employment differ across sectors.

In conjunction with compositional change across sectors, the geographic distribution of activities, the workforce and the population may also undergo significant changes. Such transformations of the economy are also manifestations of structural change.

In a modern market economy, 'shocks' affecting supply and/or demand are ubiquitous and varied. Some shocks (such as those caused by foreign crises) are unanticipated, others (such as seasonal influences) can be factored into decision-making. Shocks can be short- or long-lived, and their effects may or may not be durable. Some supply and demand changes will occur gradually, such as when demographic or income trends cause household consumptions patterns to vary. Other changes occur more suddenly, as shown by the relatively rapid increase in China's demand for Australia's resources and the impact of new technologies such as the Internet on production processes and consumer behaviour. Changes can be policy-induced, for example, those resulting from the imposition or removal of taxes and subsidies.

Not all supply and demand shocks affecting an economy will result in structural change. That is, some do not significantly alter the pattern of activities. However, there are enough shocks to make structural change a pervasive and continuous feature of the economy.

Box 1.1 **Defining and measuring structural change**

Structural change refers to a change in the structure of an economy. That structure is primarily defined in terms of the distribution of output across sectors (broad industry groupings), industries, states or regions. However, because production of goods and services requires primary inputs, the distribution of employment and, in some cases, investment is also of interest. The simplest way to represent the initial distribution is through the respective shares of sectors, industries or regions. Together, the shares add up to 100 per cent of the economy. Structural change implies that, over time, some shares become larger, others smaller. The larger the total proportion of (for example) output that 'changes' sectors from one period to another, the greater the magnitude of structural change in the sectoral dimension.

Changing sectoral shares of, for example, employment may translate into changing shares of other variables, such as female employment or casual employees. However, the changing gender balance or casualisation of the workforce, per se, are not usually regarded as structural change.

When distinguishing between many sectors, comparing individual shares over time becomes impractical. For this reason, changes over time in a multitude of shares are often summarised through a 'structural change index' (chapters 3 and 4).

Structural change is normally measured over the medium-to-long run, even though it can be the result of short-term shocks such as an economic downturn. There is a risk that measuring structural change over the short run could provide a distorted picture of durable economic transformations. Short-run fluctuations can be driven by changes in capacity utilisation, lumpy investment, market 'bubbles', cyclical crises, natural events such as droughts and cyclones and other irregularities.

Structural change is usually measured as changing shares in 'real' indicators, such as quantities, workers employed or hours worked. On occasions, structural change is also measured in terms of shares of output and investment at current prices. This 'value' approach has the advantage of accounting for the total amount of structural change, once price and quantity adjustments have taken place. However, output shares measured at current prices conflate the proximate causes of change (price movements) with their consequences (output changes).

Changes in the share of a particular industry should not be always construed as being caused by factors specific to that industry. Industries are mutually interdependent for their supply of inputs or their deliveries. For example, a driver of structural change that directly impacts on industry A may have significant indirect repercussions in industry B, through upstream or downstream linkages.

Structural change can happen with varying speed or intensity. Some change unfolds gradually, reflecting the nature of the forces driving it, such as: population ageing; rising educational attainment; or resource depletion. Other structural change may occur relatively quickly, such as when change is caused by: inventions or innovations; policy decisions; or international developments such as a financial crisis.

Sources: IAC (1977); PC (1998).

As the supply of factors of production (capital, labour and land) is not unlimited in the economy, expansion of one industry or sector can only occur if some others contract in relative or absolute terms.[1]

The process through which expansion and contraction occur is known as the structural adjustment process (box 1.2). It is driven by changes in the *relative* prices of goods, services and factors. Price changes initially 'equilibrate' excess demands or supplies and are the market signalling mechanism for bringing about shifts in outputs and factor use across industries. For example, higher output prices resulting from increased demand for a product signal the opportunity for higher returns from producing that product over others. As firms respond to this signal and investment and output expand, in the absence of further shocks, prices will tend to fall over time to reflect long-run production costs. Similar price signalling occurs in markets for factors of production, which leads to capital, labour and land being reallocated to uses in which they are most valued.

While relative price changes occur virtually instantaneously (unless prices are regulated),[2] the process of changing industry outputs and shifting factors of production generally takes more time. This is because there are real costs involved in adjusting quantities. For example, labour and capital are not homogeneous across industries and jobs.[3] Displaced workers may require retraining in order to secure another job. Investment in new plant and equipment can have a long lead time, and only some types of capital are easily deployed to other uses.

There will be natural as well as 'man-made' impediments to structural adjustment. Some people simply may not be suited to other types of work. Man-made impediments include regulatory impediments (such as barriers to new investments), or policies (such as subsidies) designed to cushion certain industries from market pressures. With scarce resources, protecting selected industries or firms from those pressures will generally mean that even greater adjustment pressures are placed on others.

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1 Limits to factor endowments (supplies of factors of production) are not immutable. Endowments can increase through foreign capital inflows, domestic investment, immigration or demographic change.

2 If relative prices cannot change, excess demands will lead to shortages and non-price rationing, while excess supplies initially will lead to unanticipated inventories or waste, followed by underutilised capital and unemployment. In other words, shocks would still have consequences, but generally more costly ones than if resources could move to higher-valued uses.

3 The term 'capital' is used throughout this supplement to refer to a firm's durable assets, including machinery, equipment and buildings. It is not meant to refer to 'financial' capital, such as loans and equity funds, or 'working' capital, which includes liquid funds and stocks of material, outputs and work in progress.

Box 1.2 **Defining and measuring structural adjustment**

Structural adjustment is the process whereby factors of production — land, labour and capital — are reallocated from one activity to another. Factors move more or less rapidly between activities in search of higher returns. Mechanisms underlying these movements differ, depending on the factor of production involved.

Labour reallocation

Labour is reallocated when workers change one or more aspects of their employment. This can occur through labour mobility, that is, the physical movement of workers between jobs, industries or locations. Labour reallocation can also take place without any worker changing his or her job. If, over time, new jobs are created at differing rates in different industries, the structure of overall employment will progressively alter. (Note that overseas immigration is not regarded as a form of labour mobility, in a domestic context. Nonetheless, it is one of the reasons why net job creation in one industry may take place without domestic workers changing jobs.) Finally, labour reallocation can occur through a change in a person's work arrangement so that, for example, he or she carries out a new set of tasks, according to a different schedule (Shomos et al. 2013).

Capital reallocation

As in the case of labour, reallocation of capital can take the form of existing equipment, plants and buildings being switched between activities. This type of reallocation includes trade in second-hand capital goods between firms, as well as the transfer of productive capacity within a firm (for example, between establishments or product lines). As with labour, structural adjustment in capital can take place 'at the margin', via differential rates of net capital creation across industries, sectors or regions. Capital creation within an industry may be the result of investment by established producers, or of net entry of new firms (or of firms switching between industries). Conversely, capital destruction occurs when redundant assets cannot be traded and are scrapped.

Net investment, therefore, is a structural adjustment mechanism that explains how some industries are able to increase their installed productive capacity over time. An alternative way of looking at investment flows is as a 'leading indicator' of structural change. That is, today's changes in the industry distribution of net investment may foreshadow tomorrow's distribution of output (with the caveat that future productive capacity may not be fully utilised at all times). For this reason, some authors include investment trends in their analysis of *structural change* (Connolly and Lewis 2010; Connolly and Orsmond 2011). This approach is adopted in this supplement.

Land reallocation

Land (including natural resources) can sometimes be reallocated from one type of activity to another through changes in land use and, where required, rezoning. For example, agricultural land on the periphery of capital cities may be rezoned to allow light industrial or service activities. Regulatory impediments to, for example, the establishment of large retail operations in some areas because of planning guidelines, may result in land not being allocated to its highest-value uses (PC 2011c).

Moreover, policies that unnecessarily 'throw sand in the wheels' will essentially mean that national income is lower than it could be. Generally speaking, the quicker shifts occur such that resources can be deployed in higher-valued uses revealed by price signals, the better. That said, if shifts are induced by *distorted* price signals — for example, because of unpriced, policy-relevant externalities or inefficient policy interventions — then they may not deliver net community benefits.

To understand the structural adjustment process is to be able to answer the following questions. Where did the additional resources flowing into an industry come from? How rapidly did resources move from one part of the economy or country to another? What motivated these movements? Were there any impediments to this movement? Did one sector's expansion lead to the net creation of jobs or businesses in the economy, or was this expansion entirely offset by job destruction and/or business exits in other sectors?

1.2 Sources of structural change

Modern economies are constantly buffeted by global and domestic forces, giving rise to structural change. The sources of change may or may not be expected, recurring or reversible. Before they can be discussed in more detail in the next chapter, it is necessary to explain how these sources lead to a change in the economy's structure.

Structural change as a new equilibrium on the production frontier

For structural change to take place, there must be a change in one or more of the three key variables that can be used to describe any economic system (Prescott 2006):

- Endowments — this refers to the stock of factors of production (land, labour and capital) available to an economy at a point in time for use in the production process. Endowments of land are defined to include stocks of minerals, energy, timber and water. Endowments of labour depend in part on demography, so that population ageing and immigration can bring about changes in the available supply of labour. Endowments of physical capital are measured through the stock of productive assets available to businesses and governments. This stock increases through investment and depreciates because of wear and tear.
- Technology — this term encompasses the way in which inputs are combined to produce goods and services. Technology includes not only the knowledge

embodied in hardware, but also such intangible factors as management practices and 'know-how'.

- Preferences — this refers to the varying levels of utility consumers derive from the consumption of different goods and services, in different quantities and combinations. Preferences can change for a number of reasons, but changing income levels and demographic change are the main long-term reasons.

To these three economic 'fundamentals', a fourth one is often added, termed 'institutions'. This refers to the set of laws, rules and regulations, governance frameworks and policies that constrain or encourage the acts of producing and consuming. In a structural change context, institutions are important for two main reasons. First, a change in some institutions can trigger structural change directly. An example is when reductions in tariff protection cause some industries to grow more rapidly, due to the lower costs of imported inputs. At the same time, those industries receiving less protection decline in relative terms, unless they can improve their competitiveness. Second, institutions can condition the structural change impact of other factors. A case in point is the workplace relations framework that — among setting other rules and principles — affects the flexibility of employment and workplace arrangements. For example, the impact of changing female work preferences on the economy's endowment of labour depends in part on employers' ability to offer part-time and casual positions.

If an economy did not engage in foreign trade, then it would form its own closed system. In that case, its combination of domestic factor endowments, technology, preferences and institutions would determine the structure of that economy at a given time — that is, the goods and services produced and consumed and the mix of factors used to make them. Prices of those goods, services and factors of production would also be entirely determined domestically.

But virtually all economies are open to foreign trade and international factor flows to some degree, and the relevant economic system consists of all trading partners considered as a group. It is then the *distribution* of the fundamentals across all trading partners that determines the structures of these economies. Differences in fundamentals will dictate each country's comparative advantage and, therefore, the extent and nature of its exchanges with others.[4]

4 For example, classical international trade theory postulates that gains from trade arise, on the production side, as a consequence of differences in relative factor endowments between nations (Woodland 1982). Differences on the demand side — for example, in consumer preferences or income per capita — also create scope for gains from trade (Markusen and Melvin 1988).

Given this interdependence, if one or more of the fundamentals changes in the domestic economy or in one of its trading partners', affecting relative prices for some goods or services, then all of these economies' structures will generally change also, reflecting new comparative advantages, world prices and trade patterns.

The influence of fundamentals is illustrated graphically in figure 1.1, in the context of a simplified two-sector economy that produces two tradeable goods: manufactures and natural resources (minerals and energy).

The first two panels of that figure illustrate how changes in factor endowments (panel A) and technology (panel B) affect equilibrium in a small, open economy such as Australia. In that economy, relative prices for the two goods are set in world markets, independently of domestic supply and demand conditions, including endowments and technology. In both scenarios, a change in one fundamental leads unequivocally to a change in the economy's structure, as the economy moves from point A to point B.

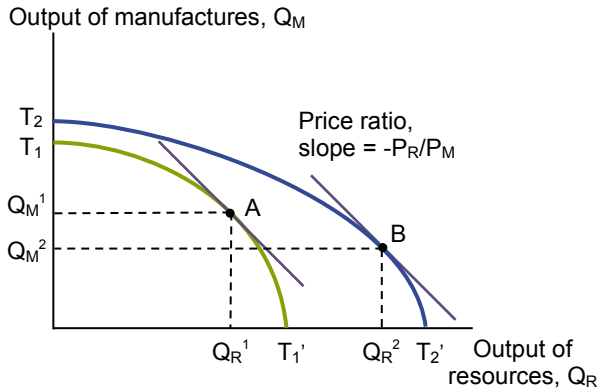
The next two panels (C and D) illustrate the consequences of a change in consumer preferences. In panel C, it is domestic preferences that are changing, in favour of manufactures. This time, the economy is assumed to be non-trading, which means that relative prices do respond to the changed demand conditions. Once equilibrium is restored at point B, more manufactures and less resources are being produced and consumed than was the case at point A.

Finally, in panel D, an increase in foreigners' preferences for Australian resources is illustrated. This time, it is assumed that such a change is sufficient to alter relative world prices in favour of resources — a broad illustration of Australia's experience during the natural resources boom. This leads to an expansion of Australian resources output as well as an increase in resources exports. Conversely, domestic manufacturing output falls and imports rise. This scenario illustrates the importance of *international relativities* in fundamentals for the economic structure of Australia. In this instance, foreign preferences for resources have increased, while Australia's have not.

It is worth noting that expanding foreign trade, in panel D of figure 1.1, allows Australian consumers to derive greater utility from their consumption of the two commodities, relative to the initial equilibrium. This is due to the fact that, in an open economy, the gains from specialisation and exchange can be exploited, so that consumption possibilities are not limited by what Australia alone can produce.

Figure 1.1 **Structural change: analytical framework and examples**

A: change in endowments (open economy)

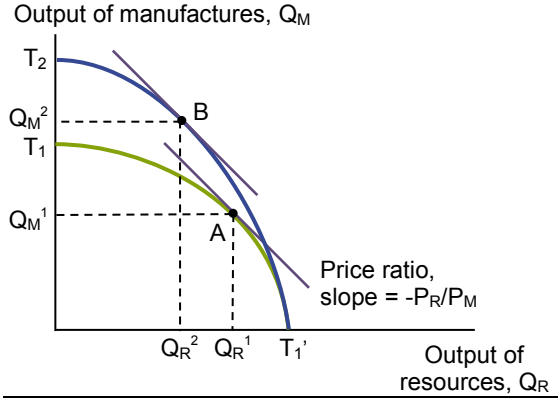


In the panel on the left, the initial equilibrium of the economy is at point A. This point is determined by the economy's production possibility frontier (T_1T_1') and the negative of the ratio of the price of resources to the price of manufactures ($-P_R/P_M$). The economy's initial structure is represented by outputs Q_M^1 and Q_R^1.

Following the discovery of new mineral deposits, the economy's endowment of 'land' increases. This shifts the production possibility frontier to T_2T_2'. Given that the world price ratio does not change, the new equilibrium is at point B. The economy's structure has now changed towards more resources output and less manufacturing output (Q_R^2 and Q_M^2, respectively).

Note that an increase in other endowments, such as labour through increased labour force participation or immigration would produce a similar effect (although not favouring resources, as that sector is normally considered to be relatively less labour-intensive than manufacturing).

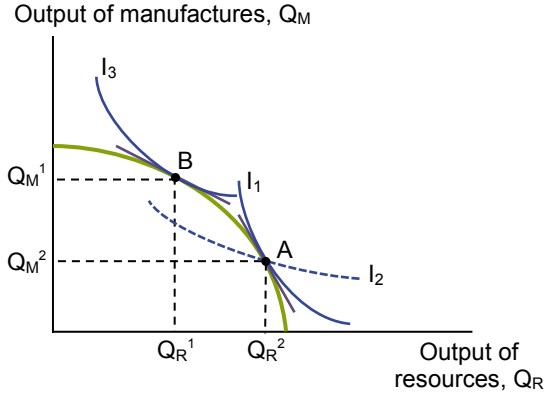
B: technological advances (open economy)



In this panel, technological advances mean that the manufacturing sector can produce a greater level of output with the same level of inputs. This has the effect of shifting the production possibility frontier towards manufactures. At the same world price ratio as prevailed initially, the economy's equilibrium moves from point A to point B.

At the new equilibrium, the improvement in manufacturing technology has caused structural change reflected in an increased share of manufacturing in production, and a commensurately lower share of resources production.

C: changing consumer preferences (closed economy)

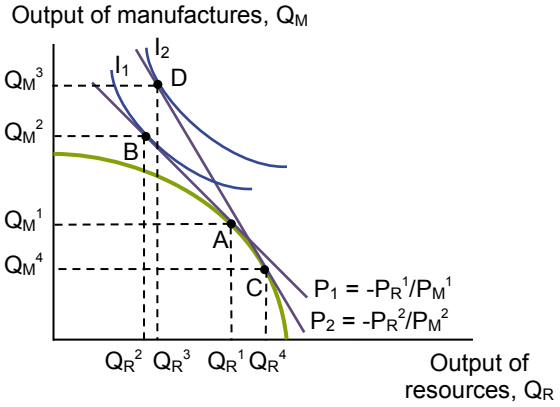


The panel on the left illustrates structural change that is fostered by changing domestic consumer preferences. At the initial equilibrium A, consumer preferences shift in favour of manufactures. This means that the initial community indifference curve I_1 going through A is no longer applicable. (An indifference curve traces out the combinations of the two goods between which consumers as a whole are indifferent.) Consumer tastes are now reflected by community indifference curve I_2, so that A is no longer an equilibrium. At that point, excess demand for manufactures causes their relative price to increase. Equilibrium is restored at B, where more manufactures and less resources are produced and consumed than before (for a higher level of community welfare on I_3).

(Continued next page)

Figure 1.1 (continued)

D: increased overseas demand for resources (open economy)



In this panel, the initial equilibrium and economic structure are defined by production equilibrium point A and consumption equilibrium point B. This means that quantity (Q_M^2-Q_M^1) of manufactures is imported and quantity (Q_R^1-Q_R^2) of resources is exported. The curve I_1 represents the community's initial consumption indifference curve.

If overseas demand for resources increases, the price of resources also rises, relative to that of manufactures. As a result, the equilibria move to C (production) and D (consumption). This translates into an increase in resource exports and an increase in manufacture imports. The structure of domestic production has changed towards resources, away from manufactures. Moreover, the welfare of the community has increased, as it is consuming on a higher indifference curve I_2. This scenario broadly illustrates the effects of the resources boom on Australia's production and consumption patterns.

An important corollary of the brief analysis presented above concerns the implications for factors of production. Whenever the position of the economy on its production possibility frontier changes, the patterns of use of, and rewards to, labour and capital change also. This is due to the fact that, as one or more of the economic fundamentals is altered (as illustrated in panels A to D of figure 1.1), excess supply and excess demand initially develop in labour and capital markets, creating pressures for adjustment. For equilibrium to be restored simultaneously in both markets, factor price movements need to occur such that, in each sector of production, the ratio of wages to capital rentals is equal to the ratio of the marginal products of labour and capital. Unless this condition is met, unused labour or capital or both will exist and the economy will operate within its production possibility frontier. The total quantity of each factor used across the economy, combined with the economy-wide price for each factor, ultimately determines how much of the nation's income accrues to workers, and how much to the owners of capital and other factors of production.

Structural change in Australia

Regardless of their stage of development, all countries experience some form of structural change. Indeed, the broad similarity of long-term patterns of change in economic structure worldwide underpins a school of thought highlighting the

so-called 'stylised facts' of structural change.[5] These stylised facts describe the three successive phases of development followed by most economies:

- the long-term decline of agriculture from its pre-development dominance
- the medium-term rise, then fall, of manufacturing as nations industrialise, and
- the long-term rise and ultimate dominance of the services sector, as nations become modern economies.

Notwithstanding these similarities, even those authors who focus on these stylised facts acknowledge the country-specific nature of much structural change (Acemoglu 2012; Herrendorf et al. 2011).

The importance of international trade and 'globalisation'

Although Australia's development trajectory accords broadly with the stylised facts of structural change (chapters 3 and 4), it stands out in some important respects. Even prior to the current resources boom, Australia has always had a much more resource-oriented economy than any other comparable developed economy. With its comparative advantage traditionally lying in broadacre rural commodities, minerals and energy — as far back as the gold rushes of the nineteenth century — Australia has tended to experience disproportionately the volatility of international commodity prices.

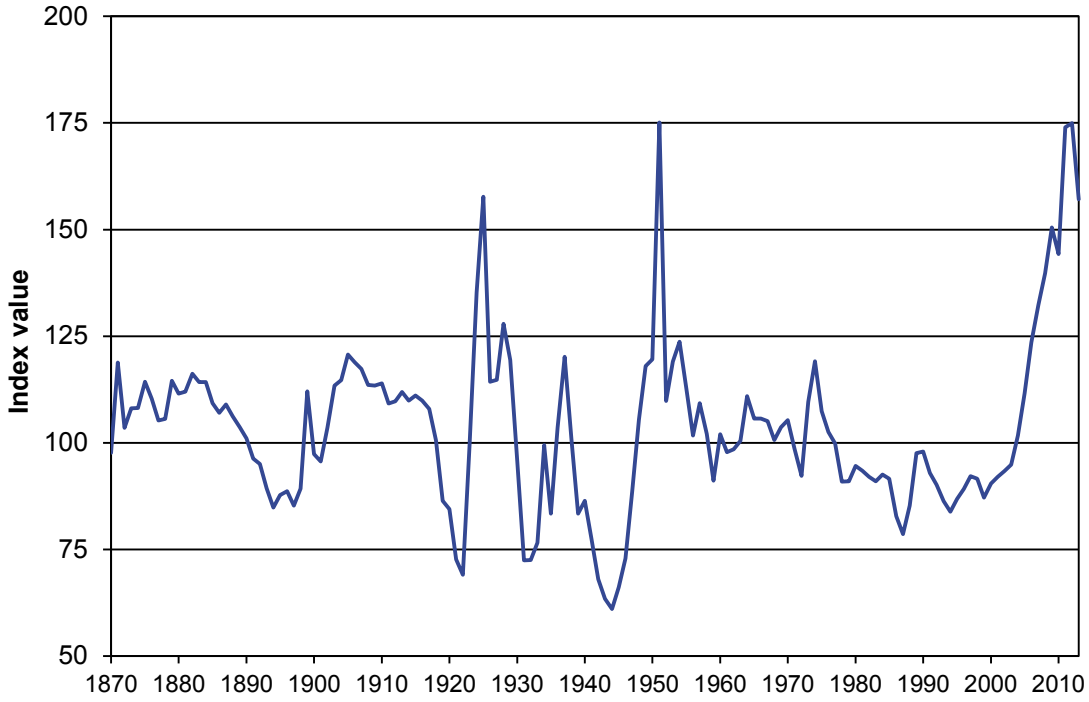
For example, during the early 1950s, the Korean War led to a spike in the demand for Australian wool that saw Australia's terms of trade reach an unprecedented high (figure 1.2). Conversely, at the time of the United Kingdom's entry into the European Economic Community in 1973, Australia lost much of that country's market for its agricultural exports (IAC 1977). This loss exacerbated other pressures felt by some major rural industries around that period, leading to a decline in their share of the economy.

Australia's sensitivity to overseas economic conditions was demonstrated repeatedly over the course of the twentieth century. On each occasion, one or more of the country's fundamentals was altered (as illustrated in figure 1.1), resulting in structural change. For example, during the early 1970s, the discovery of major bauxite and oil reserves and increased Japanese demand for iron ore and coal led to a resources boom. In the late 1970s, there was another resources boom, this time triggered by increases in the price of energy, in the wake of oil price shocks (Battelino 2010). The consequences of these resource discoveries and booms for

5 This school of economic thought is associated with the work of 1971 Nobel Prize in Economics Laureate, Simon Kuznets.

industry structure and competitiveness were the catalyst for the elaboration of the 'Gregory thesis', analogous to the 'Dutch Disease' and 'resource curse' constructs (discussed below).

Figure 1.2 **The terms of trade peaked in late 2011[a]**
Index values, 1870–2013 (1901–2000 average=100)



a Based on annual data to 1959, and seasonally adjusted quarterly data averaged over the year to June thereafter. Dates refer to the June quarter. Data for 2012-13 include only the September, December and March quarters.

Sources: Connolly, E. (RBA, Sydney, pers. comm., 28 August 2012, unpublished data) and ABS (*Australian National Accounts: National Income, Expenditure and Product, March 2013*, Cat. no. 5206.0).

The current natural resources boom is but the latest in a series of external trade shocks affecting the Australian economy. The sharp rise in the price of Australia's minerals exports, beginning in 2002-03 saw the terms of trade match the heights previously reached during the boom in agricultural export prices in the 1950s (figure 1.2).

Unlike earlier resources booms, the most recent one has proved to be long-lived. Its effects have been accentuated by the strong appreciation of the Australian dollar and a significant fall in the prices of goods imported from Asia. In the midst of these favourable developments, the occurrence of the Global Financial Crisis (GFC) led to a temporary downturn in activity which, despite being relatively mild in Australia, has nonetheless resulted in some durable effects.

Both the resources boom and the GFC have thrown into stark relief the extent to which the world economy is increasingly integrated and interdependent — in other words, 'globalised'. For example, the ratio of world merchandise exports and imports to world GDP grew from 29 per cent in 1986 to 53 per cent in 2008, prior to the downturn caused by the GFC (Productivity Commission estimates based on World Bank data). Globalisation means that countries linked by trade, financial transfers, technology, information flows, immigration and social exchanges are now enmeshed in each others' opportunities and risks. On the downside, this can mean a more rapid transmission of economic turmoil and financial crises. On the upside, it means that Australia is benefitting greatly from China's strong demand for steel, underpinned by rapid industrialisation and urbanisation and a growing standard of living.

Based on the KOF index of globalisation for 2012, Australia was the 21st most globalised country, in overall terms, and the 32nd highest globalised country in economic terms (out of 208 countries).[6] For Australian producers, globalisation presents both opportunities and risks. On the one hand, markets for traded goods and services are now larger and, in particular, Australia's minerals and energy are in great demand. Technology has also enhanced the ability of many Australian firms to achieve lower production costs through access to cheaper imported inputs, or through the outsourcing of some activities (including services) to overseas suppliers.

Technological advances are often put forward as an enabler of globalisation (Langhorne 2001, cited in Dreher, Gaston and Martens 2008). Improvements in transport and communication technology have fostered countless innovations in the ways of 'doing business' internationally and improvements in the range, speed and ease of international transactions.

Globalisation has also had a downside for some domestic producers. For example, the Australian motor vehicle, printing and publishing industries have lost domestic market share to overseas competitors. But not all firms in these and other trade-exposed industries are similarly affected. Some have been able to harness the increasing geographic dispersion of production processes to their advantage (box 1.3).

6 See http://globalization.kof.ethz.ch as well as Dreher, Gaston and Martens (2008) for details of the index. KOF is the acronym for the German word 'Konjunkturforschungsstelle', meaning 'economic research agency'. The index is produced under the auspices of the Swiss Economic Institute.

Box 1.3 **International value chains and 'made in the world'**

A value (or supply) chain is defined as 'the unbundling of stages of production across different countries, based on their cost advantages' (Lamy 2012). An example of a value chain is that underlying the manufacture of an Apple iPhone. Although iPhones are assembled in China for export to the rest of the world, it has been calculated that the value added embodied in each unit is created in a range of countries, with China among the smallest value adders. As a result, an iPhone is literally 'made in the world'.

The concept of a value chain emphasises that, increasingly, trade between countries is made up not of trade in finished products, but of trade in intermediates, tasks and value added. Thus, a country's exported goods can incorporate parts and labour supplied, via imports, by a multitude of other countries. For example, it has been estimated that, in 2005, a third of the value of Norway's exports was accounted for by the imported inputs they contained. This proportion was higher in manufacturing than in services.

The increasing dispersion of production activities across countries provides additional opportunities for countries to become part of a chain, at a level commensurate with their capabilities and endowments. As the tasks required to assemble a particular good are increasingly split-up and distributed, countries become better able to exploit their comparative advantage in building one or more components, rather than the whole product.

The rising importance of value chains has been underpinned by the rapid growth of foreign direct investment (FDI) within world trade. Many FDI flows represent a multinational company's funding of upstream and downstream activities carried out by its overseas subsidiaries or foreign affiliates. For example, over the last ten years, the US company Boeing has invested in excess of $500 million in plant, equipment, training and research laboratories (such as CSIRO) in Australia.

Sources: Lamy (2012); Isakson (2011); Austrade (2012).

1.3 Why is structural change of policy interest?

As mentioned earlier, structural change cannot take place without accompanying adjustments. Accordingly, the potential benefits of structural change cannot be realised until structural adjustment takes place. However, structural adjustments are not costless. It is this feature that causes community concern and motivates much of the government interest in this area.

Promoting the benefits of resource reallocation

In a market economy, scarce productive resources will tend to flow to their highest-value uses. If, for example, changing preferences of foreign consumers

mean that overseas demand for Australia's minerals and energy increases, relative prices received by Australian producers will come to reflect this shift in market conditions. In time, resources will be reallocated to the production of the more highly-valued product.

This is the process illustrated in figure 1.1(D) by a movement of the economy along its production possibility frontier, which results in more natural resources being produced (and exported) and fewer manufactures being produced (while more are imported). The movement of the economy along the frontier need not be smooth or orderly, particularly in response to large shocks, where structural adjustment cannot be easily accommodated within the context of economic growth. In the domestic sector less favoured by overseas demand, some or all firms will need to reduce their output and, possibly, higher-cost ones to close their doors. In the favoured sector, there will be increased production and likely entry of new firms, attracted by the higher relative prices (and, hence, returns).

In practice, the sector experiencing declining relative overseas demand often finds itself doubly hampered, because the shift of the economy towards resources exports tends to result in its decreased competitiveness both at home and abroad (via exchange rate appreciation and rising domestic input costs). This is, in essence, the 'Dutch Disease' scenario already mentioned (box 1.4). Notwithstanding their negative connotation, the adjustments that follow the initial shift in overseas demand are both predictable and desirable. In other words, they are likely to produce net community benefits.

Nevertheless, a range of factors can prevent those benefits from being realised in full. First, adjustment relies on timely, accurate and transparent price signals. If those characteristics are present, firms and consumers adjust their behaviour in ways that are inherently efficient. If, conversely, price signals are obscured, delayed or distorted, perhaps by government regulation or policy (or its absence, in the case of policy-relevant externalities), efficient adjustments may not take place to the same extent, if at all. For example, government assistance to an internationally uncompetitive industry might prolong its claim on resources that could be employed more productively elsewhere. In terms of figure 1.1(D), movement of production from point A to point C would not take place.

Box 1.4 **Is Australia suffering from the Dutch Disease?**

The term 'Dutch Disease' was coined in the 1970s to characterise structural change in the Netherlands economy, following the discovery and exploitation of North Sea gas reserves. Other terms used to describe the same set of changes include 'booming sector effect', 'deindustrialisation', 'resource curse' and, in Australia, 'Gregory thesis' and 'two-speed economy'.

The key structural changes underlying the Dutch Disease are, in addition to the expansion of the booming resources sector, the relative contraction of the non-booming industries (traditional exporters, but also providers of inbound tourism services) and import-competing industries. At the same time, the sector producing non-tradeable commodities (mainly services) expands in relative terms. These sectoral shifts are brought about by two separate effects:

- Resource movement effect — as the booming sector expands, it draws resources away from other parts of the economy. This is the scenario illustrated in figure 1.1(A).
- Spending effect — a boom in exports of resources generates additional income in the economy. For example, the additional income generated in Australia by the higher terms of trade has been estimated at 15 per cent or more of Gross Domestic Product (Stevens 2011). Part of this extra income is inevitably directed at non-tradeable goods, the price of which increases (the price of tradeables cannot rise as it is set by world markets). As production of non-tradeables becomes more profitable, that sector draws resources away from both the booming and non-booming sectors.

At the end of this process, the non-booming tradeables sector has unambiguously shrunk, in relative terms. Moreover, the real exchange rate — the ratio of non-tradeables prices to tradeables prices expressed in domestic currency — has appreciated. During Australia's resources boom, the transformation summarised above was accelerated by the historic rise in the terms of trade and the high value of the Australian dollar.

The term 'disease' suggests harmful effects, not least the contraction of the non-booming tradeables sector. However, this was not the long-term experience of the Netherlands and nor should it be in Australia. A better description is 'multi-speed' economy, which more accurately conveys that leading and lagging sectors have always been a reality in Australia. Recent structural transformations are, in many cases, consistent with longer-term trends.

The real appreciation of the exchange rate is the economy's response to the heightened price of natural resources and it is the key trigger for the necessary reallocation of factors of production from one part of the economy (the non-booming sector) to others (the natural resources and non-tradeables sectors). Put another way, in an economy close to full employment, growth in non-traded activities can only be accommodated through the relative contraction of other parts of the economy.

Sources: Corden and Neary (1982); van Wijnbergen (1984).

Moreover, if factor use and rewards are unable to respond to pressures for change, some resources could become unemployed. This is not to say that no adjustments would occur; in a context of factor or product markets rigidity, the adjustments taking place are those enforced on some economic agents that would otherwise have benefited from changing circumstances. An example of such adjustment occurs when some consumers or firms pay more for some goods or services than they would have, had the economy adjusted fully. Another is when a sector is unable to expand fully, due to the fact that resources are 'locked in' by economic distortions. In both these scenarios, 'negative' adjustments mean that community welfare lies below its potential.

To avoid such an outcome, it would be important for governments to address distortions and rigidities — in both product and factor markets — that may have accumulated over the years. This rationale for government intervention was re-emphasised recently by the Secretary of the Department of the Treasury:

> We also need to ensure that our scarce resources can move quickly so that we can take full advantage of the opportunities before us. Workers, investors and entrepreneurs must be able to direct their resources according to their best judgements and in response to appropriate price signals. To ensure that price signals are good guides, we need to maintain and foster healthy competition by regulating against price distortion and supporting dynamic and efficient markets. (Parkinson 2012)

On the other hand, beneficial adjustments may not take place because of market failures. For example, information gaps and credit constraints can mean that those affected by structural change are unable to respond as efficiently as they might. As an illustration, possible responses for newly laid-off workers might include upskilling, retraining, relocating or starting a small business. Yet, workers might lack the information about the costs and benefits of each option, or the financial means to act. Thus, they may become unemployed or leave the labour force altogether, even though they could and would prefer to be employed in another part of the economy. This represents a costly outcome for the economy, in terms of output forgone, skills decay, increased government transfers, and psychological damage to individuals.

In some cases, a change may be so sudden, unforeseen or large, that the adjustments required of some groups would be extremely costly or considered inequitable by the community. Changes introduced by governments and other public institutions are often perceived to fall into this category. According to the Industries Assistance Commission:

> Because some Government decisions have an obvious and immediate effect on the economy many people see changes in government policy as the major source of structural change in the economy. (1977, p. 45)

Instances of institutions-induced structural change are many, such as when governments began to reduce tariff protection of Australian industry in the 1970s, thus putting pressure on manufacturing's share of employment and output. In subsequent decades, further waves of microeconomic reform — including under the National Competition Policy — caused significant structural change in a number of industries, such as Electricity, gas and water and Transport and communication (De Laine, Lee and Woodbridge 1997; PC 2005c).

Government policies can have a multitude of structural effects, not all of which are readily identifiable. Policies may apply across-the-board, but create differing pressures for change on different industries (for example, environmental regulations). Or policies may just target a single industry — for example, with the aim of reforming its operation — but in doing so affect others indirectly, through inter-industry and income effects. In either scenario, identifying the 'winners' and 'losers' from the policy can be a complex task. For example, it is necessary to assess whether any group is likely to be materially more disadvantaged by the intended policy than could be expected under a baseline 'market churn' scenario:

> Individuals and firms win or lose from market-based changes every day. This is usually considered to be part of the normal operation of markets. For the losers, assistance beyond the social safety net and generally available measures is rarely provided. (PC 2001, p. 42)

Complicating factors abound in this type of exercise, such as when a change disadvantages wage earners but favours owners of capital in the same industry (or vice versa). If some individuals belong to both groups, estimating net gains or losses becomes even more challenging.

Those technical difficulties aside, governments will sometimes opt to provide assistance, over and beyond what is available through the safety net, to those groups put at risk of inequitable outcomes by structural change (policy-induced or not).

Further discussion of the potential benefits and costs of structural adjustment, and of appropriate policy settings, may be found in PC (2012a, 2001).

1.4 Aims and structure of this supplement

In a reflection of the importance of structural change and structural adjustment for economic growth and community welfare, the Productivity Commission and its predecessor organisations have devoted a number of publications to exploring these

themes (box 1.5).[7] A recent instalment in this suite of publications was contained in the theme chapter of the 2011-12 Annual Report, entitled 'Structural adjustment in a "multi-speed" economy' (PC 2012a). This supplement provides additional data and supportive analyses for this theme chapter, although its scope differs slightly in parts. The supplement includes a case study of the natural resources sector, which was a large part of the structural change and adjustment unfolding during the decade to 2012.

Box 1.5 **Selected Industry Commission and Productivity Commission publications on structural change and structural adjustment**

- Industry Commission 1993, *Impediments to Regional Industry Adjustment*, Inquiry Report, Canberra.
- De Laine, C., Lee, K. and Woodridge, G. 1997, *Microeconomic Reform and Structural Change in Employment*, Industry Commission, Staff Research Paper, no. 6, Canberra.
- Productivity Commission 1998, *Aspects of Structural Change in Australia*, Research Report, Canberra.
- Productivity Commission 2001, *Structural Adjustment — Key Policy Issues*, Commission Research Paper, Canberra.
- Thompson, G., Murray, T. and Jomini, P. 2012,* *Trade, Employment and Structural Change: the Australian Experience*, OECD Trade Policy Working Papers, no. 137, Paris.
- Productivity Commission 2012, *Trade & Assistance Review 2010-11*, Annual Report Series, Productivity Commission, Canberra, May (see chapter 4).
- Productivity Commission 2012, *Annual Report 2011-12*, Annual Report Series, Productivity Commission, Canberra, October (see chapter 1).

* Paper contributed by Productivity Commission researchers to the International Collaborative Initiative on Trade and Employment, coordinated by the OECD.

The remainder of this supplement is structured as follows.

Chapter 2 examines the global and domestic forces behind structural change in Australia, using a range of indicators. The potential implications of these forces for particular industries are also considered, as is selected empirical evidence.

Chapters 3 and 4 describe, measure and analyse the various manifestations of structural change over the last ten years and longer, using a wide range of output, investment and employment data. This allows a consideration of whether the pace

[7] Available from www.pc.gov.au.

of change accelerated in recent times, compared with earlier periods. Similarities and differences in the nature of change in successive decades are also highlighted.

Chapter 5 explores in greater detail the underlying mechanisms at work for labour market adjustment. This requires going beyond the trends observed at the sectoral and industry level to examine changes at the level of the individual worker, such as changes in labour force status and job location.

Chapter 6 provides a detailed case study of the natural resources sector[8] that serves to illustrate many of the trends and responses identified in preceding chapters. The rapid expansion of resource sector employment and investment in the last decade or so are forms of structural change made possible, in part, by the economy-wide reallocation of factors of production. Given the geographic concentration of mining areas, such movement has led to structural change at a geographic, as well as an industry, level.

8 The terms 'natural resources sector', 'resources sector', 'mining sector' and 'Mining industry' are used interchangeably in this supplement. Appendix A provides a definition of the natural resources sector.

2 Drivers of recent structural change

Key points

- Both global and domestic developments have driven structural change in the Australian economy in recent decades.
- Improvements in communications and transport technologies, combined with more open policies in Australia and overseas, have led to an expansion of international capital flows, increased trade (particularly in industry inputs) and greater labour mobility. This has given domestic producers access to cheaper capital and intermediate goods and to more skilled labour, but has also increased the competitive pressures that some of them face.
- Given Australia's relative endowments of capital, labour and natural resources, rising global connectedness can be expected to have contributed to the relative expansion of industries that are more intensive in the use of capital and higher-skilled labour.
  - It is also likely to have reduced the relative output and employment shares of import-competing industries that are more intensive in their use of less-skilled labour.
- Domestic forces have also continued to operate, with wide-ranging impacts.
  - Increased labour force participation among women and older Australians, combined with rising average educational attainment, are likely to have been both causes and consequences of structural change.
  - Population ageing, rising incomes and changing tastes have resulted in an increasing proportion of household spending on services such as health, education, housing and communications. Shares of spending on goods, particularly food, clothing and consumer durables, have declined.
- Policy changes and microeconomic reforms, particularly since the 1990s, have exposed Australian firms to increased competitive pressures, stimulating greater efficiency and fostering reduced prices for consumers and downstream producers. More recently, COAG reforms have sought to reduce regulatory burdens on firms and to increase the national stock of human capital.
  - While many of these reforms drove structural change in their own right, they also made the economy more responsive to other sources of structural change.

This chapter examines the range of global and domestic factors that have affected the structure of the Australian economy in recent decades. Many of these factors — from trade and foreign investment to technology, population ageing and policy initiatives — have affected most developed economies. As a result, Australia has

had experiences in common with many other nations. However, Australia's distinctive characteristics — plentiful natural resources, a small but skilled population and long-standing international openness — have resulted in structural change that differs in several respects from that observed elsewhere.

Section 2.1 discusses global forces, including the growth in international trade and investment, as well as recent events such as the terms of trade increase and the Global Financial Crisis. Section 2.2 considers domestic forces: population ageing; participation in education and the labour market; microeconomic reforms; and changing consumer preferences.

2.1 Global forces have brought opportunities and challenges

Recent decades have seen greater interconnectedness between the Australian economy and the rest of the world, with strong growth in international flows of goods, services and capital, and increased labour mobility. As observed by Downes and Stoeckel (2006), this interconnectedness (often described as 'globalisation') has brought greater opportunities for many firms and consumers but, at the same time, has heightened competitive pressures and the Australian economy's sensitivity to external shocks. It has yielded widespread benefits for consumers and for firms who have enjoyed increased access to imported goods and services, financial capital and labour. However, globalisation has also placed substantial pressure on domestic producers in import-competing industries.

A combination of differences in relative factor endowments and consumer preferences across economies, technological advances, and domestic and overseas policies have driven the observed increases in the mobility of goods, services and factors of production between countries.

- Differences in relative endowments of factors of production — capital, skilled and unskilled labour, land (including natural resources) — give rise to potential gains from trade and exchange between countries. These relativities are not fixed. Countries' endowments can alter as a result of factor accumulation — through investment (in physical and human capital), immigration and importation — and depletion (for example, diminishing ore grades).
- Consumer preferences can evolve with economic development and with social and cultural change, also giving rise to opportunities for mutually beneficial exchange between nations.

- Improvements in technology have dramatically lowered the cost of transport and communications, reducing the costs of international exchange.
- Policies to promote openness — particularly the liberalisation of trade and foreign investment — have lowered barriers to the international movement of goods, services and factors of production.

All these developments are reflected in changing demand, supply and prices in world markets for tradeable goods and services.

This section begins with a brief consideration of the impacts of technological advances and of domestic and international policy reforms. It then turns in greater detail to the major manifestations of increased global interdependence, highlighting the expected implications of these global forces for industry shares of economic activity in Australia.

Technological advances

Broadly, technological change refers to an increase in the set of feasible production possibilities, as a result of a change in the nature or quality of the inputs used in production, or in the way that they are used. As an example, the use of 'self check-out' machines enables supermarkets to produce a given retail output at a lower cost than previously, using a different combination of inputs (labour, capital and intermediate goods).

Some highly significant areas of technological change in recent decades have been in telecommunications and Internet technologies (Manyika and Roxburgh 2011) and in freight and logistics (Downes and Stoeckel 2006). These advances have dramatically lowered the costs of communication and transportation, expanding access to and use of these technologies by both producers and consumers. This has had profound implications for economic activity within and between national economies, including:

- reduced costs of international trade and investment
- more accessible international travel and increased cultural awareness and cross-country links, facilitating labour mobility
- increased productivity across many industries relying on transport and communications as key inputs
- changes in relative factor prices between capital, skilled and unskilled labour.

Using computable general equilibrium (CGE) analysis, Giesecke (2004, 2008) estimated that, over the period 1996-97 to 2001-02, technological change was the

key driver of change in output by industry. For example, technological advances were largely responsible for output growth rates of between 10 and 55 per cent (over five years) in knowledge-based services industries such as financial services, communications and other business services.

Technological changes have introduced new ways of doing things. Recent growth in the popularity of online retailers — driven by access to Internet technologies (box 2.1) and falling international freight costs — now presents a growing challenge to the traditional retail model. In the Australian context, the Commission estimated that in 2010, approximately 4 per cent of the value of total retail sales in Australia took place via domestic online retailers, and a further 2 per cent were via overseas online retailers (PC 2011b). Although this particular issue has attracted public debate in regards to its impact on some Australian producers, other domestic producers and consumers have benefited from cheaper access to goods and services.

Box 2.1 **Rapid expansion in access to communications technologies**

The proportion of individuals across the world using Internet and mobile telephone technologies has increased dramatically over the past few years, according to data collected by the International Telecommunications Union.

In 2013, an estimated 39 per cent of individuals worldwide were using the Internet, a figure that more than doubled from 16 per cent in 2005. (In 2013, 77 per cent of people in developed countries used the Internet.) The global number of mobile telephone subscriptions was 6.8 billion in 2013, almost equal to the world's population. In contrast, the penetration of mobile telephones was just under 34 per cent in 2005. Convergence of delivery platforms means that individuals are increasingly accessing the Internet via their mobile telephone service: mobile broadband subscriptions grew seven-fold from 4 per 100 inhabitants in 2007 to almost 30 in 2013, reaching 75 in the developed world.

Australia has been no exception to these trends, with mobile telephone subscriptions increasing from 57 to 108 per 100 people in the decade to 2011 (latest available figures). Over the same period, fixed broadband subscriptions grew from less than 1 to about 24 per 100 people. By 2011, 79 per cent of Australians were using the Internet, compared to just over half of the population in 2001.

Source: ITU (2013).

In addition to their impact on the demand facing some industries, information and communications technologies (ICT) can generate structural change via their varying impact on industry productivity. Parham, Roberts and Sun (2001) found that, depending on the industry, ICT contributed between 4 and 68 per cent of all labour productivity gains recorded during the 1990s. That contribution was particularly high in Accommodation, cafes and restaurants (68 per cent) and Finance and

insurance (52 per cent). By contrast, it was low in Mining (4 per cent) and Agriculture (10 per cent).[9] Such large differences in the productivity impact of ICT can explain part of the changes in industry output and employment shares observed over a period.

Policies and institutions

Policies and institutions can affect the extent and nature of Australia's engagement with the rest of the world and so result in structural shifts in the economy. This may happen directly, such as when trade barriers are removed at home or abroad. It can also happen indirectly, such as when similarities or differences between Australia's domestic policies and those of other countries create opportunities for international arbitrage and cost minimisation by firms. To give an example, climate change policies have the potential to cause structural change across the Australian economy (box 2.2).

Box 2.2 Climate change policies and structural change

In one sense, the purpose of climate change policies is to achieve structural change. That is, these policies seek to affect both production and consumption patterns so that the share of emissions-intensive industries in an economy declines over time. Due to carbon pricing, for example, energy producers face increased costs if they continue to rely on coal-based technologies, encouraging them to switch to renewable sources of energy. For their part, energy consumers, and consumers of emissions-intensive products such as alumina, also face higher prices, unless they switch to more emissions-efficient products.

As a result of price signals on both the supply and demand sides of some markets, output and employment shares of emissions-intensive industries (or firms) should progressively decrease.

Sources: PC (2011a, 2012e).

The wide-ranging trade and financial liberalisation implemented in Australia in the 1980s and 1990s — including reductions in tariffs and industry assistance, floating of the exchange rate and reduction in restrictions on foreign banking and investment — have been institutional factors contributing to the sustained growth in trade and investment observed in the past few decades. Patterns of trade and investment have also been shaped by Australia's participation in bilateral and regional trade

9 The terms 'natural resources sector', 'resources sector', 'mining sector' and 'Mining industry' are used interchangeably in this supplement. Appendix A provides a definition of the natural resources sector.

agreements. Recent Commission analysis suggests that tariff preferences in such agreements can affect the volume of trade between Australia and the countries with which it enters into such agreements, but typically at the cost of trade with other countries being diverted (PC 2010a). The study concluded that any increase in national income from preferential trade agreements is likely to be modest and fall short of the gains from multilateral reforms.

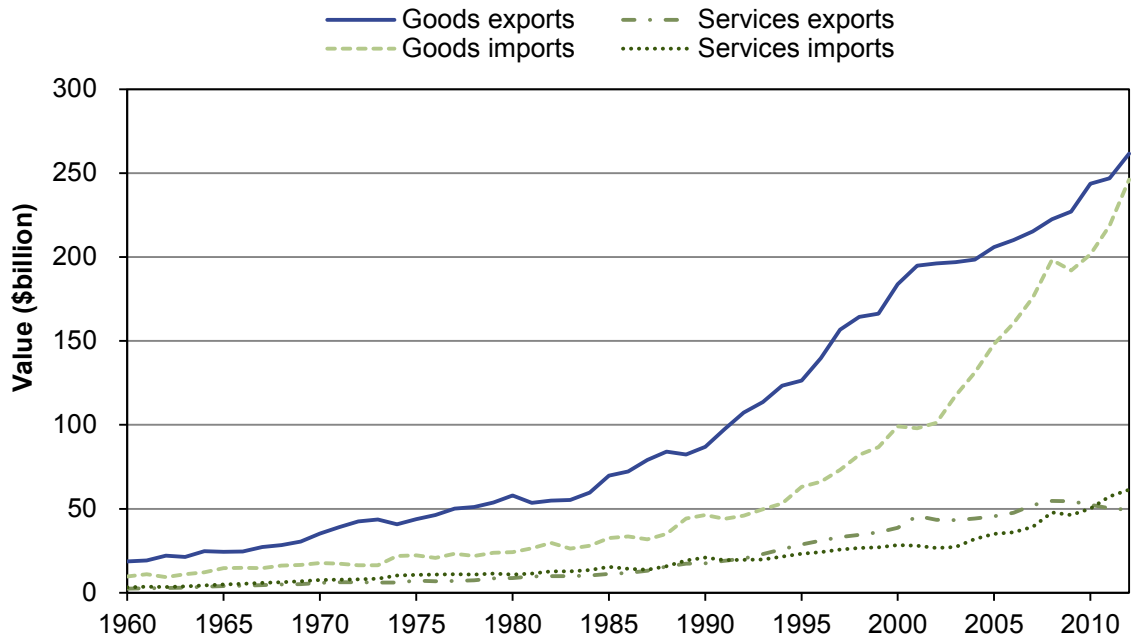
As another example of the role of institutions, the expansion of the permanent migration program (a policy initiative aimed at increasing skilled migration) has been an important contributor to the growth in immigration during the 2000s. Similarly, changes to regulations governing foreign residents studying and working in Australia, including on Temporary Work (Skilled) (subclass 457) visas, have brought about changes in temporary migration over the last ten years (PC 2010b).

Increasing trade volumes and lower-cost imports

Worldwide, growth in real per-capita incomes, reduced trade barriers and lower transport and communications costs have resulted in large increases in trade volumes in the past 50 years. In real terms, Australia's exports of goods and of services, and imports of services, have each almost tripled since 1990; imports of goods have grown nearly five-fold during the same period (figure 2.1). As a result, the degree of openness of the Australian economy, when measured by the sum of imports and exports as a proportion of GDP, has grown over recent decades, although most of the increase took place in the 1980s and 1990s (figure 2.2).

On the export side, the growth of China and other emerging economies has contributed to large increases in world demand for Australia's mineral and energy resources. This is reflected in the high export prices received by the Mining industry during the 2000s (figure 2.3). Export prices received by agricultural producers, by contrast, grew more slowly, on the whole, during that decade. Moreover, they experienced volatility from the 1980s onward, reflecting the impact of natural events in a number of major producing countries. Manufacturing export prices have also been somewhat volatile, although their growth outstripped that of agricultural prices over the 1974–2012 period.

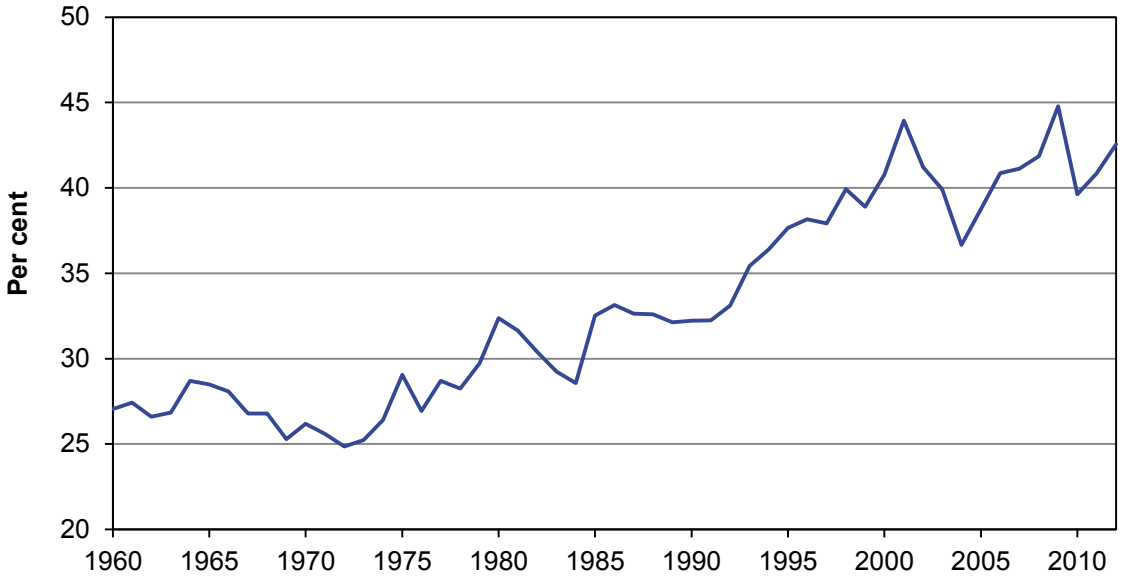
Figure 2.1 **Imports and exports volumes, 1960 to 2012[a]**



[a] Chain volume measures for year ended June. Reference year is 2010-11.

Source: ABS (*Balance of Payments and International Investment Position, Australia,* Cat. no. 5302.0).

Figure 2.2 **Foreign trade as a proportion of GDP, 1960 to 2012[a]**

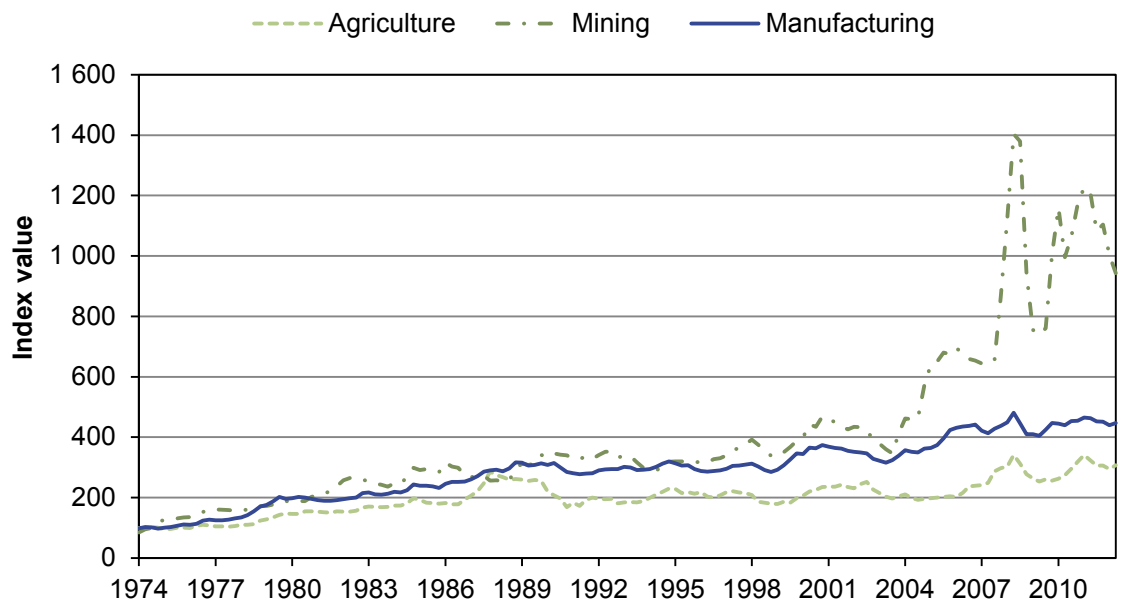


[a] Measured as imports plus exports as a percentage of gross domestic product, based on current price data for year ended June.

Source: ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0).

Figure 2.3 **Export prices, selected industries, 1974 to 2012**[a, b, c]

Export price index (1974-75=100)



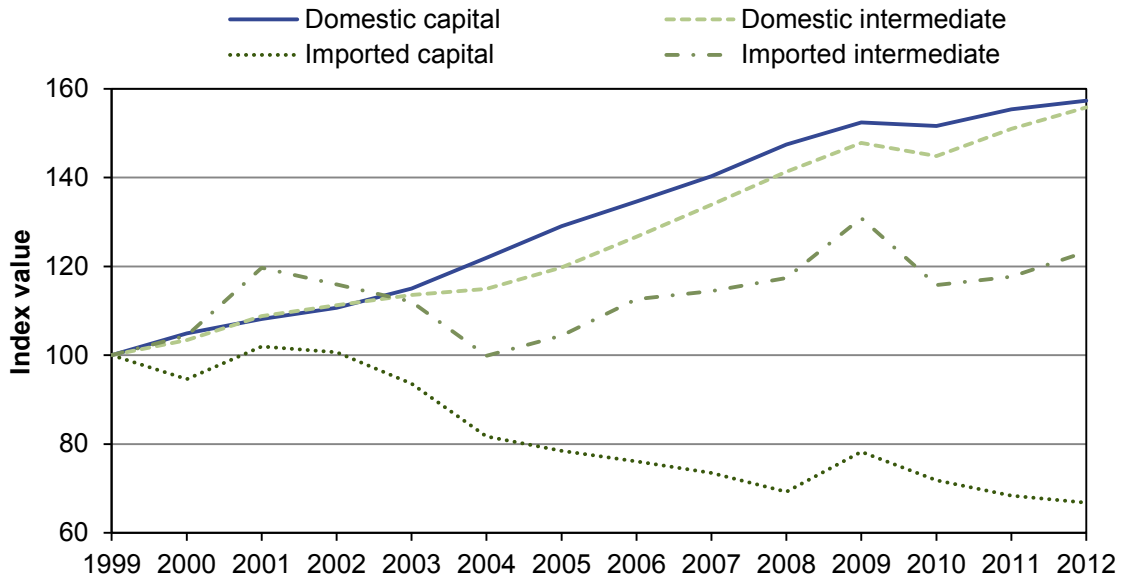
[a] Quarterly data from September 1974 to December 2012. Date labels refer to the June observation. [b] Industry classifications (including Mining) and industry subdivisions (including mineral and energy commodities produced by Mining) are outlined in appendix A.

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

With respect to imports, the rapid industrialisation of China and other emerging countries such as Malaysia, Indonesia and Thailand has significantly increased the supply of lower-cost imported manufactured goods. At the same time, technological advances have reduced the price of high-technology goods (which Australia tends to import rather than produce domestically) (Gruen 2001). Consequently, Australian firms have enjoyed declining relative prices for imported intermediate and capital goods. On an index basis, the producer price of imported capital goods has fallen by over 30 per cent since 1999, while the price of domestically-sourced capital goods has increased by almost 60 per cent (figure 2.4). Similarly, since 2002, imported intermediate goods have become relatively cheaper than those purchased domestically.

Figure 2.4 **Producer prices for domestic and imported capital and intermediate goods, 1999 to 2012[a]**

Producer price index (1998-99=100)



[a] Year ended June. Annual averages of quarterly data.

Source: ABS (*Producer Price Indexes, Australia, June 2012*, Cat. no. 6427.0).

The divergence in producer prices between domestic and imported goods is an indicator of the strong rise in the real exchange rate since the early 2000s (figure 2.5). This rise is due to the shifts in the supply of imports, caused by improved technology and reduced overseas labour costs, and to the strong appreciation in the Australian dollar since 2002. The high relative price of domestically-produced capital and intermediate goods is also due to the fact that they incorporate non-tradeable inputs (mainly services), the price of which has risen (chapter 3).

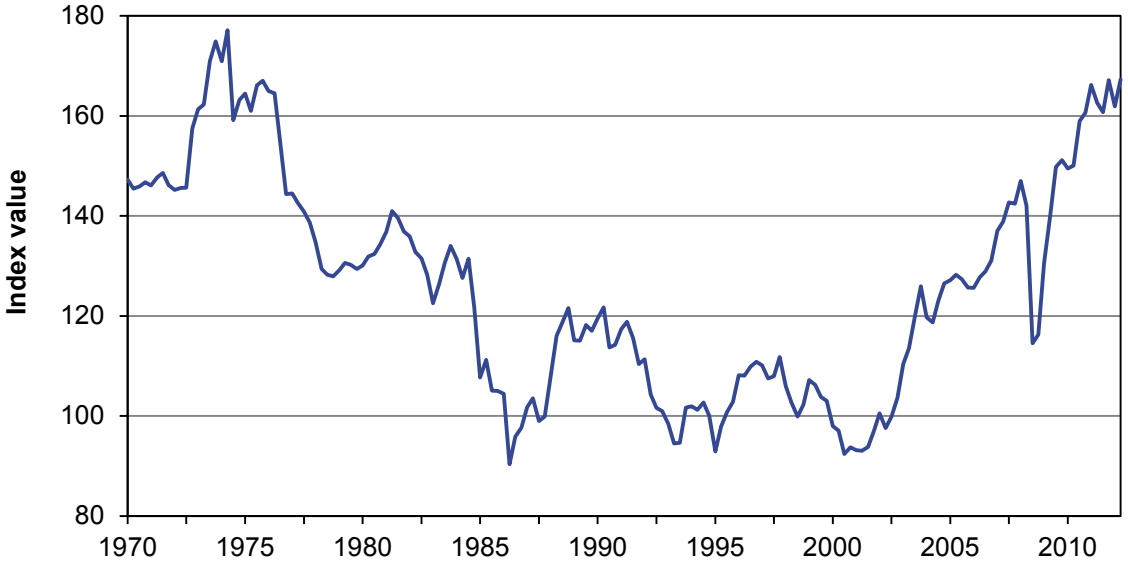
Given these price trends, it is unsurprising that volumes of capital and intermediate goods imported by Australian producers have increased markedly in recent decades (figure 2.6). The real value of intermediate goods imports grew from less than $20 billion in 1986 to $96 billion in 2011, while capital goods imports (primarily destined for the mining sector) increased tenfold to $56 billion over the same period.

These patterns in import and export prices and volumes contribute to observed changes in industry shares of domestic output. The increased availability of lower-cost imported intermediate and capital inputs would tend to favour the expansion of relatively capital-intensive industries. At the same time, the expansion in imports of these goods (as well as of consumer goods) has likely played a part in

the relatively slow growth or (in some cases) decline of import-competing domestic manufacturers. To the extent that these imports are produced overseas in a manner that is relatively intensive in the use of lower-to-medium-skilled labour, they would tend to place competitive pressures on domestic industries with a similar skill intensity, effectively amounting to the substitution of lower-cost overseas labour (embodied in the imported manufactures) for higher-cost domestic labour.

Figure 2.5 **Real exchange rate, 1970 to 2012[a]**

Real trade-weighted index (March 1995=100)

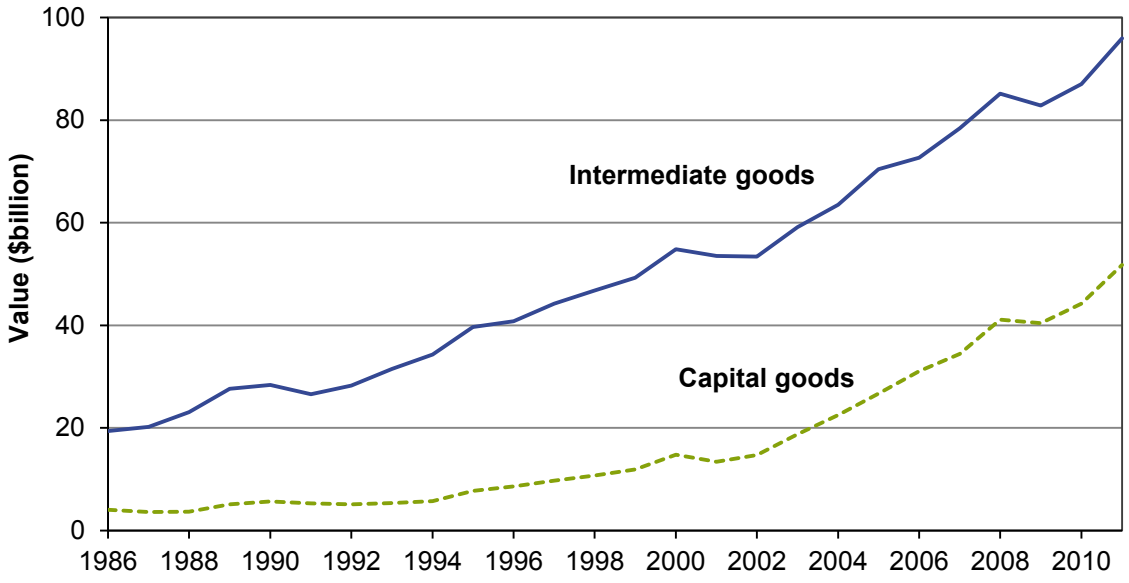


[a] Quarterly data from June 1970 to September 2012. Date labels refer to June observation.

Source: RBA (2012).

Due to these substitution effects, increased imports of intermediate and capital goods may alter the relative returns to skilled and unskilled labour in Australia, at least in the short run. This outcome may be the result of the technological improvements embodied in those imports. Such improvements are often a complement to skilled labour but a substitute for unskilled labour. Changing relative wages may also be a consequence of the similarities or differences between the skill intensity of imports and that of the domestic products they compete with. Imports embodying lower-skilled labour will tend to lower the returns to equivalent domestic labour. However, any effects of imports on relative wages may not persist in the long run, when firms are able to enter and exit industries, and when real wages for all types of labour can adjust to restore full employment.

Figure 2.6 **Quantity of imported capital and intermediate goods, 1986 to 2011[a]**



[a] Chain volume measures. Year ended June. Reference year for chain volume measures is 2008-09.

Source: ABS (*Balance of Payments and International Investment Position, Australia,* Cat. no. 5302.0).

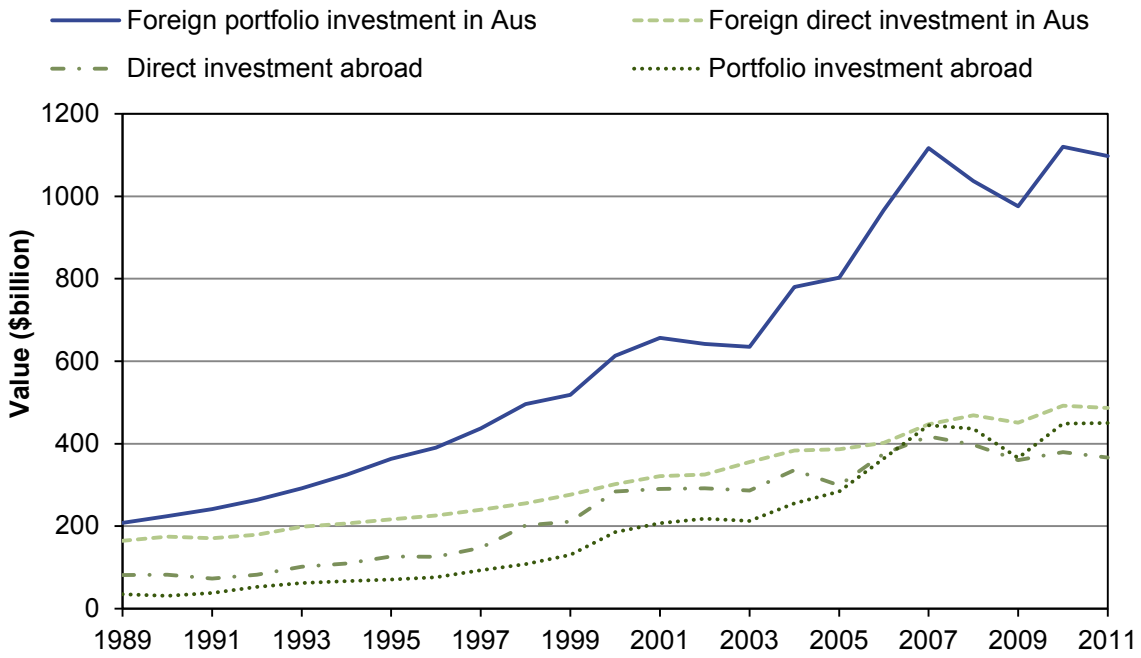
The foregoing analyses have highlighted the many avenues through which international trade developments can influence Australia's economic structure. This influence has been supported empirically by Giesecke (2004, 2008), for the period from 1997 to 2002. Using CGE analysis, he found that foreign demand and import prices had had a strong positive impact on the mining industry and an equally strong negative impact on manufacturing industries such as Textiles, clothing and footwear. (The latter was also particularly affected by changing domestic consumer preferences in favour of imported (rather than locally-produced) goods, as was the transport equipment manufacturing industry.)

Increased financial flows

While Australia has long been a net importer of capital funds, the liberalisation and deregulation of its financial markets in the 1980s and 1990s facilitated large real increases in the flows of financial capital between Australia and the rest of the world. As indicated in figure 2.7, both foreign direct investment (investment that ensures a significant interest in, and influence on, the Australian enterprise in which the funds are invested) and foreign portfolio investment (which includes mainly the purchase of privately- and publicly-issued securities such as bonds) recorded sustained growth over the past two decades. Of the two categories, portfolio investment has grown far more rapidly, but has also displayed greater volatility.

Figure 2.7 **Foreign investment in Australia and Australian investment abroad, 1989 to 2011[a]**

Real values of assets and liabilities



[a] Value in June of the specified year, deflated by the chain price index for gross domestic product. The reference year is 2009-10.

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

That growth mainly reflected increased foreign purchases of Australian private sector debt (mostly issued by the banking sector) as well as increased foreign investment in Australian public debt, with the shift into deficit of federal and state government budgets in the second half of the decade (D'Arcy and Ossolinski 2009).

The construction phase of the 2000s natural resources boom has played a large part in driving growth in foreign direct investment in the past decade. The RBA recently estimated that about 80 per cent of the investment boom in the resources sector has been foreign-funded, through a combination of overseas-based investors and partly foreign-owned, Australian-listed companies such as BHP (Debelle 2013).

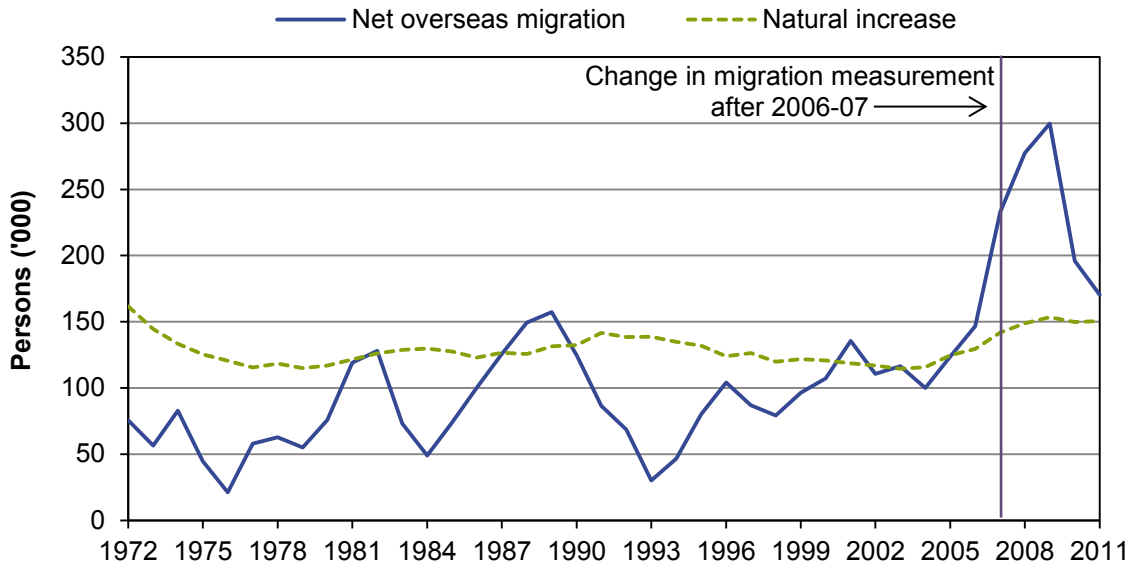
The substantial growth in inflows of foreign capital linked to the resources boom has had repercussions throughout the economy, via the impact on the exchange rate. Increased net foreign investment into Australia involves an increase in the demand for Australian dollars in currency markets. Under a floating exchange rate regime, this demand leads to an appreciation of the Australian dollar. Although there is some associated outflow of funds in the form of increased imports, (lagged) payments of dividends and Australian purchases of foreign assets, foreign inflows

are still likely to result in a net appreciation of the dollar (Corden 2012). The twin results are an exacerbation of the pressures felt by the trade-exposed sectors of the economy, accompanied by greater purchasing power of Australians over imports.

Increased labour supply through immigration

As illustrated in figure 2.8, net overseas migration, although typically a volatile component of population growth, has been consistently above the natural increase in population since around 2005 (although part of the gap between the two series is due to a change in the measurement of migration by the ABS from 2006-07 onward).

Figure 2.8 **Net overseas migration and natural population increase, 1972 to 2011[a, b]**



a Data are for year ended June. **b** Net overseas migration data prior to 2006-07 are not directly comparable with those from later years, due to a change in ABS measurement. According to Commission estimates (PC 2010b), if the old method were applied from 2006-07, net overseas migration figures for these years would likely be 15 to 20 per cent lower than those presented.

Sources: ABS (*Australian Demographic Statistics,* Cat. no. 3101.0, *Australian Historical Population Statistics*, Cat. no. 3105.0.65.001); PC (2010b).

Immigration levels vary considerably, based on the perceived attractiveness of Australia's economic opportunities and amenities to potential migrants, the overall level of economic activity and the profile of Australian firms' demand for labour, and government policies to attract or limit immigration inflows. In contrast, the rate of natural increase (births minus deaths, as a proportion of the population) tends to change more slowly, mostly in accordance with longer-term social and

technological change (the latter, in the form of advances in medical and pharmaceutical goods and services that contribute to reduced mortality rates) (PC 2010b).

Net migration is particularly sensitive to fluctuations in economic activity (both in Australia and in source countries). Periods of sustained growth generally give rise to increased immigration, for both supply- and demand-side reasons. Greater business and employment opportunities draw in more immigrants, while increased labour demand leads employers to lobby governments for more liberal migration programs (PC 2010b).

During the 1990s and 2000s, sustained economic growth and a lift in the immigration target saw net overseas migration increase from less than 50 000 persons per year to a peak of about 300 000 in 2009. Much of this growth was in the form of temporary business migrants (who may stay for up to four years) and overseas students (PC 2006a, 2010b). This expansion has had the effect of increasing the quantity of labour available to Australian producers at any given unit labour cost.

Over the past few years, net migration has fallen quickly to below 200 000 persons annually. This has reflected a drop in demand due to the impact of the Global Financial Crisis, but is also partly attributable to policy changes that restricted eligibility for permanent residency. These changes have likely discouraged many temporary workers and overseas students from arriving with a view to subsequently obtaining permanent residency.

Immigration can be expected to have implications for industry shares of output and possibly for the returns to labour of different skill levels, depending on the number, composition and characteristics of immigrating workers. For example, to the extent that increased immigration consists of higher-skilled workers, it might contribute to slower growth in domestic returns to skilled labour in the short run (PC 2006a, 2010b). It would also be anticipated to contribute to increased activity in industries relatively intensive in skilled labour, such as those industries in the services and resources sectors[10] that depend heavily upon professional and technical expertise. Finally, greater immigration can increase the share of those industries — such as dwelling construction — that depend closely on the number of households.

[10] Sectors and industries are defined in appendix A.

Outsourcing and offshoring

For any given intermediate good or service a firm uses in production, it can choose to produce the good or service itself or else 'outsource' that activity by purchasing it from another firm. Improved logistics and communications technologies have given firms the additional choice to outsource locally or overseas. Global outsourcing, or 'offshoring' — one feature of increased global interconnectedness — involves firms sourcing part or all of their intermediate goods and services from overseas. The multi-country sourcing of an Apple iPhone's components is a prime example of a globally outsourced good (box 1.3). The telephone call centre located offshore but providing services to an Australian firm and its customers is a common example of a globally outsourced service input.

Indirect evidence of the growth of offshoring can be seen in the growth of services imports in recent years (figure 2.1), as well as the sustained growth in the quantity of imported intermediate goods (figure 2.6). Although importing offshored services is a newer and at-times more controversial practice than importing intermediate inputs, its effects on employment and wages are 'not qualitatively different' (Bhagwati, Panagariya and Srinivasan 2004, p. 94). That is, to the extent that workers overseas are a close substitute for some domestic workers (lower-skilled manufacturing workers, for instance, or higher-skilled ICT workers), the latter will face a higher risk of unemployment or experience slower growth in real wages, than otherwise would be the case.

That said, Henry (2012) argues that offshoring by Australian producers may have saved some local jobs, by enabling firms to remain profitable and preserve at least part of their domestic operations. Similarly, increased offshoring by overseas producers might give Australian firms opportunities to become part of international value chains, where they can specialise in that part of the production process in which they have a comparative advantage (Lamy 2012).

Evidence of local (as opposed to external) outsourcing is difficult to find. Breunig and Bakhtiari (2013) identified some domestic outsourcing among manufacturing firms in the 1990s, using data on small-to-medium-sized firms from the ABS Business Longitudinal Survey. They reported that, in the year to June 1995, almost 11 per cent of manufacturing firms had contracted out (mainly domestically) jobs previously performed by their own employees. In the two financial years that followed, 8 per cent and 7 per cent (respectively) of firms engaged in contracting out.

2.2 A changing domestic environment

This section summarises the major forces at work in the domestic sphere, and describes how they have contributed to structural change.

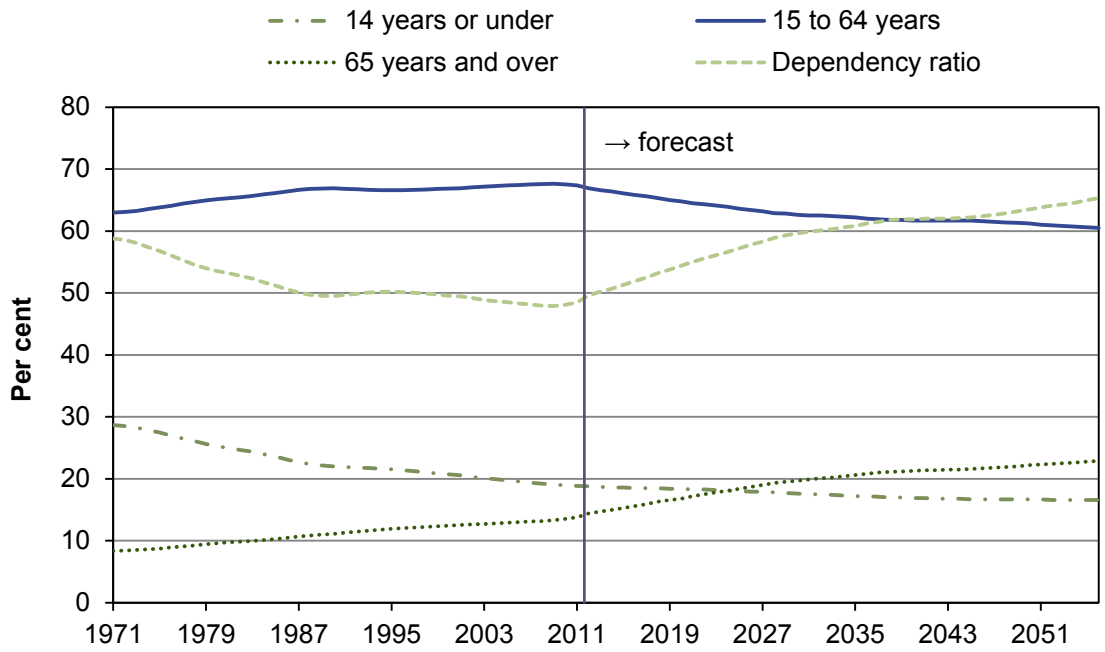
An older population

Changes in demography — the size, age structure and composition of the population — have driven structural change through both supply- and demand-side effects. A changing population has compositional effects on labour force participation and productivity, as well as on expenditure in areas such as health and aged care.

As previously noted by the Productivity Commission (2005a, 2006a, 2010b), Australia's population size and composition are changing and will continue to do so. Assuming a continuation of long-term trends towards lower fertility (despite a recent upturn since the mid-2000s), lower mortality and higher net overseas migration, the ABS has projected a substantial ageing of the population over the next 50 years (figure 2.9). Similar trends have also contributed towards a general ageing of the population in many developed countries (Auer and Fortuny 2000; OECD 2008; PC 2005a; Treasury 2010).

On the supply side, an increase in the proportion of the population aged 65 years and over has the potential to reduce the relative size of Australia's labour force. This, in turn, could reduce the productive capacity of the economy and per-capita incomes, if all else is held constant (PC 2005a; Treasury 2010). Moreover, the scarcity of labour might increase, thus encouraging firms to become more capital-intensive in their production methods. For example, population ageing is likely to affect (and already has affected) services industries reliant on skilled labour, such as health care and education. Such industries may then become more capital-intensive, as workers retire or reduce their working hours. Increased returns to labour could trigger a labour supply response and, potentially, the increased accumulation of skills through education and training. This may mitigate any labour shortages, but is unlikely to offset them completely.

Figure 2.9 **Population age structure, past and projected, 1971 to 2056[a, b]**



[a] Figures for 2012 to 2056 are projections from the ABS 'Series B' scenario (ABS 2008). This scenario has as its key parameter assumptions: total fertility rate of 1.8 babies per woman; net overseas migration of 180 000 per year; life expectancy at birth of 85 years for males and 88 years for females. Based on these parameter values, the 'Series B' scenario projects an Australian resident population of 35.5 million in 2056. [b] The dependency ratio is the number of children aged 0–14 years and persons aged 65 years and over per hundred persons aged 15–64 years.

Sources: ABS (*Australian Demographic Statistics,* Cat. no. 3101.0, *Population Projections, Australia, 2006 to 2101*, Cat. no. 3220.0).

On the demand side, an older population is expected to lead to increased household spending on health and aged care services. The interaction of technology and demography has generally resulted in a rise in the expenditure, output and employment shares of the health industry (ABS 2011e; AIHW 2012; Daley 2013; PC 2005a, 2005b). This has tended to occur because of the availability of new, more costly health care interventions and the rising prevalence of people suffering from lifestyle and age-related conditions.

These factors can be reinforcing, as technological change can influence demographic change. For example, advances in medical care and interventions leading to increased life expectancy can have implications for population size, age structure and the dependency ratio (as defined in figure 2.9). At the other end of the age spectrum, technological advances — for example, in assisted reproduction or family planning — are unlikely to have a material impact on population size and structure, or on female labour force participation.

Participation in work and education

A person's choices about whether to invest in education and training, and whether to work or not, depend on his or her preferences for consumption versus leisure, in a contemporaneous sense but also over time. The two decisions are related: for example, the decision to seek work is influenced by expected returns to the skills and qualifications a person holds. Outcomes from these decisions affect the size (through labour force participation) and quality (through educational attainment and skill levels) of the labour force and, hence, the productive capacity of the economy. For example, the Commission has estimated that achievement of the COAG Certificate III target — halving the proportion of Australians without at least this qualification by 2020 — alone could raise employment by 1 per cent, productivity by 0.35 per cent and gross domestic product by 2 per cent by 2020 (PC 2012d).

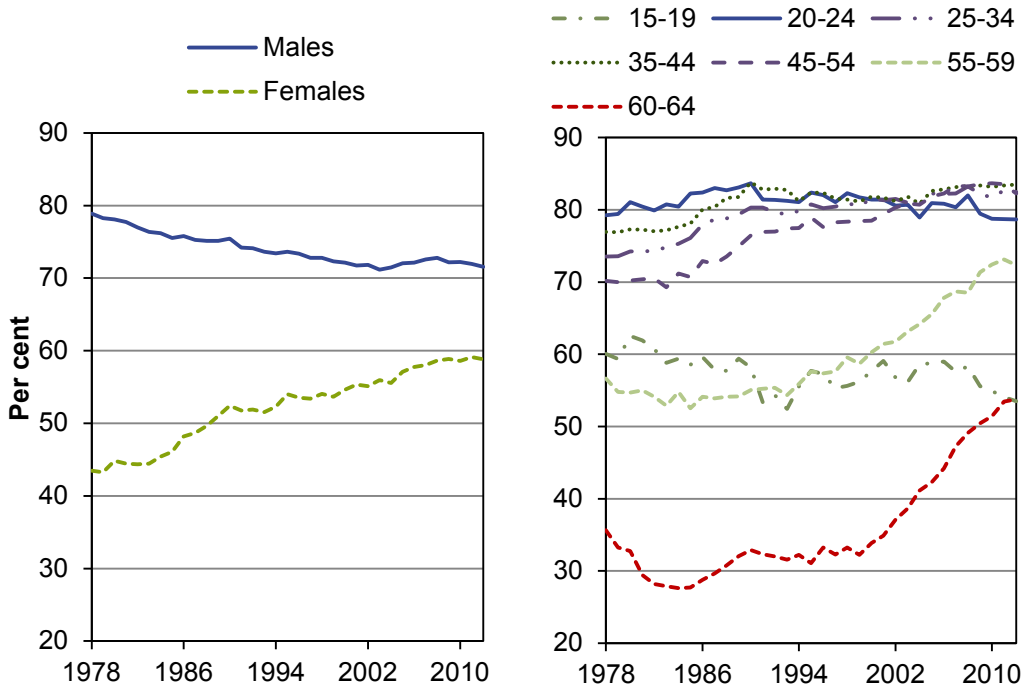
Moreover, both labour force participation and human capital accumulation decisions can generate structural change, as they affect the endowment of labour of various qualities available for production. To give an example, an increase in the supply of university-educated workers will, all else equal, result in the relative expansion of knowledge-intensive industries.

By the same token, structural change can influence people's decisions to participate in education and work. Changes in industry shares of output and differing growth rates among industries will generally alter the relative returns to different occupations, and so affect individuals' choices to work or not, to work in particular occupations or industries, and to undertake education and training for these occupations and industries.

The labour force participation of women has been increasing since the mid-1980s, while participation rates of people of both genders, aged 55 to 59 and 60 to 64, have been rising since the late 1990s, from a low base (figure 2.10). These trends have been driven by the marked increase in participation by older women (aged 55 to 64 years) over the past two decades, as well as a more modest rise in participation by women of prime child-bearing age (25 to 34 years) (ABS 2012g; gender breakdown not shown).

On the supply side of the labour market, trends in female participation reflect women's changing preferences for work, leisure and non-market activities (such as caring responsibilities). These preferences are shaped by social, cultural, technological and economic forces, as well as by government policies. For example, increased participation among women of child-bearing age is partly a reflection of changing perceptions of the role of women, aided by gender anti-discrimination measures, as well as government policies towards childcare and paid parental leave.

Figure 2.10 **Labour force participation rates, by gender and age, 1978 to 2012[a, b]**



[a] Persons aged 65 years and over not shown. [b] Observations are for the June quarter of each year.

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

Government policy settings across a range of other areas, particularly in relation to education and training subsidies and the income taxation system, can also alter the relative returns to paths of study and work (as well as of non-participation).

On the demand side, the growth in women's labour market involvement has been facilitated by the structural expansion of certain industries — primarily in the services sector — that are traditionally female labour-intensive or which tend to employ workers on a part-time and/or casual basis. This trend is particularly noticeable at the older end of the age spectrum. Gilfillan and Andrews (2010) report that almost half of all mature-aged women (45–64) are employed in just three industries: Health care and social assistance; Education and training; and Retail trade.

The increase in the share of skilled migrants in the immigration program has contributed to higher labour force participation and overall skill levels. On average, immigrants are more likely than the existing resident population to have a bachelor degree (or higher), while permanent immigrants arriving on a Skilled visa between 2000 and 2004 had a participation rate of 82 per cent in 2004, compared with 67.3 per cent for their Australian-born counterparts (PC 2006a).

The overall labour force participation rates of men has remained steady since 2002, after a prolonged decline. However, participation rates among younger men (aged 15–24) have declined (gender breakdown not shown). Even though younger men are generally over-represented among those who do not complete Year 12, the proportion who are 'not fully engaged' in school or work has remained stable since 2002 (data not shown). This suggests that the declining labour force participation of younger men is primarily due to the decision to remain in education and training, motivated by both market forces and institutional factors such as increases in the minimum school leaving age (ABS 2012g).

The participation rate of males aged 55 years and over increased from 33 per cent to 42 per cent between 2000 and 2010 (data not shown). According to Borland (2011, p. 179), possible explanations for this significant increase are 'increasing life expectancy, strong business cycle conditions (at least until the late 2000s), the growth in service sector jobs (which are less physically demanding), and improved health of the older population'. However, Gregory (2012) notes that the ratio of full-time employment to population for unskilled males aged 50–59 is very low (56 per cent in 2006). The decline in manufacturing employment is one of the reasons he puts forward for this trend, along with technological change and labour market reform.

Microeconomic reforms

Over the last four decades, successive Australian governments have implemented a wide range of initiatives in the area of microeconomic policy. Some of these measures have contributed to increased productivity and sustained growth in per-capita incomes (PC 2005c, 2012d). They have also fostered significant structural change, in some cases.

From the early 1970s onward, assistance to manufacturing and agricultural industries began a long-term decline (PC 2012f). For example, the manufacturing sector received an estimated effective rate of assistance of 35 per cent in 1970-71. As a result of major reductions in import tariffs and other forms of assistance over subsequent decades, that rate has decreased to 5 per cent, on average since 2000. For the agricultural sector, the effective rate of assistance has dropped from more than 25 per cent in 1970-71 to about 5 per cent since 2000, although it has shown far greater volatility over this period, due to drought conditions.

Throughout the 1980s and 1990s, a series of additional major reforms was introduced, which included:

- National Competition Policy — this ambitious set of reforms implemented recommendations from the 1991 Special Premiers' Conference and the 1993 'Hilmer' Report. The reforms extended the reach of competition or competitive pressures to a number of previously sheltered areas of the economy, such as public natural monopolies and unincorporated businesses. It affected some sectors directly (for example, utilities) and most sectors indirectly (through a strengthened competition regulation framework) (PC 2005c)
- labour market deregulation (for example, the introduction of enterprise bargaining in 1993 and of individual contracts in 1996)
- financial reforms, including the floating of the Australian dollar, deregulation of financial markets and the shift in monetary policy to inflation targeting.

Since the 2000s, a new wave of more detailed policy changes has been (and continues to be) introduced under the Council of Australian Governments' reform agenda. These have included (PC 2012d):

- 'seamless national economy' initiatives designed to reduce regulatory impediments to domestic trade and factor reallocation, such as national occupational health and safety standards
- regulatory changes in education and training systems — such as in the early childhood education and care, and vocational education and training sectors — designed to facilitate long-term productivity increases by expanding the national stock of human capital.

Consumer preferences

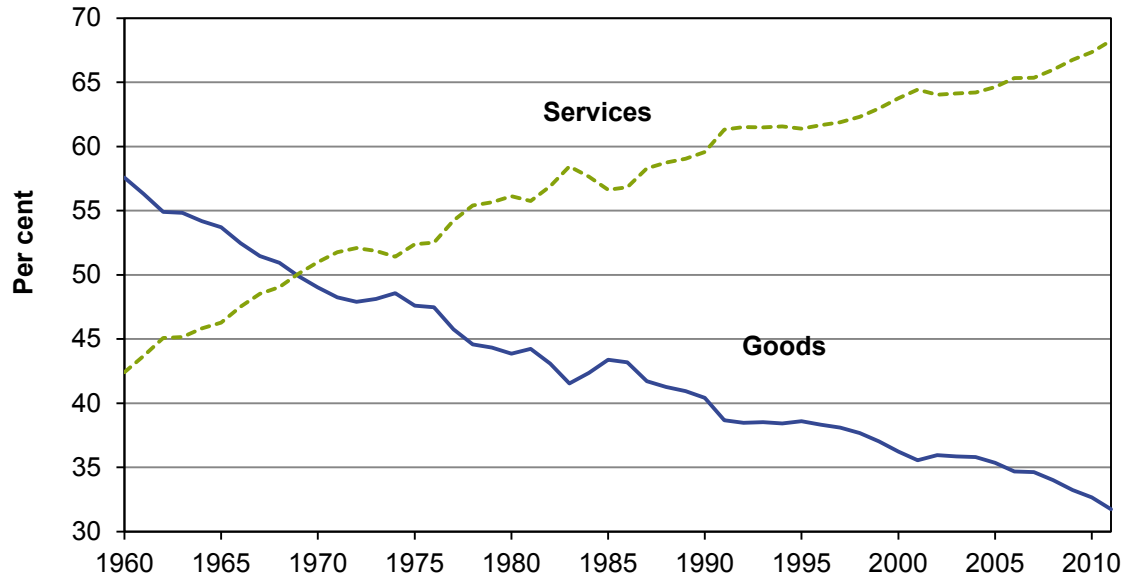
In Australia, as in other developed economies, shifts in observed consumer choices have resulted from a combination of rising incomes, changes in tastes arising from social and cultural influences, and technological advances that permit both new products and new ways of purchasing products.

Changing patterns of household expenditure also reflect demographic change that alters the size and composition of the population, as noted earlier. For example, increased shares of migrants and older people in the Australian population can be expected to increase the demand for goods and services preferred or required by these groups.

Over the past 50 years, with increasing per-capita real incomes, Australian households have substantially increased their expenditure on services relative to

goods (figure 2.11). As in many other countries, rising incomes have also led to increasing household expenditure on external services that replace those previously produced within the household, such as restaurant meals, childcare and home maintenance services (OECD 2012a).

Figure 2.11 **Share of household consumption expenditure accounted for by goods and services, 1960 to 2011[a, b]**



[a] Year ended June. Current prices. [b] The definition of goods is food, alcohol and tobacco, clothing and footwear, furnishings and household equipment, purchase of vehicles, goods for recreation and culture, books, papers, stationary and artists' goods and personal effects. Services are defined as residual consumption expenditure. 'Other goods and services' have been excluded (from goods, from services and from the total used to calculate shares).

Source: ABS (*Australian System of National Accounts, 2010-11*, Cat. no. 5204.0).

One key driver of this observed pattern is Engel's Law (Acemoglu 2012). According to this principle, households need to purchase a minimum level of 'basic' goods for subsistence, but, as their income rises, they are able to satisfy their preferences for goods and services that are not essential for survival. As a result, demand for basic products (such as food) increases less than proportionately with income, while demand for discretionary goods and services (such as recreational and cultural outings) increases more than proportionately.

Aside from income, consumption patterns are also influenced by changing relative prices. There is evidence that, in Australia, discretionary spending has increased in all household income deciles in recent times (AMP-NATSEM 2012). This suggests that relative price movements — for example, between electronic equipment and other goods and services — may have favoured this form of expenditure.

Consistent with Engel's Law, the proportion of household consumption spent on food has almost halved in the past five decades, from 18 per cent in 1960 to 10 per cent in 2012 (table 2.1). This period has also seen declining shares of consumption spending on basic goods such as clothing and footwear, and furnishings and household durables. In contrast, there has been corresponding growth in the shares of expenditure on 'knowledge' services such as communication, recreation and cultural services, and education services. Dwelling services have also received a greater share of household spending, reflecting real increases in spending on housing by owner-occupiers following the boom in residential property values during the 2000s. Between 2003-04 and 2009-10, for example, the median dwelling value among owner households increased from just under $360 000 to $440 000, in 2009-10 dollars (ABS 2011d).

Table 2.1 **Shares of household spending, 1960 and 2012[a, b]**

	Share in 1960	*Share in 2012*	*Change in share*
	%	%	Percentage point
Food	18.0	10.2	-7.8
Clothing and footwear	10.2	3.1	-7.1
Rent and other dwelling services	8.8	20.5	11.7
Electricity, gas and other fuel	2.3	2.4	0.1
Furnishings and household equipment	9.3	4.5	-4.8
Health	3.8	5.9	2.1
Transport	11.5	10.7	-0.8
Communication	0.6	2.4	1.8
Recreation and culture	9.1	10.5	1.4
Education services	1.0	4.3	3.3
Hotels, cafes and restaurants	9.5	7.0	-2.5
Miscellaneous goods and services	9.7	15.1	5.4

a Shares of household consumption expenditure, calculated using current price data for year ended June. **b** Shares may not add up, due to rounding.

Source: ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0).

Apart from income and price effects, population ageing is likely to explain part of the increase in expenditure on health services observed in table 2.1. Ageing may also have exerted downward pressure on the share of household spending devoted to rent and dwelling services, but the strong rise in that share over time suggests that the effects of population growth have more than offset those of ageing.

In the last decade, patterns of household spending have also been affected by a significant reversal in consumers' saving behaviour. The household saving ratio (the proportion of net household disposable income remaining after consumption expenditure) fell from around 15 per cent in the mid-1980s to near zero by the early to mid-2000s. Since that time, however, there has been a sharp upturn in household

saving. This was accompanied by financial deleveraging by households, following the Global Financial Crisis. There has been some debate about whether the turnaround in the saving trend (as mirrored in other countries such as the United States) is a cylical or structural phenomenon (Carroll, Slacalek and Sommer 2012; Swanson 2012). In the Australian context, the Reserve Bank of Australia (2011) has suggested that the saving ratio observed at the end of the 2000s is closer to 'normal', in historical terms, than that observed up to the mid-2000s.

Recent changes in saving behaviour by households would have affected the shares of disposable income devoted to basic products and discretionary products, respectively, resulting in structural change. For example, Stevens (2012) has noted that the new patterns of household consumption (and investment) have had adverse implications for industries such as financial, retail and real estate services.

3 Structural change in output and investment

Key points

- The magnitude of structural change *between major sectors* during the 2000s was significant but not unprecedented. The Australian economy has experienced comparable levels of change in sectoral shares of output in previous decades.
  - In an historical context, changes in sectoral shares of *real* output were relatively modest in the 2000s, notwithstanding the significant impact of the terms of trade and the high Australian dollar on some individual industries.
  - Sectoral shares of nominal output and investment changed relatively quickly over the decade to 2012, reflecting the natural resources boom, as well as the longer-term shift towards the production of services and the relative decline of manufacturing.
- On some measures, however, there were record rates of structural change *between states and territories*.
  - Structural change in state and territory shares of *nominal* output and investment in the 2000s exceeded rates recorded at any time in the previous 40 years.
  - The natural resources boom and associated 'multi-speed' economy appear to have had more pronounced effects on factor reallocation among states and territories than among sectors.
  - Rates of structural change in state and territory shares of *real* output, on the other hand, while large, were comparable to the peaks in previous decades.
- The higher rates of change observed in nominal, rather than real, shares of output — by sector, as well as by state and territory — indicate that structural change in the 2000s reflected changes in relative prices (the high terms of trade and real exchange rate appreciation) more than changes in output volumes.

This chapter presents selected patterns of change in the composition of output and investment, across industries and regions. (Patterns of change in the composition of employment are covered in chapter 4.) These patterns chart the way in which the economy has responded, over time, to the interaction between the fundamental economic variables described in chapter 1 and the global and domestic forces of change (chapter 2). Section 3.1 examines structural change in output and section 3.2 structural change in investment. Section 3.3 analyses structural change across states and territories.

3.1 Structural change in output

Structural change in the Australian economy is apparent even at a relatively aggregated level, and several long-term trends are discernible. First, the manufacturing and agricultural sectors' shares of total output (nominal gross value added) have been in decline since at least the 1960s (figure 3.1). Most of the decline in manufacturing's share of output preceded the 2000s natural resources boom. At its relative peak in the mid-1960s, manufacturing accounted for over one-quarter of total output, declining to about 14 per cent in 2000, and then to 9 per cent in 2011. Agriculture, for its part, began its long-run decline even earlier than manufacturing — in 1950, it was responsible for one-quarter of the nation's total nominal output but, by 1990, this had dropped to 5 per cent. In the past two decades, its output share has been steady at about 3 to 4 per cent.

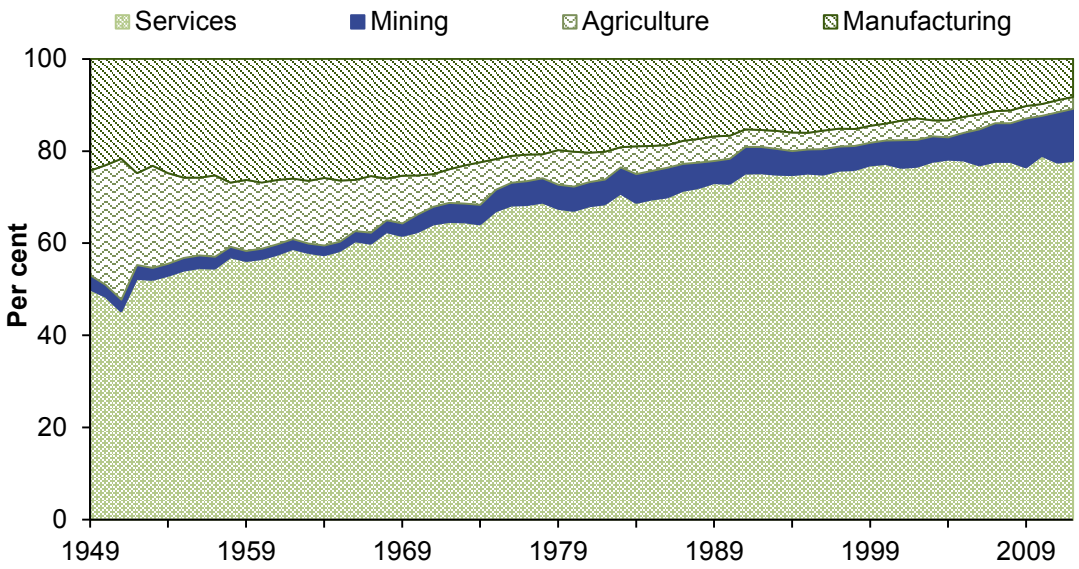
Second, the scale of the recent expansion of the mining sector is clearly in evidence in figure 3.1. Between 2000 and 2012, that sector's share of total nominal output more than doubled from 5 per cent to 11 per cent, a larger share than reached in previous mining booms. The nominal output share of mining is now approximately back to where it was at the turn of the twentieth century (Battelino 2010).[11]

Third, figure 3.1 reveals a steadily rising output share of services until the early 2000s, followed by a plateauing in the last ten years or so. This recent trend is likely to be due to a number of factors. First, the rapid growth in the value of mining output has, by definition, 'crowded out' the shares of the other sectors, including services. Second, the international competitiveness of some trade-exposed services industries such as higher education and tourism was affected by the strength of the Australian dollar, resulting in output reductions. Last but not least, the ABS measures outputs of 'non-market' services such as health and education via input costs, due to the absence of market valuation of those outputs.[12] As labour accounts for the bulk of input costs in the production of those services, the relatively slow growth of nominal wages in the last decade (PC 2012a) constrained measured growth in the overall value of services.

[11] This share remains much lower than the 35 per cent recorded during the 1850s gold rush (Battelino 2010).

[12] In the ABS classification, non-market services include, in addition to health and education, Public administration and safety services.

Figure 3.1 **Sectoral shares of output, 1949 to 2012[a, b]**
Nominal gross value added



a Data in nominal (current price) terms for year ended June. **b** Sectors and industries are defined in appendix A.

Sources: Productivity Commission estimates using ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0) and Connolly, E. (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

Overall, the broad sectoral shifts mentioned above are unsurprising, given the drivers of change mentioned in the previous chapter and the stylised sectoral patterns observed in other developed economies. On the supply side, globalisation and the specialisation by newly-industrialising economies in the production of lower-cost manufactures have coincided with a corresponding specialisation by developed economies in the production of services. Rapid technological advances, an increased stock of human capital, and the availability of cheaper imported consumer, capital and intermediate goods have all supported expansion of industries that are either relatively more capital-intensive (Mining, Construction) or those intensive in skilled labour ('knowledge' services industries). On the demand side, demographic changes — such as population ageing and immigration — and higher incomes have contributed to increased final demand for services, relative to demand for goods (chapter 2).

The sectoral patterns illustrated in figure 3.1 are based on data in nominal terms (current price data), and so include the effect of changes in output prices. To focus instead on changes in output volumes, and at a more disaggregated level, sectoral growth rates and shares of real output (based on chain volume measures) are presented in table 3.1. This breakdown (across nine aggregated sectors, as defined in appendix A) reveals modest real growth in mining and strong growth in some,

but not all, services sectors. Notably, mining recorded output growth of 4.3 per cent per year on average, between 1978 and 2002, but only 3 per cent, on average, in the decade thereafter, the period of the recent natural resources boom. As a result, the share of mining in total *real* output remained largely unchanged during the boom. The contrast between nominal and real output shares of mining reflects the dominance of value over volume effects over this period, due to the strong rise in the terms of trade and exchange rate. This was compounded by the lag between the resources construction boom and the anticipated output response. The magnitude of the investment effort undertaken by the natural resources sector in the past decade is reflected in the strongly growing share of the construction sector over that period.

Table 3.1 **Sectoral growth rates and shares of real output, 1978 to 2012**
Real gross value added by sector[a, b]

	Average annual growth rate		*Share of total output*			*Change in output share*	
	1978 to 2002	2002 to 2012	1978	2002	2012	1978 to 2002	2002 to 2012
	%	%	%	%	%	Percentage point	Percentage point
Agriculture	2.7	2.3	3.6	3.0	2.7	-0.6	-0.2
Mining	4.3	3.0	9.5	11.3	11.3	1.8	-0.1
Manufacturing	1.7	0.4	17.3	11.3	8.6	-6.0	-2.7
Utilities	3.1	1.2	3.5	3.2	2.7	-0.3	-0.6
Construction	2.6	5.9	8.2	6.5	8.7	-1.7	2.1
Distribution services	3.6	3.4	18.3	18.7	19.2	0.4	0.5
Business services	5.6	3.8	13.4	21.9	23.7	8.5	1.7
Social services	3.2	3.0	19.1	17.6	17.5	-1.4	-0.2
Personal services	3.0	2.0	7.1	6.4	5.7	-0.8	-0.7
Total (9 sectors)	3.5	3.1	100.0	100.0	100.0	na	na

a Chain volume measures (reference year 2010-11) for year ended June. Sectors are broad industry groupings, as defined in appendix A. Output shares are calculated by dividing real gross value added for the sector by the sum across the nine sectors. This sum is not the same as reported real gross domestic product, due to the way chain volume measures are calculated. **b** Shares may not add up, due to rounding. **na** Not applicable.

Source: ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0).

Figure 3.1 provides further illustration of the continuing relative contraction of the manufacturing and agricultural sectors. Even though both these sectors experienced real output growth between 1978 and 2012, their share of total real gross value added declined further over the period.

The picture provided by the remaining sectors — covering service activities — is diverse. The rapid growth in the share of business services stands out, particularly during the 1978–2002 period. Conversely, some service categories such as social

and personal services, despite being largely non-tradeable, have seen their output share fall in the last 30 years or so. For social services in particular, this may reflect in part the effects of input costs valuation of non-market services, already mentioned, as this sector comprises both the Education and training and Health care and social assistance industries.[13] Despite the declining share of the overall social services sector in total real output, the individual share of the Health care and social assistance industry grew by 1.6 percentage points between 1978 and 2012 — from 5.3 per cent to 6.9 per cent (data not shown).

Increased structural change reflects price effects

Price effects are apparent in structural change indexes (SCIs). These indexes are a commonly-used method for measuring the rate of structural change, and have been used in previous Commission work (De Laine, Lee and Woodbridge 1997; PC 1998; Parham 2012) as well as by others (Connolly and Lewis 2010; Connolly and Orsmond 2011). The SCI shows the rate at which sectoral (or regional) shares of output (or employment or investment) are changing over time.

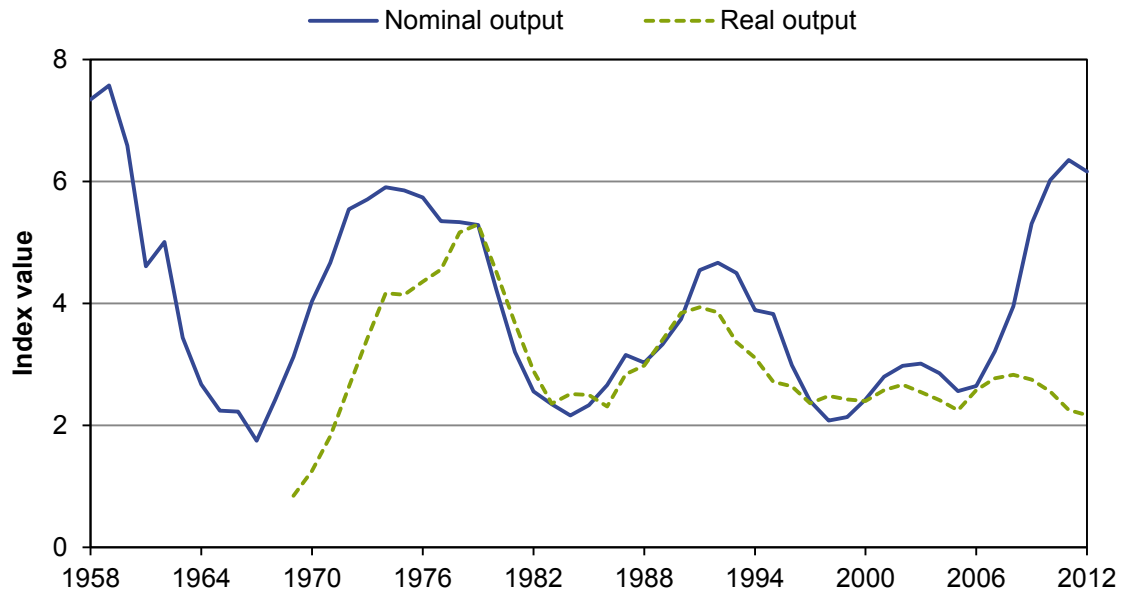
Following standard practice, structural change indexes presented in this chapter (and in chapter 4) are calculated as half the sum of the (absolute) five-year change in the five-year moving average of industry shares of output. Thus, an SCI value of 2 in a given year indicates that 2 per cent of total output has been 'reallocated' between sectors, on average, over the preceding five years. An increase in the index value over time implies an increased rate of change in sectoral shares of output. It should be noted that the index is sensitive to settings such as the level of disaggregation (greater disaggregation results in greater measured structural change) and the choice of time span (the longer the span, the 'smoother' the indicator). Further discussion of the calculation and use of SCIs is provided in appendix B.

In nominal terms, the rate of structural change in sectoral shares of output increased during the 2000s — reaching a peak in 2011 — but is nevertheless comparable with that observed in previous periods of rapid structural change (figure 3.2). By contrast, measured structural change in real output has been considerably lower in the past decade than in earlier periods. As shown in table 3.1, changes in most sectoral shares of real output were relatively small during the 2002–2012 period. This suggests that the rising nominal structural change index during that period predominantly reflected the effects of high commodity prices on the value of the

[13] Between 2002 and 2012, nominal hourly wages grew at an average annual rate of less than 5 per cent in both the social and personal services sectors, lower than the 7 per cent growth recorded for nominal GDP over that period (data not shown).

natural resources sector's output. Relatively slow volume growth in that sector also underlies the low rate of structural change in real terms (figure 3.2). However, once the recently-installed mining and energy extraction capacity comes on stream, that measure of structural change could increase.

Figure 3.2 **Structural change in sectoral shares of nominal and real output**
Structural change indexes for an eight-sector aggregation of industries[a]



[a] Calculated as half the sum of the (absolute) five-year change in the five-year moving average of sectoral shares, with the final year indicated. The eight-sector classification follows Connolly and Lewis (2010), footnote 8, and is described in appendix A. 'Nominal output' is factor income by industry, at current prices, for year ended June. 'Real output' is gross value added by industry in chain volume terms (reference year 2010-11) for year ended June.

Sources: Productivity Commission estimates using ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0) and Connolly, E. (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

The results in figure 3.2 suggest that the 1970s to early 1980s period was the 'peak' era for structural change in real terms, as measured through SCIs, in Australia's recent past. Although it is beyond the scope of this supplement to examine the reasons for the much greater level of the measured real SCI in the 1970s–1980s, plausible contributing influences would have been energy price rises due to the multiple oil shocks, as well as natural resources discoveries, rural and minerals commodities booms, and trade reforms.

It should be noted that a comparison of structural change peaks over time is unavoidably influenced by the level of aggregation selected. If the five-sector aggregation of services used as part of figure 3.2 were replaced with the underlying 16 disaggregated service industries, structural change index values for each year would be higher. Moreover, the size of the various peaks, relative to each other,

would change, as the scope for shifts in industry output shares would increase. For example, the adverse impact of the high Australian dollar on some trade-exposed components of the Education and training and Accommodation and food services industries would be more likely to be reflected in a 19-industry structural change index than in the 8-sector index in figure 3.2.

Nonetheless, the conclusion that the peak era for structural change in real output was in the late 1970s and early 1980s would not be affected by a move to a 19-industry index.[14]

Goods-producing industries

Due to the tradeable nature of their output, goods-producing industries (agriculture, mining and manufacturing) tend to be more exposed to competition from overseas producers, in both domestic and foreign markets. The past decade has seen increasing price pressures on many manufacturing industries by lower-cost overseas producers and an appreciation of the exchange rate — part of the 'Dutch disease' or 'two-speed economy' concepts, as discussed in chapter 1 (box 1.4). These competitive pressures have contributed to low growth rates and declining shares of output in many manufacturing industries (table 3.2). The decline is most pronounced in the relatively labour-intensive production of trade-exposed goods such as Textiles, clothing and footwear. Emerging economies such as China and other Asian countries (Malaysia, Thailand, Indonesia), with much larger endowments of low-cost, lower-skilled labour, have a pronounced comparative advantage in these products. Recent decades have also seen significant reductions in tariff assistance to local manufacturers (PC 2012f).

[14] A graph showing the structural change index in real output at the 19-industry level is provided in appendix B. While the index cannot be constructed prior to 1984, the index values for the late 1970s–early 1980s period would necessarily be higher than those observed subsequently.

Table 3.2 **Manufacturing industries — growth rates and shares of real output**

Real gross value added by sector, 1978 to 2012[a, b]

	Average annual growth rate		*Share of manufacturing output*		
	1978 to 2002	2002 to 2012	1978	2002	2012
	%	%	%	%	%
Food, beverage and tobacco	1.9	0.1	20.1	21.3	21.5
Textiles, clothing and other	0.2	-6.4	16.9	12.1	6.3
Wood and paper	0.9	-1.4	8.9	7.6	6.6
Printing and recorded media	3.4	-2.5	3.0	4.6	3.6
Petroleum, coal, chemical and rubber	2.2	-0.7	15.8	18.0	16.9
Non-metallic mineral products	1.7	2.1	3.5	3.5	4.3
Metal products	1.8	1.9	16.5	17.3	20.9
Machinery and equipment	1.7	2.4	15.4	15.6	19.9
All manufacturing	na	na	100.0	100.0	100.0

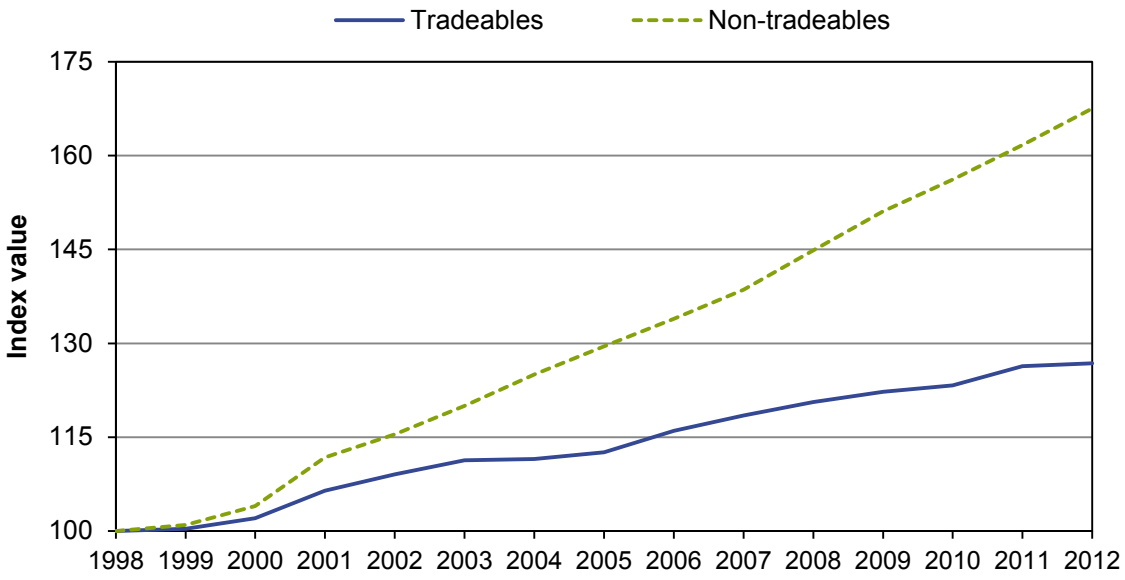
a Chain volume measures (reference year 2010-11) for year ended June. Output shares are calculated by dividing real gross value added for each manufacturing industry by the sum of gross value added across all the manufacturing industries. This total is not the same as the reported gross value added for the manufacturing sector, due to the way chain volume measures are calculated. **b** Manufacturing sector classification is as per ABS Type of Activity Units, the disaggregation used in some national accounts data (discussed in appendix A). These units are not exactly the same as ANZSIC subdivisions, and so may differ from manufacturing sector classifications used in other parts of this supplement. **na** Not applicable, due to the fact that total output for the manufacturing sector is not equal to the sum of its components, because of the way in which chain volume measures are calculated.

Source: ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0).

The competitive pressures facing goods-producing industries were manifest in the much slower relative growth in consumer prices of tradeables in the 2000s (figure 3.3). (Different trend inflation rates for tradeables and for non-tradeables are expected, given that the latter are less exposed to international competition.) Some tradeable goods have been much more affected than others by declining relative prices since the 1990s — most notably clothing and footwear and motor vehicles (figure 3.4). For these two categories of goods, increased access to low-cost imports has contributed to the stability of consumer prices since the 1990s, and to the decline in shares of real manufacturing output (table 3.2). In contrast, prices of food and non-alcoholic beverages, also illustrated in figure 3.4, have climbed steadily in the past two decades. This assisted the food and beverage manufacturing industry with maintaining its share of manufacturing output (at about one-fifth) over this period (table 3.2).

Figure 3.3 **Consumer prices, tradeables and non-tradeables, 1998 to 2012[a]**

Consumer price index (1997-98=100)

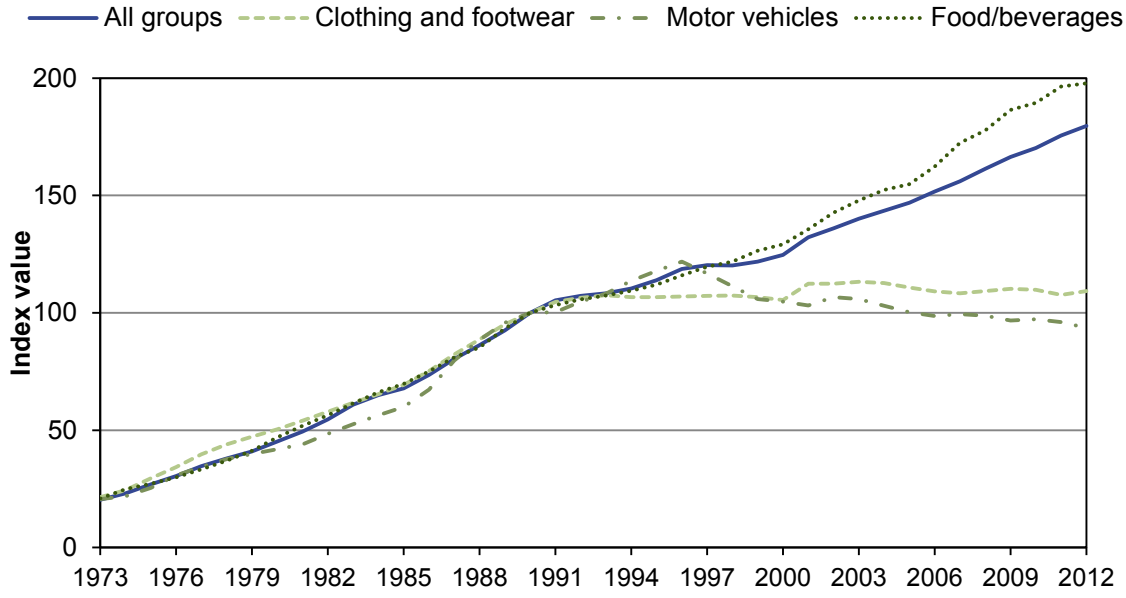


a Year ended June, annual averages of quarterly data.

Source: ABS (*Consumer Price Index, Australia*, *June 2012*, Cat. no. 6401.0).

Figure 3.4 **Consumer prices: all groups, clothing and footwear, motor vehicles, food and beverages, 1973 to 2012[a, b]**

Consumer price index (1989-90=100)



a Denotes food and non-alcoholic beverages. **b** Year ended June, annual averages of quarterly data.

Source: ABS (*Consumer Price Index, Australia*, *June 2012*, Cat. no. 6401.0).

Other manufacturing industries, most notably Machinery and equipment, bucked the manufacturing trend, to grow rapidly during the 2000s, perhaps reflecting the dynamism of mining-induced manufacturing activities (Shann 2012; Bishop et al. 2013).

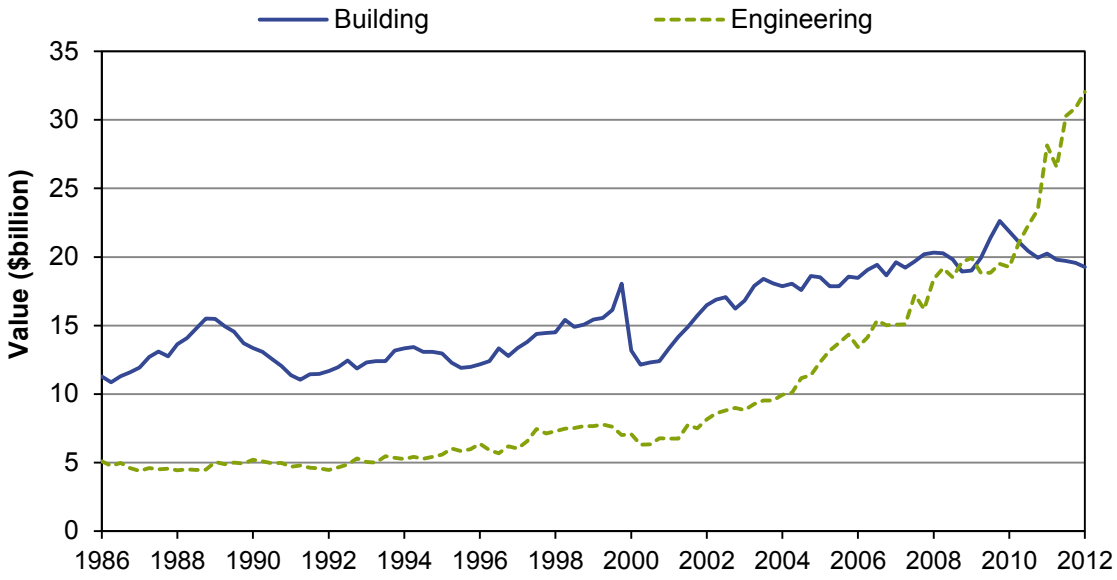
Service-producing industries

Among service-producing industries, the past decade has seen strongest growth in the business services and construction sectors (table 3.1). The business services sector recorded average annual growth in real output of 3.8 per cent from 2002 to 2012, following rapid growth of about 5.6 per cent per year on average between 1978 and 2002. By 2012, the sector accounted for almost one-quarter of the total value of output, compared to 14 per cent in 1978.[15] Its expansion has been driven by growth in some 'knowledge' services industries, namely Finance and insurance services and Professional, scientific and technical services (data not shown). These two industries may have benefited in part from links with the mining industry, which has had increased requirements for specialised technical, engineering and financial expertise (Shann 2012; Bishop et al. 2013). The growth of the superannuation industry — prompted by the introduction of compulsory employer superannuation contributions for most employees from 1992 (PC 2012b) — has also played a role in the financial services industry's rising output share. Major financial deregulation in the 1980s also contributed to strong growth in financial markets and in the finance industry's share of economic activity in the ensuing years, according to the Reserve Bank of Australia (Battelino 2000).

The construction sector recorded average annual real growth of 5.9 per cent in the decade to 2012, more than double the average annual growth rate of 2.6 per cent over the period 1978 to 2002. In 2012, it was responsible for almost 9 per cent of total output, about the same as the output share of the manufacturing sector. The recent natural resources boom has driven strong growth in the engineering construction side of the industry, far outpacing growth in (mainly residential) building construction (figure 3.5).

[15] Sectoral shares of 'real output' are measured as the ratio of each sector's gross value added to the sum of gross value added across the nine sectors. That sum does not equate to reported real GDP, due to the way in which chain volume measures are calculated.

Figure 3.5 **Building and engineering construction, 1986 to 2012[a]**
Real value of work done



a Seasonally adjusted quarterly data, chain volume measures (reference year 2010-11). Year indicated refers to September quarter.

Source: ABS (*Construction Work Done, Australia, Preliminary, September 2012*, Cat. no. 8755.0).

Engineering construction work includes the construction of large projects as diverse as roads, bridges, railways and pipelines, as well as infrastructure for natural resources industries including iron ore, coal and gas. However, the past two decades have seen substantial changes in the relative shares of these project types in total engineering construction, reflecting the dramatic increase in investment in the natural resources sector. Since 1986, the real value of engineering construction carried out for that sector has increased from 18 per cent of total engineering construction, to reach almost 55 per cent in 2012. As discussed in section 3.2 on investment trends, the construction phase of the resources boom appears to have peaked in 2013 (Barber et al. 2013).

The distribution services sector — which includes the Information media and telecommunications industry — has also grown strongly, at an average of 3.4 per cent per year in the decade to 2012. Rapid change in computer and telecommunications technology has driven the expansion of this sector. New technologies, and the availability of cheaper imported capital and intermediate inputs have significantly reduced the price of providing telecommunications services. In turn, lower prices have triggered the widespread adoption of these services by firms and consumers. Beginning in the 1990s, competition reforms to government enterprises — including privatisation and corporatisation — brought efficiency gains in rail transport services and utilities in the decade to 2006

(PC 2005c; 2006b). This is likely to have contributed to the sustained growth in distribution services as well as in utilities (although the latter has grown more slowly in recent years than previously, at an average annual rate of 1.2 per cent over the period 2002 to 2012 (table 3.1)).

Decreases in freight costs and the widespread use of Internet-based technologies have also increased the substitutability of overseas online retail services for their traditional domestic retail counterparts. As noted in chapter 2, recent years have seen online retailers present a growing challenge to the dominance of traditional 'bricks and mortar' retail services. According to a survey by the National Australia Bank (NAB 2012), online retail sales to Australians — by both domestic and overseas retailers — amounted to $12.8 billion, or about 5.8 per cent of the value of traditional retail sales in the year ended November 2012. In December 2012, online retail sales increased by 23 per cent from the same month in 2011. By contrast, traditional retail sales increased by just 3.3 per cent year-on-year in November 2012 (2.5 per cent on a seasonally-adjusted basis) (NAB 2013). Estimates of the penetration of foreign online retailers vary between 20 per cent and 50 per cent of total online purchases by value over the 2010-11 period (National Retail Association 2012). For some goods, the percentage may be much higher, such as up to 80 per cent for books and media.

Moderate growth in the social services sector — 3.0 per cent per year in the past 10 years or so — reflects a combination of relatively slow growth in expenditure on public administration and education and faster growth in expenditure on health services. The health industry's real output expanded by 4.6 per cent per year, on average, from 2002 to 2012 (data not shown), exceeding the average annual real growth rate of the mining industry over the same period (3.0 per cent). Increasing expenditure on health services has been driven in part by population growth and ageing. However, the main contributor to growth in health services has been new, improved and more services per person at any age (Daley 2013; PC 2005b). As their incomes increase, people demand more and better services, which results in higher expenditure. As discussed in chapter 2, newer technology often increases the average cost of treatment, treats entirely new conditions or enables a greater proportion of people to be treated. In this sector, supply and demand indirectly reinforce each other, as medical advances have increased average life expectancy, and so have had (and will continue to have) an impact on population age structure.

3.2 Structural change in investment

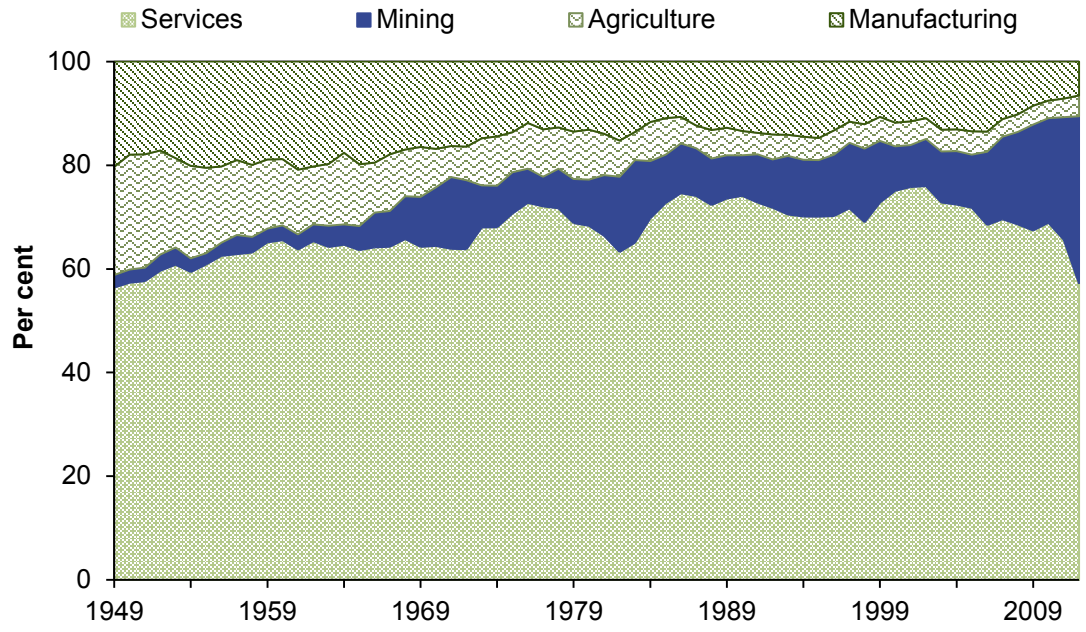
Capital goods are durable assets used to produce goods and services for intermediate and final consumption. Growth in an economy's capital stock represents an increase in its productive capacity, so that investment (expenditure on capital goods) is a key determinant of current and future output. In the short run, output can usually be increased by augmenting the amount of labour (such as through increased participation rates, immigration programs and so on) used in combination with the existing capital base. In the long run, however, industries must replace and repair the capital base and invest in new capital to expand their productive capacity.

As noted in chapter 1 (box 1.2), net investment is a means by which firms can reallocate their capital goods, and alter the size and composition of their capital stock and the uses and activities to which their capital goods are devoted. In other words, investment is one avenue for structural adjustment. However, changes in sectoral patterns of investment can also be viewed as a leading indicator of changes in sectoral shares of output. For example, industries with good growth prospects will likely increase both their investment and employment, although rarely to the same degree. On the other hand, net investment could be a response by firms facing increased overseas competition and/or high wage costs. Such firms may elect to substitute capital for labour to reflect changing relative factor prices, and as a means of keeping unit costs down. (Outsourcing and offshoring — covered in chapter 2 — can be alternative strategies taken up by firms seeking to boost their international competitiveness.)

The mining industry's share of nominal investment more than trebled during the past decade, from 9 per cent in 2002 to 32 per cent in 2012 (figure 3.6). This expansion was a response to the high export prices obtained for resources over the 2000s (figure 2.3). Investment of this magnitude substantially exceeds levels observed in previous mining investment booms. For example, mining accounted for almost 14 per cent of total nominal investment in 1971, and 16 per cent in 1983.

Also notable is the continued decline in manufacturing's share of total investment: after decreasing from 19 per cent in 1960 to 11 per cent in 2002, it dropped to 6.6 per cent in 2012. This is a more modest decline than that observed in the output share of manufacturing, which is likely explained by capital deepening (discussed later in this chapter).

Figure 3.6 **Sectoral shares of nominal investment, 1949 to 2012[a, b]**
Nominal gross fixed capital formation



a Data in nominal (current price) terms, for year ended June. **b** Sectors and industries are defined in appendix A.

Sources: Productivity Commission estimates using ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0) and Connolly, E. (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

Long-term shifts towards services and knowledge-based capital

Changes in disaggregated sectoral shares of investment since 1978 also reflect the Australian economy's long-term re-orientation away from agriculture and manufacturing towards the production of services (table 3.3). The large expansion in mining investment has meant that each of the other sectors' shares of total investment declined slightly during the decade to 2012. For most services sectors, the past decade's relative decline has been a consequence of the 'crowding-out' effect of the resources boom, but for agriculture, the pattern has represented a continuation of the sector's longer-term relative decline in investment. Between 1978 and 2002, agriculture's share of real investment halved from about 14 per cent to about 7 per cent. These changes are at least partly attributable to adjustment within this industry, with a trend towards greater concentration of production on fewer and larger farms (PC 2005d).

Table 3.3 **Sectoral real investment, growth rates and shares, 1978 to 2012**

Real gross fixed capital formation by sector[a, b]

	Average annual growth rate		*Share of total investment*			*Change in share*	
	1978 to 2002	2002 to 2012	1978	2002	2012	1978 to 2002	2002 to 2012
	%	%	%	%	%	Percentage point	Percentage point
Agriculture	1.4	6.1	13.6	6.8	5.1	-6.7	-1.8
Mining	3.9	19.9	4.6	10.7	31.5	6.1	20.8
Manufacturing	3.8	3.7	13.6	11.2	6.6	-2.4	-4.7
Utilities	2.9	7.8	16.8	8.9	7.8	-7.9	-1.1
Construction	4.3	7.7	0.9	2.1	1.8	1.2	-0.3
Distribution services	4.2	6.0	20.5	24.9	18.2	4.4	-6.7
Business services	9.3	7.1	1.4	15.1	12.4	13.7	-2.8
Social services	4.5	7.8	13.0	15.7	13.8	2.7	-1.9
Personal services	6.0	4.3	2.2	4.6	2.8	2.4	-1.7
Total (9-sector)	4.3	9.1	100.0	100.0	100.0	na	na

a Chain volume measures (reference year 2010-11) for year ended June. Excludes ownership of dwellings. Sectors are broad industry groupings, as defined in appendix A. Investment shares are calculated by dividing real investment for the sector by the sum across the nine sectors. This sum is not the same as reported real gross fixed capital formation economy-wide, due to the way chain volume measures are calculated. **b** Shares may not add up, due to rounding. **na** Not applicable.

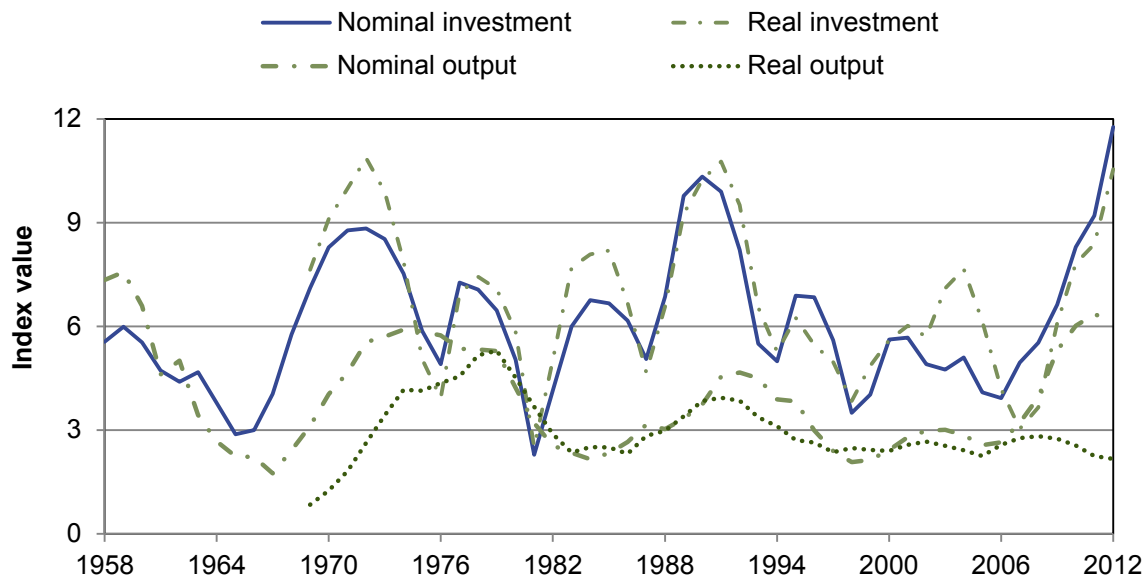
Source: ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0).

Meanwhile, the 'construction boom' in the natural resources sector has driven a large increase in that sector's share of total real investment over the past decade — from less than 11 per cent in 2002 to almost 32 per cent in 2012, with average annual growth of about 20 per cent per year over that decade. As noted earlier, this in turn has resulted in strong growth in engineering construction, contributing to the almost 6 per cent annual increase in construction sector output (table 3.1). However, the expansion in mining investment appears to have reached a peak in the first half of 2013, according to the Bureau of Resources and Energy Economics. At April 2013, a total of 73 major investment projects in the resources and energy sector were considered to be at the 'committed' stage, with a total value of $268 billion (Barber et al. 2013). This total value was the same as that recorded at October 2012, but represented 14 fewer projects.

As was the case for output shares in table 3.1, it is difficult to discern an overall pattern of structural change in sectoral investment shares across time from table 3.3, which describes only end-to-end changes. Here too, SCIs prove to be useful summary measures. As illustrated in figure 3.7, the rate of structural change in sectoral shares of investment is greater (on average) than that in output shares (provided in the graph for comparison purposes). Investment shares have recorded

an elevated rate of change at times in the 2000s, although not dissimilar from that observed in the late 1980s to early 1990s (which reflected, in part, the commercial property and finance boom of that period). The pace of structural change in real investment has generally been close to that in nominal investment although, in the early to mid-2000s, real investment shares changed more quickly than nominal shares.

Figure 3.7 **Structural change in sectoral shares of investment and output**
Structural change indexes, 1958 to 2012[a]



[a] Calculated as half the sum of the (absolute) five-year change in the five-year moving average of sectoral shares, with the final year indicated. Sectoral classifications are as described in Connolly and Lewis (2010), footnote 8. 'Nominal investment' is gross fixed capital formation at current prices, year ended June. 'Real investment' is gross fixed capital formation in chain volume measures (reference year 2010-11) for year ended June. Output SCIs as defined in figure 3.2.

Sources: Productivity Commission estimates using ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0) and Connolly, E. (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

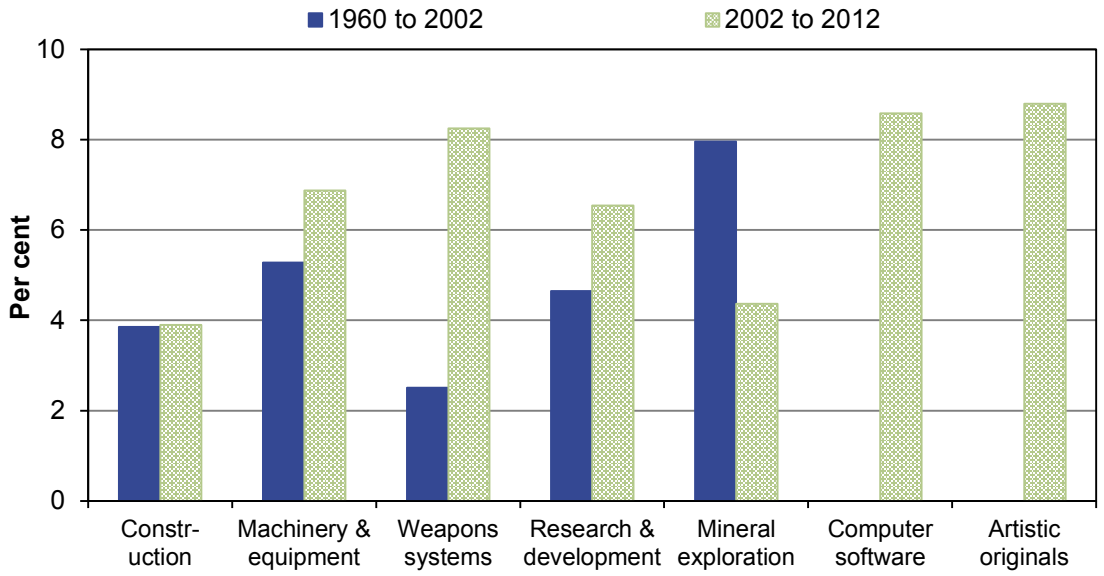
The nature of investment has changed over time

The profile of capital goods purchased by firms has changed over time (figure 3.8). From 1960 to 2002, investment was strong in traditional physical assets, such as buildings, machinery and equipment. Investment that adds to a firm's intangible stock of income-generating information — mineral and petroleum exploration and research and development — also grew strongly.[16] Since 2002, expenditure on

16 The ABS recognises expenditure on research and development as capital formation (investment) rather than consumption expenditure, in the sense that it increases the stock of knowledge. Similarly, it counts mineral and petroleum exploration in this category as it is expenditure

research and development and machinery and equipment has accelerated, while that on mineral exploration has about halved. Over the same period, stocks of computer software, artistic original and weapons systems that have expanded the fastest. The strong rise, since 2002, in stocks of software, machinery and equipment and research and development may be viewed as stemming from the same structural adjustment process, that is, firms seeking to capitalise on improvements in technology and low-cost high-technology imported inputs.

Figure 3.8 **Average annual growth in net capital stock, by asset[a]**
Chain volume measures, 1960 to 2012



[a] Reference year for chain volume measures is 2010-11. Growth rate for computer software and artistic originals calculated for the 2002 to 2012 period only, due to data availability. 'Construction' refers to non-dwelling construction.

Source: ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0).

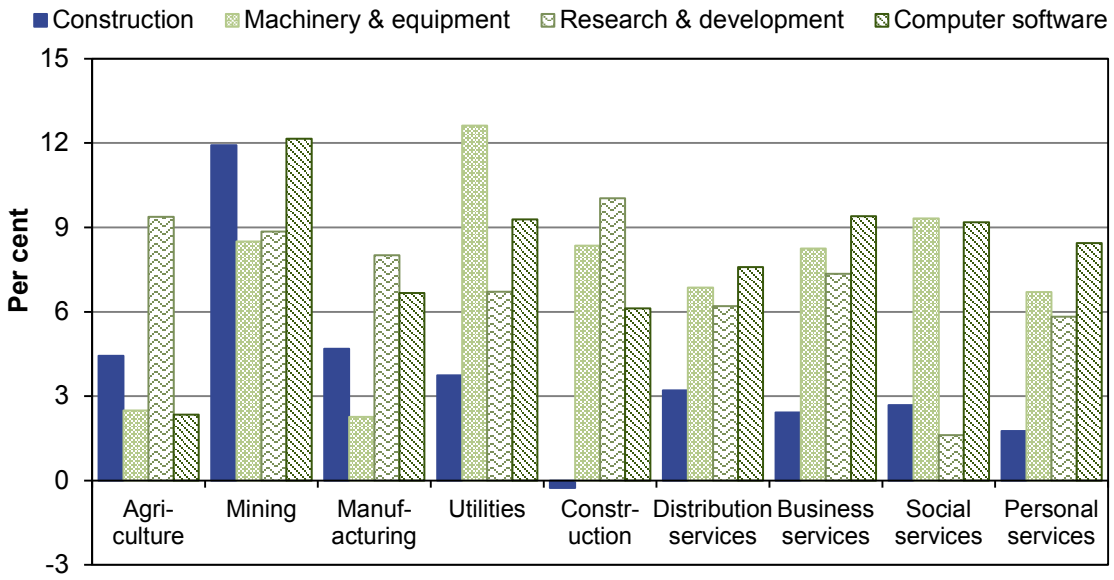
In the past decade, growth in the stock of computer software and research and development has been relatively strong in sectors not traditionally thought of as 'knowledge-based' (figure 3.9). For example, the mining and utilities sectors have expanded their stocks of computer software by about 12 per cent and 9 per cent per year since 2002, respectively — at least as fast as in the business services and social services sectors. The agriculture, mining and construction sectors have also

needed to acquire knowledge about new reserves of these resources (ABS 2012b). In both cases, that is, the expenditure is incurred to increase the quantity and value of an intangible asset that is expected to yield future income. As a result, accumulated expenditure in these areas is counted as part of net capital stock in the national accounts. For a detailed exposition of investment in intangibles, see Barnes and McClure (2009).

recorded strong growth in their net stocks of research and development. (Recent patterns in capital accumulation in the mining sector are presented in chapter 6.)

Figure 3.9 **Average annual growth in net capital stock, by asset type and sector, 2002 to 2012[a]**

Chain volume measures



a Reference year for chain volume measures is 2010-11. Sectors are broad industry groupings, as defined in appendix A. 'Construction' refers to non-dwelling construction.

Source: ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0).

Among the services sectors, business services has also increased its stock of computer software relatively quickly, consistent with the suggestion that technological change has played a central role in the strong investment growth in this sector. Interestingly, the social services sector — which includes education, health and public administration — has recorded slightly higher annual growth in its stock of machinery and equipment than has the mining sector. Technological change has been a major contributor to increased expenditure on advanced equipment such as computer hardware in education and specialised medical devices in health.

Capital intensity has risen

As a result of net investment, rising capital intensity in production has been a pervasive trend in the past two decades or so, as measured by changes in real net capital stock per worker. This trend is likely to reflect some of the drivers of structural change that were identified in chapter 2. In particular, it is likely that improved technology, combined with the greater purchasing power over imports of

the Australian dollar in the last ten years, have made it profitable for firms to substitute plant and equipment for relatively scarce labour.

The mining and utilities sectors, traditionally the most capital-intensive, have become considerably more so since 1985 (figure 3.10). That said, their capital intensity declined slightly between 1998 and 2011, relative to the preceding period.

Manufacturing, traditionally more labour-intensive, has followed a similar trend towards capital deepening, nearly doubling its capital–labour ratio since 1985. Moreover, virtually all manufacturing subdivisions consistently increased their capital intensity in the period from 1988-89 to 2007-08 (Barnes, Soames and Li, forthcoming).[17] It is likely that, in the decade to 2012, the purchasing power of the Australian dollar over imported capital goods has provided businesses with incentives to invest. In some manufacturing industries, additional incentives were at work. In Petroleum, coal, chemical and rubber products, evidence suggests that investment surged from 2002 in order to meet tighter environmental standards imposed under the Commonwealth Government's *Cleaner Fuels* program. In that industry and in Metal Products, investment was also undertaken to expand capacity in response to higher demand and prices (Barnes, Soames and Li, forthcoming).

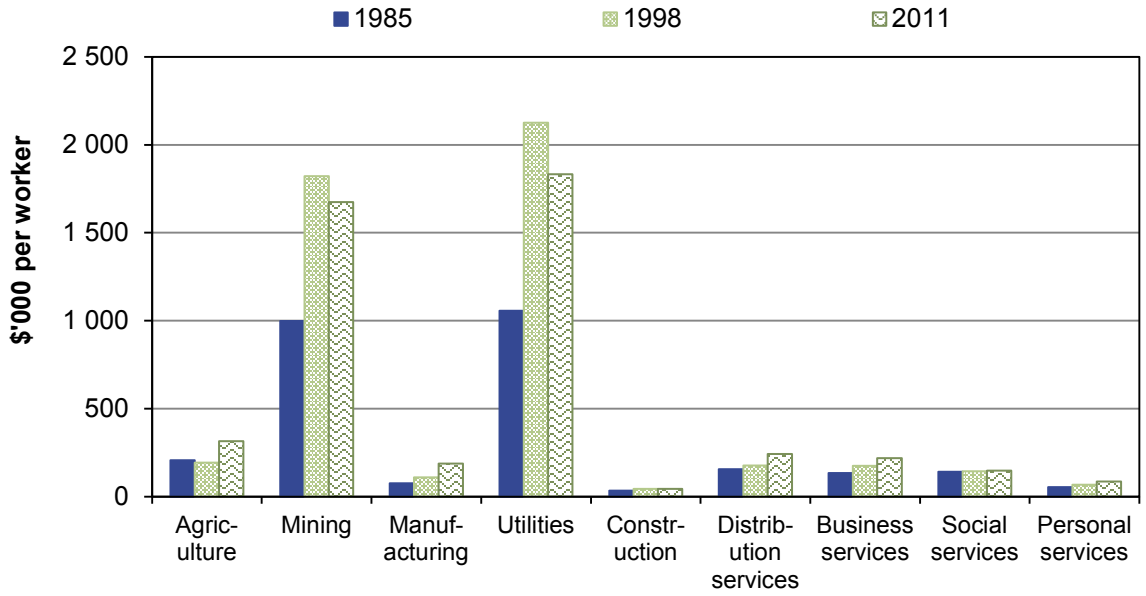
It is noteworthy that parts of the services sector — traditionally regarded as labour-intensive — are now at least as capital-intensive as manufacturing. The rise in capital intensity has been particularly pronounced in business services and distribution services.

3.3 Structural change across states and territories

The geographic concentration of the natural resources boom is evident in the strong real output per capita growth observed during the 2000s in the resource-rich jurisdictions of Western Australia, the Northern Territory and (to a lesser extent) Queensland (figure 3.11). The latter jurisdiction recorded average per-capita output growth that was slightly lower in the period 2002 to 2012 than in the preceding decade. Nonetheless, the strong expansion of its mining sector is likely to have prevented that growth from dropping off to the extent experienced by New South Wales, Victoria and South Australia. (Although the mining sector also increased its activity in those jurisdictions during the 2002–2012 period, its growth was more subdued than in the resource-rich states.)

[17] The only exception was the Wood and paper products manufacturing subdivision, during the 1998-99 to 2003-04 productivity cycle (Barnes, Soames and Li, forthcoming).

Figure 3.10 **Real net capital stock[a] per worker,[b] by sector[c]**
Selected years[d]



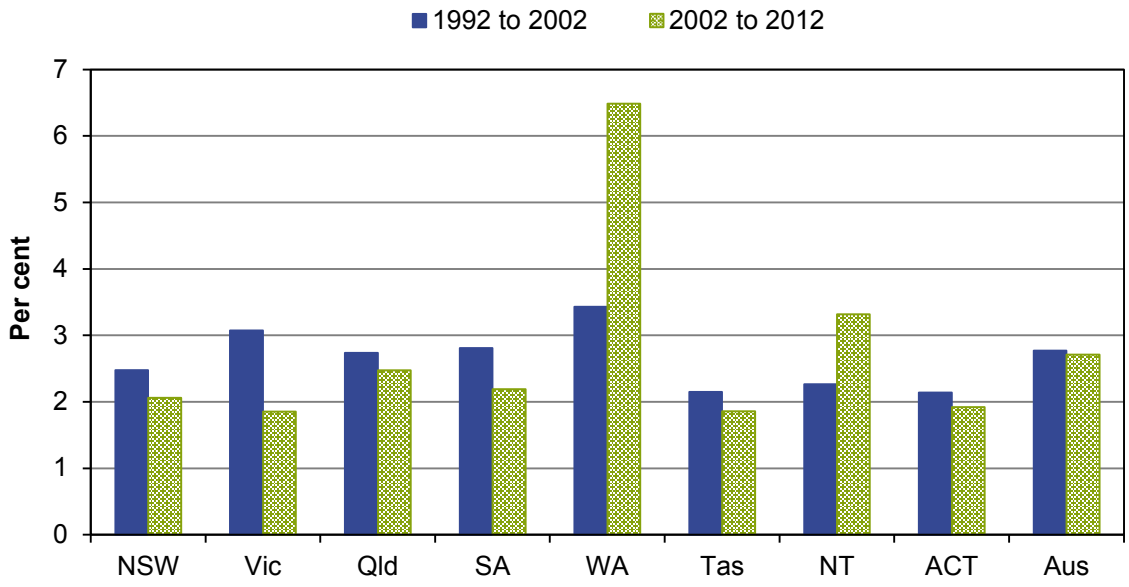
[a] Net capital stock in chain volume measures (reference year 2009-10), year ended June. [b] Total number of workers, seasonally adjusted, annual averages of quarterly figures. Figures for 1985 are averages of three quarters of data only (November 1984, February 1985 and May 1985) due to data availability. [c] Sectors and industries are defined in appendix A. [d] 1984-85 data are the earliest available (for employment).

Sources: Productivity Commission estimates using ABS (*Australian System of National Accounts, 2010-11*, Cat. no. 5204.0; *Labour Force, Australia, Detailed, Quarterly*, *May 2012*, Cat. no. 6291.0.55.003).

Figure 3.11 underscores the long-term nature of structural change, with Western Australia enjoying the highest average output per capita growth of all jurisdictions in the last twenty years, and Tasmania the lowest.

Similarly, the resource-rich jurisdictions have seen faster growth in real investment in recent years (figure 3.12). Investment in Western Australia expanded by about 12 per cent per year, on average, between 2002 and 2012. Consistent with that state's mining expansion, the fastest rates of investment growth in the Western Australian private sector, in the past decade, have been with respect to expenditure on construction (almost 21 per cent per year, on average) and machinery and equipment (14 per cent) (data not shown).

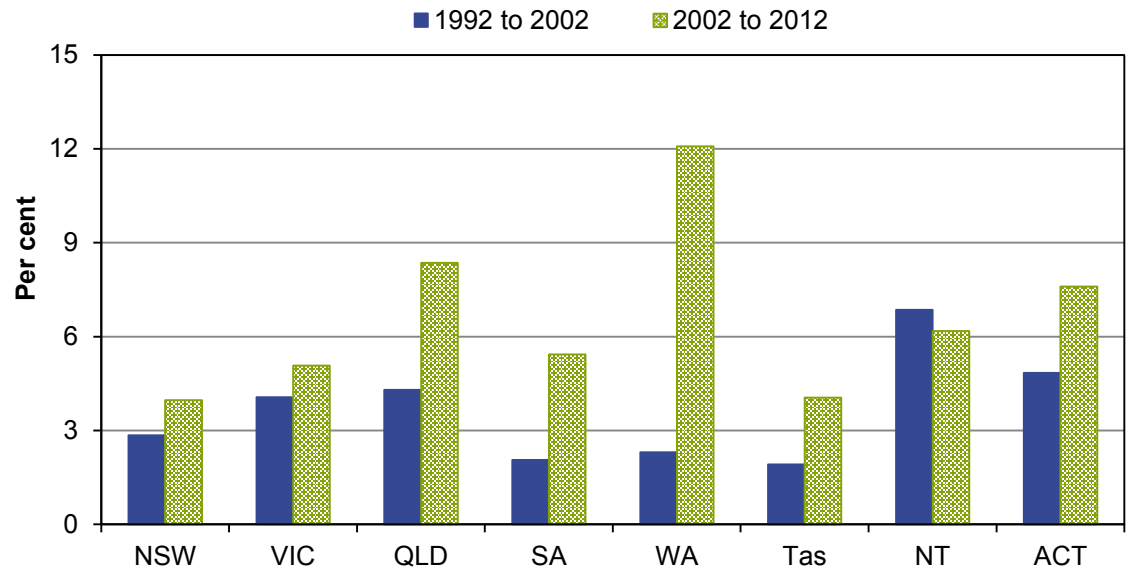
Figure 3.11 **State and territory real output per capita, 1992 to 2012[a]**
Average annual growth rates



a 'Output per capita' refers to real gross state product per capita (real gross domestic product in the case of Australia), average annual growth rates from 1992 to 2002 and 2002 to 2012, years ended June. Chain volume measures (reference year 2010-11).

Sources: ABS (*Australian National Accounts: State Accounts, 2011-12*, Cat. no. 5220.0; *Australian Demographic Statistics, June 2012,* Cat. no. 3101.0).

Figure 3.12 **State and territory investment, 1992 to 2012[a]**
Real gross fixed capital formation, average annual growth rates



a Chain volume measures (reference year 2010-11).

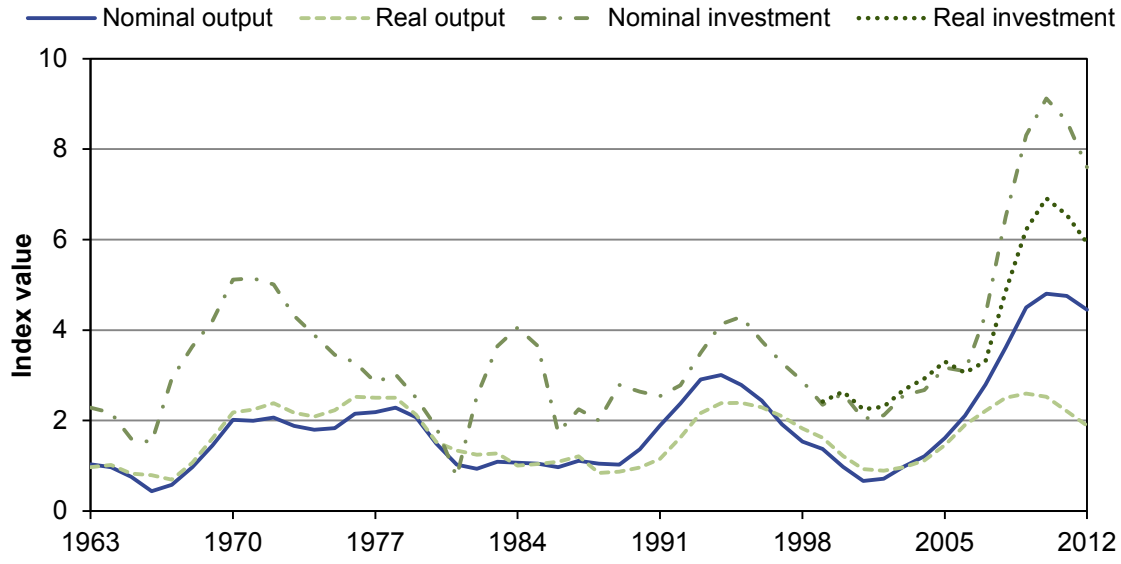
Source: ABS (*Australian National Accounts: State Accounts, 2011-12*, Cat. no. 5220.0).

Geographic structural change reflects the concentration of the resources boom

The recent rates of structural change observed among states and territories, at least in terms of nominal investment and nominal output, have been unprecedented in the last 50 years (figure 3.13). This stands in contrast with the extent of structural change in sectoral shares of output and investment (economy wide), as observed earlier in this chapter. The historically high rates of measured structural change among states and territories confirm that the location of the additional output and investment linked to the resources boom has been concentrated geographically. As would be expected, regions with the richest endowments of minerals and energy increased their share of output and investment.

Figure 3.13 **Structural change in state and territory shares of investment and output**

Structural change indexes, 1963 to 2012[a]



[a] Calculated as half the sum of the (absolute) five-year change in the five-year moving average of state and territory shares, with the final year indicated. State and territory classifications are as described in Connolly and Lewis (2010), footnote 8. 'Nominal output' refers to gross state product, at current prices. 'Real output' refers to gross state product in chain volume terms (reference year 2010-11). 'Nominal investment' refers to gross fixed capital formation at current prices, year ended June. 'Real investment' refers to gross fixed capital formation in chain volume terms (reference year 2010-11), year ended June.

Sources: Productivity Commission estimates using ABS (*Australian National Accounts: State Accounts, 2011-12*, Cat. no. 5220.0) and Connolly, E. (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

The patterns observed in figure 3.13 are consistent with the three-phase characterisation of the natural resources boom. The effect of the initial 'price phase' is apparent in the fact that measured structural change has been higher in nominal than in real terms, whereas the impact of the completed 'construction phase' is

reflected in the observation that there has been greater structural change in investment than in output. This latter pattern might, in turn, be superseded during the emerging 'production phase', when the rate of measured structural change in real output would be expected to increase as a rising number of mining projects reach full production.

4 Structural change in employment

Key points

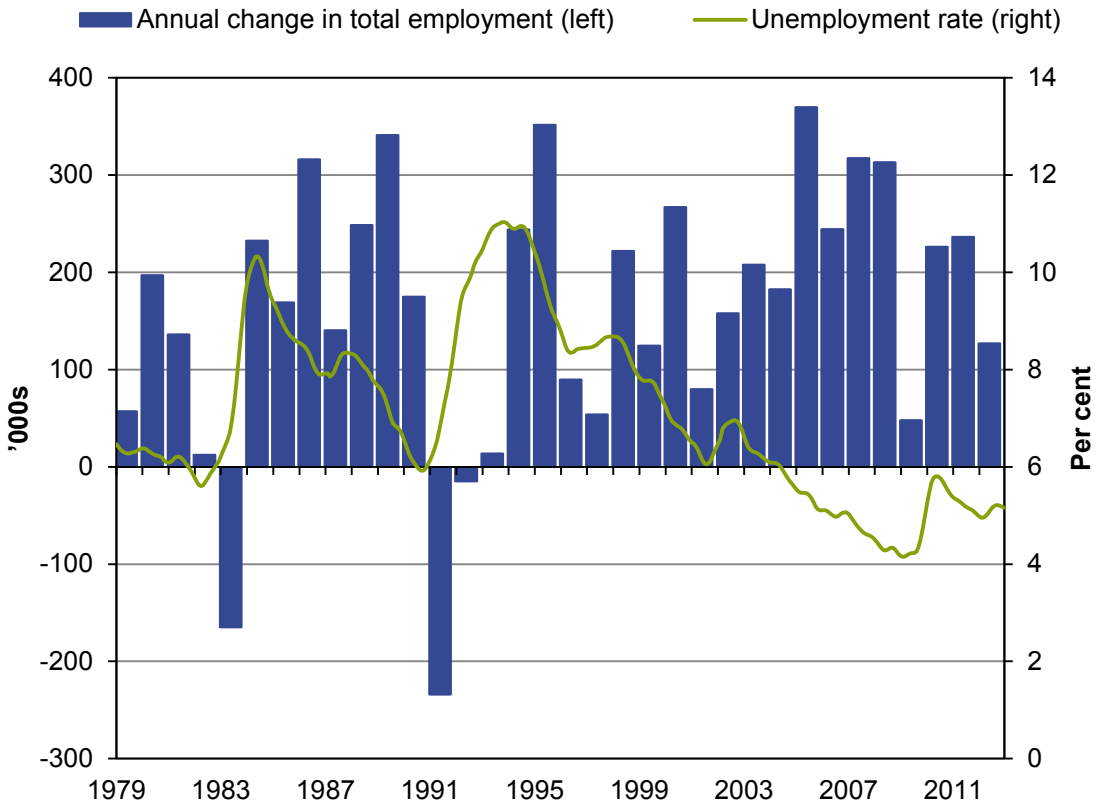
- In the decade to 2012, structural change in employment has taken place in the context of a historically low rate of unemployment and generally solid growth in the number of people employed.
- Structural change indexes suggest that the recent natural resources boom has not been associated with an unprecedented rate of structural change in employment. Higher rates of structural change in employment were experienced in the late 1970s and early 1980s across sectors, and in the mid-1990s across states and territories.
- Over the last 25 years, relatively few industries have experienced large changes in their share of total employment.
  - The largest decreases in employment shares were in Manufacturing and Agriculture.
  - Employment in Professional, scientific and technical services and Health care and social assistance experienced the greatest increases.
  - The rate at which employment shares in these industries has changed has been relatively constant.
- The states, territories and regions differ in their factor endowments, population and labour force profiles and industrial composition. Consequently, they tend to differ in the nature and rate of their structural change in employment.
  - Western Australia and Queensland have seen rapid growth in mining employment, while Victoria and New South Wales have experienced pronounced declines in the employment share of manufacturing, and rises in the employment share of services.
  - These industry trends resulted in structural change in employment being particularly concentrated in certain regions of the jurisdictions involved.
- Analysis of the geographic composition of employment suggests that the shift in employment shares occurred mostly between states and territories, rather than between regions and capital cities within jurisdictions.

This chapter describes structural change that has taken place in the Australian labour market during parts of the twentieth and twenty-first centuries. To that end, a range of employment indicators are presented that reflect various aspects of structural change. These indicators describe developments occurring nationally at the sectoral and industry employment levels (sections 4.1 and 4.2, respectively), as well as happening at the state and territory and regional levels (section 4.3).

Labour market changes are a key element of structural change. As industries react to changes in demand for their outputs, patterns of labour demand are altered, leading to changes in aggregate employment and unemployment, as well as in the distribution of workers across sectors (mostly broad groupings of industries) and geographic areas.

In recent times, structural change has occurred within the context of a historically low rate of unemployment and generally solid growth in the number of people employed (figure 4.1). Between 2002 and 2012, total employment increased from 9.3 to 11.5 million people, while the unemployment rate remained below 6.5 per cent. Even in the last four years, when employment growth slowed in some quarters due to the Global Financial Crisis and its aftermath, the unemployment rate remained below the 6 per cent that prevailed following the 1971-1972 boom in the price of rural commodities (PC 2012a).

Figure 4.1 **Changes in employment and unemployment, 1979 to 2012[a]**



a Change in employment is the annual change to June in each year. Unemployment is the monthly unemployment rate. Both series are trend data.

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

A key observation that can be made from the series presented in figure 4.1 is that, irrespective of the amount of structural change undergone by the economy between

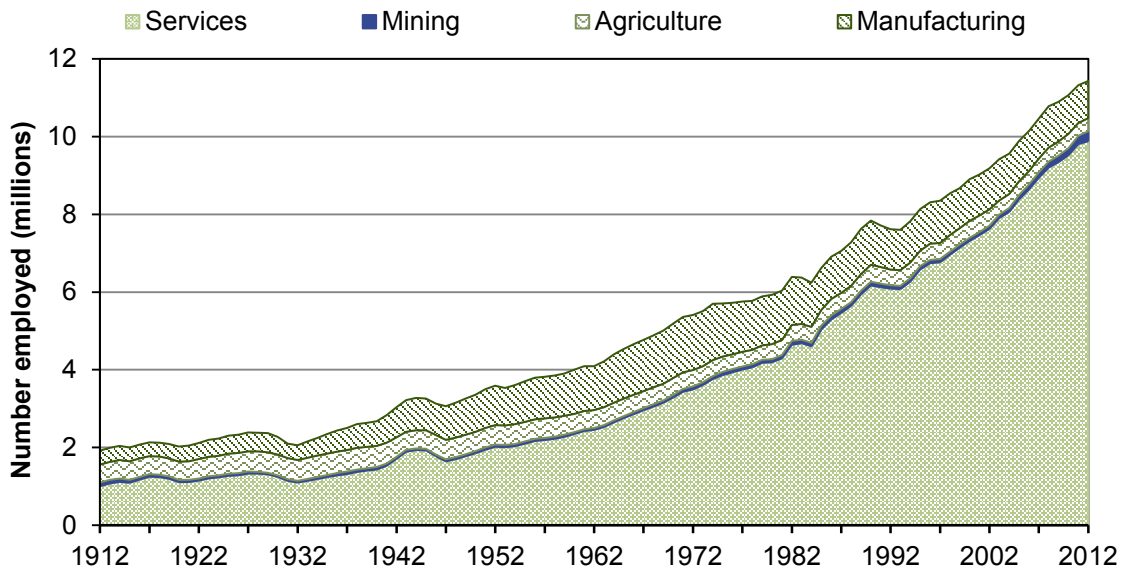
2002 and 2012, the overall labour market generally proved resilient. Indeed, Borland (2011) termed the 2000s 'the quiet decade' for that market.

4.1 Structural change at the sectoral level

This section presents indicators of structural change in the labour market, at a broad sectoral level. To contextualise and draw a distinction with Australia's recent experience, these indicators cover both the past decade and the longer term.

Figure 4.2 shows the growth in employment across broad sectors over the past one hundred years. Between 2002 and 2012, total employment in services increased by over 2.2 million people (from around 7.6 million) while, in the mining sector,[18] around 180 000 new workers were added, in addition to the 80 000 employed at the start of this period. That is, the mining workforce more than trebled in 10 years. Over the same period, employment in agriculture and manufacturing both declined by around 90 000 people, from around 425 000 and 1 million persons, respectively.

Figure 4.2 **Aggregate employment by broad sectors, 1912–2012[a, b]**



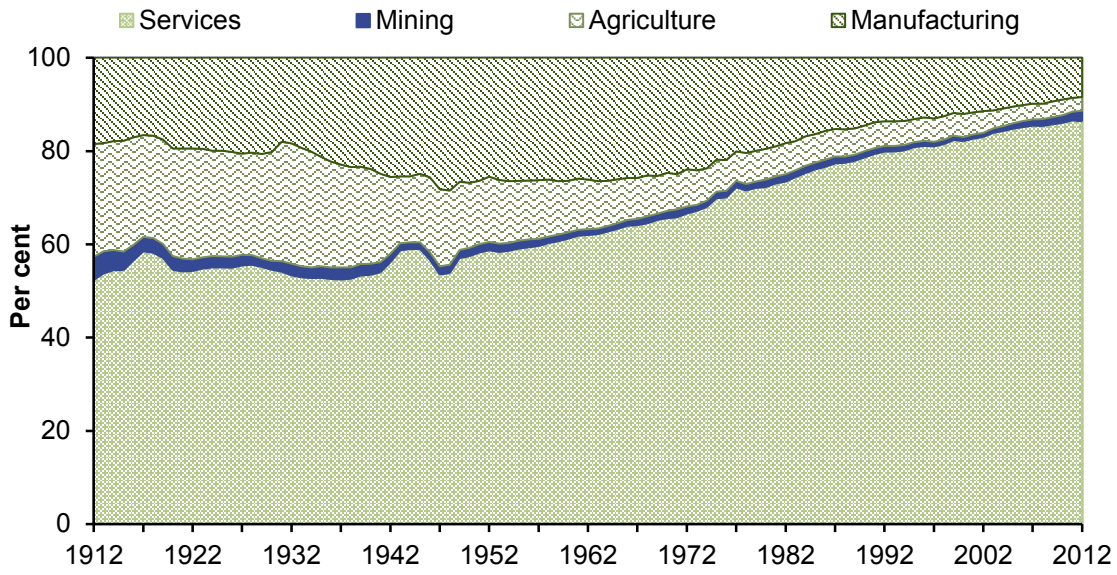
a Data presented are for financial years. **b** Refer to appendix A for details of the four-sector aggregation.

Sources: Productivity Commission estimates using Withers, Endres and Perry (1985) and ABS (*Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003).

18 The terms 'natural resources sector', 'resources sector', 'mining sector' and 'Mining industry' are used interchangeably in this supplement. Appendix A provides a definition of the natural resources sector.

Figure 4.3 provides the 'stacked shares' equivalent of figure 4.2. The employment share of agriculture has experienced a relatively steady, long-term decline over the entire period. In contrast, the share of manufacturing rose until the late 1940s, but declined thereafter. From around the same time, services have recorded a strongly rising share, now amounting to almost 90 per cent of total employment in the economy.

Figure 4.3 **Australian employment shares by broad sectors, 1912 to 2012[a, b]**



a Data presented are for financial years. **b** Refer to appendix A for details of the four-sector aggregation.

Sources: Productivity Commission estimates using Withers, Endres and Perry (1985) and ABS (*Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003).

To some extent, this broad picture is similar to that which has occurred in other developed nations, characterised by the decline of agriculture and the rise of services (Herrendorf, Rogerson and Valentinyi 2011). However, Australia is distinctive given the relative size of its mining sector workforce. After declining in relative terms for virtually all of the twentieth century, the employment share of mining almost trebled between 2000 and 2012. At the end of that period, mining employment comprised around 2.2 per cent of all employment, a figure much greater than the OECD average of less than 0.5 per cent (OECD 2012b).

The historical trends in figure 4.3 reflect significant change in Australia's economic structure, particularly over the course of the twentieth century. Early in that century, the country was 'riding on the sheep's back', with agriculture accounting for more

than 23 per cent of employment in 1920.[19] By the mid-1960s, agriculture's share of total employment had fallen to less than 10 per cent, and it has continued to decline ever since.

The prolonged decline in employment in agriculture has coincided with a strong shift to employment in the services sector, a trend that shows little sign of abating. This is illustrated further in table 4.1 which shows the changes in the share of employment in different sectors between 1958 and 2012. This table disaggregates services into five broad components (appendix A), most of which have increased their share of total employment over recent decades. Most notable are the increases in the proportion of employment in the social services sector, from around 10 per cent in 1958 to over 25 per cent in 2012, and employment in business services from around 5.5 per cent in 1958 to around 17 per cent in 2012. (The increasing share of social services employment is particularly striking, given that this sector's share of total output declined from 1978 to 2012 (table 3.1). As mentioned in chapter 3, this is likely to have been an artefact of the way in which the ABS measures the output value of non-market services.)

Table 4.1 **Changes of sectoral shares in employment, 1958 to 2012[a, b]**

	Share of total employment			*Change in share of total employment*	
	1958	2002	2012	1958 to 2002	2002 to 2012
	%	%	%	Percentage point	Percentage point
Agriculture	12.2	4.8	2.9	-7.4	-1.9
Mining	1.4	0.9	2.2	-0.5	1.3
Manufacturing	26.2	11.4	8.4	-14.8	-3.0
Construction	27.6	23.7	22.4	-3.9	-1.3
Distribution services	8.2	7.6	8.9	-0.6	1.4
Business services	5.5	15.5	16.9	10.0	1.3
Social services	10.9	22.9	25.8	12.0	2.9
Personal services	8.0	13.2	12.5	5.2	-0.7

a 1958 data are for the 1958-59 financial year. 2002 and 2012 data are annual averages of quarterly data, ending in the May quarter of each year. Employment is in terms of total number of people employed. **b** Refer to appendix A for definitions of sectors.

Sources: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003) and E. Connolly (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

The bulk of these increases took place between 1958 and 2002, and were accompanied by correspondingly large decreases in the shares of manufacturing and

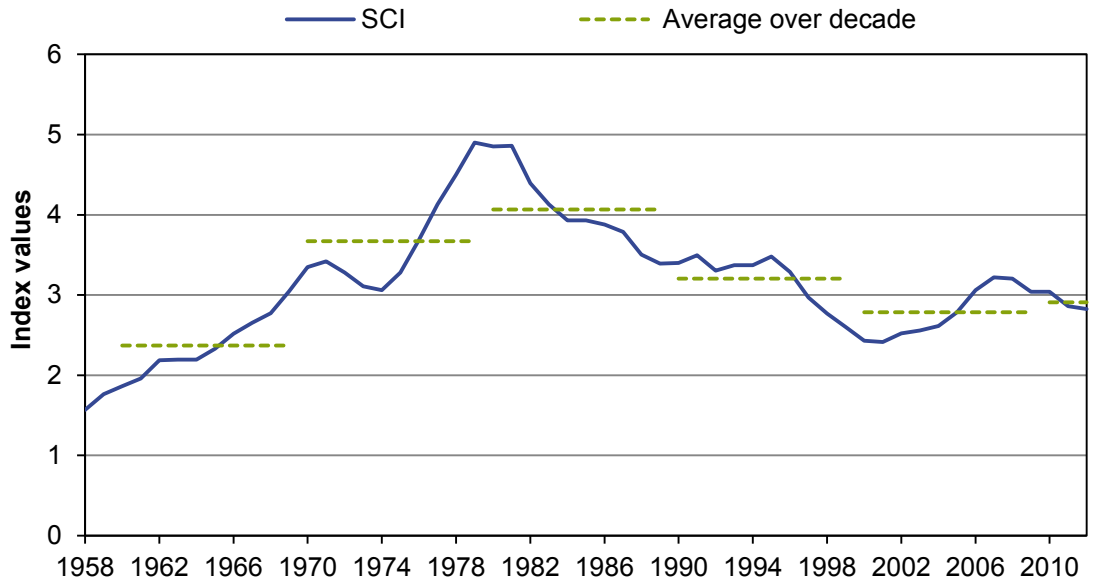
19 Analysis of the history of wool exports from Australia — which in 1921 accounted for 26.7 per cent of the value of total exports — can be found in Cashin and McDermott (2002).

agriculture. For its part, mining has more than doubled its share of total employment in the last decade, following a slight contraction from 1958 to 2002.

The rate at which the structure of employment in Australia has changed can be summarised by a 'structural change index' (SCI). In figure 4.4, the rate of structural change in employment occurring between eight broad sectors — agriculture; mining; manufacturing; construction; distribution services and utilities; business services; social services; and personal services — is shown over time. In essence, the SCI measures the net overall share of the workforce that has changed sector over a period of time. The higher the index, the greater the amount of structural change that is deemed to have occurred in the labour market. Note that an SCI does not capture the gross flows underlying transitions of individual workers, a measure covered in chapter 5. Appendix B contains further information on the methodology underlying SCIs.

Figure 4.4 **Employment structural change index by sector, 1958 to 2012[a, b]**

Eight–sector aggregation of industries



[a] Data are for financial years until 1985, and annual averages of quarterly data, ending in the May quarter of each year, from 1986 to 2012. [b] Sectors are defined in appendix A. Appendix B gives details of SCI methodology.

Sources: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003) and E. Connolly (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

As shown by the eight-sector SCI above, the natural resources boom has not been associated with an unprecedented rate of structural change in employment; previous periods were times of more rapid change. The average for 2000–2009 was 2.8, compared to the peak of 4.1, recorded in the 1980s. The annual SCI values suggest that in the late 1970s and early 1980s the redistribution of employment between

sectors amounted to about 5 per cent of employment, in contrast to around 3 per cent since the turn of the twenty-first century.[20]

It is beyond the scope of this supplement to examine the reasons behind the structural change that occurred in earlier periods. Nevertheless, writing about the 1970s peak in the Australian employment SCI, the Commission stated that 'the impact of the two oil shocks in the 1970s, including the commodity price boom of 1973-74, is clearly evident' (1998, p. 16).

Comparison of structural change in employment and output

Structural change indexes in employment and in output are likely to be related, given that they both reflect aspects of an economy's transformation.[21] Figure 4.5 reveals both similarities and differences between the two indexes. After some divergence in the early 1970s and mid-1980s, the indexes were similar for most of the 1990s and 2000s. Examination of the underlying data (not shown) suggests that the divergence in the two indexes during the mid-1980s was driven primarily by changes in manufacturing, and business and social services:

- Employment in manufacturing as a proportion of total employment declined more sharply than manufacturing output as a proportion of total output.
- The employment shares of business and social services increased more rapidly than their respective shares of output.

Conceptually, two variables can explain the divergence between a sector's share of output and share of employment. The first is labour productivity — a sector's level of real output per worker. When labour productivity in different sectors changes at different rates, a 'wedge' is introduced between the output and employment SCIs.

It is likely that some of the major competition and labour market reforms introduced in the 1980s were at least partly responsible for some of the differences observed between output and employment SCIs during that period (chapter 2). For instance, De Laine, Lee and Woodbridge (1997) found that, in manufacturing, the average

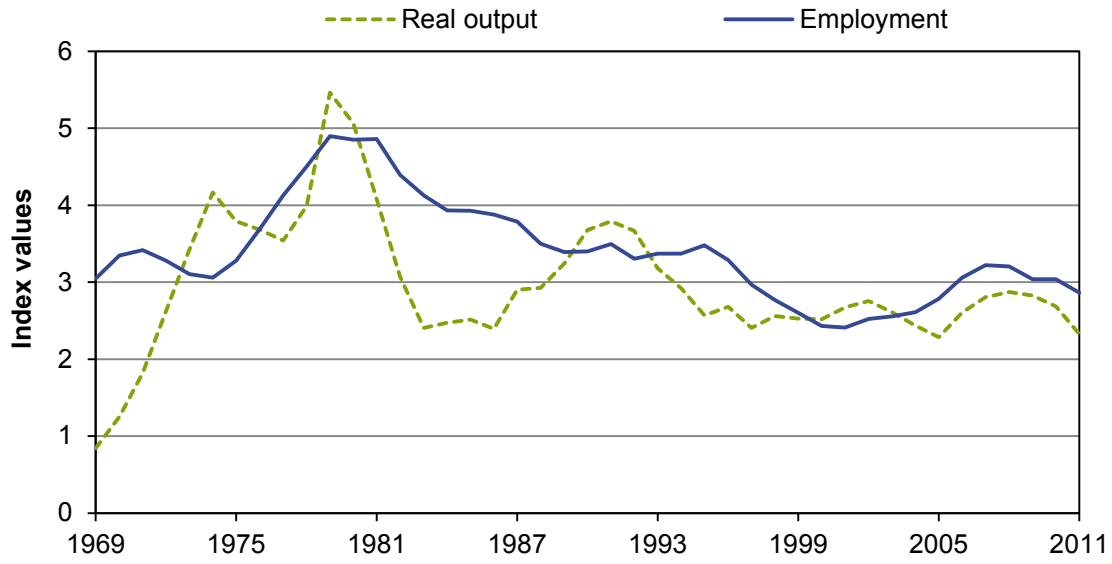
[20] This redistribution may be due to the physical movement of workers between sectors. However, sectoral shares of employment can expand or contract even if no worker changes jobs. This can happen when overall endowments of labour increase, for example, through higher immigration or greater labour force participation, resulting in some sectors expanding their workforce faster than others. (See appendix B for details of the interpretation of structural change indexes.)

[21] Despite the conceptual link between output and employment structural change indexes, the correlation coefficient between the two measures is equal to around 0.55, suggesting only a moderate correlation.

annual decrease in employment due to improved labour productivity was greater between 1983-84 and 1992-93 (a period that they associate with microeconomic reform) than between 1977-78 and 1983-84. This finding is consistent with the observation that manufacturing was a major source of output and employment SCI divergence during the 1980s.

Figure 4.5 **Employment and real output structural change indexes, 1969 to 2011[a, b]**

Eight-sector aggregation of industries



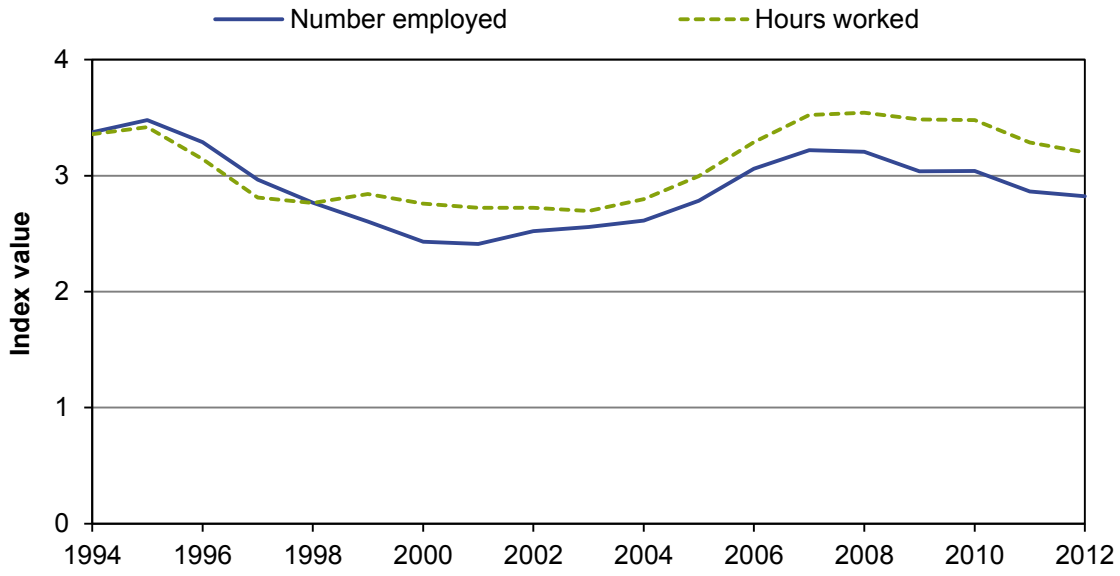
[a] This figure combines the employment structural change index shown in figure 4.4 and the real output structural change index shown in figure 3.2. Employment data are for financial years until 1985, and annual averages of quarterly data, ending in the May quarter of each year, from 1986 to the present. Real output data reflect financial years. [b] Sectors are defined in appendix A. Appendix B gives details of SCI methodology.

Sources: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003; *Australian System of National Accounts*, Cat. no. 5204.0) and E. Connolly (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

The differing use of part-time employment — across sectors and over time — is the second possible explanation for the divergence between output and employment SCIs. The latter index traditionally uses 'headcount' measures of employment to calculate sectoral shares. These shares may differ from the 'hours worked' shares if some sectors are more prone than others to using part-time and casual staff. To investigate this possibility, figure 4.6 plots SCIs calculated using both the total number of people employed and total hours worked. The latter measure gives an indication of the total labour 'used', and is not affected by changes in the level of part-time work.

The indexes generate broadly similar results, although it is notable that, since 1998, structural change in terms of hours worked has risen above structural change in total employment. This implies that the change in the distribution of hours worked has exceeded the change in the distribution of people employed across sectors. A possible explanation for this trend is that some sectors intensified their use of part-time work, while others reduced it. This possibility is investigated further in chapter 5.

Figure 4.6 **Employment structural change indexes, 1994 to 2012[a, b]**
Number of people employed and hours worked



[a] Data are derived from annual averages over quarterly data, ending in August of each year, from 1986 to the present. From these data, 5-year moving averages of employment shares across eight sectors are calculated. The structural change index is calculated by halving the sum, over all sectors, of the absolute values of the difference in employment shares between year *t* and year *t-5*. [b] Sectors are defined in appendix A. Appendix B gives details of SCI methodology.

Source: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003).

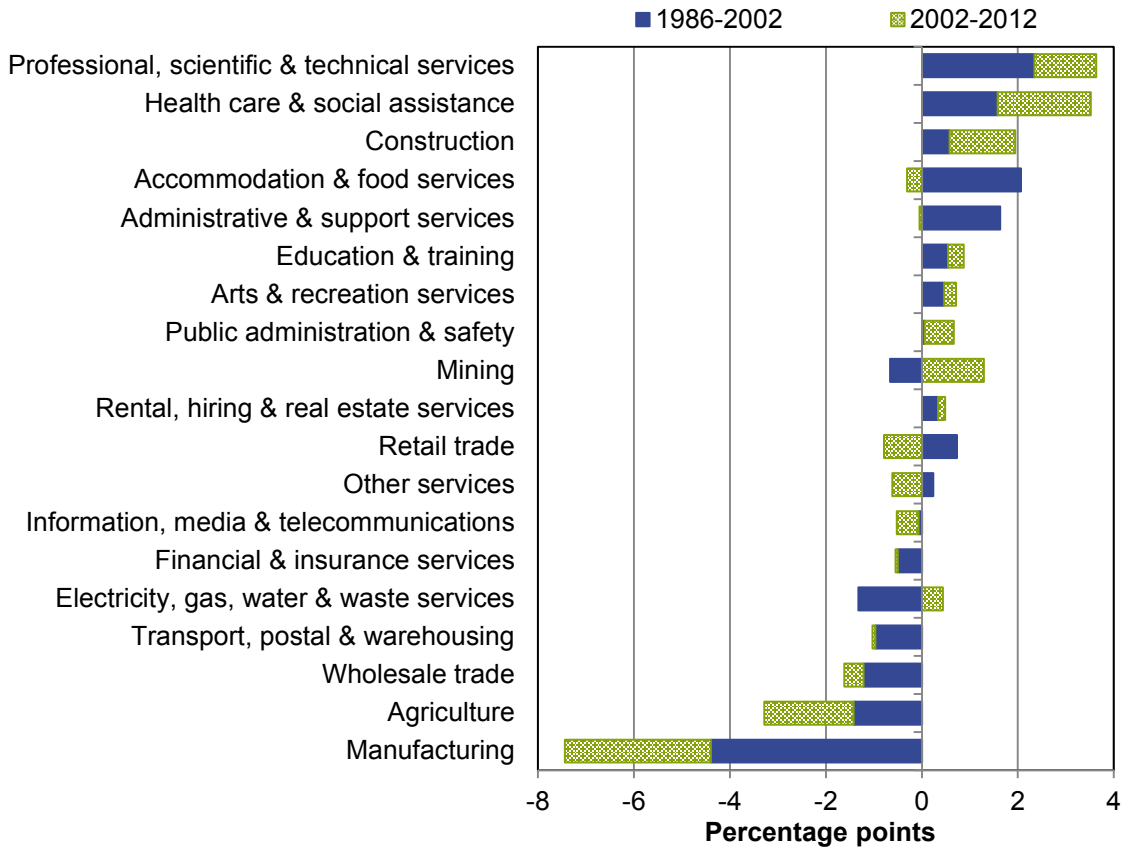
4.2 Structural change in employment at the industry level

The graphs and tables presented in section 4.1 illustrate changes in employment at the level of the sector. However, they do not identify specific industries as having expanded or contracted their share of overall employment over time. A more disaggregated examination of industry changes is presented below.

Which industries have expanded or contracted?

To focus on the sources of structural change in employment at the industry division level, figure 4.7 shows the change in employment share of individual industries between 1986 and 2002, and between 2002 and 2012. Industries are categorised by whether their relative share of total employment has grown (overall) since 1986, and ranked in descending order of (overall) percentage point change in employment.

Figure 4.7 **Changes in employment shares by industry, 1986 to 2012[a]**
Percentage point change in share of total employment



a Percentage point changes are calculated as the difference between the annual averages (over quarterly data to May).

Source: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003).

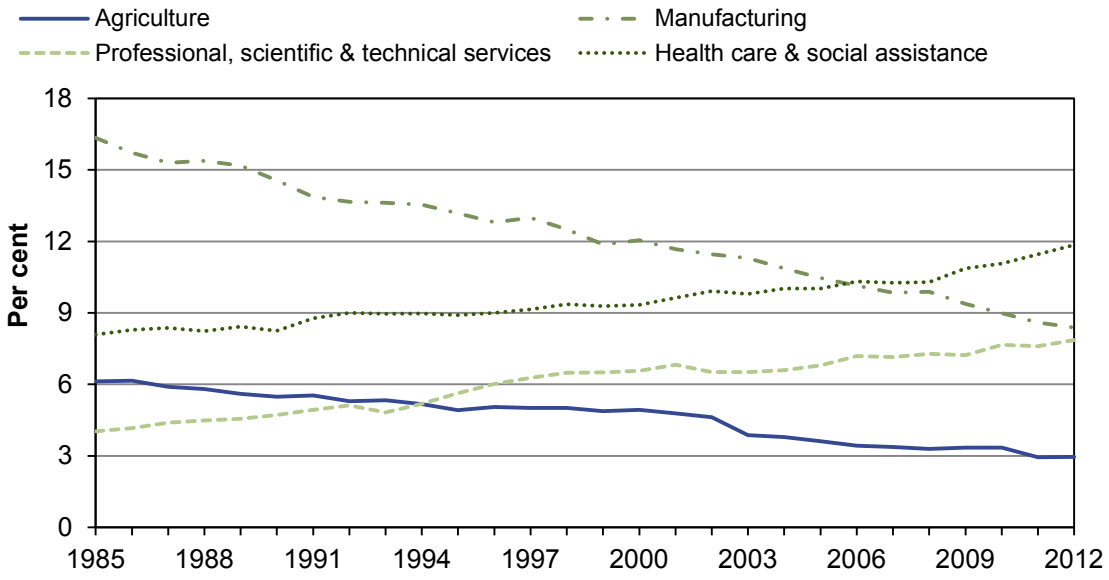
It is readily apparent that, in both sub-periods, the largest declines in employment share occurred in the Manufacturing and Agriculture industries. In contrast, the two industries with the largest expansions in employment share over the whole period were Professional, scientific and technical services, and Health care and social assistance. Interestingly, for all four major 'movers', there was no discernible

change in the underlying trends of growth (positive or negative) between 1986–2002 and 2002–2012. By contrast, for some of the smaller movers, the trends reversed between the two periods.

Figure 4.7 does not show annual fluctuations in employment shares of individual industries. In order to analyse some of these fluctuations, figure 4.8 plots annual employment shares between 1986 and 2012 for the four industries with the largest percentage point changes in their employment shares over this period.

Figure 4.8 **Shares of employment of selected industries, detailed, 1985 to 2012[a]**

Per cent of total employment



a Quarterly data averaged annually to May for each year. ANZSIC industry divisions are used in this figure; 'Agriculture' is Agriculture, forestry and fishing, 'Professional' is Professional, scientific and technical services and 'Health care' is Health care and social assistance.

Source: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003).

It appears from this graph that the rates of change have been relatively constant over time. By and large, the employment share of each of the industries represented has been rising or declining at a steady rate since 1986, with no clear breaks or reversals. The drop in Agriculture's share in 2002-03 was the result of the drought prevailing at that time (PC 2005d). Exchange rate pressures faced by traditional exporters during the 2000s do not appear to have significantly altered the long-term

trends, with the possible exception of Manufacturing, where the trend has accelerated slightly since 2007-08.[22]

The detailed industry picture emerging from figures 4.7 and 4.8 confirms that the key features of structural change in employment, at least since the mid-1980s, were:

- a contraction in the shares of Manufacturing and Agriculture
- an expansion in the shares of Health care and Professional services.

These graphs also reveal that, underlying the overall expansion of services, were some notable contractions, as well as expansions. While the Professional services and Health care industries expanded for reasons analysed in chapter 2, other service activities such as Wholesale trade and Transport experienced significant declines in their employment share over the period.

4.3 Patterns of regional structural change in employment

Australian states and territories,[23] and the geographic regions within them, differ in many respects, including in terms of their factor endowments, population and labour force profiles, demand for labour and industrial composition. Consequently, they can be expected to respond differently to pressures for structural change.

Structural change may be examined in geographic terms using two related approaches:

- By looking at the changing sectoral or industry distribution of employment within a region or state.
- By looking at the changing distribution of employment across all regions (or states).

These approaches are complementary because, in many cases, changes in the geographic distribution of employment are due to changes in its industry distribution, combined with the fact that some industries tend to be geographically concentrated.

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22 Productivity Commission estimates suggest that the combined effect of the rising dollar and the Global Financial Crisis served to bring forward the structural decline of this industry's employment share by between 1.7 and 3.5 years, relative to the pre-existing trend (PC 2012a).

23 In the remainder of this section, the word 'states' is occasionally used to refer to all states and territories.

At the sectoral and industry level

The broad changes in sectoral shares of national employment between 1986 and 2012 were mirrored in all jurisdictions, to a greater or lesser extent (table 4.2). The largest contractions in the employment share of manufacturing — and corresponding increases in the employment share of services — were recorded in New South Wales, Victoria, South Australia and Tasmania. These trends existed before the onset of the resources boom and continued thereafter.

Table 4.2 **Change in sectoral employment shares by state and territory[a, b]**
Percentage point change between 1986 and 2002, and 2002 and 2012

	Agriculture		*Mining*		*Manufacturing*		*Services*	
	1986 to 2002	2002 to 2012	1986 to 2002	2002 to 2012	1986 to 2002	2002 to 2012	1986 to 2002	2002 to 2012
New South Wales	-0.9	-1.8	-0.9	0.7	-5.7	-2.4	7.4	3.5
Victoria	-1.4	-1.3	-0.2	0.3	-5.6	-4.4	8.6	5.1
Queensland	-2.0	-2.9	-0.6	2.0	-1.8	-3.1	5.4	3.5
South Australia	-1.4	-2.2	-0.9	1.1	-4.1	-4.4	7.4	5.1
Western Australia	-2.7	-1.9	-1.0	5.3	-2.2	-1.9	6.8	-2.1
Tasmania	0.3	-4.1	-0.9	1.2	-3.2	-3.2	6.3	5.5
Northern Territory	1.0	-2.1	-4.1	2.3	0.4	-1.2	2.7	0.1
ACT	-0.3	-0.2	0.0	0.1	-1.0	-1.4	1.3	0.9
Australia	-1.3	-1.9	-0.6	1.5	-4.5	-3.1	7.8	3.3

a Years to November, averaged over four quarters. **b** Sectors are defined in appendix A.

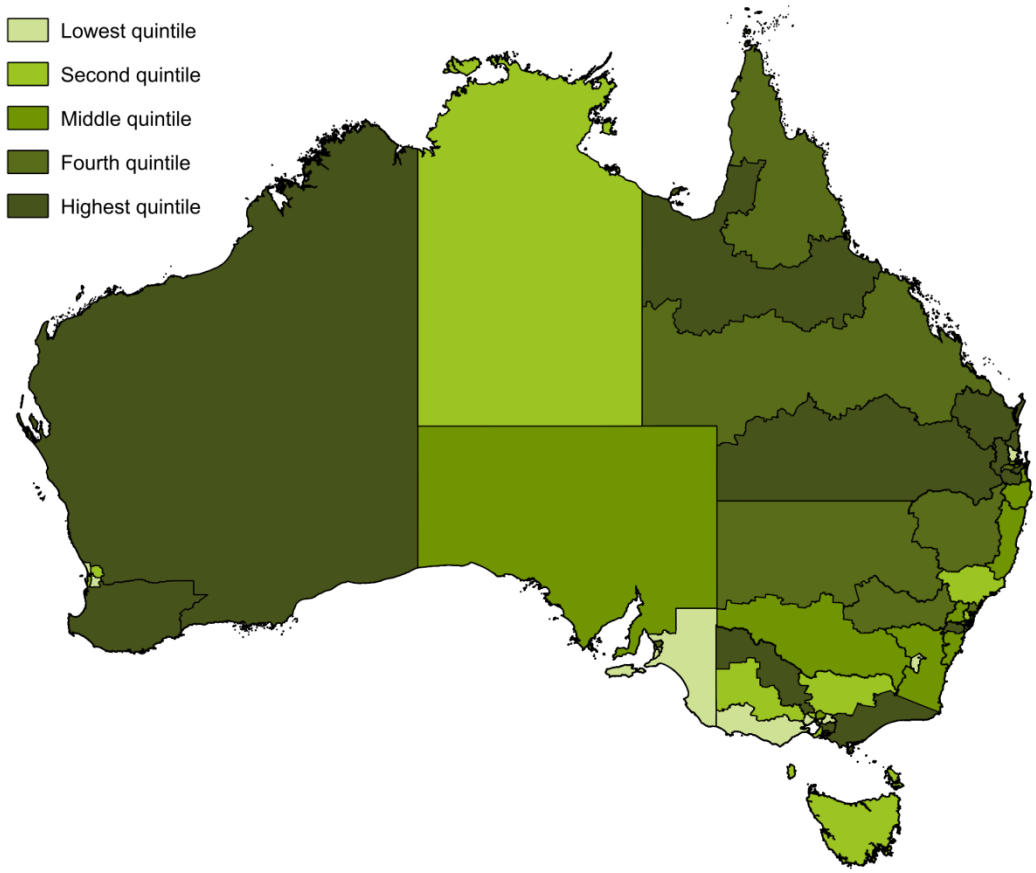
Source: ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003).

In Queensland and Western Australia, there was also a large decline in agriculture's share of employment. In Queensland, this was offset by an expansion in services and, to a lesser degree, mining. In Western Australia, mining-related employment increased substantially in the 2002–2012 period, with resulting falls in the shares of all other sectors. The scale of the resources boom in Western Australia is reflected in the fact that it is the only jurisdiction to have experienced a fall in the employment share of services between 2002 and 2012.

As well as taking place within states and territories, changes in the industry structure of employment are also evident within regions, as shown in figure 4.9 for the period 2008–2012. As this figure illustrates, structural change index values in the top quintile (20 per cent) were recorded in all mining regions, except the Northern Territory. Moreover, around 75 per cent of the statistical regions in

Queensland had SCI values that were in the top two quintiles across the country.[24] The growth in mining-related employment was the key reason behind the high levels of structural change in Queensland and Western Australia. In contrast, the high rates of change recorded in parts of Victoria and New South Wales reflected growth in the employment share of services, alongside the fall in employment in the manufacturing and agricultural sectors.

Figure 4.9 **Regional structural change in employment, 2008 to 2012[a, b]**
Structural change index by quintile and Statistical Region



[a] Structural change indexes at a regional level measure the change in sectoral shares of employment in that region between 2008 and 2012. Industry-level employment data have been aggregated to 9 sectors using the aggregation described in appendix A. Employment shares are averaged over the year to August in each year. [b] Highest quintile = top 20 per cent of SCI values. Lowest quintile = bottom 20 per cent.

Source: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003).

[24] Structural change index values in this analysis range from 4.2 to 7.5. However, their construction precludes direct comparison with employment SCIs calculated at the national level (figure 4.4), due to a different industry aggregation and time span.

At the geographic level

To examine the rate of change in the geographic composition of employment across Australia over time, figure 4.10 plots two SCIs:

- A 'state/territory' SCI, based on employment shares of states and territories.
- A 'region' SCI, based on employment shares of regions (where jurisdictions are disaggregated into capital cities and the balance of each state).

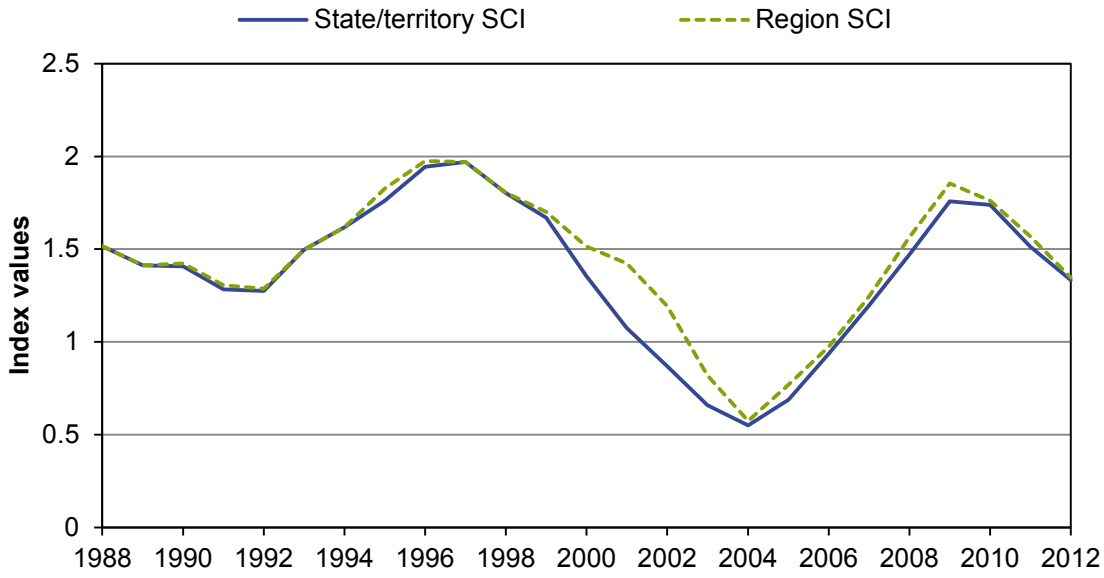
By construction, the region SCI is always greater than, or equal to, the state/territory SCI, as changes in state or territory shares of total employment over time must also involve changes in regional shares. However, within-jurisdiction changes, such as would be caused by the movement of people between a capital city and regional areas (in either direction), are only recorded by the region SCI. Given that the two indexes shown in figure 4.10 generally track each other, it is apparent that redistribution of employment shares mostly occurred *between* states and territories, in net terms, rather than between regions and capital cities *within* states (the period between 1999 and 2003 being an exception).[25]

Interestingly, the rate of redistribution of employment across jurisdictions or regions in figure 4.10 is substantially below the rate of redistribution between sectors (figure 4.4). The long-term average SCI at the jurisdictional level is around half the corresponding average at the sectoral level (around 3 percentage points).[26] This difference suggests that much of the structural change in employment by sector in Australia happens without a significant redistribution of employment shares between states and territories, such as would be caused by work-related interstate migration. (Geographic labour mobility is examined further in chapter 5. This issue is also the subject of a current Productivity Commission commissioned study, which is due to release a draft report in December 2013 — see www.pc.gov.au for details.)

[25] The absence of major net redistribution of employment between a capital city and the remainder of that state does not preclude the possibility that gross flows of equal but opposite magnitude have taken place.

[26] In undertaking this comparison, the number of sectors in figure 4.4 is equal to the number of states and territories in figure 4.10 (that is, eight). As with sectors, a finer disaggregation of jurisdictions or regions would result in a greater level of structural change measured by state/territory or region employment SCIs (appendix B).

Figure 4.10 **Employment structural change indexes, by states and territories and regions, 1988 to 2012**[a, b]



a The 'State/territory SCI' is calculated using employment shares of all eight states and territories. The 'Region SCI' is calculated using employment shares of the state capital cities and of the balance of the states. For the ACT and the Northern Territory, the entire territory's share is used in both indexes. Each index is calculated as half the sum of the (absolute) five-year change in the five-year moving average of state territory/region shares of output, with the final (financial) year indicated (as per: Connolly and Orsmond 2011; and Connolly and Lewis 2010). A Region SCI that exceeds the state/territory SCI signals that changes in employment shares are occurring *within* each jurisdiction, between the capital city and the balance of that jurisdiction (the direction of urban/regional change is indeterminate from the SCI). **b** Data are for financial years.

Source: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003).

Structural change and the distribution of unemployment

As well as affecting the distribution of employment across Australian jurisdictions and regions, structural change may influence the distribution of unemployment. As regions with different industry profiles expand or contract at varying speeds, the spread of unemployment rates across Statistical Local Areas (SLAs) will change. This could be due to time lags in labour market equilibration, as a result of imperfect job matching or labour market segmentation, wage inflexibility or low geographic labour mobility. However, in time and all else equal, jobseekers are likely to move from low growth areas to high growth areas, where expected incomes are higher.[27] This would tend to reduce regional disparities in

[27] Labour mobility occurring between regions within a state or territory (excluding capital cities) is not captured by the region SCI shown in figure 4.10.

unemployment. Debelle and Vickery (1998) have found internal labour migration to play such an equilibrating role among Australian states.

To some extent, the mechanisms described above seem to work as depicted. Mining regions have tended, over the decade to 2012, to have unemployment rates that were below the national average, while areas with a high concentration of manufacturing- and tourism-related employment have tended to have higher-than-average unemployment rates. Regions with higher employment in agriculture have generally reported unemployment rates closer to the national average (Productivity Commission estimates (not shown) from DEEWR *Small Area Labour Markets* database (2012c)).

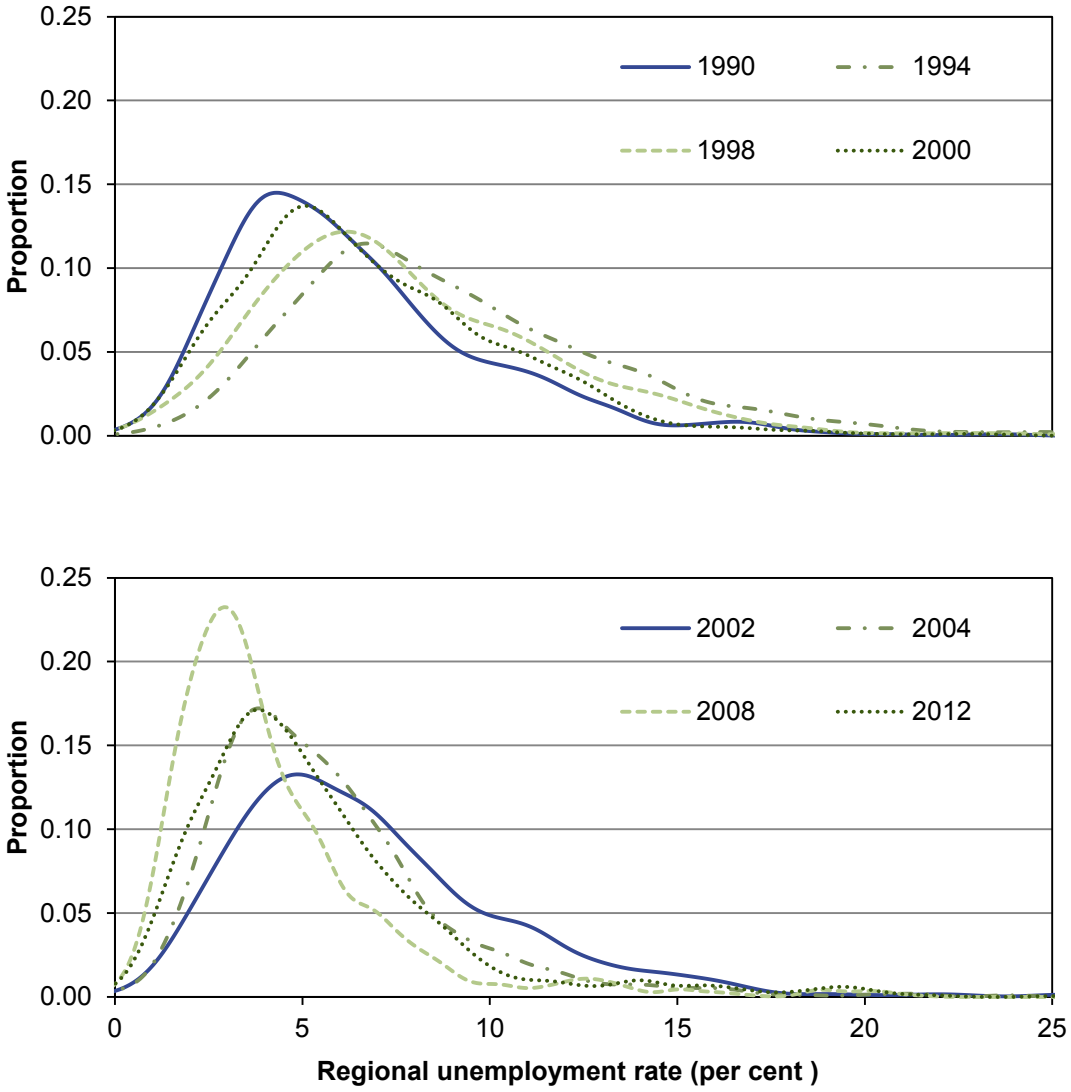
While regional unemployment disparities remain, there is evidence that they have been moderated by labour mobility, at least with respect to some regions. Cunningham and Davis (2011) attribute the low average unemployment rates in agricultural and mining regions to significant labour mobility into, and out of, those regions, depending on economic conditions. This is consistent with the expectation that workers tend to move in search of higher income. By contrast, Cunningham and Davis found that labour mobility has not played as important a role in manufacturing- and tourism-dominated regions, suggesting differences in locational amenities.

Alongside structural change, a competing explanation for changes in the dispersion of regional unemployment rates lies with national economic conditions. Debelle and Vickery (1998) found that movements in the national unemployment rate explained most the variation in state unemployment rates. At the regional level, the distribution of unemployment rates has shifted over time, 'compressing' in times of growth, and expanding in times of increased unemployment (figure 4.11). In the early 1990s, the distribution initially widened, as the proportion of SLAs with relatively high levels of unemployment increased:

- In 1990, unemployment exceeded 10 per cent in only 15 per cent of SLAs, while unemployment was less than 5 per cent in two out of five SLAs.
- In contrast, by 1994 around 34 per cent of SLAs had an unemployment rate in excess of 10 per cent, with only 10 per cent reporting unemployment below 5 per cent.

As national unemployment decreased from its 1993 peak (figure 4.1), the regional distribution of unemployment rates became more compressed, with the median unemployment rate across SLAs falling. This generally continued throughout the following decade, marked by strong employment growth across the economy.

Figure 4.11 **Distribution of regional unemployment rates[a]**



[a] Distribution of regional unemployment rates are produced using a Gaussian kernel density estimator. Data are from the June quarter of the indicated year, with the exception of 1998 and 2008, which are taken from the September quarter, due to data availability.

Source: Productivity Commission estimates from DEEWR *Small Area Labour Markets* database.

The second panel of figure 4.11 shows the continued narrowing of the dispersion in regional unemployment rates until 2008. In the first quarter of 2008, the national unemployment rate reached a low point of 4.1 per cent, after which it began to increase as the Global Financial Crisis took hold. Correspondingly, as unemployment increased to 5.4 per cent towards the end of 2012, the distribution of regional unemployment rates widened slightly, compared with its 2008 profile. In 2012, the distribution of regional unemployment rates resembled that observed in 2004.

The data presented in figure 4.11 suggest that overall economic activity was the main driver of the dispersion in regional unemployment rate disparities during the 2000s (and earlier). This conclusion is consistent with Debelle and Vickery's (1998) findings for states. It is also consistent with Cunningham and Davis' (2011) observation that the dispersion of regional unemployment rates decreased overall in the decade to 2011, irrespective of which industry dominated a particular region.

5 Some underlying trends in labour adjustment

Key points

- During any given period, some people move into or out of the workforce, or change industries, occupations and/or locations. Shifts in the sectoral composition of the economy are one of many reasons people change jobs.
- In the past decade, gross labour flows have largely been consistent with the long-standing sectoral shifts observed in the workforce composition of the Australian economy.
  - The slowest-growing sectors in terms of employment, agriculture and manufacturing, have been shedding proportionally more workers and attracting fewer new workers. Meanwhile, most new and existing workers gravitated towards the rapidly-expanding services sector (which includes Professional, scientific and technical services and Health care and social assistance).
- Aspects of work have changed in ways that reflect structural change. Compared to the early 2000s, employers are:
  - requiring workers to have higher skills and qualifications
  - adopting non-traditional modes of employment more widely
  - increasingly negotiating wages at the level of the workplace.
- These features are generally more prevalent among the fastest-growing sectors. This suggests that such features have not impeded and may have facilitated their expansion and, therefore, facilitated structural adjustment.
- The process of structural adjustment relies on workers responding to various signals from the labour market that indicate where the demand for labour is strongest and, as a result, give them an incentive to move.
  - Among these signals, relatively higher job vacancies, lower redundancies, higher wage levels and stronger wage growth have generally been exhibited by the fastest-growing sectors, particularly mining.
  - The overall shift towards more decentralised, enterprise-level wage-setting mechanisms appears to have aided the structural adjustment process, as clearer signals can be conveyed to workers about where their labour is in greater demand.

Earlier chapters of this supplement (chapters 2 and 3) looked at how drivers of structural change have, over time, altered the type of goods and services demanded

in the economy and the way in which they are produced. These drivers have, consequently, also altered the demand for, as well as the supply of, labour. This has resulted in changes in the distribution of workers across different industries and locations, as was profiled in chapter 4. Underlying these observed changes, a multitude of adjustment mechanisms guide and facilitate the reallocation of labour within the workforce. This chapter presents a range of indicators that illustrate how workers, in response to pressures for change, have made adjustments to their engagement with the labour market throughout the past decade.

Section 5.1 describes the extent to which workers have been changing their sector, occupation and geographic location of employment. Section 5.2 discusses some of the ways in which the nature of work (including work arrangements and wage-setting mechanisms) has changed over time, and how these changes not only reflect the process of structural adjustment, but might also have facilitated it. Since structural adjustment involves workers responding to signals from the labour market to move to those parts of the economy where they are most highly valued, section 5.3 examines some of the signals that motivate workers to adjust.

Throughout this discussion, it is recognised that while labour market outcomes reflect the interplay of supply and demand, they are also affected by broader institutional and policy settings. Given the multitude of factors at play, the labour market's adjustment to structural change does not necessarily transpire instantly or smoothly, and some of the potential barriers to the process are noted.

Most of the analysis in this chapter centres on changes observed in the labour market during the decade to 2010. This is due to a reliance on detailed individual-level data, only available from the Household, Income and Labour Dynamics in Australia (HILDA) survey.[28] Although this period overlaps inexactly with the 2002–2012 focus of this supplement, it nonetheless captures structural adjustment that accompanied the natural resources boom, as well as that associated with the Global Financial Crisis (GFC).

5.1 Indicators of labour mobility

A certain degree of mobility is expected in the labour market, as some workers change their sector, occupation or job, or move in and out of the labour force completely, due to changes in their personal preferences or circumstances or in aggregate business conditions. Yet, in part, these transitions can also align with

[28] See appendix C for more information about the HILDA Survey dataset used in this chapter's analysis.

patterns of industry expansion and contraction indicative of long-term structural change.

Movements into and out of employment

Workers' movements into employment (from being unemployed or 'not in the labour force' in the previous year) and away from it — in terms of the sectors (broad industry groupings)[29] that they most commonly joined and exited — largely accord with broader shifts in the composition of employment during the 2000s (figure 5.1).[30]

This is demonstrated by the fact that, between 2001 and 2010, a majority of new entrants into the workforce joined the distribution, social and personal services sectors. Within these sectors, a large and rising share joined the Health care and social assistance industry (data not shown). This is partly indicative of a key demographic shift underlying structural change, namely the growth in demand for the services required to meet the needs of the ageing population (chapter 2). By contrast, a falling proportion of new entrants into the workforce joined the agricultural and manufacturing sectors, which is consistent with the long-term decline in these sectors' shares of output and employment (chapters 3 and 4).

Large shares of workers who were moving into, or out of, employment joined or exited the distribution services and personal services sectors (particularly the Retail trade and Accommodation and food services industries (data not shown)). This can be partly explained by the high prevalence of casual employment (section 5.2) and the lower skill requirements of these industries, which mean that, compared with most other industries, they offer more accessible job opportunities for young workers and those who tend to seek employment only sporadically. Indeed, the expansion of these industries over time is due, in part, to the job opportunities they have been able to offer women, who have been a growing component of the workforce and who, for a variety of reasons, are more likely to work intermittently. The high intake of new entrants also reflects a tendency for young workers to take up jobs in these industries (typically on a casual basis and, often, while studying) as a stepping stone towards a more permanent career in another higher-paying industry. Collectively, these features contribute to a generally high rate of staff turnover, as reflected in figure 5.1.

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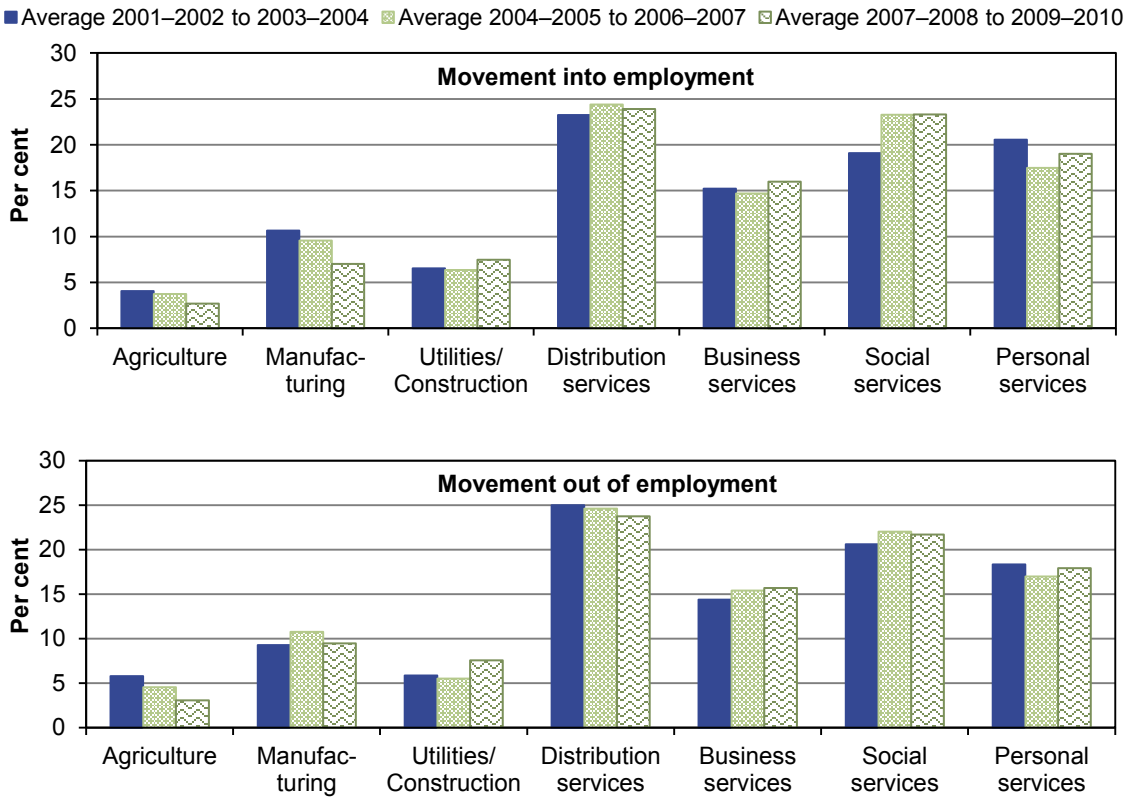
29 In this chapter, industries have been classified into eight sectors, as explained in appendix A.

30 This refers to the shrinking workforce shares of the agriculture and manufacturing sectors, and expanding workforce shares of segments of the services sector (especially the Professional, scientific and technical services and Health care and social assistance industries) over recent decades (figure 4.7 in chapter 4).

Figure 5.1 **Workers moving into or out of employment between consecutive years, by sector, 2001 to 2010**[a, b, c, d]

Per cent of all workers moving into or out of employment



[a] If not in employment, individuals were either unemployed or 'not in the labour force'. [b] Estimates are averaged values for three pairs of consecutive years, for example, 'average 2001–2002 to 2003–2004' refers to workers who moved between 2001 and 2002, between 2002 and 2003, and/or between 2003 and 2004. [c] Mining is excluded due to low sample count and high standard errors associated with these estimates. [d] Estimates refer to the working-age population (15–64 years) and are population-weighted.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

ABS data on labour mobility between 2009 and 2010 present a similar picture. Workforce entrants most commonly joined the distribution, social and personal services sectors (driven chiefly by movements into Retail trade, Accommodation and food services, and Health care and social assistance). These were also the sectors, in addition to manufacturing, from which most workers exited (largely due to exits from Retail trade and Accommodation and food services) (ABS 2010c).[31]

The data presented in figure 5.1 measure gross flows of workers in and out of each sector, as a percentage of all workers (economy-wide) entering or exiting employment. Larger sectors would be expected to attract a commensurately higher

[31] The 2010 ABS survey data on labour mobility refer to individuals' employment at February 2009 and February 2010.

proportion of new workers (and smaller sectors a smaller proportion of new workers). Similar reasoning applies to exits.

Adjusting the proportions of entries and exits in figure 5.1 for each sector's respective workforce size reveals the 'propensity' of sectors to be a destination for entering workers, or a source of exiting workers, over the 2001–2010 period (figure 5.2). This analysis shows three sectors — agriculture, distribution services and personal services — to have been both a stronger destination *and* source than their size would predict. This is indicated by 'relative proportion' values consistently above one in figure 5.2. The remaining sectors, with values below one, recorded inflows and outflows lower than expected based on their size.

The data in figure 5.2 illustrate the role played by workers entering employment and leaving employment altogether in the relative expansion or contraction of sectoral workforces. For example, the agriculture sector consistently lost more workers than it recruited, during the 2001–2010 period. This net loss contributed to the contraction in its share of the overall workforce (chapter 4).[32]

In contrast to agriculture, manufacturing's propensities to attract new workers and shed existing ones were both low, relative to its workforce size (with relative proportion values consistently below 1 in figure 5.2). That sector's workforce contraction over the 2000s — in both absolute and relative terms — is partly explained by:

- its recruitment of progressively fewer workers from the ranks of the unemployed and people outside the labour force, and
- its loss of progressively more workers who became unemployed or left the labour force altogether.

In utilities and construction, the scenario is similar to that in manufacturing, in that the sector's propensities to attract new workers and shed existing ones were both low, relative to its workforce size. In personal services, the sector's propensity to lose existing workers during the 2000s was much higher than in other sectors, relative to its workforce size. But the sector attracted an even higher proportion of new entrants.[33] These trends would have contributed to an expansion in the sector's

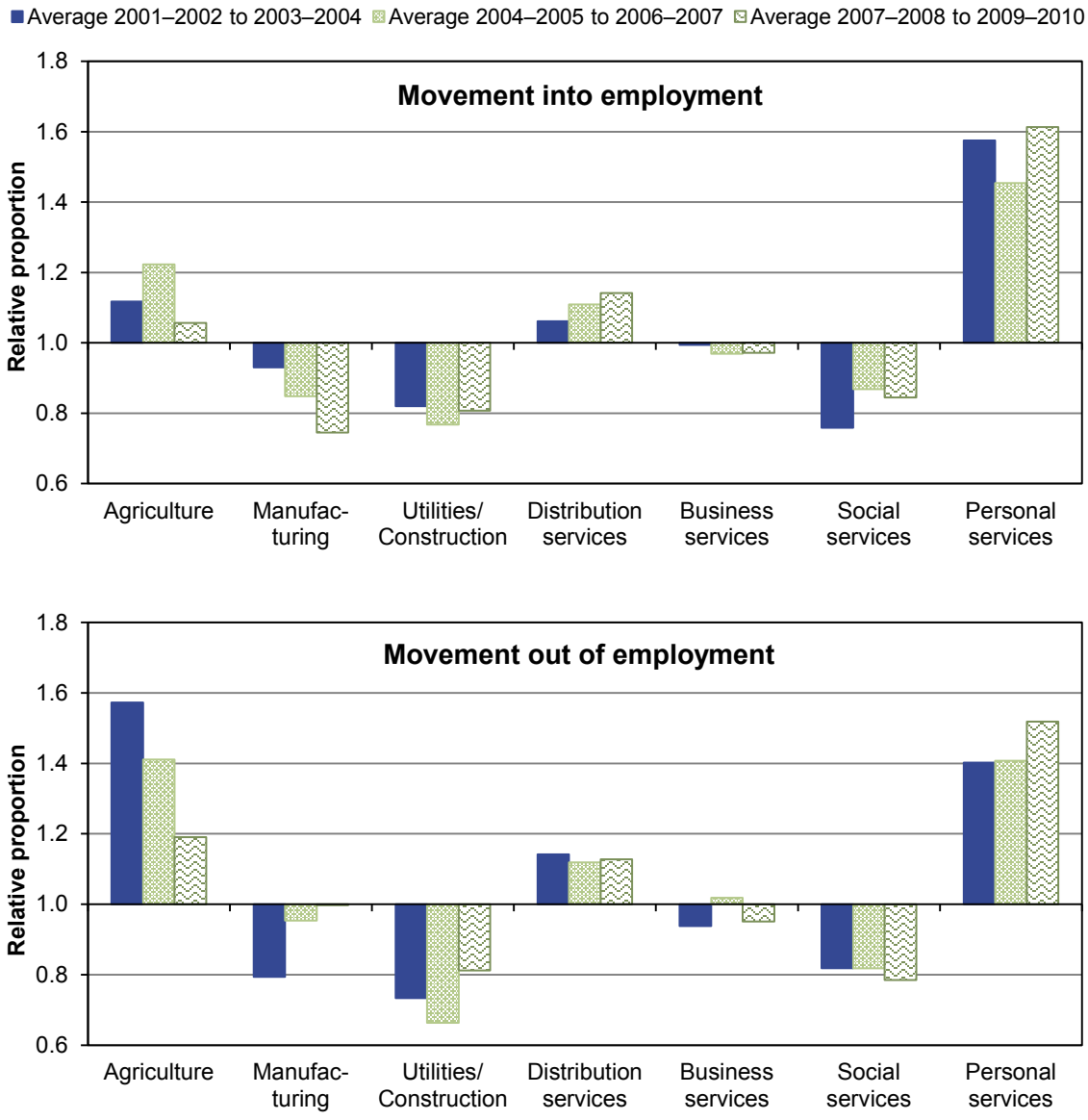
[32] This net loss only explains part of the decrease in the agricultural share of employment. Other contributing factors were the movement of workers between sectors and the net loss or gain experienced by other sectors beside agriculture. (Mobility between sectors is discussed below.)

[33] This is illustrated by the large values in the top panel of figure 5.2 (movements into employment) exceeding the similarly large values in the lower panel (movements out of employment) for most of the year groupings pertaining to that sector.

relative employment size, all else equal. Distribution services exhibited features similar to those of personal services, though to a lesser extent.

Figure 5.2 **Workers moving into or out of employment between consecutive years, by sector, relative to sector size, 2001 to 2010**[a, b, c, d]

Relative proportion of all workers moving into or out of employment, by sector



[a] 'Relative proportions' compare sectoral shares of entering/exiting workers to that sector's share of total employment. For example for 'movements into employment', a value greater (less) than one indicates that the share of new entrants joining a sector is greater (less) than its share of total employment. A sector's proportionally high (low) intake of new entrants contributes to an expansion (contraction) of that sector's share of total employment. [b] Mining is excluded due to a low sample count and high standard errors associated with its estimates. [c] See figure 5.1 (note b) for an explanation of the year groups. [d] See figure 5.1 (note d).

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

As was the case with unadjusted numbers in figure 5.1, the magnitude of adjusted movements into and out of these two sectors is a reflection of the amount of job 'churning' that is typical of some of their component industries, such as Accommodation and food services and Retail trade. This trend is facilitated by the more accessible job opportunities offered by those industries, for those who are new entrants or marginally attached to the workforce.

In contrast to the personal and distribution services sectors, in social services, the propensities to attract new workers and shed existing ones were low, relative to the sector's workforce size. Given the growth in social services employment, in relative terms, over time (chapter 4), this suggests that workers in social services are less likely than those in other sectors to be new entrants to the workforce at the time that they join the sector.

Business services, with relative proportions close to one in figure 5.2, illustrates a scenario whereby entries into and exits from the sector were on par with its relative employment size. Given this, the rapid expansion in the employment share of Professional, scientific and technical services employment (a component of business services — chapter 4) is likely due to that industry drawing existing workers from other industries, rather than from the pool of the unemployed and those not in the labour force.

The mining sector[34] appeared to attract only a relatively small share (less than one per cent) of new entrants to the workforce (data not shown due to the small sample count in the dataset and the indicative nature of the estimates). Yet, this sector's workforce expanded rapidly during the 2000s (chapter 4). This suggests that, compared to other sectors, mining sourced proportionally more of its additional workforce from existing workers in other sectors (both from the same jurisdiction and from interstate) and from newly-arrived skilled migrants from overseas.[35] (Chapter 6 further examines this point.)

[34] The terms 'natural resources sector', 'resources sector', 'mining sector' and 'Mining industry' are used interchangeably in this supplement. Appendix A provides a definition of the natural resources sector.

[35] D'Arcy et al. (2012) calculate that, from 2001 to 2010, the total cumulative number of new entrants into employment in mining exceeded that of workers joining the sector from other industries. However, their estimates of new entrants include newly-arrived skilled migrants, by construction. The datasets used to track the movements of workers — such as HILDA — generally cannot capture the employment activity of newly-arrived or newly-departed migrants.

Mobility between sectors

The labour reallocation component of structural adjustment also entails workers moving between different industries or sectors. Across all sectors, on average, around 20 per cent of workers changed sectors within any given year during the 2000s (Productivity Commission estimates using HILDA Survey data from 2001 to 2010).[36]

Figure 5.3 illustrates the share of workers who changed their sector of employment from one year to the next, according to the sector they moved out of. A relatively high share of workers moved from manufacturing and personal services, while a very low share moved from social services. Over the period, the share moving from manufacturing and agriculture grew, while the share moving from mining and business services contracted (figure 5.3). Again, these flows are consistent with broader observed patterns of industry expansion and contraction associated with structural change.[37]

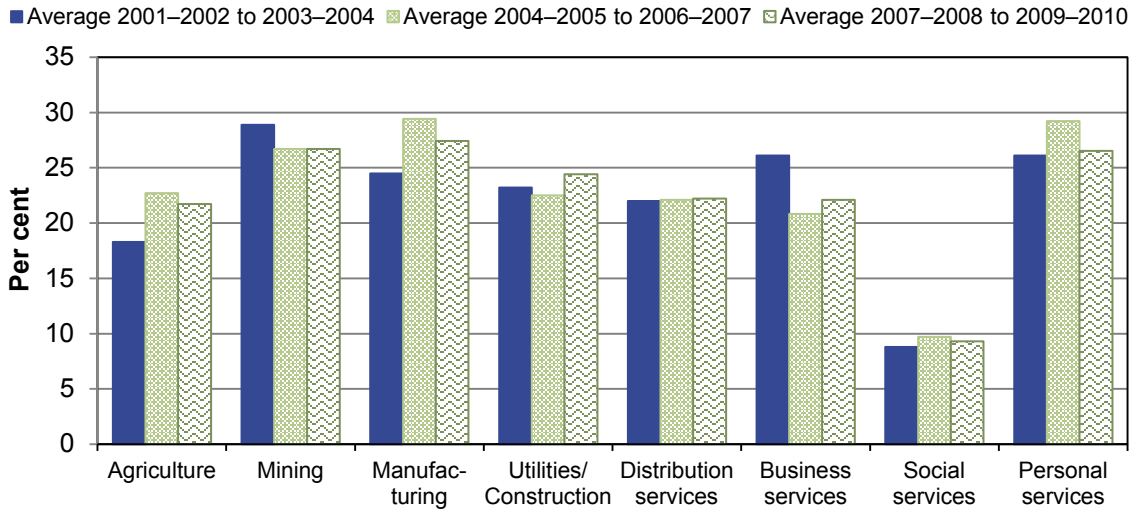
The flows of individual workers between sectors can be mapped more precisely than in figure 5.3. Detailed estimates of the number of workers moving into and out of each sector between 2001 and 2002 and between 2009 and 2010 are presented in figure C.1 (appendix C). Reiterating some broader patterns of structural change, these estimates show how, when comparing the start and end of the decade, the number of workers moving into manufacturing declined, while the number moving into social services grew.

36 This finding is consistent with similar analysis conducted by the RBA using HILDA data from 2001 to 2007 (Berger-Thomson and Roberts 2012).

37 These estimates include workers who changed sector even though they did not change employer. This form of mobility can occur for a number of reasons: workers employed through labour hire or temporary employment agencies retain their employment agency but are appointed to work in a different industry; workers engaged as independent contractors change industries but do not report changes of employer because they are considered to be working for themselves; or workers are employed by firms that have been reclassified to another industry. The latter event can occur when firms: restructure; are taken over or merge; move some of their activities offshore; or perform an activity that gets reclassified by the ABS. Estimates of the prevalence of firm inter-industry movements are presented in appendix C. Another study of labour mobility (D'Arcy et al. 2012) assumed that a worker's change of sector or industry must also entail a change of employer or job, resulting in an average inter-industry rate of labour mobility of 8 per cent during the 2000s (lower than that implied by figure 5.3, therefore).

Figure 5.3 **Workers changing sector between consecutive years, 2001 to 2010[a, b, c, d]**

Proportion of workers moving out of each sector to join another, as a percentage of all workers in the sector of origin



[a] Sectoral categories refer to the sector that workers moved *out* of. [b] Estimates are averaged values for three pairs of consecutive years, for example, 'average 2001–2002 to 2003–2004' refers to workers who changed sector between 2001 and 2002, between 2002 and 2003, and/or between 2003 and 2004. Estimates exclude workers who moved into or out of the workforce completely. [c] Estimates refer to the working-age population (15–64 years) and are population-weighted. [d] Sectors are defined in appendix A.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

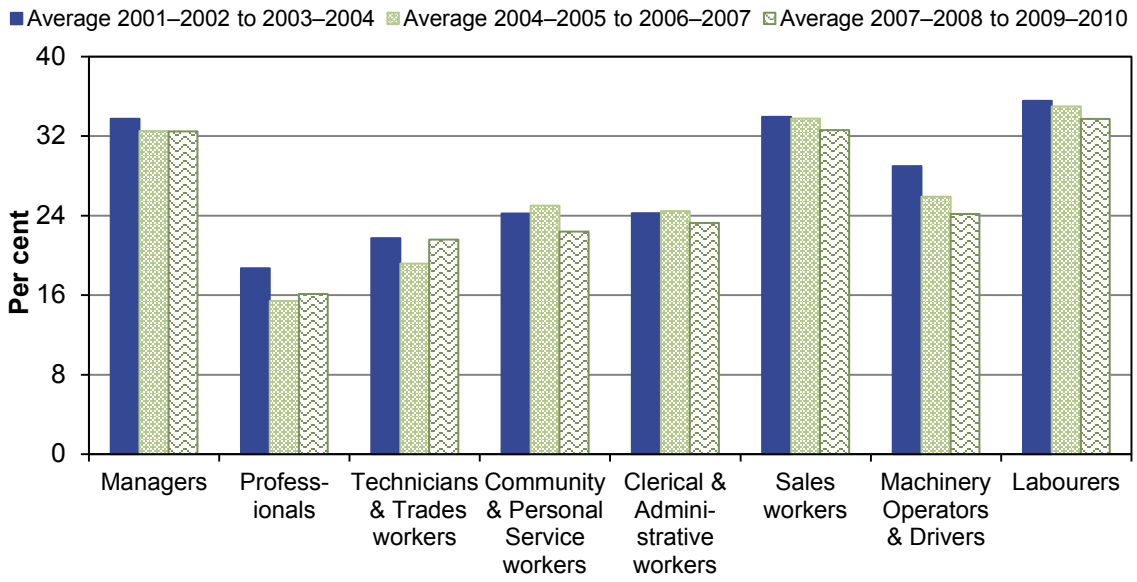
Mobility between occupations

Given that occupational profiles differ between industries, workers' adjustment to the changing structure of the economy sometimes entails them changing occupation. Figure 5.4 shows the share of workers who switched out of their occupation from one year to the next. Managers, Sales workers and Labourers generally demonstrated the greatest propensity to switch to another occupation. Most commonly, they switched to either a Professional, Clerical or Administrative role (data not shown).

While some workers' occupational trajectories reflect a transition to a higher-skilled job as part of their career progression (such as Labourers transitioning to Technicians or Trades Workers, or Professionals moving into management roles), other trajectories reflect the rising skills or qualifications requirements of jobs in general, which is a feature of recent structural change. As discussed further in section 5.2, some workers have shifted to a higher-ranked occupation (reflecting a higher-skilled job) because their former, lower-skilled job has disappeared. Others have shifted because their job has been reclassified to a higher-ranked occupation, due to the skills or qualifications requirements of that job rising over time.

Figure 5.4 **Workers changing occupation between consecutive years, 2001 to 2010[a, b, c]**

Proportion of workers moving out of each occupation and into another, as a percentage of all workers in the occupation of origin



[a] Occupational categories refer to the occupation that workers moved *out* of. [b] Estimates are averaged values for three pairs of consecutive years, for example, 'average 2001–2002 to 2003–2004' refers to workers who changed occupation between 2001 and 2002, between 2002 and 2003, and/or between 2003 and 2004. Estimates exclude workers who moved into or out of the workforce completely. [c] Estimates refer to the working-age population (15–64 years) and are population-weighted.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

Mobility between jobs

On average, during the past decade, around one of every five workers changed his or her main job from one year to the next (Productivity Commission estimates using HILDA Survey data 2001–2010).[38] This is generally consistent with ABS labour mobility data collected at intervals throughout the same decade. In February 2010, for instance, almost 20 per cent of all workers had started working for their current employer within the previous 12 months (ABS 2012i).

Of those who changed jobs while remaining within the same sector, the highest rates of intra-sectoral job change occurred in utilities and construction, business services and personal services. In contrast, workers were less likely to change jobs within manufacturing, agriculture, social services and distribution services (Productivity Commission estimates using HILDA Survey data 2001–2010).

[38] These estimates include workers who changed their job multiple times within a year, as well as those who held multiple jobs at the same time.

Workers' length of tenure provides another indicator of labour mobility. Throughout the 2000s, on average, the personal services sector had the largest share of workers who had been working for their current employer for less than one year, and the lowest share of those who had been working for their current employer for at least five years (figure C.2 in appendix C).

The mining sector underwent the largest degree of change in the composition of its workforce during the 2000s. Between 2002 and 2010, the share of mining workers who had been working for their current employer for between one and three years expanded considerably, while the share of those employed for at least 10 years shrank considerably. These data reflect the sector's large intake of new employees from 2003 onwards. As a contrast, the profile of workers by tenure in manufacturing did not change much between 2002 and 2010. This suggests that movements from this sector throughout the 2000s were concentrated neither among the sector's short-term nor among long-term employees (figure C.2 in appendix C).

Mobility between geographic locations

Better job opportunities and earnings prospects can motivate workers to move location, be it across regional, state or international borders. Previous research indicates that interstate and even overseas migration patterns can be linked to differences in unemployment rates and average wage levels (Debelle and Vickery 1998; PC and NZPC 2012).

Australian data are lacking with which to analyse annual movements of workers in the geographic dimension. The main data source available for that purpose (and used below) is the HILDA Survey. However, the size of that survey means that the number of people who move locations *for work purposes*, from one year to the next, is relatively small. Moreover, HILDA is a longitudinal survey, so that individuals are surveyed over several consecutive years. This characteristic means that the number of 'movers' in the sample may become unavoidably lower over time, as data collectors lose track of some individuals who changed addresses. Further caveats applying to the HILDA Survey are listed in appendix C.

Between 2001 and 2010, between 15 and 18 per cent of Australian workers changed their residential address between one year and the next.[39] However, only around 3 to 4 per cent of all workers moved for work purposes, with reasons including to look for work, start a new job with a new employer, be near to work, undergoing a work transfer, or to start or relocate their own business. Of those workers who

[39] Estimates for later years of the survey, however, could be partly affected by attrition bias in the sample (appendix C).

moved for work purposes, around half moved by more than 50 kilometres (Productivity Commission estimates using HILDA Survey data 2001–2010).

Further light is shed on geographic labour mobility by ABS survey data showing that a majority of self-reporting 'underemployed' workers[40] would not be prepared to move 'if offered a suitable job'.[41] On average from 2000 to 2010, around 25 per cent of underemployed workers were prepared to move intrastate, while around 18 per cent would move interstate (ABS 2012j). This result is likely to be influenced by the fact that underemployed workers are mainly part-time and female. Their ability to move may, therefore, be constrained by the employment status of the primary income earner in their household, as well as broader family characteristics.

Household composition and preferences are one of the factors influencing the movement of workers, geographically or just between jobs. A number of other potential influences have been identified in the literature, some of which are relevant across countries and some of which are specific to Australia (box 5.1).

Among the group of workers (not just those who are underemployed) who moved residential location for work purposes from one year to the next during the 2000s, some distinctive patterns are apparent (figure 5.5). For example, as a percentage of the destination sector's workforce, a small and declining number of workers joined manufacturing during that period. This may reflect the fact that a sector with declining employment is likely to offer relatively few job opportunities worth relocating for. In addition, relocation is not always necessary, when changing jobs, if the destination sector also happens to be concentrated geographically.[42]

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40 Underemployed workers refer to workers who are employed but seeking, and able to work, more hours. This group mainly includes part-time workers who would prefer to work more hours, plus some full-time workers who did not work full-time hours in the reference week of the survey due to economic reasons (including because they were made redundant or because there was insufficient work available for them).

41 The ABS defines a suitable job as 'any job for which the person is qualified (if applicable), is capable of performing and which provides adequate job conditions (including pay, hours, travel to work, etc.)'; and which is 'a job that would be accepted by the person irrespective of whether a move was required' (ABS 2012j, p. 44).

42 For example, manufacturing workers changing jobs are less likely to have to relocate, compared to mining workers. As an indication of the high geographic concentration of manufacturing activity in Australia, in 2011, around 20 per cent of all manufacturing workers were based in Melbourne or Geelong, and a further 17 per cent were based in Sydney (ABS 2011b).

Box 5.1 Factors influencing labour mobility

A range of factors can potentially influence labour's capacity to respond to pressures for structural change, especially with respect to moving geographic location. Factors identified in the literature that might reduce the mobility of Australian workers include:

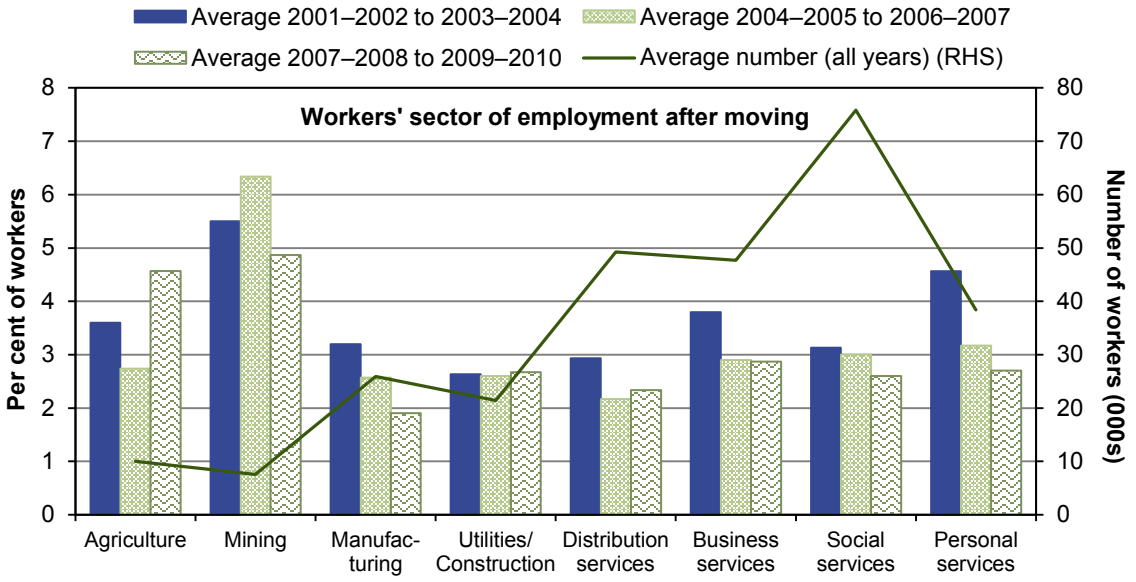
- the costs of relocation, including the costs of travel, removal and property transaction, such as stamp duties and conveyancing (Ferreira, Gyourko and Tracy 2011; Grady and Macmillan 2007; PC 2004, 2013)
- rates of home ownership and factors affecting home ownership, such as conditions in the housing market and differences in housing prices between different areas (Blanchflower and Oswald 2013)
- registration and licensing requirements of a given industry or occupation, which can sometimes be jurisdiction-specific (Grady and Macmillan 2007; Knox 2010; PC 2009)
- the portability and eligibility requirements of a worker's employment-based entitlements (such as some forms of leave) (Grady and Macmillan 2007)
- the needs and preferences of a worker's family and other household members, including the availability of school and community facilities, and their employment and earning prospects (Berger-Thomson and Roberts 2012)
- less tangible factors, including a worker's ability to cope with separation from their family and social networks, the sense of isolation if relocating to a remote area, and the potential stress of dislocation experienced by their family if they relocate too (McKissack et al. 2008).

At the very least, workers' capacity to respond to the changing structure of the economy requires them to be aware of job opportunities and wages available in other industries, occupations and locations. A lack of sufficient information could, therefore, impede workers' responsiveness, which could be borne out in lower mobility.

Information deficiencies and other barriers to mobility mean that, even if workers are willing to move as a result of a downturn, their relocation may take time. Previous research suggests that, during the 1990s, it took an average of four years for most of the out-migration of labour to occur, in response to state-specific economic downturns (Debelle and Vickery 1998). All else equal, the entire process of adjustment through interstate migration was estimated to reach completion after seven years. Labour's responsiveness appears to have increased during the 2000s, yet such adjustments are still thought to take several years (McKissack et al. 2008). The lengthy nature of the geographic mobility process may contribute to the persistence of unfilled vacancies in some industries and regions.

Figure 5.5 **Workers who moved residential location between consecutive years for work reasons, by sector, 2001 to 2010[a, b, c, d, e]**

Moving workers as a percentage of all workers in each destination sector (LHS) and number of workers (RHS) in each sector who moved for work reasons



[a] Sectoral categories refer to workers' sector of employment *after* moving, which, in some cases, might differ from the sector they were employed in *before* moving. Estimates also include people who were not employed before moving, but gained employment after moving. [b] Data represented by the vertical bars refer to the left-hand side axis, and the solid line refers to the right-hand-side axis. [c] Number of workers employed in each sector is the average number for each year between 2001 and 2010. Estimates are averaged values for three pairs of consecutive years, for example, 'average 2001–2002 to 2003–2004' refers to workers who moved between 2001 and 2002, between 2002 and 2003, and/or between 2003 and 2004. [d] Estimates refer to the working-age population (15–64 years) and are population-weighted. [e] Sectors are defined in appendix A.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

By contrast, mining workers appear to have a greater relative propensity to move for work purposes, compared to those in other sectors (figure 5.5). This is to be expected, since many workers now employed in mining have come from other industries, in other locations (chapter 6). Indeed, those now employed in mining are more likely to have moved for work purposes than for any other reason (data not shown). These findings illustrate that, as expected, some labour has relocated in response to the growing job opportunities and higher wages associated with the resources boom.

The estimates for mining, discussed above, focus on workers moving their permanent place of residence. But an increasing number of workers in that sector have taken up job opportunities in remote areas, without needing to move to these locations permanently, under 'Fly-in, Fly-out' and 'Drive-in, Drive-out' work arrangements. As discussed further in chapter 6, the rising prevalence of these long-distance commuting arrangements has challenged the traditional notion that

geographic labour mobility entails workers changing their permanent place of residence. Viewed in this way, figure 5.5 is likely to understate the overall rate of geographic mobility of Australia's labour force, especially within, but not limited to, mining.

Compared to that in the other sectors (except manufacturing), permanent geographic labour mobility towards the services sectors was generally low and declining throughout the 2000s (figure 5.5). In absolute terms, however, these sectors received the largest number of 'movers', due to their size.[43]

5.2 The changing nature of work

This section looks at how the nature of work itself has evolved in ways that not only reflect broader pressures for structural change, but can also help to facilitate labour's adjustment. Changes in the nature of work encompasses changes in the types of skill and qualification required by employers, the flexibility of workplace arrangements and the flexibility of wage-setting mechanisms.

Changes in skill requirements

In Australia as in most modern economies, structural change has been accompanied by an overall increase in the complexity, and hence the skill requirements, of jobs (De Laine, Laplagne and Stone 2000; Downes and Stoeckel 2006; Jorgenson and Timmer 2011). This increase had been fuelled, in particular, by advances in technology that have not only reduced demand for a number of lower-skilled jobs, but also created new highly-skilled ones and heightened the level of cognitive skill component of most existing ones. For example, many of the jobs that are core to today's Information, media and telecommunications industry (such as Web developers and Network administrators) used to be rare or non-existent. Also in recent decades, the qualifications requirements of many jobs have risen. For example, those for nurses and teachers have been upgraded from Certificate-level to Bachelor-level qualifications (ABS 2009), meaning that these occupations were reclassified from Technicians and trades workers to Professionals in employment statistics.

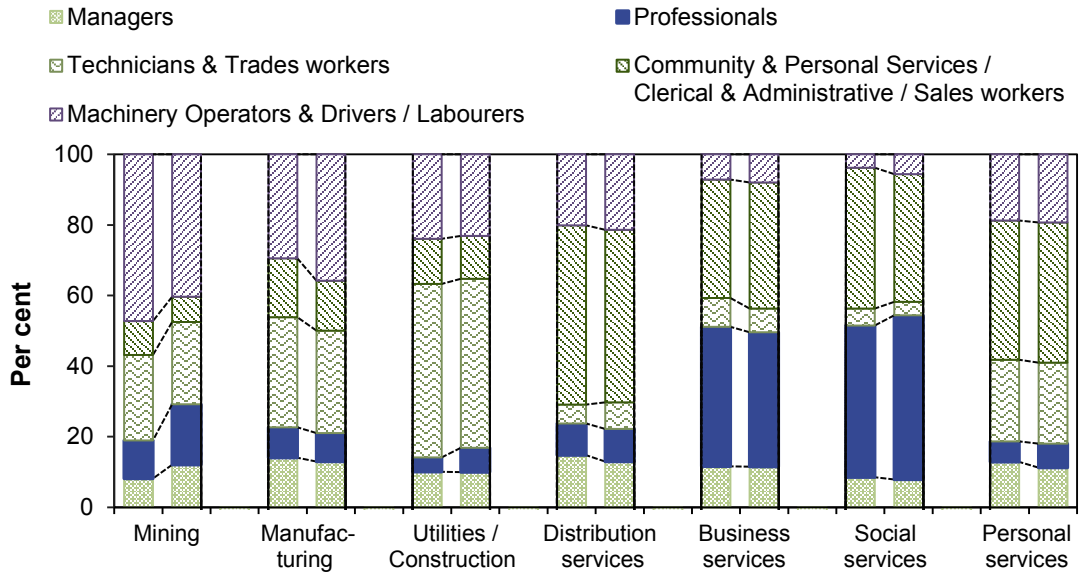
The comparative mix of skills required by each sector, and the way in which this mix has changed during recent years, is illustrated in figure 5.6. (Occupational

[43] The total number of workers in each sector who moved location for work purposes in any given year (averaged for all years between 2001 and 2010) is measured on the figure's right-hand side axis and is denoted by the thin black line.

categories are traditionally used to represent workers' skill levels.) In general, the sectors requiring proportionally the most highly-skilled workers are business services and social services. Within these sectors, Managers and Professionals together constitute at least half of the workforce. When comparing 2001 and 2010, however, the sector with the largest proportional increase in its higher-skilled workforce is mining. Although a large component of mining workers are Machinery operators and drivers or Labourers (the lowest-skilled occupations), their share of the mining workforce has shrunk over the past decade.

Figure 5.6 **Change in occupational composition of sectors, 2001 and 2010**[a, b, c, d]

Percentage of workers in each occupation, within each sector



[a] For each sector, the left bar refers to 2001 while the right bar refers to 2010. Similar occupational categories have been grouped together to retain a sufficiently large sample size. From highest-skilled to lowest-skilled, occupations are approximately ranked in the following order: Managers and Professionals; Technicians and trades workers; Community and personal services, Clerical and administrative, and Sales workers; Machinery Operators and Drivers; and Labourers (ABS 2006a). [b] Agriculture is excluded because of the high proportion of owner-managers in this industry. [c] Estimates refer to the working-age population (15–64 years) and are population-weighted. [d] Sectors are defined in appendix A.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

Manufacturing presents a striking contrast to mining. The proportion of Machinery operators and drivers and Labourers within manufacturing grew over the decade, while the proportion of higher-skilled workers shrank. This could imply that, in the course of the sector's workforce contracting over time, it has mainly been the higher-skilled rather than the lower-skilled workers who have been moving out of the sector. It is likely that the former group is better equipped to find alternative employment elsewhere in the economy, such as in mining.

Indeed, if displaced by structural change, workers' capacity to transition from a contracting to an expanding industry depends on how well they can acquire the skills necessary for their prospective new job, or how well their existing skills can be applied to their new role. Some industries or occupations require workers to have a high level of specialised, firm-specific knowledge or skills, which are inherently less transferable. A worker's skills deficiency, therefore, represents a potential barrier to labour mobility: around 10 per cent of unemployed jobseekers who experienced difficulty finding work during the 2000s attributed this to a lack of skills or education (ABS 2012e).

Non-traditional modes of employment

Permanent, full-time employment remains by far the most common mode of employment across the labour force as a whole (ABS 2011c; Shomos, Turner and Will 2013). Nonetheless, compared with earlier decades, non-traditional modes of employment — such as casual and part-time employment, flexible start and finishing times, and working from home — have become more common. This trend began with the rising casualisation of the workforce during the 1980s and 1990s. Although there is clear evidence that casualisation plateaued throughout the 2000s (Shomos, Turner and Will 2013), non-traditional modes of employment are more widely used across today's workplaces than they were several decades ago. The increased availability of these work arrangements partly reflects demand-side drivers of structural change. Technology, as well as changing preferences, have meant that consumers are increasingly demanding that goods and services providers extend their hours of operation beyond a standard working day, giving rise to the greater use of home-based work and flexible start and finishing times.

At the same time, non-traditional work arrangements can facilitate the labour market's adjustment to the changing shape of the economy. As a case in point, the greater skills demands of today's jobs, and hence the higher importance of post-compulsory education in today's economy, mean that proportionally more workers are seeking employment arrangements that allow them to study while working. Forms of employment that depart from the traditional, permanent, full-time work contract are one way to accommodate this. Non-standard work arrangements have opened-up opportunities for more people to participate in the labour force. Greater use of part-time work arrangements, and flexible start and finishing times, have enabled more women to join the labour market, especially those with young children. Such shifts in the composition of the workforce have been associated with the expansion of the services sector, for both labour demand and supply reasons (Gilfillan and Andrews 2010; McLachlan, Clark and Monday 2002).

The prevalence of non-traditional work arrangements is not uniform across sectors. The fastest-growing sectors tend to have a high reliance on at least one of the modes of employment identified in figure 5.7. For instance, compared to most other sectors, personal services and distribution services sectors have a high prevalence of casual and part-time employment (especially in the Accommodation and food services and Retail trade industries), while the business services sector has a high, and rising, share of workers with flexible starting and finishing work times or entitlement to home-based employment (especially in Professional, scientific and technical services). This is unsurprising, given that these sectors have been reliant on the growing labour force participation of women as a source of additional workers.

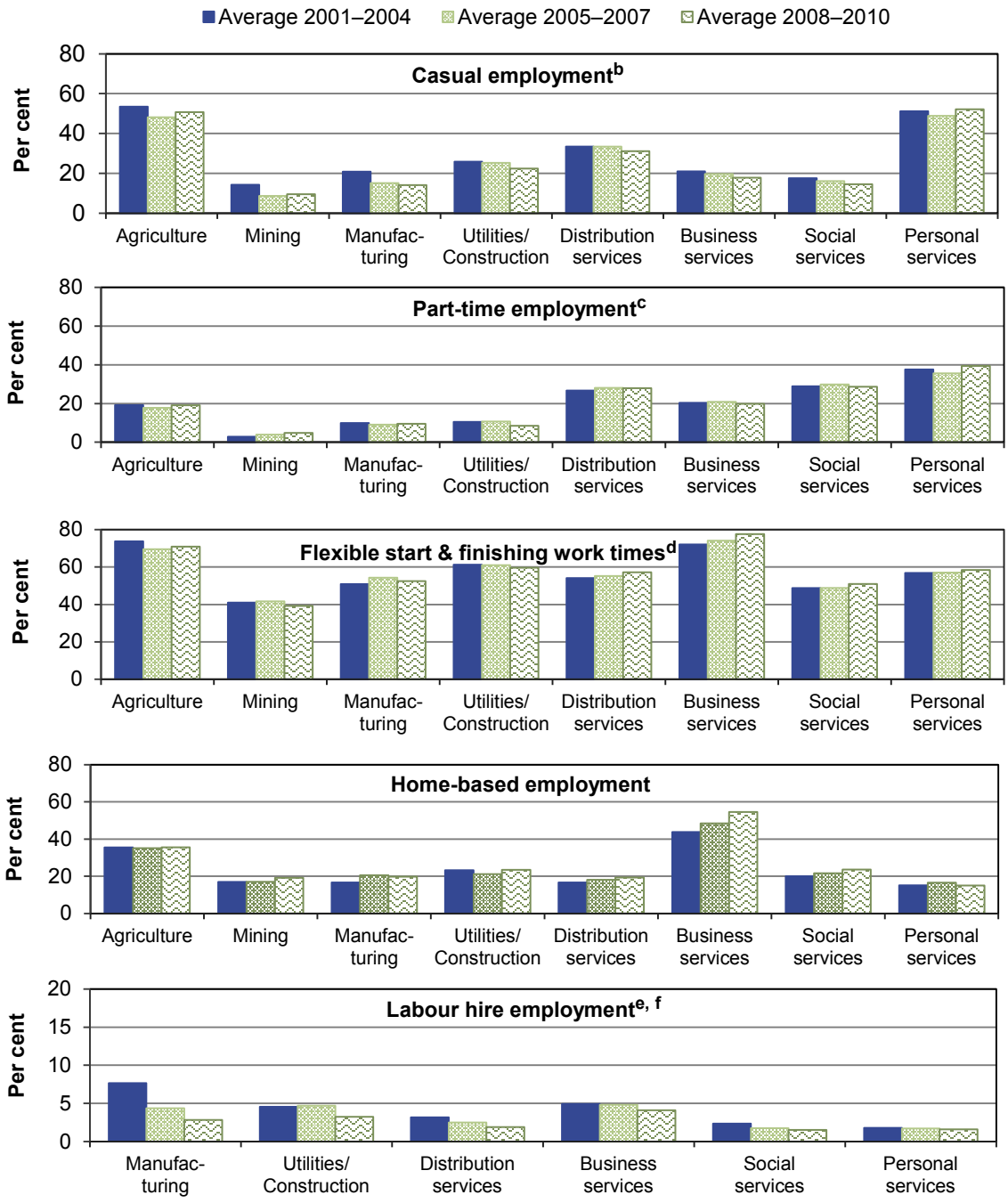
Of the slowest-growing sectors in terms of employment, agriculture is characterised by a relatively high prevalence of some forms of non-traditional work. The prevalence of flexible start and finishing times, as well as of home-based employment, may be partly associated with the high proportion of self-employed workers and owner-managers within the agricultural workforce. High casualisation, on the other hand, may be explained by the seasonal nature of much agricultural work (ABS 2011c).

Manufacturing, on the whole, has a lower prevalence of non-traditional work arrangements than other sectors. A possible exception is its use of labour hire, even though it is declining. Indeed, the prevalence of labour hire workers fell in most sectors during the 2000s, particularly during the 2008–10 period. This could be indicative of the effects of the GFC, with employers laying off labour-hire and other short-term contract workers in preference to permanent staff.

The indicators presented in figure 5.7 suggest that the mining sector offers relatively few non-traditional work arrangements. However, this figure does not capture the prevalence of another non-traditional work arrangement in this sector, namely 'Fly-in, Fly-out' employment. As discussed in chapter 6, this long-distance commuting arrangement has been instrumental in assisting the mining sector adjust its workforce capability during the natural resources boom.

Figure 5.7 **Share of workers with non-traditional work arrangements, by sector, 2001 to 2010[a, g]**

Percentage of workers, as a share of all workers in each sector



[a] Data for flexible work times, home-based employment and labour hire are for 2002 onwards. Estimates are averaged values for the groups of years, refer to working-age population (15–64) and are population-weighted. [b] Workers do not have an entitlement to paid sick or holiday leave. [c] Excludes part-time workers who wanted to work more hours. [d] Entitlement to 'flexible start and finishing work times' or to 'home-based employment' does not necessarily mean that a worker is making use of these arrangements. [e] Workers employed through labour hire company or temporary employment agency. [f] Agriculture and Mining are excluded from the estimates for labour hire. [g] Sectors are defined in appendix A.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

Decentralised wage-setting systems

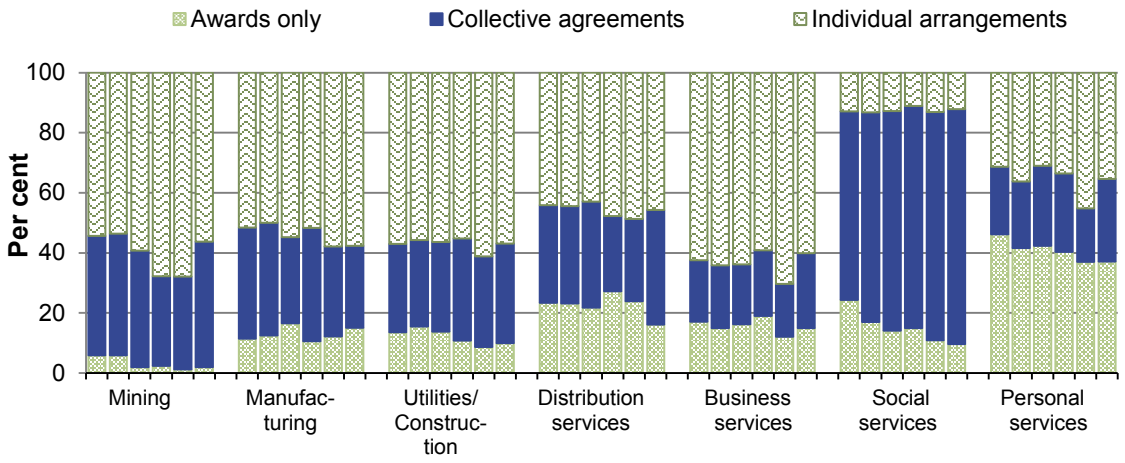
Another key aspect of labour market adjustment is the scope for employers and workers to negotiate wages and work arrangements that are not only tailored to their individual needs and preferences, but also reflect the labour market conditions of their particular industry. In recent decades, Australia's industrial relations landscape has progressively shifted away from centralised methods of wage setting, with a rising prevalence of collective (or enterprise bargaining) agreements and individual arrangements, in place of awards-only arrangements.

Decentralised wage setting is more responsive to different demand and supply conditions faced by different firms or industries. When pressures for change impact on the economy, any shortages or surpluses of labour that arise in a particular sector or region are signalled in the market if wages are able to adjust accordingly. In a decentralised wage-setting environment, employers in sectors or regions with the most acute demand for labour can offer higher wages or adjust work conditions, so as to retain their existing workers or attract more workers. When wages are bid up for some types of labour, decentralisation reduces the likelihood that wage inflation pressures will be spread to other labour categories for which demand is not as strong (Banks 2011; Borland 2011; Connolly and Orsmond 2011; Lowe 2012).

Higher wages initially benefit 'incumbents' employed in expanding sectors or regions. However, over time, higher wages provide 'outsiders' with an incentive to undertake training and equip themselves with the skills necessary to fill the new jobs, and to move to the locations where the jobs are based. As a result of workers moving to take up jobs in sectors/regions offering higher wages (or better work conditions), growth in wages in these areas would be expected to moderate, while wages on offer in other parts of the economy could rise, due to greater labour scarcity. Thus, it has been shown empirically that the combination of decentralised wage setting and labour mobility can result in higher real wages for all workers, not just those in expanding sectors (Thompson, Murray and Jomini 2012; PC 2009).

While much of the reform in wage-setting methods occurred during the 1990s (Borland 2011, 2012), industry-specific data are difficult to obtain for the period prior to 2000. The analysis presented in this section therefore focuses on the past decade. Figure 5.8 shows the relative prevalence of the three main wage setting methods — awards-only, collective (or enterprise bargaining) agreements, and individual arrangements — within each sector from 2000 to 2010.

Figure 5.8 **Wage-setting methods, by sector, 2000 to 2010[a, b, c, d]**
Percentage of workers , as a share of workers in each sector



[a] For each sector, the vertical bars represent, from left to right, 2000, 2002, 2004, 2006, 2008 and 2010. For each of these years, values are for May, except for 2008 which is for August (due to data availability). [b] Estimates exclude owner-managers of incorporated enterprises. [c] Data are not available for Agriculture. [d] Sectors are defined in appendix A.

Sources: ABS (*Employee Earnings and Hours, Australia*, Cat. no. 6306.0; *Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003).

Looking specifically at some of the fastest-growing sectors in terms of employment, the business services sector displays a strong reliance on individual arrangements (driven largely by their take-up in Professional, scientific and technical services). In the mining sector, the use of individual arrangements increased notably between 2004 and 2006, coinciding with rapid growth in the sector's workforce size. Although the social services sector has a proportionally very low use of individual arrangements, it has made strong and increasing use of collective agreements, especially due to arrangements in the Education and training and Health care and social assistance industries. Measured differences in wage levels, by sector, are examined in more detail in the next section.

5.3 Signals for labour market adjustment

This section looks at three indicators that signal a need for adjustment in the labour market: job vacancies; job redundancies; and wage differentials. Essentially, these are indications that there is some imbalance between demand for and supply of labour, by sector or region. Such disequilibrium may be ephemeral, such as that caused by daily start-ups and closures of individual businesses. It may be longer-lasting, if resulting from cyclical influences. More long-lasting still are

imbalances that arise from patterns of industry expansion and contraction associated with structural change.

Job vacancies

Persistent job vacancies could indicate that:

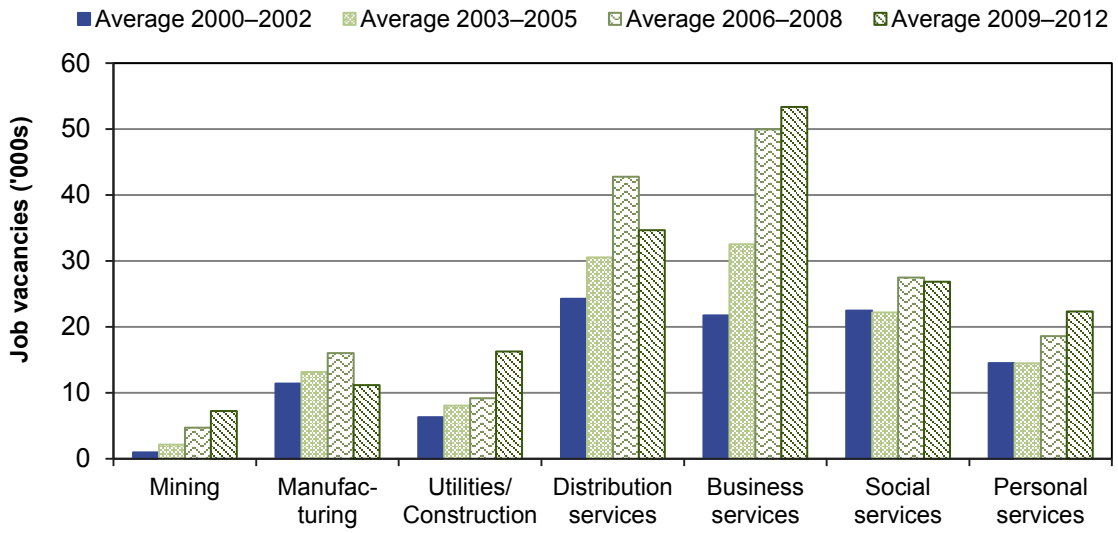
- available workers are not suitable to fill the jobs on offer (because, for example, they might lack the necessary skills or qualifications)
- prospective workers are not making themselves available to fill the job opportunities (for example, they might not be able or willing to move locations)
- employers are not offering sufficient incentives (in the form of wages, other components of remuneration or work conditions) for workers to take up the job opportunities on offer.

Based on ABS Job Vacancies Survey data, figure 5.9 shows the number of job vacancies reported from 2000 to 2012.[44] For most of this period, the sectors with the largest number of job vacancies were business services and distribution services. Yet, the sector with the fastest growth in vacancies over this period was mining, followed by business services. The only sector to record a drop in the number of vacancies over the whole of this period was manufacturing. While the drop in vacancies observed in some sectors between 2009 and 2012 reflects the impact of the GFC, others appeared more resistant to this downturn. Mining and utilities and construction, in particular, recorded large proportional increases in vacancy numbers between 2006–08 and 2009–12 (figure 5.9).

Job vacancy figures, when expressed relative to each sector's workforce size, shed further light on the relative growth of different sectors. In the February quarter of 2012, mining employed around 250 000 workers, with nearly another 10 000 jobs on offer. That is, for every 100 existing jobs in mining, another four jobs were advertised. Manufacturing, with an existing workforce of 970 000 workers, had only another 12 000 jobs on offer. That is, for every 100 existing jobs in manufacturing, only around one extra job was advertised.

44 The Job Vacancies Survey provides a quarterly estimate of the number of job vacancies in the labour market, based on a survey of a sample of approximately 5000 employers. The survey defines a vacancy as a job which is available for immediate filling during the reference period and for which the employer has taken recruitment action. Data on job vacancies are collected on a single day within the quarterly reference period.

Figure 5.9 **Job vacancies, by sector, 2000 to 2012[a, b, c]**



[a] Data based on the number of vacancies reported quarterly, except for 2008 (based on February and May quarters only) and 2009 (based on November quarter only), due to data unavailability. Estimates are based on the annual averages using quarterly data, which are then averaged out over multiple years. [b] Data are not available for Agriculture. [c] Sectors are defined in appendix A.

Source: ABS (*Job Vacancies, Australia*, Cat. no. 6354.0).

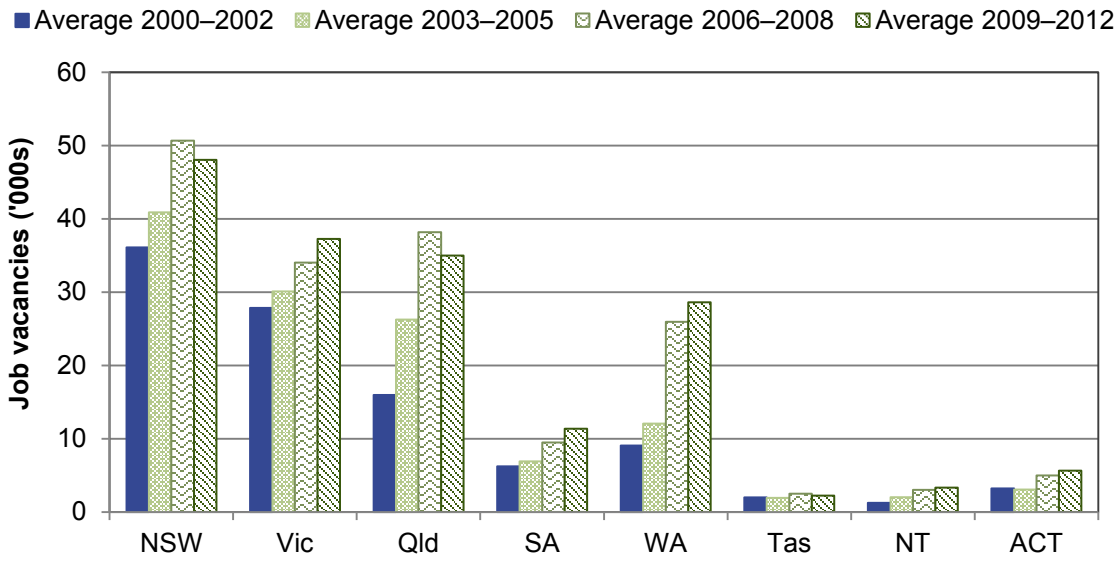
Job vacancy numbers, disaggregated by state or territory, are also indicative of broader sectoral shifts in the economy (figure 5.10). Most notable are the jumps in the number of jobs advertised in Queensland and Western Australia at the height of the resources boom (that is, comparing 2003–2005 to 2006–2008).

Job vacancies, by region, are reported by the Department of Education, Employment and Workplace Relations (DEEWR) in the form of the Internet Vacancy Index (IVI). The IVI reports the number of online job vacancies for 38 regions across Australia, including specific mining areas, such as the Pilbara and Kimberley.[45] Exemplifying the contrast between regions, between April 2010 and 2011, online vacancies increased in all regions of Western Australia and the Northern Territory, and in the central and outback regions of Queensland. The highest vacancy growth rates were experienced in the Pilbara and Kimberley, Goldfields and Southern Western Australia, South-West Western Australia, Central Queensland, and Regional Northern Territory (DEEWR 2012d). In contrast, all other regions within Australia experienced a decline in online job vacancies during the same period. The largest rates of decline were experienced in several inland regions of New South Wales (including Bathurst and Central West New South

[45] DEEWR's Internet Vacancy Index is a monthly count of online vacancies newly lodged on the following online search engines: SEEK, My Career, CareerOne and Australian JobSearch. The regions are DEEWR's own classification (DEEWR 2012d).

Wales and the Blue Mountains) and in much of Tasmania (DEEWR 2012d). These data broadly accord with the Job Vacancies Survey data presented in figure 5.10.

Figure 5.10 **Job vacancies, by state/territory, 2000 to 2012[a, b]**



a Data based on the number of vacancies reported quarterly, except for 2008 (based on February and May quarters only) and 2009 (based on November quarter only), due to data unavailability. Estimates are based on computing the annual averages using quarterly data, which are then averaged out over multiple years. **b** Data exclude job vacancies for the Agriculture industry.

Source: ABS (*Job Vacancies, Australia*, Cat. no. 6354.0).

Job redundancies

Examining patterns of job redundancies, by workers' previous sector of employment, can help to identify those parts of the economy that are shedding jobs for reasons related to structural change.

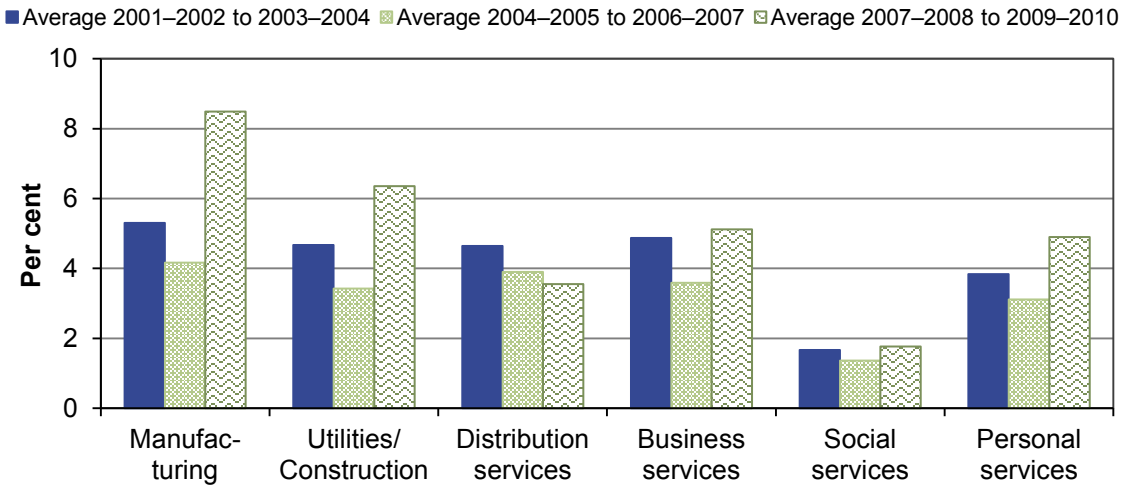
During the 2000s, the sector that shed the largest proportion of its workforce due to redundancies was manufacturing (figure 5.11).[46] The next highest redundancy rates were experienced in utilities and construction and business services (especially in Rental, hiring and real estate services within the latter). In contrast, social services had, by a considerable margin, proportionally fewer redundancies than the other

46 The estimates include workers who were fired from their job, which is more likely to be due to workers' unsuitability for the job rather than structural change. However, it is assumed that firing rates are similar between the sectors and over time. This means that relative differences between the sectors, and trends over time, are not distorted by the inclusion of fired workers in the statistics presented.

sectors. This was particularly due to the low redundancy rates in Health care and social assistance — the industry with the most rapidly growing workforce during the 2000s.

Figure 5.11 **Share of workers in each sector made redundant or fired, 2001 to 2010**[a, b, c, d]

Percentage of workers , as a share of workers in each sector



[a] Number of workers made redundant or fired, as a share of all workers in the sector. Estimates are averaged values for three pairs of consecutive years, for example, 'average 2001–2002 to 2003–2004' refers to workers who were made redundant or fired between 2001 and 2002, between 2002 and 2003, and/or between 2003 and 2004. [b] Agriculture and Mining are excluded due to low sample count and high standard errors associated with these estimates. [c] Estimates refer to the working-age population (15–64 years) and are population-weighted. [d] Sectors are defined in appendix A.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

Even though these broad trends accord with the broad traits of structural change over the 2000s, the impact of the GFC is also evident across most sectors, with a general rise in vacancy numbers between 2009 and 2012.

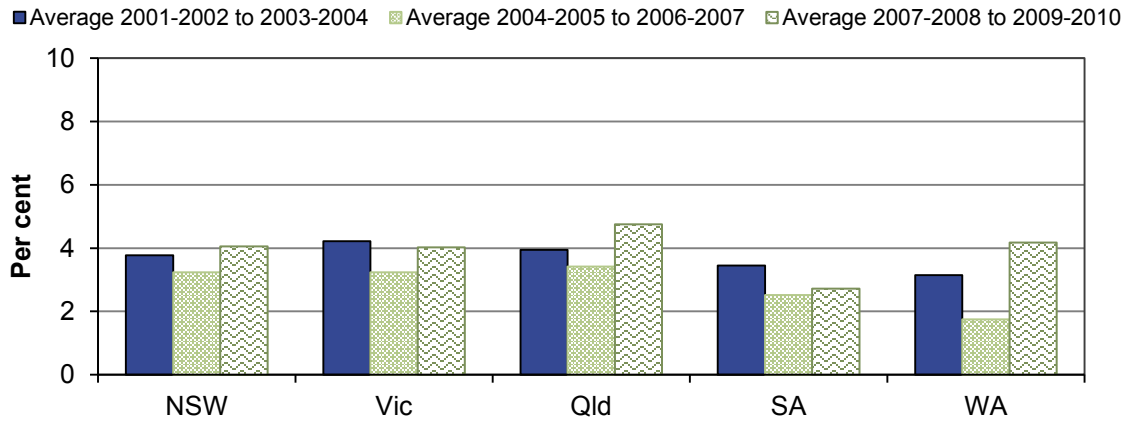
Although the data for the Agriculture and Mining industries are not presented (due to small sample counts and high standard errors), indicative estimates for Agriculture suggest that redundancy rates were highest between 2003 and 2007, coinciding with the drought that affected much of Australia's rural areas. This demonstrates how workers' involuntary departures from a sector can be triggered by external shocks to the economy, such as natural disasters. For Mining, indicative estimates suggest that, unsurprisingly, redundancy rates dropped to their lowest during the resources boom.

Turning to job redundancies in each state, the effects of the boom are evident, with Western Australia generally having the lowest redundancy rates (out of all the states under analysis) during the early and mid-2000s (figure 5.12). However, the Western

Australian job market still appeared volatile, with many of these workers later losing their jobs as the resources boom temporarily subsided and the GFC took hold.

Figure 5.12 **Share of workers in each state made redundant or fired, 2001 to 2010[a, b, c, d]**

Percentage of workers , as a share of all workers in each state



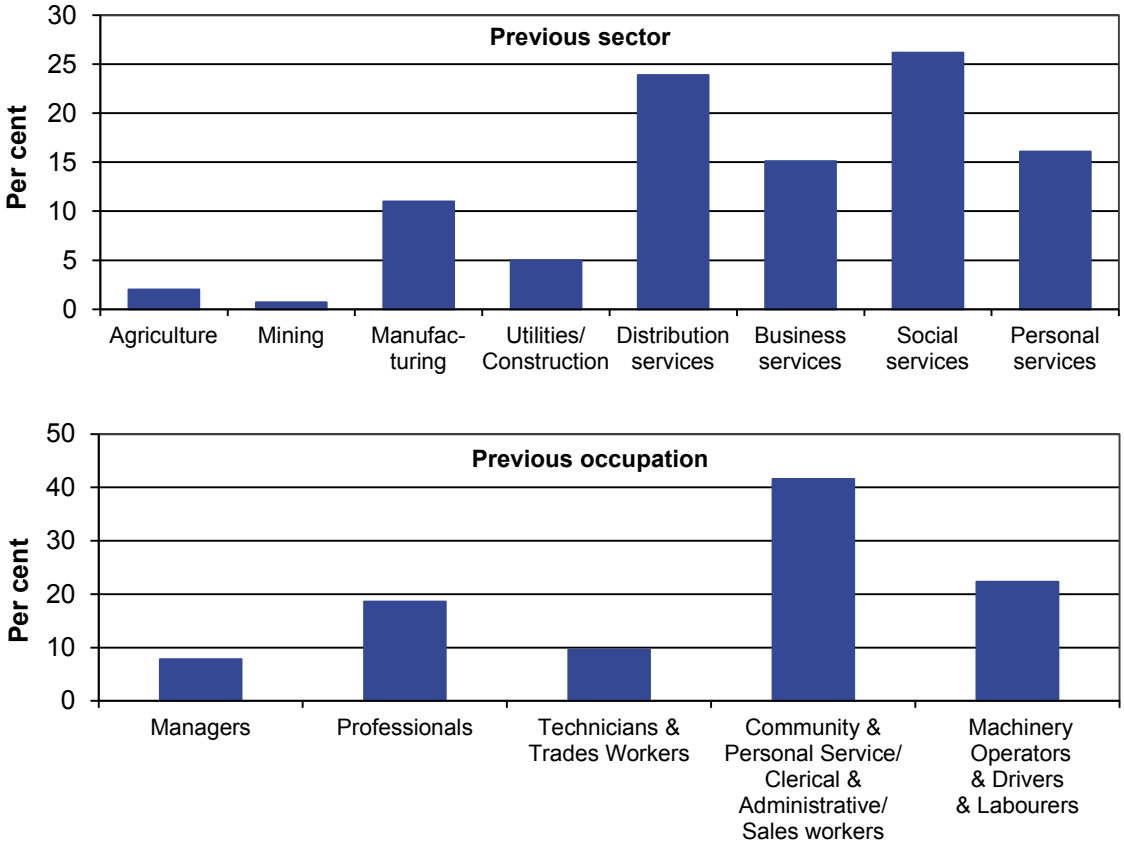
[a] Estimates are averaged values for three pairs of consecutive years, for example, 'average 2001–2002 to 2003–2004' refers to workers who were made redundant or fired between 2001 and 2002, between 2002 and 2003, and/or between 2003 and 2004. [b] Tasmania, Northern Territory and Australian Capital Territory are excluded due to low sample count and high standard errors associated with these estimates. [c] Includes workers of all industries (including industries excluded from figure 5.11). [d] Estimates refer to the working-age population (15–64 years) and are population-weighted.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

Figure 5.13 profiles people no longer in the workforce but who were looking for work in 2010-11, according to their previous sector and occupation of employment. In terms of sector, most were last employed in either distribution services (mainly Retail trade) or social services (mainly Health care and social assistance). In terms of occupation, the majority were last employed as Community and personal service workers, followed by Machinery operators, drivers or labourers.

Figure 5.13 **Persons wanting paid work, by previous sector or occupation, 2010-11[a, b]**

Per cent of all jobseekers, as a share of all jobseekers

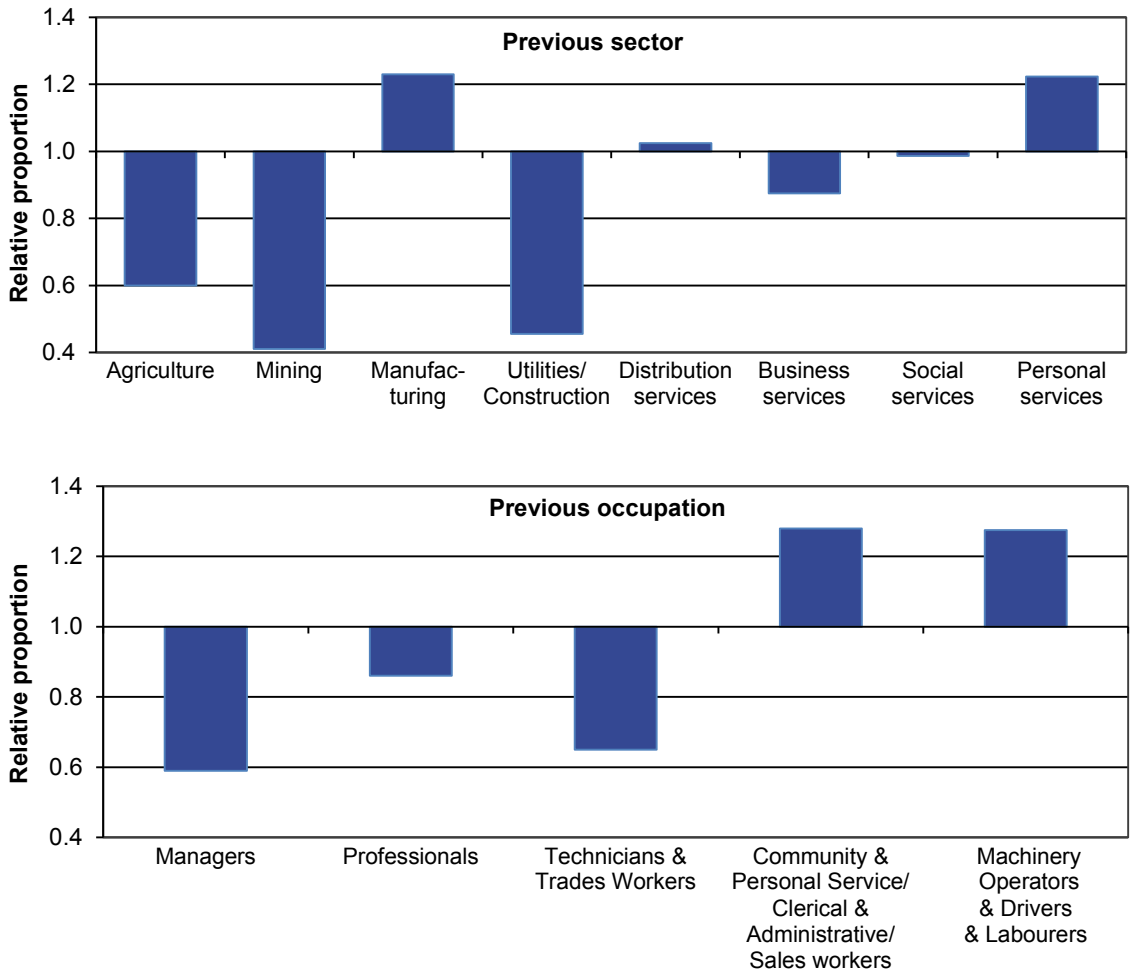


[a] Data collected during 2010-11 financial year. Includes unemployed persons who were actively looking for work (classified as 'unemployed') and persons who wanted paid work even though they were not actively looking (classified as 'not in the labour force'). Share across all sectors, and across all occupations, sum to 100. [b] Sectors are defined in appendix A.

Source: ABS (*Barriers and Incentives to Labour Force Participation, Australia*, Cat. no. 6239.0).

The shares in figure 5.13 partly reflect the relative size of each sector and occupational category within the total workforce. When scaled according to each sector's or occupation's respective share of total employment (figure 5.14), those who were previously employed in manufacturing, distribution services or personal services (in particular, Accommodation and food services and Retail trade) or in lower-skilled occupations (particularly Sales workers and Labourers) were over-represented in the total pool of jobseekers. This reflects some of the ongoing shifts associated with structural change — including the sectoral decline of manufacturing and the rising skills requirements of most jobs. The scaled jobseeker figures also reflect the high degree of staff turnover that is a feature of some industries such as personal services.

Figure 5.14 **Persons wanting paid work, by previous sector or occupation, relative to sector or occupation size, 2010-11[a, b, c]**



[a] Data collected during the 2010-11 financial year. Includes unemployed persons who were actively looking for work (classified as 'unemployed') and persons who wanted paid work even though they were not actively looking (classified as 'not in the labour force'). [b] 'Relative proportions' represent the number of persons who were 'unemployed' or 'not in the labour force', according to their previous sector or occupation, relative to each sector's or occupation's share of total employment (for August 2010). A ratio greater than 1 indicates that the sector or occupation is over-represented among persons who recently left employment and wanted paid work, relative to its workforce size (and vice versa for a ratio less than 1). [c] Sectors are defined in appendix A.

Source: ABS (*Barriers and Incentives to Labour Force Participation, Australia*, Cat. no. 6239.0).

On the other hand, those previously employed in the mining, utilities and construction sectors, or as Managers, Technicians or Trades workers, were under-represented in the total pool of jobseekers. This is, in part, evidence of the strong demand for some categories of worker due to the resources boom.

Wage differentials

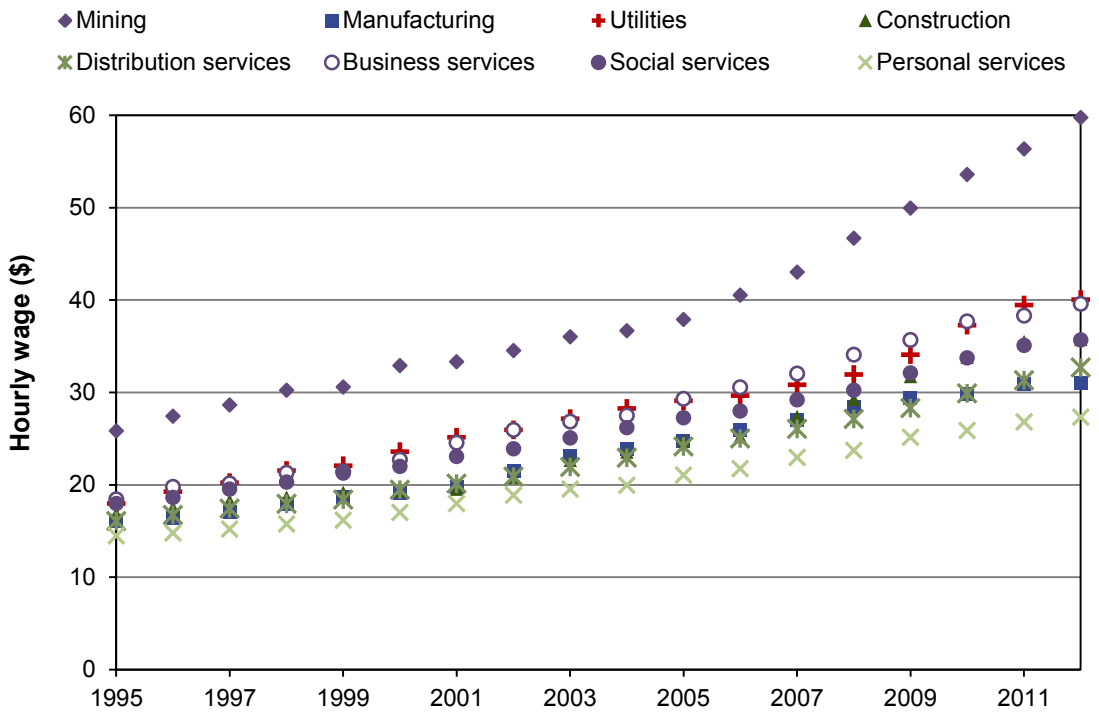
As discussed in a preceding section, industry (or regional) wage differentials — underpinned by decentralised wage-setting systems — play an important role in structural adjustment. Along with job vacancies and redundancies, these differentials signal to workers where they are valued relatively more (or less) highly in the labour market. Higher relative wages provide workers with an incentive to change jobs and/or locations, as long as their consumption costs, such as housing, would not rise more than proportionately with wages, following a move (Kent, Smith and Holloway 2005).[47] The incentive effect of higher wages is evident in findings that workers:

- who change their job experience a higher gain in wages than those who stay in the same job (Wilkins and Warren 2012; Wilkins et al. 2011)
- are more likely to switch industries if they are from a lower-income household (Berger-Thomson and Roberts 2012).

The difference in nominal wage levels between different sectors of the Australian labour market over recent decades is illustrated in figure 5.15. The mining sector stands out, not only as being consistently the highest-paid sector (reflective in part of the wage premium associated with the hazardous and remote nature of much mining work), but also as having the fastest-growing wage level of all sectors over the last decade. This recent wage growth coincides with the rapid expansion of the mining sector's share of employment. By contrast, during the same period, wage levels in manufacturing, personal services and distribution services were generally the lowest of all the sectors, and also grew at the slowest pace. With the exception of distribution services, these sectors were also among those with the weakest growth in their employment shares in recent years (table 4.1 in chapter 4).

47 More precisely, it is a difference in the *consumption wage* — the wage rate expressed in terms of the consumption goods and services that the wages are used to purchase — available to a worker that would be expected to influence a decision to relocate. Conversely, differences in the *product wage* — the wage rate expressed in terms of the price of outputs — indicate a difference in the value of an employee to an employer, and will, therefore, influence hiring decisions.

Figure 5.15 **Nominal hourly wage, by sector, 1995 to 2012**[a, b, c, d]



[a] Nominal hourly wages are based on the ordinary time earnings of full-time workers, who are assumed to work a 38-hour week. Wage data exclude overtime and bonuses. [b] Data are not available for Agriculture. [c] To compute the average wage for each sector, the average wage of each industry within the sector is weighted by the industry's respective employment share of the sector. [d] Sectors are defined in appendix A.

Sources: ABS (*Average Weekly Earnings*, Cat. no. 6302.0; *Labour Force*, Cat. no. 6202.0).

The dispersion in sectoral wage levels has widened over time, even when the acceleration of wages in the mining sector from 2005 onwards is discounted. In part, this growing dispersion is likely to reflect the widening gap in the growth rates of employment and output between the sectors, aided by the labour market's overall shift towards more decentralised wage-setting instruments (as discussed earlier in section 5.2). Differences in the use of wage-setting instruments across sectors could also play a role (figure 5.8).[48]

48 Across all industries, average earnings are consistently higher for employees on collective agreements or individual arrangements, compared to those whose wages are set by awards only (ABS 2010a).

6 Resources: a case study in structural adjustment

Key points

- Australia's natural resources sector experienced significant adjustment pressures during the decade to 2012.
  - Export prices rose substantially from the early 2000s onward, driven by demand from China and other Asian countries, although they have declined since 2012.
- Price increases encouraged resource businesses to expand their output. Those with easy access to additional reserves and capacity were able to do so at relatively low cost.
  - Many resource businesses, however, faced capacity or ore grade constraints and were only able to respond by using substantially more inputs or by investing.
  - The construction boom in new projects is generally expected to yield substantial increases in output over the next few years, thereby increasing the sector's output as well as measured multifactor productivity.
- Dramatic declines in the prices of some inputs, such as information and computing technologies, have allowed many resource operations to increase their automation, continuing a long-term trend towards mechanisation in the sector.
- Australia's resources workforce more than trebled between 2002 and 2012. It is likely that workers who moved into that sector from other industries mainly came from manufacturing (in the early years) and construction (in subsequent years). Service industries were also a source of new labour.
- The natural resources sector has increasingly made use of a 'Fly-in, Fly-out' (FIFO) workforce. In 2011, there were at least 34 000 resources and construction FIFO workers employed in Australia's main mining regions.
- The rising prevalence of FIFO workers can be attributed to multiple factors affecting the costs and benefits of this work arrangement, including: the shrinking population and housing shortages of remote towns; technological advances shortening the time taken to complete resources projects; the short-term nature of the construction component of resources projects; the greater availability of regional flights; and tax changes that have made it more cost effective for employers to provide their staff temporary accommodation rather than permanent residence onsite.
- The natural resources sector has also relied on migrants to address skilled labour shortages, more so than most industries. Yet, some skill shortages are still reported.

Australia's natural resources (minerals and energy) sector[49] faced significant adjustment pressures during the decade from the early 2000s. The economic growth of Asia in general, and China in particular, increased world demand for minerals and energy which, in turn, increased prices for those resources and Australia's terms of trade to historically high levels (chapters 1 and 2). Beginning in 2008, the Global Financial Crisis (GFC) dampened the demand for, and prices of, many commodities. By the end of 2011-12, many export prices had risen again to levels observed before the GFC, although some have fallen back significantly since then (chapter 2).

The pattern of natural resource price rises and declines provides an opportunity to examine how resource businesses and their workforces have adjusted to the pressures placed upon them.

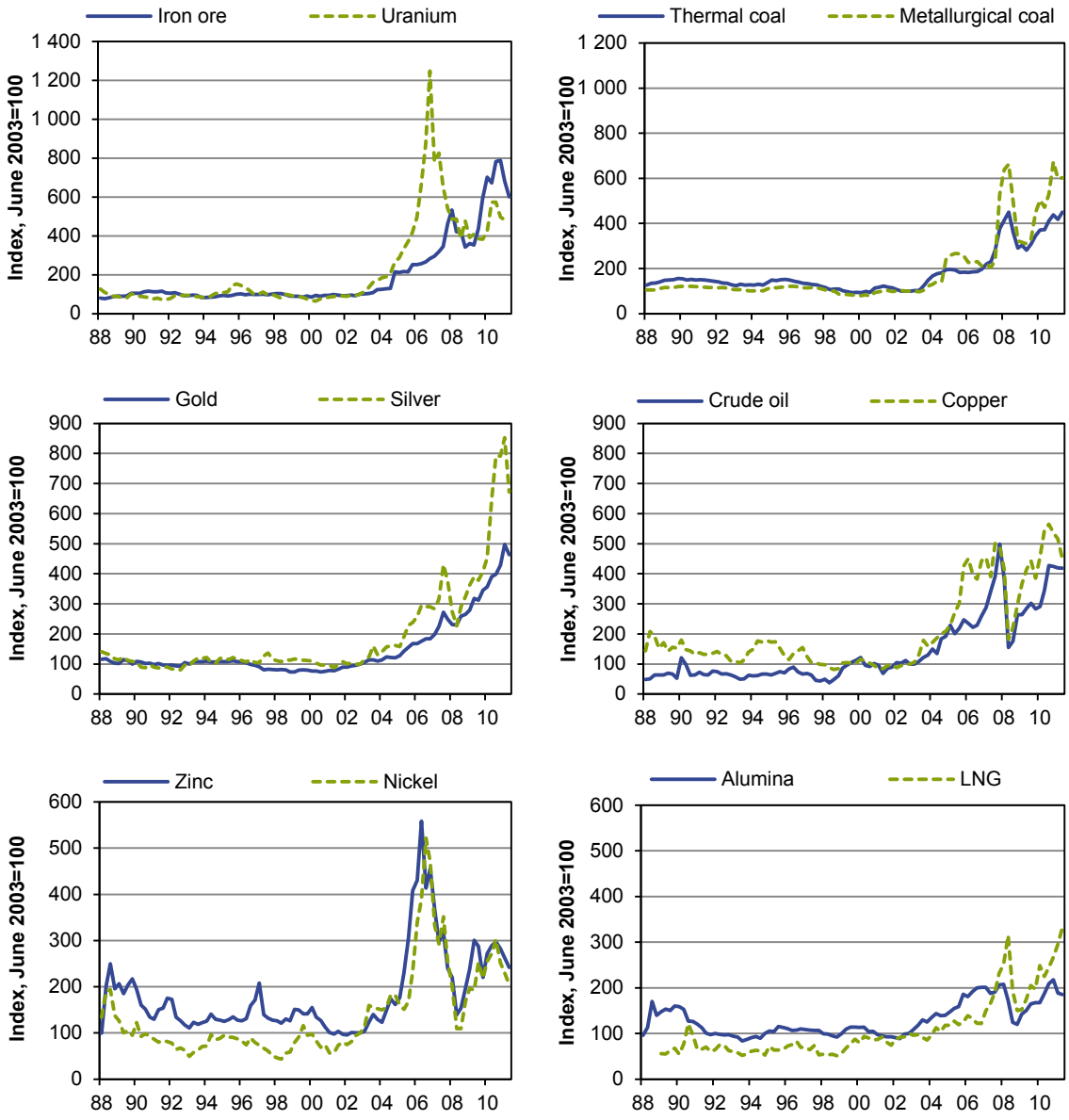
Section 6.1 describes the main drivers of structural change facing the resources sector in recent years. Section 6.2 analyses the effect of these factors on the sector's output. Section 6.3 describes some of the implications for the sector's capital and productivity. Finally, section 6.4 considers some of the implications for the sector's workforce of the recent rapid growth in its activity.

6.1 Recent drivers of change facing the resources sector

The most important driver of structural change affecting the natural resources sector in recent years has been the sharp rise in resource prices (figure 6.1). This rise marked the first phase of the resources boom, during which the growth in demand for minerals and energy exceeded the growth in supply in world markets. This led directly to the observed rise in prices and ensuing increase in the terms of trade and the exchange rate.

[49] The terms 'natural resources sector', 'resources sector', 'mining industry', and 'mining sector' are used interchangeably in this chapter. Unless otherwise indicated, the data used to describe this sector are based on the ABS's 'Mining' division (ABS 2006b). Definitions of that division, its subdivisions and the commodities and services they produce are provided in appendix A.

Figure 6.1 **Selected resource (minerals and energy) prices, September 1988 to December 2011**[a, b, c, d]



[a] Quarterly data are from ABARES (2011). Updated crude oil prices are from OPEC (2013). Exchange rate data are from RBA (2012). [b] Indexed to 100 at June quarter 2002-03 based on US dollar prices, except liquid natural gas which is indexed to 100 at June quarter 1997-98. [c] Alumina, iron ore, thermal and metallurgical coal and liquid natural gas prices based on average export values. Nickel and zinc prices based on London Metal Exchange cash price. Uranium price based on the industry's spot price. Crude oil price based on world trade (OPEC) basket price which is a weighted average of OPEC oil prices. [d] The correspondence between the commodities appearing in the figures above and the industries they belong to is given in appendix A.

Sources: ABARES (2011); RBA (2012); OPEC (2013).

Price increases, however, were not uniform across commodities. Furthermore, the prices of many commodities fell sharply after the GFC of 2008. Although some prices subsequently recovered to match or exceed their levels of 2007-08 by 2011, others did not. For example, by December 2011, the price(s) of:

- silver was seven times higher than in 2002-03
- iron ore and metallurgical coal were six times higher
- gold was five times higher
- thermal coal, copper and crude oil were over four times higher
- alumina, zinc and nickel were about twice as high (figure 6.1).

One year on, by the end of 2012, many of these commodity prices had fallen from their previous peaks (data not shown).

Along with the change in commodity prices, the prices of many capital inputs used by the resources sector also changed.[50] Some key assets, such as Non-dwelling construction, Industrial machinery and equipment, Other plant and equipment and Road vehicles recorded price increases after 2002-03. By 2010-11, the quality-adjusted prices of these inputs were between 25 and 200 per cent higher than they were in 2002-03.[51] Topp et al. (2008) attributed the price increases to the resources boom, which increased the demand for these inputs and led to shortages and delays in obtaining key capital equipment, despite the appreciation of the Australian dollar. In a further illustration of rising input prices, Connolly and Orsmond (2011) report that, from the mid-2000s onward, the price index for materials and services used in coal mining grew at twice the rate of prices in the broader domestic economy.

Conversely, the quality-adjusted prices of Computer equipment, Computer software and Electrical and electronic equipment declined substantially, at least from 1989-90, and were about 20, 90 and 70 per cent respectively, of their 2002-03 prices in 2011-12 (figure 6.2). While some of the falls in quality-adjusted prices can be attributed to declines in nominal prices, much of those falls was the result of substantial increases in the capabilities of the inputs, such as the processing power of Computer equipment.

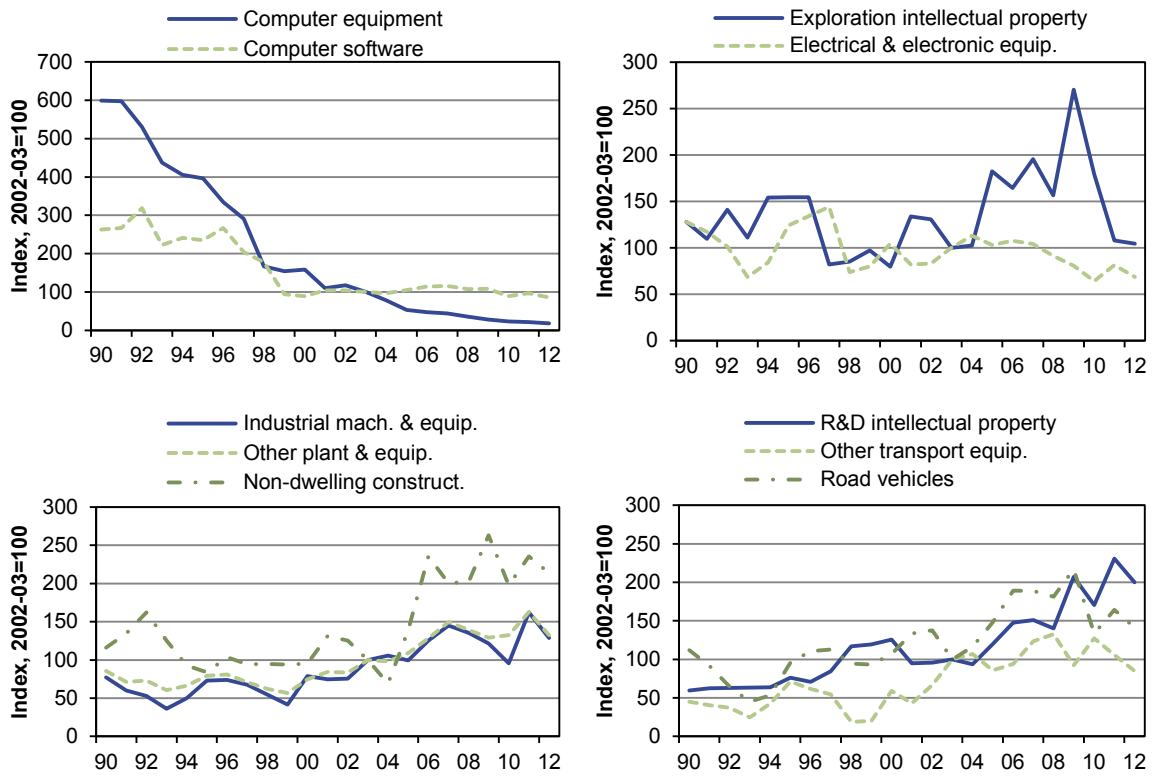
50 The issue of changing labour requirements and their effect on wages is discussed in section 6.4.

51 Quality-adjusted prices are the prices paid for capital items after accounting for changes in the quality (as measured by the productive potential) of the item. For example, computers in 2013 have much more powerful processors than they did in 1980. After accounting for computing power improvements, and notwithstanding inflation, computers in 2013 are only a fraction of the price of those in 1980.

The two trends in input prices have had opposing implications for resource businesses. First, the increases in the prices of capital and intermediate inputs increased the cost base of resource businesses.

Second, the rapid reduction in the quality-adjusted prices of information and communication technologies (ICT) contributed to a surge of ICT investment (Topp et al. 2008) that has led to technological change in the natural resources sector. For example, for Exploration and services to mining, the new assets allowed the use of three-dimensional seismic surveys and global positioning systems to target ore bodies more accurately. In many businesses, ICT allowed stages of the mining and resource-extraction processes to be automated (Topp et al. 2008; CSIRO 2013). For example, technology has enabled Rio Tinto to manage some of its resources operations remotely to overcome the difficulties in recruiting staff with the necessary expertise (Rio Tinto 2013).

Figure 6.2 **Quality-adjusted prices of selected capital items used by incorporated resource businesses, 1989-90 to 2011-12[a, b]**



a Year ending 30 June. **b** Capital rental price, in terms of dollars per unit of 2009-10 capital, indexed to 100 in 2002-03.

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

Although the technological change in favour of ICT-enabled production pre-dated the recent boom, the increase in commodity prices gave it added impetus.

Moreover, the adoption of ICT-enabled production processes is part of a longer-term trend in favour of innovation in the natural resources sector, such as the substitution towards open-cut mining instead of underground mining, the use of draglines instead of trucks and shovels and the use of deep-water drilling and slant-drilling offshore (Topp et al. 2008). More recent research and development efforts have focused on identifying low-energy cost mining methods, exploring advanced underground mining techniques (such as block caving) as an alternative to open-cut mining, and removing minerals from ore *in situ* as an alternative to moving the ore first (Rio Tinto 2013).

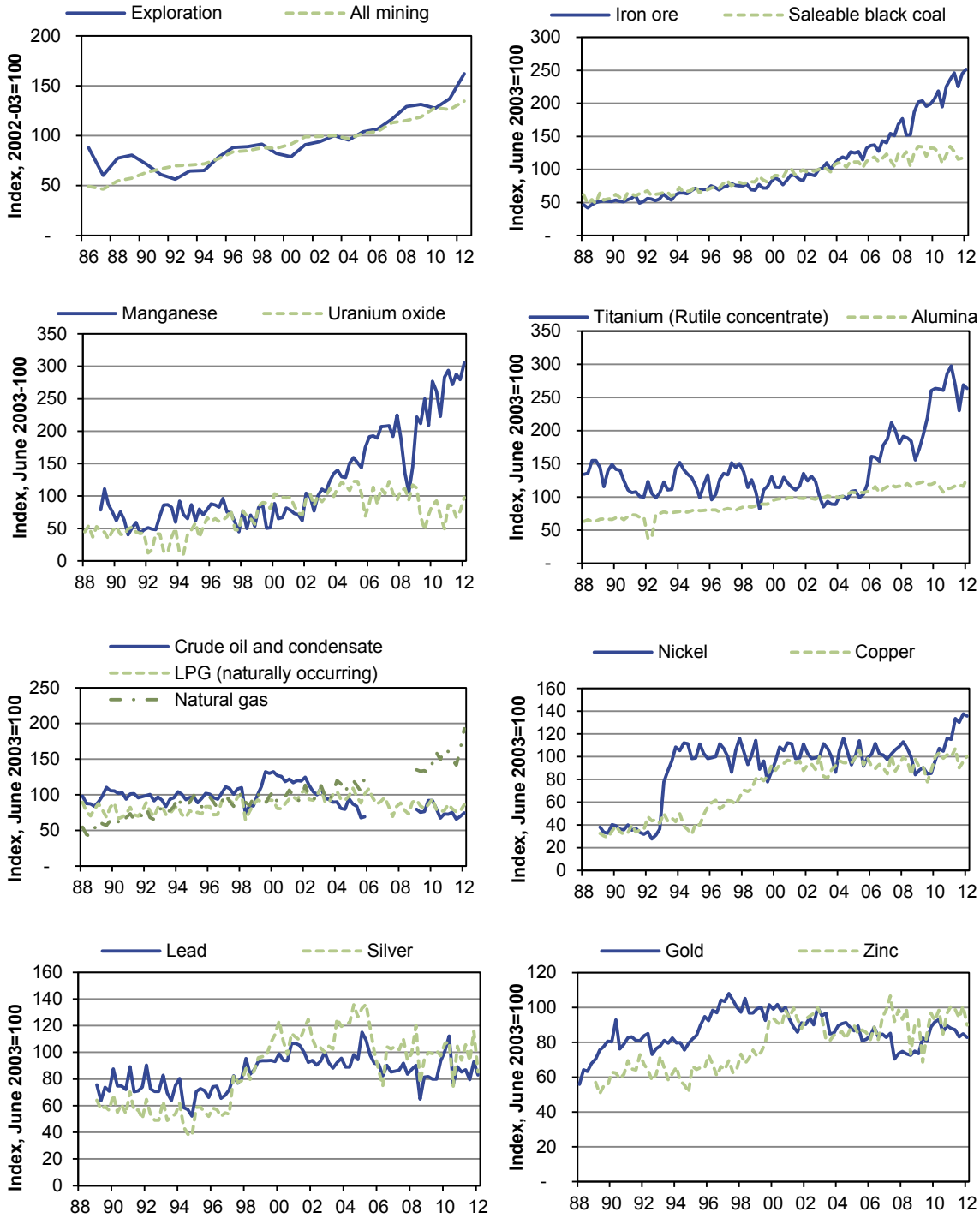
6.2 What were the effects on output?

In terms of the resources sector as a whole, despite high prices, the rate of real output growth was lower during the resources boom than before it (as discussed in chapter 3). To what extent have individual industries within the natural resources sector increased their output since 2002-03, in response to improved commodity prices? What other factors may have influenced the decision of businesses in those industries to increase their output during the boom years?

There were significant differences across industries within the resources sector. The output of some commodities (such as iron ore, liquefied natural gas (LNG)) and Exploration and services to mining grew more quickly after 2002-03 than it did earlier. For example, iron ore production grew by 12.1 per cent per year after 2002-03, compared with 7.1 per cent per year prior to this (figure 6.3). In contrast, coal production grew by 1.6 per cent per year after 2002-03, compared with 5.7 per cent per year in the preceding period, while the output of crude oil and naturally occurring liquid petroleum gas (LPG) declined after 2002-03.

There are three main reasons why output expanded more for some commodities than for others during the 2000s. First, some commodities, such as iron ore, experienced relatively large increases in prices that provided a strong incentive to increase output. Conversely, the prices of a number of non-ferrous metals (such as aluminium) grew more slowly after 2002-03 and were not sufficient to induce new investment and, in some cases, to offset higher energy costs (Barber et al. 2012).

Figure 6.3 **Production indexes of selected resources and industries**[a, b, c]



[a] Output for 'Exploration and services to mining' and 'All mining' are financial year data and are based on a chain volume measure of gross value added as reported in ABS (2012a). The annual data series were indexed to 100 relative to 2002-03. [b] All other output data were drawn from quarterly mine production (tonnages or volume) data reported by ABARES (2011) and BREE (2012b), and were indexed to 100 relative to the June quarter 2003. There are breaks in the data for oil and gas between September 2006 and June 2009. [c] The correspondence between the commodities appearing in the figures above and the industries they belong to is given in appendix A.

Sources: ABARES (2011); BREE (2012b); ABS (*Australian System of National Accounts*, Cat. no. 5204.0).

Second, for some commodities, output expanded relatively quickly because of access to known high-quality deposits and the ability of producers to expand the capacity of their existing projects at relatively low cost. For example, the rapid growth in iron ore output after 2002-03 was partly the result of a relative abundance of iron ore reserves that could be readily accessed by expanding existing operations (Geoscience Australia 2012; Barber et al. 2012).

Finally, the ability of some industries to increase output was limited by diminishing reserves or grades of natural resources. For example, the output of crude oil and LPG declined after 2002-03 because of diminishing economically demonstrated reserves (BREE 2012a; Barber et al. 2012; figure 6.3). Similarly, gold production declined after 2002-03 because of declining ore grades.[52] The role of reserves as an enabler of output expansion underlines the importance of natural resources endowments for structural change (chapter 1). Such endowments are only partly a function of the total amount of minerals in the ground. They are more directly influenced by the *known* amount of resources, which are a function of exploration activity.

In the short run, extraction of marginal deposits required substantial expansion in the use of variable inputs (such as labour). In the medium term, undertaking additional on-site or off-site investment became necessary. Many producers thus undertook large infrastructure investments and consequent increases in output have yet to materialise. Overall, 45 resource and resource-related projects were completed between April 2012 and April 2013 (table 6.1). While some of these projects are likely to be producing at full capacity already, others are not, suggesting that there is a prospect of output increases after April 2013. Another 73 projects (as at April 2013) have received a final investment decision and are about to start or have started construction (table 6.1).[53]

Recently-completed investments have tended to be in non-energy mineral commodities (such as copper and gold), whereas committed projects are dominated by energy commodities, in particular LNG, LPG and petroleum, and infrastructure facilities (Barber et al. 2012).

[52] Despite large price increases, the output of uranium declined after 2002-03 due to the fact that it is governed by regulatory, rather than economic, considerations.

[53] The BREE notes that projects can still experience a change in scope and schedule, or even be halted, even after their final investment decision is reached.

Table 6.1 **Recently completed and committed natural resource projects**

Resource	*Recently completed*[a]		*Committed*[b]	
	No. of projects	*Investment value*	*No. of projects*	*Investment value*
		$m		$m
Bauxite, alumina, aluminium	2	3 185	–	–
Coal	11	4 258	16	14 194
Copper, gold[c]	13	3 816	8	1 759
Infrastructure[d]	na	na	15	21 067
Iron ore	10	9 832	8	22 022
Lead, zinc, silver	1	303	4	1 933
LNG, LPG, petroleum	3	2 240	18	204 912
Other commodities	5	3 582	3	1 595
Uranium	–	–	1	98
Total	45	27 216	73	267 579

[a] Completed between April 2012 and April 2013. Data not separately available for infrastructure projects in April 2013. [b] Final investment decision issued as at April 2013. [c] Includes silver from the Mt. Carlton (Silver Hill) project. [d] Infrastructure projects include investments in road, rail and port facilities. – Nil.

Sources: Barber et al. (2012, tables 5 and 7) and Barber et al. (2013, tables 5 and 6).

Only one new resource project received a final investment decision between October 2012 and April 2013 (Barber et al. 2012 and 2013). The authors attributed the decline in the number of committed projects to an emerging trend of project delays and cancellations, with about $150 billion of projects having been delayed, cancelled or re-assessed in the preceding 12 months. They forecast the total value of committed investment to drop slightly to $256 billion by the end of 2013 and then to about $70 billion in 2017. This suggests that investment has peaked in the 'second phase' of the current resources boom, and that the third 'production' phase of the boom has started in some industries such as iron ore (Plumb, Kent and Bishop 2012; Sheehan and Gregory 2012; Stevens 2012). Following these large investments, resource exports are estimated to at least double in volume between 2010-11 and 2020-21 (Sheehan and Gregory 2012).

6.3 Some implications for capital use

As well as varying their output, resource businesses can also adjust to the pressures of structural change by varying their use of factors of production such as capital and labour (investment and employment are discussed extensively in chapters 3 and 4). As mentioned, labour usage tends to vary in the short term, while changes in capital use take longer to implement.

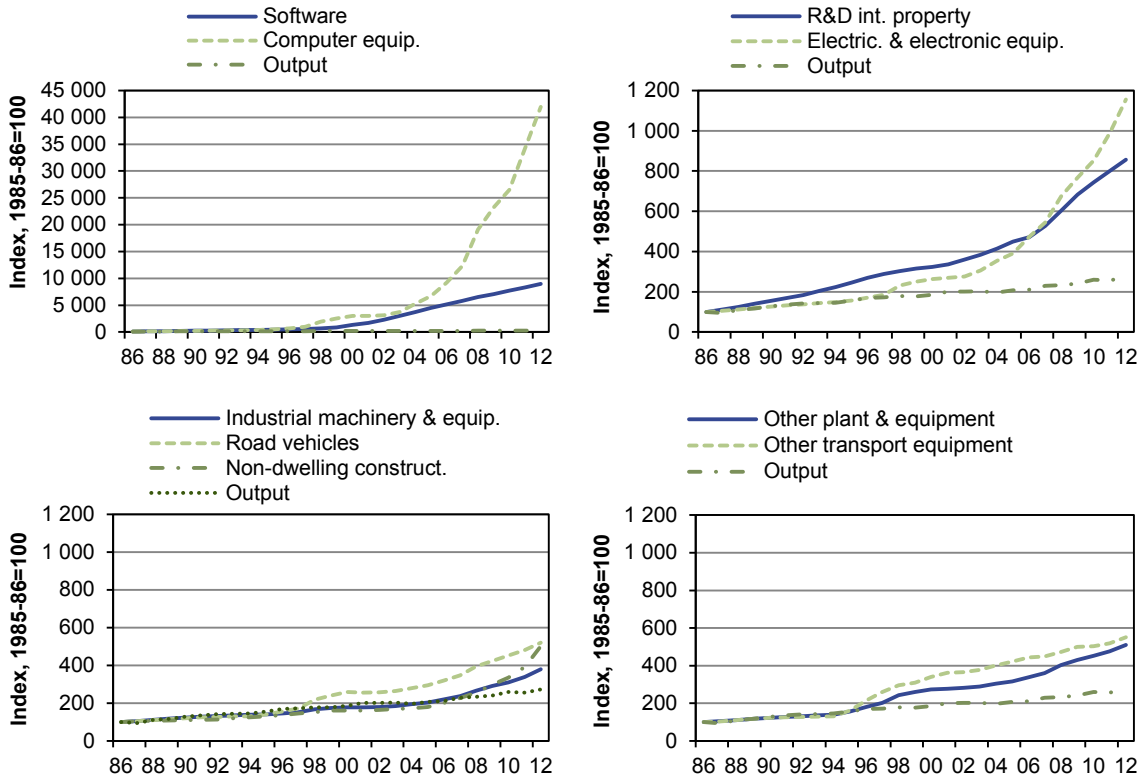
There is clear evidence that capital stocks in the resources sector have increased in recent years (figure 6.4). Stocks increased most rapidly for Computer equipment, Computer software, Electrical and electronic equipment, Research and development intellectual property, Other plant and equipment and Other transport equipment. These assets grew more quickly than the sector's output. For example, Computer equipment grew by 28 per cent per year and Computer software by 18 per cent per year between 1994-95 and 2011-12 (figure 6.4).

The three key determinants of how much capital is used by an industry are the:

- technology of production, which refers to the method by which resources are extracted
- price of capital relative to other inputs
- output level of the industry, including any returns to scale.

Figure 6.4 **Resource sector capital stocks and overall output, 1986 to 2012[a, b, c, d]**

Index value, 1985-86=100



[a] Incorporated mining businesses. [b] Capital stock and output are chain volume measures with 1985-86 as their reference year. [c] Year ended June. [d] The resources sector is as defined in appendix A.

Sources: ABS (*Estimates of Industry Multifactor Productivity*, Cat. no. 5260.0.55.002; *Australian System of National Accounts*, Cat. no. 5204.0).

As mentioned, resource projects employ a variety of technologies to extract minerals and energy. Access and geological considerations play a large part in determining the type of technology used. Some technologies are inherently more capital-intensive than others. For example, 'longwall' and 'room and pillar' mining are two commonly used underground mining methods. Longwall mining is more capital intensive and is better suited for coal deposits that follow a long and even stratum. The older room and pillar technique, although more labour-intensive, can be more flexibly configured to accommodate a variety of coal deposit formations.

Changes in the relative prices of factors of production influence how a business uses those factors. Businesses attempt to economise on factors that are relatively costly in favour of less expensive ones, within the constraints imposed by the technology of production. For example, mines are often located in remote locations, making it costly to attract and retain skilled labour. Mining work is also very hazardous, making occupational health and safety an important consideration for mine management (Fisher and Schnittger 2012). Both characteristics contribute to the cost of labour. The price of ICT and Electrical and electronic equipment, as noted, declined dramatically from about 1989-90 onward, especially in comparison with the cost of labour (figure 6.2). These price declines influenced the decision of resource businesses to invest more heavily in ICT, not only to increase the productivity of capital, but also to reduce labour-related costs (such as those associated with workplace accidents).

Finally, the use of capital also depends on whether a project is experiencing increasing, constant or diminishing returns to scale. A resource project will tend to exhibit increasing returns if it is operating below capacity and it has ready access to proven and economic reserves. Such a project will be able to expand its production at relatively little cost. Conversely, a project will experience diminishing returns to scale if it is constrained by either capacity utilisation or diminishing resource reserves and grades. In such cases, a project will only be able to expand its output in the short term by employing more variable inputs, such as labour, whose marginal contribution to production would gradually diminish. In the longer term, such a project would need to invest in additional capacity, discover new deposits or identify new methods to better extract existing reserves.

Implications for productivity

Each of the factors reviewed above contributed to the observed changes in the capital stocks of the resources sector. As a result, they also contributed to changes in the sector's capital–labour ratio and multifactor productivity. Like many industries in the Australian economy, the resources sector experienced strong

multifactor productivity (MFP) growth in the 1990s (Zhao 2012). ABS data show that in the years leading up to 2001-02, output grew more quickly than labour and capital use jointly, and capital use grew more quickly than labour use. Since 2001-02, however, employment has increased faster than capital use, and both employment and capital use have increased faster than output (ABS 2012k). These trends suggest that both MFP and the capital–labour ratio increased before 2001-02 and decreased afterwards, in part due to the fact that the construction phases of a mine are more labour-intensive than the production phases.

Topp et al. (2008) reported that the decline in productivity and capital–labour ratio was the result of diminishing returns to scale among resource businesses. Many projects experienced declines in ore grade (metal per tonne of ore), ore quality (impurities), reservoir pressure, or experienced increases in the overburden ratio (the proportion of overburden to ore).[54] Other projects experienced increased mine or well depth and increased complexity in the terrain or mine geology. This meant that production could only be maintained, in the short run, through incurring higher unit costs. Nonetheless, the large increase in resource prices offset those rising costs, thereby allowing many lower-productivity mines to continue operating. In addition, prices also made it worthwhile for miners to exploit lower-quality ore grades.

Adding to this, the substantial investment program for many resources (table 6.1) has not yet led to a substantial increase in output. As a result, the long lead times of these investment projects is contributing to the lack of growth in MFP. In coming years, it is generally expected that this new capital base will generate sizable increases in resource output that should eventually lead to increases in MFP.

6.4 What were the implications for labour?

Alongside the recent boom in demand for its products, the natural resources sector has recorded a rapid increase in its workforce. While Australia's total workforce grew by just under 25 per cent between 2002 and 2012, the resources workforce more than trebled in that time. Rising from around 80 000 to 260 000 workers, the resources sector was the fastest-growing of all 19 industry divisions during this period. This section describes the expansion of the resources workforce and analyses how the sector was able to source additional labour to meet the increasing demand for its output.

54 These authors estimated that, after accounting for resource depletion, the growth in mining MFP over the 1974-75 to 2006-07 period was 2.50 per cent per annum, compared to the 0.01 per cent measured by the ABS (Topp et al. 2008).

Where has the growth of the resources workforce occurred?

The rapid expansion of the resource sector workforce during the recent natural resources boom is illustrated in figure 6.5, by industry subdivision. From 2000 onwards, the largest increase in employment, in absolute terms, occurred in Metal ore mining. This industry subdivision has long been, and continues to be, the largest component of the resources workforce, with most of these workers involved in Iron ore or Gold ore mining (ABS 2011b).[55] The fastest rates of employment growth from 2000 onwards, however, occurred in Coal mining and Exploration and other mining support services.[56] Employment in Oil and gas extraction also expanded rapidly, although from a relatively small base. Figure 6.5 illustrates that the recent surge in resources employment was unprecedented, compared to the preceding 15 years. Moreover, during the 1990s, employment numbers in some subdivisions within the sector actually fell.

Around 40 per cent of Australia's resources workforce is currently located in Western Australia, with the next largest shares found in Queensland (almost 30 per cent) and New South Wales (almost 20 per cent) (ABS 2012h). Western Australia's position as the largest employer of resource workers only emerged from around 2000 onwards (figure 6.6). In the preceding 15 years, its resources workforce was not much larger than that of New South Wales or Queensland.

To give a sense of the rapid expansion of the regional workforces within the resource-rich states, the total number of people employed in regional Western Australia almost doubled between 2008 and 2012, while the number employed in the Mackay-Fitzroy-Central West region of Queensland swelled by 40 per cent (ABS 2012h).[57] In 2011, the Western Australian Outback region recorded an employment-to-population rate of around 70 per cent, which was around 9 percentage points higher than that for Australia overall. In the Pilbara, a part of this region, that rate reached 84 per cent (ABS 2011b).

Machinery operators and drivers currently make up the largest occupational share (around one-third) in the resources sector (figure 6.7). Of these workers, most are employed as Drillers, miners or shot firers (ABS 2011b). Technicians and trades

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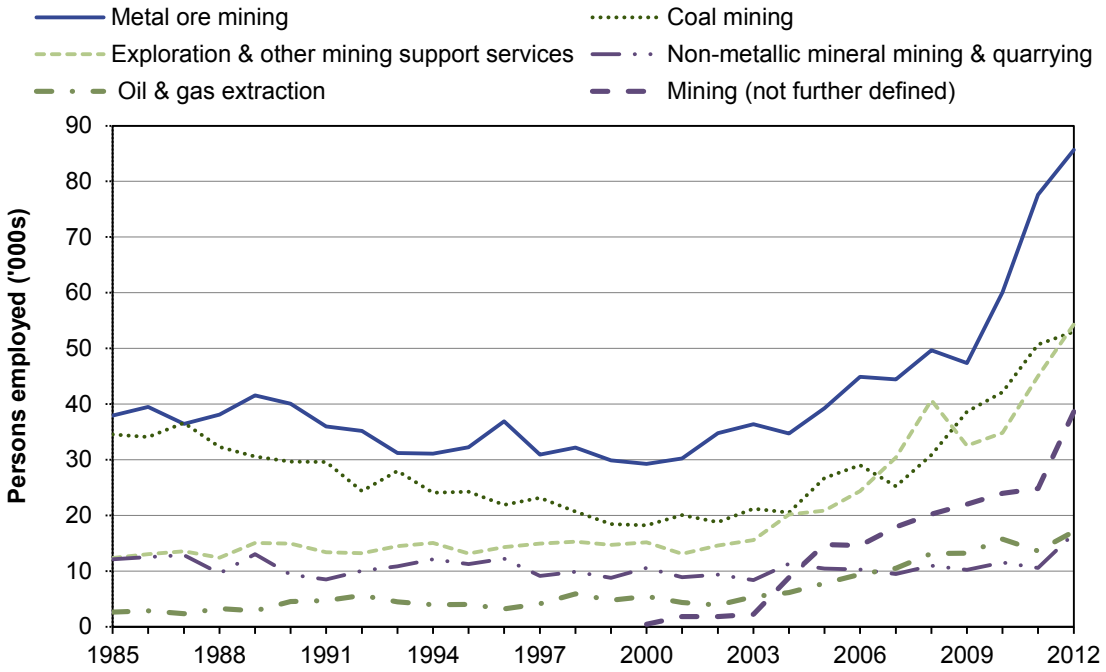
55 Unless otherwise indicated, all citations of Census data in the remainder of this chapter refer to Productivity Commission estimates drawn from the ABS *Census of Population and Housing* and calculated using ABS *TableBuilder 2006* (Cat. no. 2065.0) and ABS *TableBuilder 2011* (Cat. no. 2072.0).

56 Excluding the industry subdivision 'Mining (not further defined)'.

57 'Regional Western Australia' refers to the 'Balance of Western Australia' statistical region, which includes Kalgoorlie, Port Hedland, East Pilbara, Roebourne, Ashburton and Broome (among other regions). Employment numbers refer to August.

workers and Professionals constitute the next largest occupational categories within the sector. Employers in the resources sector reported that, in recent years, the most difficult occupation to fill was the Professional occupation of Mining engineers (DEEWR 2012b).

Figure 6.5 **Employment in the resources sector, by subdivision, 1985 to 2012[a, b]**

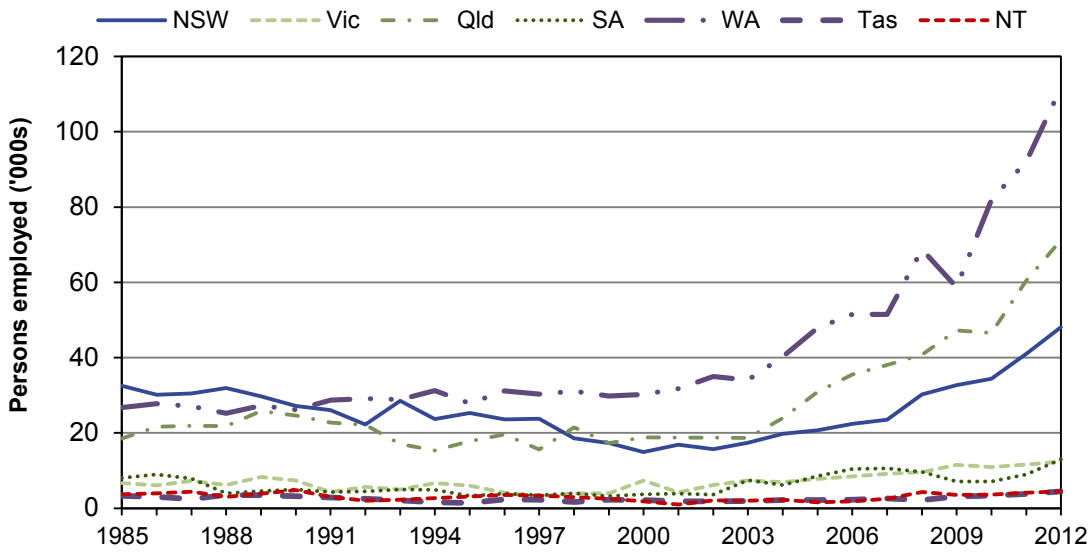


a Annual count of persons employed for each year based on averaged original quarterly data. See appendix A.2 for explanation of mining industry subdivisions. **b** The commodities produced and services delivered by the resource sector subdivisions listed in the figure above are detailed in appendix A.

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

The profile of occupations required by a firm in the natural resources sector are partly determined by the phase in which the resources project is engaged. During the exploration and early 'planning' phases of a project, the skills of Professionals (such as Geologists, Surveyors and Mining and mechanical engineers) are generally in high demand. During the construction and operational phases, the skills of Technicians and trades workers and Machinery operators and drivers (such as Engineering technicians, Machinists and Truck drivers) are more in demand. Overall demand for labour generally peaks during the construction phase, although workers employed during this phase are typically employed on a short-term, rather than ongoing, basis (CMEWA 2011a; MCA, CMEWA and QRC 2010; Western Australian Regional Cities Alliance 2011). These patterns, however, are not clearly visible in the aggregated data in figure 6.7, because the many projects currently underway are at different stages of their life cycle.

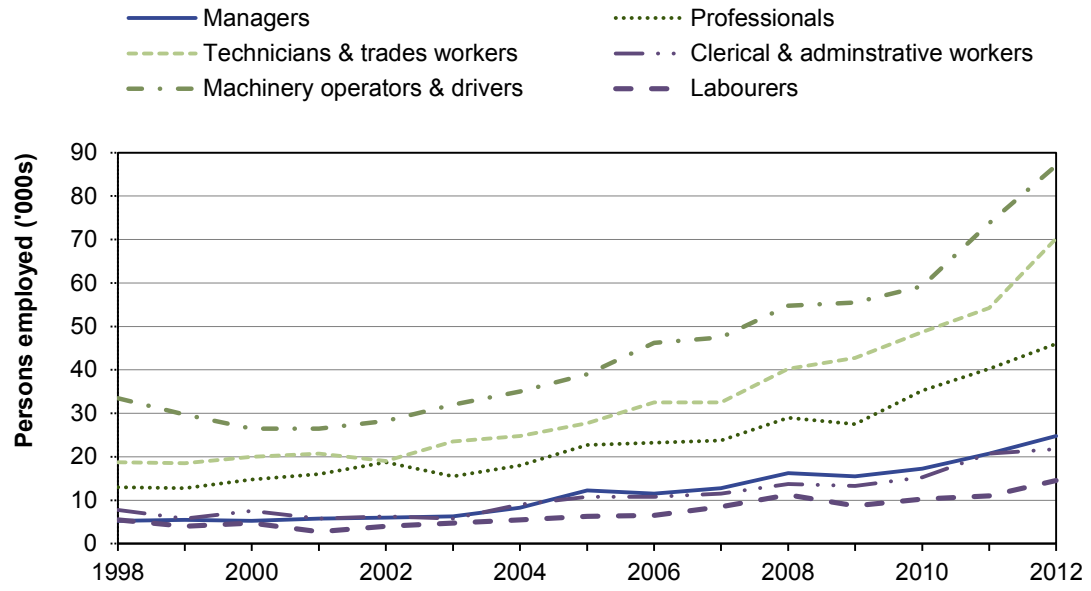
Figure 6.6 **Resource sector employment, by jurisdiction, 1985 to 2012[a, b, c]**



[a] Annual count of persons employed for each year based on averaged original quarterly data. [b] Estimates for the ACT have been excluded due to the low sample count and high sampling variability for this jurisdiction. Some estimates for Victoria for 1996 to 2001 were subject to high sampling variability. [c] The scope of the resources sector is defined in appendix A.

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

Figure 6.7 **Resource sector employment, by occupation, 1998 to 2012[a, b]**



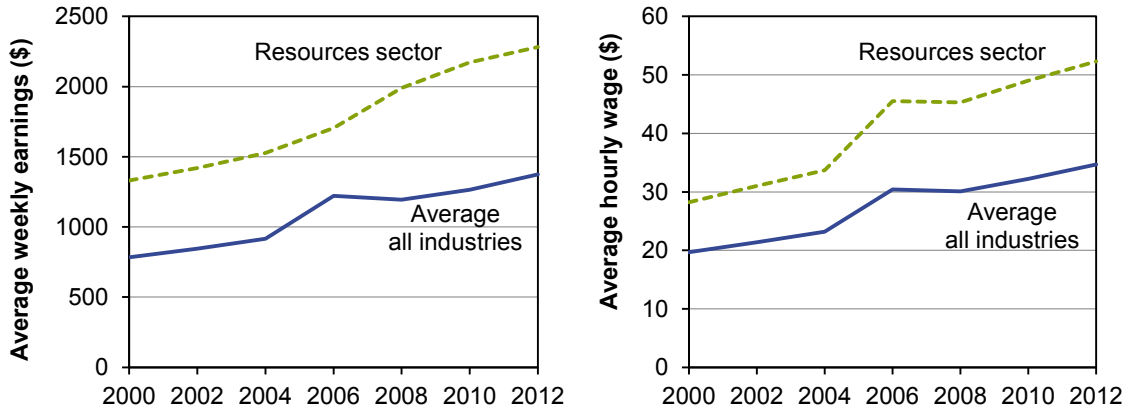
[a] Annual count of persons employed for each year based on averaged original quarterly data. Figure excludes Community and personal services workers and Sales workers, due to the low and inconsistent count. [b] The scope of the resources sector is defined in appendix A.

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

Nominal wage growth in the resources sector

The growing demand for resource workers has translated into strong growth in their nominal wages.[58] While earnings in the resources sector have long exceeded earnings in the rest of the workforce due to the hazardous and remote nature of this work, the gap has widened in recent years (figure 6.8). Between 2006 and 2010, average weekly earnings across the whole of the workforce plateaued, while earnings in the resources sector continued to climb. Even after accounting for differences in hours worked (by measuring average hourly wage), this industry differential persists.

Figure 6.8 **Average weekly earnings and hourly wage, resources sector and all industries, 2000 to 2012[a, b, c]**



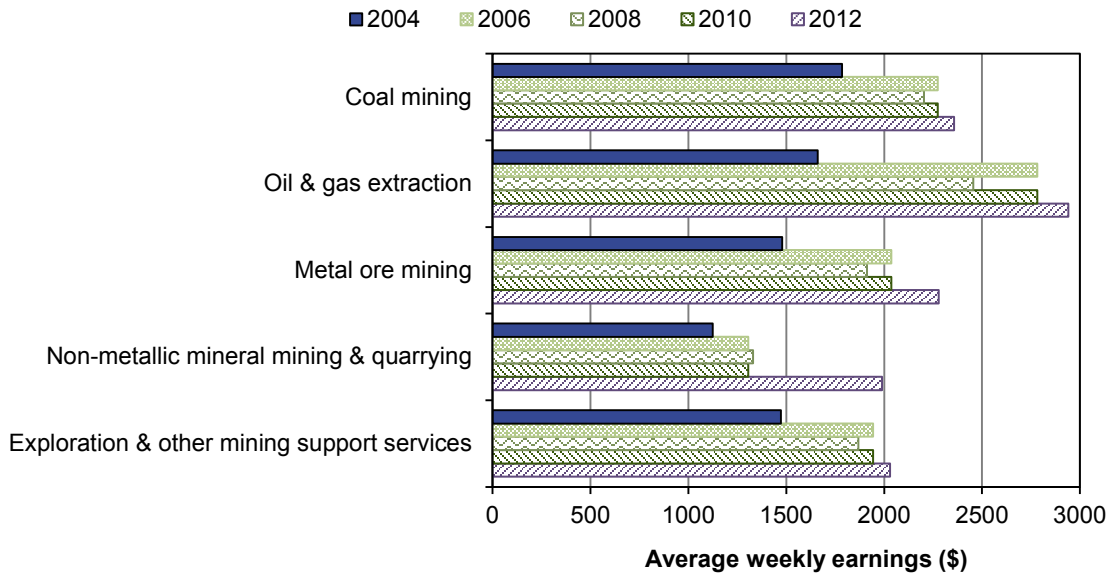
a Nominal earnings and wages, including overtime, of full-time non-managerial employees. **b** 'All industries' includes the resources sector. **c** The scope of the resources sector is defined in appendix A.

Source: ABS (*Employee Earnings and Hours, Australia*, Cat. no. 6306.0).

Within the natural resources sector, earnings have generally been highest in Coal mining and Oil and gas extraction (figure 6.9). The average earnings of the lowest-paid subdivision in the resources sector are still significantly higher than in other industries. Looking at growth in earnings within the resources sector, from 2004 to 2012, the fastest rate of increase occurred in Oil and gas extraction. In 2006, Oil and gas extraction overtook Coal mining as the highest-paying one within the resources sector. As noted earlier, Oil and gas extraction also experienced one of the highest rates of employment growth of all the resource sector subdivisions during this time.

58 Nominal wages are an appropriate comparator of wages across industries and regions, provided consumer prices do not differ much geographically.

Figure 6.9 **Average weekly earnings in resources sector, by subdivision, 2004 to 2012[a, b, c]**



[a] Nominal weekly earnings, including overtime, of full-time non-managerial employees for May of the respective year (except for 2008 which, due to data availability, is for August). [b] The large jump in earnings for 'Non-metallic mineral mining and quarrying' from 2010 and 2012 could be due to the large standard errors associated with the overtime component of these measurements and to changes in the approach used by the ABS to measure these data. [c] The commodities produced and services delivered by the resource sector subdivisions listed in the figure above are detailed in appendix A.

Source: ABS (*Employee Earnings and Hours, Australia*, Cat. no. 6306.0).

Where has the additional labour come from?

Given the unprecedented rate of expansion of the resources workforce in the past decade, analysing the way in which the sector was able to satisfy its booming demand for labour can shed light on some of the labour dynamics of structural adjustment occurring within Australia's economy.

Workers from other industries

In the course of its expansion, the resources sector drew some of its new workers from other industries. D'Arcy et al. (2012) estimate that, in the five years to 2010, the number of workers moving to the resources sector from other parts of the economy more than doubled.

Although it is difficult to track precisely the movements of workers into the resources sector from other industries, due to the small size of the destination workforce, it is possible to produce some indicative estimates using several sources.

These estimates should be interpreted with care, but the fact that various data sources generate a consistent picture lends weight to their robustness.

Estimates drawn from the Household, Income and Labour Dynamics in Australia (HILDA) Survey suggest that, during the early years of the 2000s, most workers moving into the resources sector were coming from manufacturing. In later years of the decade, proportionally more came from construction. Estimates drawn from the ABS Labour Mobility Survey generate a similar picture: workers that moved into the resources sector between 2009 and 2010 were found to have mainly moved from construction and, to a lesser degree, manufacturing (ABS 2010b). The HILDA Survey data also indicate that various services industries — including Wholesale trade, Transport, postal and warehousing and Professional, scientific and technical services —provided sources of new labour for the resources sector throughout the 2000s (see appendix C for more details). Observations from some resource businesses further confirm these general findings: for example, Waratah Coal noted that manufacturing tends to be the main industry from which the sector's workers were being drawn throughout the 2000s (Waratah Coal 2011, cited in Denniss and Grudnoff 2012).

The relative prominence of manufacturing workers as a source of resource sector workers is attributable, in part, to the similarity, and hence transferability, of their skills set (Waratah Coal 2011, cited in Denniss and Grudnoff 2012). It can also be explained by the fact that, at the same time that the resources sector was seeking new workers, manufacturing was shedding workers. These observations illustrate that, even though the resources price boom and resultant exchange rate appreciation displaced some workers in trade-exposed industries, it also opened up potential job opportunities for them elsewhere in the economy.

Insofar as socio-demographic factors can partly explain employment patterns (Salma et al. 2008), it is expected that workers are more likely to move between industries that have similar socio-demographic profiles. Of all 19 industry divisions, mining has the smallest shares of part-time workers and female workers (DEEWR 2012a). This helps to explain why industries with similarly low shares of female or part-time workers — namely Manufacturing, Construction, Transport, postal and warehousing and Wholesale trade — have been sources of new workers for the resources sector.

Another factor influencing workers' capacity to switch industries into resources — given the remote location of most mining jobs — is their capacity to move geographic location. Although it was previously observed that relatively few workers changing residence for work purposes moved further than 50 kilometres, it

was also noted that the propensity of workers to move location is higher if it is to take up a job in the resources sector (chapter 5).

Indigenous population

Given the remote geographic location of most mining and gas extraction sites, and the high representation of the Indigenous population in the remote, resource-rich regions,[59] it might be expected that the rapid expansion of the resources sector provided a large number of job opportunities for the Indigenous population.

There are indications that, to some extent, the resources sector did draw upon the Indigenous population as a source of new workers during its expansion. Between 2006 and 2011, the number of Indigenous persons employed in the resources sector roughly doubled, from 3150 to 6170 workers (ABS 2011b). Furthermore, the resources sector's share of the total Indigenous workforce grew considerably during the 2000s, rising from 1.8 per cent to 3.1 per cent between 2006 and 2011 (ABS 2006c and 2011b). However, the proportional increase in Indigenous employment numbers in the resources sector was similar to the growth of the sector's workforce size overall. Consequently, Indigenous workers' share of the total resources sector's workforce remained unchanged between 2006 and 2011, at around 3 per cent (ABS 2006c and 2011b).[60]

Around half of all Indigenous workers who were employed in the sector in 2011 were employed in Metal ore mining, which was the fastest-growing of the resource sector subdivisions. This industry specialisation underpinned strong local Indigenous employment growth in some resource-rich regions. For example, in the Pilbara region, the employment rate of the working-age Indigenous population rose from 45 per cent to 51 per cent between 2006 and 2011. The 2011 figure was five percentage points higher than the Indigenous employment rate nationwide (ABS 2006c and 2011b). By contrast, in the Goldfields, Kimberley and Mid-West regions of Western Australia's outback, the Indigenous employment rate in 2011 was lower than the employment rate of the Indigenous population for Australia overall.

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59 Although the Indigenous population makes up around 2.5 per cent of Australia's total population, this share is much higher in many mining regions. For example, 40 per cent of the people living in the Kimberley region are Indigenous (ABS 2011b).

60 This statistic notwithstanding, anecdotal evidence suggests that the representation of Indigenous workers within the workforce of individual resource businesses has grown considerably over recent decades. For instance, Rio Tinto reported that, as a share of its company's total workforce, the proportion of Indigenous workers increased from less than half of one per cent during the mid-1990s to 8 per cent by 2010 (Rio Tinto 2011a).

Skilled migrants

In circumstances where employers cannot find suitably skilled workers who are Australian citizens or permanent residents, 'Temporary Work (Skilled) (subclass 457)' visas (formerly 'Temporary Business (Long Stay) (subclass 457)' visas) — referred to here as 'temporary work' visas — can be granted to skilled workers from outside Australia who have been sponsored and nominated by a business to work in Australia on a temporary basis.[61]

Around 9 per cent of all primary temporary work visa holders at June 2012 worked in the resources sector, and another 13 per cent worked in construction (DIAC 2012b). These industries appear to have been relatively more reliant than others on this visa program as a source of labour (box 6.1). Nonetheless, almost as many temporary work visa holders work in the Health care and social assistance industry as work in construction.

Box 6.1 **Use of Temporary Work (Skilled) visas in resources**

At June 2012, there were 7860 primary visa holders of Temporary Work (Skilled) (subclass 457) visas (or 'temporary work' visas) sponsored to work in Australia's natural resources sector (equivalent to about 3 per cent of the sector's workforce). There were a further 11 730 primary visa holders sponsored to work in construction (equivalent to about 1 per cent of that sector's workforce).

In **Western Australia**, 4630 temporary work visa holders were sponsored to work in the resources sector and a further 4270 in construction. Collectively, they constituted almost half of Western Australia's temporary work visa holders across all industries. The number of temporary work visa holders in the resources sector was equivalent to 4 per cent of Western Australia's total resources workforce.

Although Western Australia provided around 11 per cent of all jobs in Australia, its share of the total number of temporary work visa holders in Australia stood at just over 20 per cent at June 2012. Around one-quarter of all newly-issued temporary work visas in WA during the 2011-12 financial year were for occupations related to the resources sector, including Mechanical engineers, Civil engineers, Mechanical engineering technicians, Geologists, Metal fabricators, Welders, Fitters, Construction project managers and Engineering managers.

(Continued next page)

61 This visa applies only for occupations that have been approved by the Australian Government.

Box 6.1 (continued)

In **Queensland**, 2070 temporary work visa holders were sponsored to work in the resources sector and another 2550 in construction. Together, they amounted to around 30 per cent of all temporary work visa holders in Queensland. The number of temporary work visa holders working in Queensland's resources sector represented around 3 per cent of that state's total resource sector workforce. Civil engineers, Mechanical engineering technicians, Geologists, Construction project managers, and Program or Project administrators were among the most common occupations of new visa recipients in the financial year 2011-12.

While the **Northern Territory**'s resources workers constitute a small share of Australia's total resources workforce, 15 per cent of all temporary work visa holders in the Territory were sponsored to fill resource sector jobs, and a further 15 per cent worked in construction. As a proportion of all temporary work visa holders in **New South Wales**, those working in the resources sectors did not make up a significant share. This suggests that employers in the resources sector in New South Wales did not encounter the same degree of difficulty in sourcing labour, compared to those in other jurisdictions.

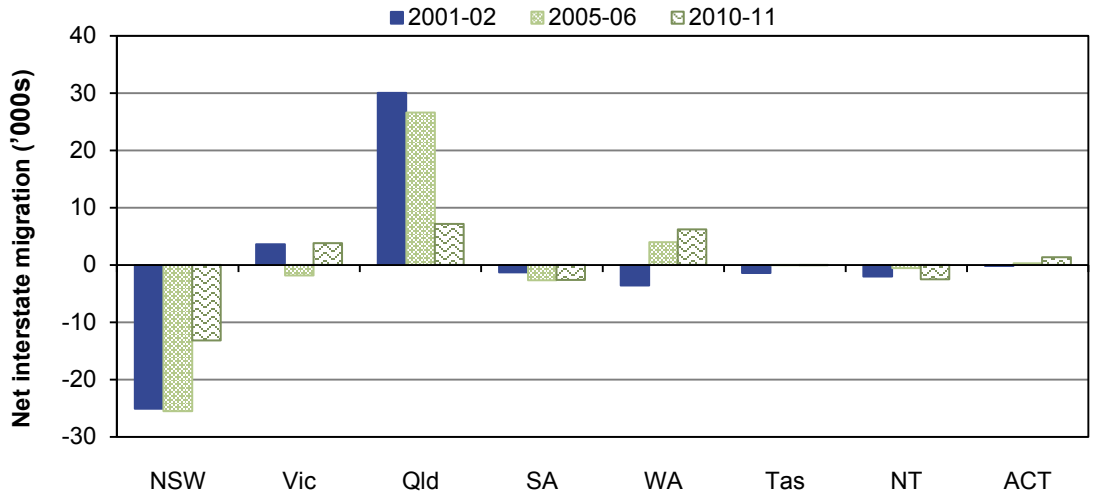
Sources: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003) and DIAC (2012b).

In addition to temporary work visas, Australia's regional migration scheme offers employer-sponsored visas to skilled migrants who are prepared to live and work outside of the Gold Coast, Brisbane, Newcastle, Sydney, Wollongong and Melbourne. Nearly 16 500 skilled migrants were granted these visas in 2011-12, with almost one-quarter filling positions in Western Australia (DIAC 2012a).

Workers from other states or regions

There is some evidence that the natural resources boom attracted workers into resource-rich states, with Queensland and Western Australia experiencing the largest net intakes of interstate migrants (and nearly every other jurisdiction experiencing negative net flows) during the 2000s (figure 6.10). In Western Australia, the ongoing inflow of interstate migrants reversed the net outflow of interstate migrants experienced prior to the boom. The interstate migrant intake in Western Australia was largely comprised of young professionals working in the field of engineering and science (CMEWA 2011b).

Figure 6.10 **Net interstate migration of working-age population, by destination, 2001 to 2011[a]**



a 'Working age' refers to the population aged 15 to 64 years.

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

Despite some workers migrating to the resource-rich states, that flow has not been substantial, relative to the total size of the resource sector workforce. This may be partly reflective of the length of time required for workers in one location to respond to higher wages or lower unemployment in another location, as discussed in chapter 5. At the same time, however, interstate migration data do not capture the sizeable flow of workers moving into the resources sector and resource-rich states, but not necessarily moving their place of permanent residence, by way of 'Fly-in, Fly-out' (FIFO) and 'Drive-in, Drive-out' (DIDO) employment.

A closer look at Fly-in, Fly-out employment

To attract a sufficient number of new workers during the recent resources boom, employers in the resource industries have made strong use of FIFO and DIDO work arrangements.[62] Such arrangements see workers commuting to work at mines or wells in (usually) remote locations without changing their permanent residence. FIFO and DIDO workers generally work and live at the project site for relatively short periods of time (9 days every fortnight, or 14 days every 3 weeks) during which food, temporary accommodation and travel between the project site and the

62 This analysis focuses mainly on FIFO, rather than DIDO, employment. While FIFO arrangements appear to be most commonly used in Western Australia, DIDO arrangements are used in many regions of Queensland and New South Wales, where there are a larger number of established regional centres that can serve as a permanent residential base for workers in driving distance to the work sites (MCA 2011).

worker's permanent place of residence are usually provided by the employer (House of Representatives Standing Committee on Regional Australia 2013). Another distinguishing feature of FIFO work is that workers typically work twelve-hour shifts, rather than the traditional eight-hour shift.

Long-distance commuting arrangements are not a new phenomenon within the wider workforce. In the provision of the health and education services, for example, it has been common for workers to fly in and out of remote towns as required. Such arrangements have also long been used by the construction industry to supply workers for short-term projects (NRSET 2010b). Even within the resources sector, during the 1960s and 1970s, specialist workers were often flown in to the work sites and housed temporarily in camps (CMEWA 2011a).

Yet, perhaps never before in Australia's history has FIFO been so closely associated with the booming growth of a single industry. According to some peak bodies in the sector, FIFO workers have provided 'a significant and growing proportion of the workforce needed by the resources sector' (CMEWA 2012, p. 2). As the mining boom took hold throughout the 2000s, the number of resource sector workers employed under FIFO arrangements not only increased substantially in absolute terms, but also as a proportion of the resources workforce (CMEWA 2011a; Hogan and Berry 2000; House of Representatives Standing Committee on Regional Australia 2013; Morris 2012; WALGA 2012).

While the prevalence of FIFO within the resources sector varies from project to project, a snapshot of Rio Tinto's workforce illustrates its prevalence in some parts of the sector. Within its iron ore operations in Western Australia, around 46 per cent of Rio Tinto's workforce (equivalent to 10 700 workers) were employed on FIFO arrangements in 2011 (Rio Tinto 2011b). It is especially common for FIFO arrangements to be adopted during the construction phase of a mining project, given the short-term nature of construction work. In Western Australia, it has been forecast that 92 per cent of all construction workers involved in resources projects between 2012 to 2015 would be employed on a FIFO basis (CMEWA 2011b).

How many Fly-in, Fly-out workers are there?

Notwithstanding the widespread perception that FIFO has grown in prevalence in the resources sector, there are some pragmatic difficulties in measuring the total number of workers employed under FIFO arrangements in Australia's resources sector. This was acknowledged in the Parliamentary Inquiry report on FIFO work practices (House of Representatives Standing Committee on Regional Australia 2013) and by the ABS (ABS 2012c and 2012d). One major impediment is that many datasets collect information about workers' residential location but not

their work location. If FIFO workers live in metropolitan or inner regional areas, there might be no way of knowing that they work in remote areas.

Nevertheless, some broad estimates are feasible. Using the most recent Census data, it is estimated that, in 2011 — in the main mining regions of Western Australia, Queensland and New South Wales alone — there were around 34 000 Mining and Construction workers employed under FIFO arrangements (see Productivity Commission estimates in box 6.2).[63] The total number of FIFO workers across all regions of Australia is upwards of this figure.

Box 6.2 Estimating the number of Fly-in, Fly-out workers in the resources sector

The latest ABS Census of Population and Housing, collected in August 2011, allows the number of 'Fly-in, Fly-out' (FIFO) workers employed in the resources sector to be estimated, insofar as some workers reported a different place of usual residence from their place of work. Table 6.2 presents the number of workers employed in the Mining industry in Australia's major mining regions who usually lived outside of these regions. These workers are likely to be working on mining projects under FIFO arrangements. Since these projects frequently also employ construction workers under FIFO arrangements, an estimate of Construction workers is also computed.

According to these data, roughly one in four mining workers in Western Australia, and one in six mining workers in Queensland, were employed under FIFO arrangements.

Another way to gauge the FIFO workforce size is to look at the number of workers residing in 'staff quarters' in mining and gas extraction regions on Census night. In Western Australia's resource regions, around 13 500 Mining workers and 6300 Construction workers were residing in staff quarters. In Queensland's main resource regions, there were around 6200 Mining workers and 2800 Construction workers in staff quarters. These numbers generally corroborate the derived estimates reported in the table below.

In addition to staying in staff quarters, Mining and Construction workers tended to be the most common type of worker residing in hotels and motels, which is another form of temporary accommodation for FIFO employees.

(Continued next page)

63 Based on the number employed in Mining or Construction, working in the main mining regions (limited to a selection of statistical areas known to be predominantly mining regions), but not permanently residing there. Where the distance between a worker's place of residence and the mining region in which s/he worked was sufficiently large, s/he was assumed to be employed under FIFO arrangements (that is, workers who: worked in Darling Downs–Maranoa and lived in Toowoomba; worked in Fitzroy and lived in Mackay (or vice versa); or worked in the Hunter Valley and lived in Newcastle–Lake Macquarie.) Includes workers who worked offshore or were in long-distance transit for work purposes (classified as Migratory/Offshore/Shipping).

Box 6.2 (continued)

Table 6.2 **Estimated Census count of FIFO workers in the Mining and Construction industries, 2011[a, b, c]**

	WA	*Queensland*	*NSW*
Mining workers			
Work in region, but live outside region	15 000	7 400	1 000
Share of state's total mining workforce	23%	16%	3%
Construction workers			
Work in region, but live outside region	5 600	3 700	1 100
Share of state's total construction workforce	6%	3%	0.7%

[a] WA refers to the WA-Outback statistical area (comprised of the Esperance, Gascoyne, Goldfields, Kimberley, Mid-West and Pilbara areas). Queensland refers to the Darling Downs-Maranoa; Fitzroy; Mackay; and Queensland-Outback statistical areas. NSW refers to the Central West; Far West and Orana; and Hunter Valley (excluding Newcastle) statistical areas. All areas also include workers who worked offshore (for example, on oil rigs and drilling platforms) or were in long-distance transit for work purposes (classified as Migratory/Offshore/Shipping). [b] Estimates of the shares exclude workers who gave insufficient information about their place of work. [c] The Mining industry is defined as in in appendix A and equates with the resources sector. That sector does not include the Construction industry, which is added to the table above for completeness.

Source(s): Productivity Commission estimates using ABS (*Census of Population and Housing 2011, TableBuilder*, Cat. no. 2072.0; *Labour Force, Australia, Detailed, Quarterly*, Cat. no. 6291.0.55.003).

Summing up the figures in table 6.2, in 2011, in the main mining regions of Western Australia, Queensland and New South Wales, there were in the vicinity of 23 500 Mining workers and 10 500 Construction workers employed under FIFO arrangements.

These estimates — totalling almost 34 000 workers — are most likely a lower bound of Australia's total FIFO resource and resource-related workforce, since they do not capture FIFO activity in other, smaller mining or gas extraction regions within Australia. Nor do they include workers who are ancillary to the core resource and construction workforces (such as transport, cleaning, and catering staff) who also fly in and out of mining sites.

Some other caveats apply to table 6.2. First, since these estimates are based on large-scale statistical areas, and exclude workers who live relatively close to their work location, they mainly capture FIFO (not DIDO) workers. Second, some workers living outside mining regions who did not provide information about their location of work could not be included the estimates, even though some of them are expected to be FIFO workers. Third, not all non-residential construction workers commuting to mining regions for work are involved in the resources sector. This caveat is more likely to affect estimates for the mining regions of NSW, given their greater diversity of economic activity.

Improvements to data collection, as recommended by the House of Representatives Standing Committee on Regional Australia (2013), would facilitate a more precise count of Australia's FIFO resource workforce.

Using alternative approaches, other researchers have constructed similar (albeit significantly higher) estimates from Census data. RBA research estimates that the total number of FIFO workers involved in mining and construction in 2011 was at least 50 000 (D'Arcy et al. 2012).[64] Analysis commissioned by the Minerals Council of Australia (MCA) estimated that in 2011 there were around 44 600 mining workers, and 23 400 construction workers, across the whole of Australia, who undertook 'long-distance commuting' (KPMG 2013).[65] This analysis found that around 18 700 workers in the Pilbara were long-distance commuters, with almost half employed in mining and one-quarter employed in construction. In the Bowen Basin, this figure stood at 16 500 workers, with almost two-thirds of these employed in mining (KPMG 2013).

Why has Fly-in, Fly-out employment grown in the resources sector?

As is true for any form of work, the use of FIFO reflects the interaction of labour supply and demand, mediated by the relevant institutions (Shomos, Turner and Will 2013). The fact that the prevalence of FIFO has grown in the last decade suggests that some of the determinants of supply and demand for mining workers have shifted and/or that institutions affecting that market have changed. Such changes would have altered, in turn, the relative balance between the benefits that FIFO provides, the costs that it entails and the costs associated with alternative work arrangements, from the perspectives of both employers and workers.

On the demand side of the labour market, it is possible to identify a number of developments that have made the use of FIFO relatively more attractive for employers than employing local workers:

- FIFO broadens the pool of labour available, as more workers with appropriate skills and qualifications can be transported from wherever they permanently reside in the country or internationally, to wherever they are required. This enhances the numerical and functional flexibility of mining operations.

64 The RBA publication's estimate is a count of the number of 'visitors' in mining regions on Census night, but includes all visitors regardless of their industry of employment or whether or not they are employed. This approach has the benefit of capturing ancillary workers involved in the resources sector, who also work under FIFO arrangements (such as cleaning or transport workers contracted by mining companies), yet it also captures people who are visiting the area but not involved in mining (including workers involved in non-mining industries and tourists).

65 KPMG's estimate is a count of the number of mining or construction workers who commuted at least 100 kilometres to work (measured by the distance between the geographic centres of the statistical area in which they lived and the statistical area in which they worked). However, this count was not limited to workers commuting to mining regions: it encompasses workers who commuted to *any* region in Australia, which included metropolitan cities such as Sydney.

- Prior to the natural resources boom, the permanent population in remote areas had grown less quickly than in regional and metropolitan areas. This made it difficult for employers to source sufficient workers from the local residential population — as had been the practice previously — when the boom began (CMEWA 2011a; Rio Tinto 2011b; FMG nd; Mount Isa Chamber of Commerce 2012).
- The resources sector's move to continuous 12-hour shifts rather than weekday 8-hour shifts has lowered the relative cost of transporting and housing workers for resource businesses.
- A greater number of direct public flights have become available to mining regions from urban centres such as Brisbane, Melbourne and Sydney (NRSET 2010b). For example, in 2012, Karratha airport in Western Australia's mining region served five times more passengers than it did ten years earlier (BITRE 2012).
- Due in large part to advances in technology, the length of time that mining or construction workers are required to remain at a given location has generally become compressed (Buchanan, Baldwin and Wright 2011).

On the supply side of the labour market, some factors have also increased the relative attractiveness of FIFO for workers:

- This form of work enables resource sector employees to take up high-paying jobs in remote locations while maintaining their lifestyle, family commitments and social networks in their permanent place of residence. In addition, FIFO work is better able to accommodate the rising prevalence of two-income families, for whom the prospect of securing non-resource jobs in the same remote area is minimal.
- Technological advances in communications and transport technology have helped alleviate some of the sense of isolation and separation that FIFO workers would otherwise experience.

Finally, as is the case in any market, the interaction of supply and demand is shaped by the nature of institutions governing, or influencing, that market:

- Various components of the tax system influence the financial incentives faced by both employers and workers regarding FIFO. General tax provisions of particular relevance to the resources sector because of the remote location of much of its operations are the: (i) Fringe Benefits Tax (FBT); (ii) Goods and Services Tax (GST); and (iii) Zone tax offset. In some circumstances, the application of the FBT and GST can make it cost-effective for employers to provide travel and temporary accommodation to their employees at work sites,

rather than provide or subsidise permanent residential accommodation for them at those sites (ARC Research Team 2011; Buchanan, Baldwin and Wright 2011; Haslam McKenzie 2010; CMEWA 2011a; House of Representatives Standing Committee on Regional Australia 2013; NRSET 2010a; Storey 2001; Western Australian Regional Cities Alliance 2011). The effects of the zone tax offset on the tax-effectiveness of workers opting for FIFO work rather than permanent relocation are not easily predicted, as they depend on the frequency and length of stays in remote areas.

- While the expansion in airline services to mining areas is in part a response to booming demand, changes in policies governing the airline industry, resulting in improved performance and flexibility, have also played a role (MCA 2011).

To date, the combination of supply, demand and institutional factors outlined above has resulted in the growth of FIFO numbers in the resources sector. To what extent this growth will continue is difficult to predict. Recent changes to tax arrangements governing FBT exemptions for living-away-from-home allowances appear to favour the provision of FIFO work over longer, temporary relocation (ATO 2013). On the other hand, the current transition from the construction phase of the resources boom to its production phase should see the demand for FIFO workers abate, all else equal (CMEWA 2011b).

A Industry classifications

This appendix outlines the various industry classifications used in this supplement's analyses. First, section A.1 provides details of the industry breakdowns underlying chapters 2 to 5, and of the aggregations of industries into sectors also used in these chapters. Following this, section A.2 defines the scope of the data used in the case study of the natural resources sector in chapter 6, with particular emphasis on the correspondence between that sector, the industries it comprises, and the commodities that the sector produces.

A.1 Classification of industries

ABS data on output, investment and employment are commonly reported at the industry 'division' level, which comprises 19 divisions labelled 'A' to 'S' (table A.1).

Table A.1 **List of industries, ANZSIC division level**

ANZSIC industry division code	*ANZSIC industry division title*
A	Agriculture, forestry and fishing
B	Mining
C	Manufacturing
D	Electricity, gas, water and waste services
E	Construction
F	Wholesale trade
G	Retail trade
H	Accommodation and food services
I	Transport, postal and warehousing
J	Information media and telecommunications
K	Financial and insurance services
L	Rental, hiring and real estate service
M	Professional, scientific and technical services
N	Administrative and support services
O	Public administration and safety
P	Education and training
Q	Health care and social assistance
R	Arts and recreation services
S	Other services

Source: ABS (*Australian and New Zealand Standard Industrial Classification (ANZSIC)*, Cat. no. 1292.0).

When analyses in chapters 5 and 6 present data by industry from the Household, Income and Labour Dynamics in Australia (HILDA) survey, the industry classification mirrors the ABS industry divisions shown in table A.1.

Some data are available at a more detailed level than divisions. For example, ABS labour force data are available at the ANZSIC industry 'subdivision' level (table A.3 provides an example).

For some of the ABS national accounts data used in this supplement, the ABS disaggregates the division-level data into smaller categories known as TAUs (Type of Activity Units). The TAU categories do not overlap exactly with the ANZSIC subdivisions. Some TAUs represent a single subdivision, while others, due to data limitations, represent a combination of subdivisions (ABS 2011a, 2012b). The TAU classification applies only to some of the national accounts data reported in chapter 3 (for example, table 3.2).

Aggregation of industries into sectors

In some parts of this supplement, the industry division-level data in table A.1 have been aggregated into 'sectors' (broad industry groupings). In some cases, this aggregation has been performed for presentational simplicity and to draw inferences about industries with similar functions. In other cases, it has been necessary to aggregate industry division data to produce statistically reliable estimates, given the small size of the dataset (for example, in chapter 5, Electricity, gas, water and waste services — collectively termed 'utilities' — were grouped with Construction).

The different levels of aggregation that have been used in this supplement (based on the 19 ANZSIC industry divisions) are outlined in table A.2.

At the broadest level of aggregation, analyses in this supplement look at four core sectors: agriculture; mining; manufacturing; and services (with the latter comprising the 16 ANZSIC industry divisions 'D' to 'S') (4-sector classification, table A.2, column 2). This aggregation was used in parts of chapters 3 and 4.

Two observations are important. First, the 'Mining industry' (division) and the 'mining sector' are equivalent (under all levels of aggregation), so that these terms may be used interchangeably, and are both equivalent to the 'resources sector'. Second, some researchers combine the Agriculture and Mining industry divisions into a single sector, often termed 'primary'. This approach was not adopted in this supplement, because the two industries have been subject to different forces of market demand and supply, and undergone demonstrably different patterns of growth, in recent decades. The rapid expansion of the Mining industry in the decade

to 2012 (especially in terms of its share of total investment and employment) stands in stark contrast to the declining economic share of the Agriculture industry, for instance.

The eight-sector aggregation allows a deeper level of analysis (8-sector classification (i), table A.2, column 3). Under this approach, the 16 services divisions were collated into five sectors, based on the similarity of their function within the economy: distribution services; business services; social services; personal services; and another group combining utilities and construction. These groupings were used in chapter 5. The allocation of the services divisions into these broader groups was informed by the work of McLachlan, Clark and Monday (2002), in their study of Australia's services sector (which itself was based on seminal work in this field by Browning and Singelmann (1978) and Elfring (1988)). Industry aggregation was also crafted, in some cases, to respond to the need for a sufficiently large sample with which to produce statistically reliable estimates.

In some parts of this supplement's analysis, this first eight-sector classification was modified, with utilities grouped with distribution services instead of with construction (8-sector classification (ii), table A.1, column 4). This was due to the way in which the data required to undertake the analysis were made available, and follows the approach used by Connolly and Lewis (2010) and Connolly and Orsmond (2011). This modified eight-sector classification applies to the structural change indexes presented in chapters 3 and 4.[66]

Where the data permitted, utilities and construction were kept as separate sectors, corresponding to ABS divisions D and E, respectively (9-sector classification, table A.1, column 5). This was motivated by the fact that these two industries exhibited somewhat divergent patterns of growth over recent years. This nine-sector classification was used in parts of chapters 3 and 4.

66 This supplement's calculation of structural change indexes uses extended time series data supplied on request by Connolly (Connolly, E., RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

Table A.2 **Different aggregations of industries into sectors**

ANZSIC industry divisions	*4-sector classification*	*8-sector classification (i)*	*8-sector classification (ii)*	*9-sector classification*
Agriculture, forestry & fishing	Agriculture	Agriculture	Agriculture	Agriculture
Mining	Mining	Mining	Mining	Mining
Manufacturing	Manufacturing	Manufacturing	Manufacturing	Manufacturing
Electricity, gas, water & waste services	Services	Construction & Utilities	Distribution services & Utilities	Utilities
Construction	Services	Construction & Utilities	Construction	Construction
Wholesale trade	Services	Distribution services	Distribution services & Utilities	Distribution services
Retail trade	Services	Distribution services	Distribution services & Utilities	Distribution services
Accommodation & food services	Services	Personal services	Personal services	Personal services
Transport, postal & warehousing	Services	Distribution services	Distribution services & Utilities	Distribution services
Information media & telecommunications	Services	Distribution services	Distribution services & Utilities	Distribution services
Financial & insurance services	Services	Business services	Business services	Business services
Rental, hiring & real estate services	Services	Business services	Business services	Business services
Professional, scientific & technical services	Services	Business services	Business services	Business services
Administrative & support services	Services	Business services	Business services	Business services
Public administration & safety	Services	Social services	Social services	Social services
Education & training	Services	Social services	Social services	Social services
Health care & social assistance	Services	Social services	Social services	Social services
Arts & recreation services	Services	Personal services	Personal services	Personal services
Other services	Services	Personal services	Personal services	Personal services
Usage in this supplement	Chapters 3 & 4	Chapter 5	Chapters 3 & 4	Chapters 3 & 4

A.2 Mining industry (natural resources sector)

A major focus of this supplement is on structural change and adjustment experienced by the 'natural resources sector' (the 'resources sector'). For this purpose, the natural resources sector extends to, and is limited to, those businesses producing minerals and energy, or providing specialised services such as exploration services.

The natural resources sector, as defined, aligns with the ABS Mining industry division (ABS ANZSIC industry division B, table A.1). For this reason, throughout the report (in particular in chapters 5 and 6), the terms 'Mining industry', 'mining sector', 'natural resources sector' and 'resources sector' are used interchangeably.

The mining industry data in this supplement are disaggregated into subdivisions using one of two approaches. The first uses the ABS's standard subdivision classification, which distinguishes five industries, and the second uses the subdivision classification, but with iron ore identified separately from other metal ores (table A.3). Further details of the commodities and activities covered by each subdivision are provided in table A.4.

Table A.3 **Mining industry at different levels of aggregation[a]**

Industry division	*Industry subdivision*	*Industry subdivision with iron ore separately identified*
Mining	Coal mining	Coal mining
	Oil and gas extraction	Oil and gas extraction
	Metal ore mining	Iron ore mining
		Non-ferrous metal mining
	Non-metallic minerals mining	Non-metallic minerals mining and quarrying
	Exploration and services to mining	Exploration and services to mining
	Mining (not further defined)	Mining (not further defined)

a 'Mining (not further defined)' refers to industry activity that cannot be classified due to insufficient detail being provided. This category came into use from 2000 onwards. Prior to 2000, unclassifiable observations were included as a fixed share of other subdivisions. The ABS advises that the 'Mining (not further defined)' category can include 'new' types of industry activity that are yet to be formerly classified.

Source: ABS (*Australian and New Zealand Standard Industrial Classification (ANZSIC)*, Cat. no. 1292.0).

Non-ABS data are also presented in chapter 6 of this supplement, for individual minerals such as manganese, uranium oxide and thermal coal. These detailed data are intended to illustrate production and price trends occurring within the disaggregated industries. For example, data for liquefied natural gas, liquefied petroleum gas and crude oil condensate are reported to distinguish trends occurring within the Oil and gas extraction industry. The data were obtained from the Bureau of Resources and Energy Economics (and its predecessor, the Australian Bureau of

Agriculture and Resource Economics and Sciences), the Organization of the Petroleum Exporting Countries and the Reserve Bank of Australia. Detailed sources are indicated in notes underlying the relevant tables and figures in chapter 6.

Table A.4 **Main commodities and activities represented in the Mining industry, by subdivision**

Industry subdivision	*ABS Group Code*	*ABS Class Codes*	*Main commodities and activities*
Coal mining	Coal mining	Coal mining	Black (thermal and metallurgical) coal, brown coal, lignite and peat
Oil and gas extraction	Oil and gas extraction	Oil and gas extraction	Crude oil, natural gas, petroleum gas, and shale oil
Metal ore mining	Iron ore mining	Iron ore mining	Iron ore and iron sand
	Non-ferrous metal mining	Bauxite mining	Aluminium ore and bauxite
		Copper ore mining	Copper ore
		Gold ore mining	Gold ore
		Mineral sand mining	Ilmenite, leucoxene, mineral sands, monazite sand, rutile sand, synthetic rutile and zircon sand
		Nickel ore mining	Nickel ore
		Silver-Lead-Zinc ore mining	Lead, silver and zinc ore
		Other metal ore mining	Antimony, beryllium, bismuth, iron pyrite, manganese, molybdenite, platinum, tantalite, tin, tungsten and uranium
Non-metallic minerals mining and quarrying	Construction material mining	Gravel and sand quarrying	Pebble, river gravel, ornamental rock and sand
		Other construction material quarrying	Aggregate, bentonite, blue stone, brick shale, building stone, cement clay, chalk, clay, earth or soil filling, granite, limestone, marble, sandstone, slate, stone and tile clay
	Other non-metallic mineral mining and quarrying	Other non-metallic mineral mining and quarrying	Alabaster, alunite, barite, chrysoprase, diatomite, felspar, flint, fluorspar, gemstone, glauconite, graphite, gypsum, jade, kyanite, lithium, magnesite, mica, opal, phosphate, quartz, salt, silica, talc, vermiculite and zeolite
Exploration and services to mining	Exploration	Petroleum exploration	Petroleum, and natural gas
		Mineral exploration	Mineral exploration
	Other mining support services	Other mining support services	Cementing oil and gas well castings, directional drilling and redrilling, mining draining and pumping nec, and oil and gas field support nec

nec Not elsewhere classified

Source: ABS (*Australian and New Zealand Standard Industrial Classification (ANZSIC)*, Cat. no. 1292.0).

B Structural change indexes

B.1 Calculation

Structural change indexes (SCIs) are used throughout this report to measure the extent of change in the sectoral composition of the economy as a whole. The SCIs summarise information about changes in the distribution of economic activity — usually output or employment — into a single indicator. This means, on the one hand, that changes in disaggregated output or employment share data can be presented in a convenient and readily interpretable manner. On the other hand, SCIs do not make use of all the information available — for example, they provide no information about within-sector change or changes in the *level* of output or employment.

An SCI may be thought of as the total number of percentage points of economic activity that has 'moved' sectors (broad industry groupings) within a given period. The SCI is calculated by halving the sum of the absolute value of the changes in the share of economic activity of each sector, in percentage points (equation 1). The absolute value of changes is used to ensure that positive and negative changes in shares do not cancel each other out. The total is divided by two so as to avoid counting the same shifts twice.

$$SCI_t = \frac{1}{2}\sum_{i=1}^{n}\left|s_{it} - s_{it-1}\right| \tag{1}$$

where s_{it} is the percentage employment share of sector *i* in the economy at time *t*

By construction, the value of SCI_t falls between zero and 100, with a value of zero representing no structural change between time *t-1* and time *t*, and a value of 100 representing a complete change in composition over that time.

Given the methodology underlying SCIs, it is important that any comparison of SCI values use indexes that are calculated in the same way. This is because the formula above is sensitive to both the level of industry or sector aggregation, and the time period chosen for comparison.

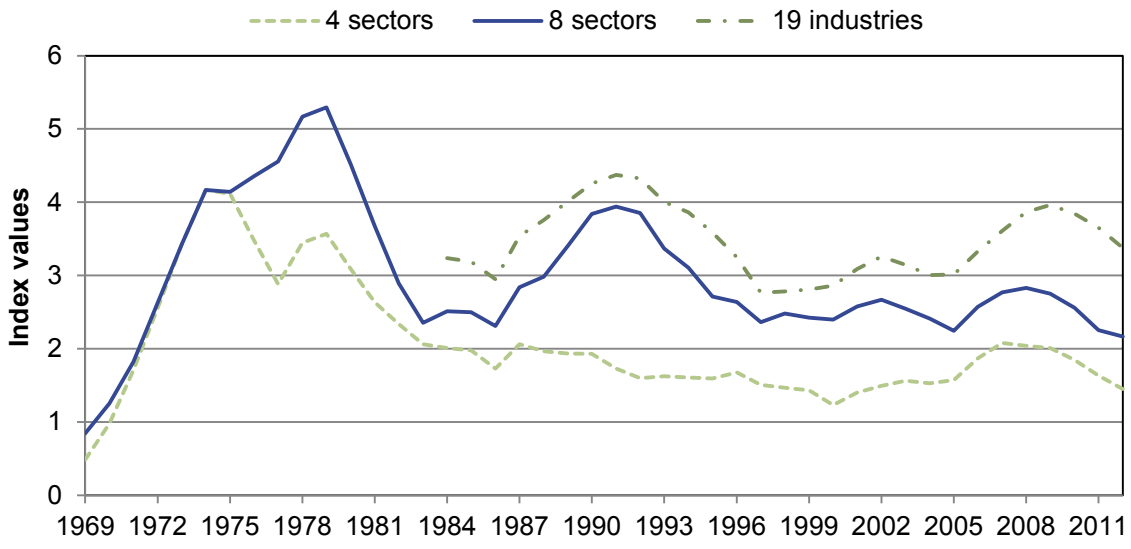
Level of industry or sectoral aggregation

The level of aggregation used in constructing an SCI impacts on the value of that index. This is by virtue of the fact that the index does not quantify changes that occur *within* a sectoral grouping, but only includes changes *between* sectoral groups. As a result, an index calculated using the four broad sectors — agriculture, mining, manufacturing and services — will always be less than or equal to an index calculated using the 19-industry divisions that make up those sectors (appendix A).

Decisions regarding the level of data aggregation depend largely on the research questions being considered and the data available. However, it is important to recognise that it is not possible to interpret an SCI value without knowing the industry aggregation used in creating it. Where SCI values are to be compared (say, across countries), it is crucial that they be based on the same aggregation for the comparison to be valid.

To illustrate this point, figures B.1 and B.2 each plot three separate SCIs (for real output and employment, respectively), using an increasingly disaggregated breakdown of the services sector (alongside the agriculture, mining, and manufacturing sectors).

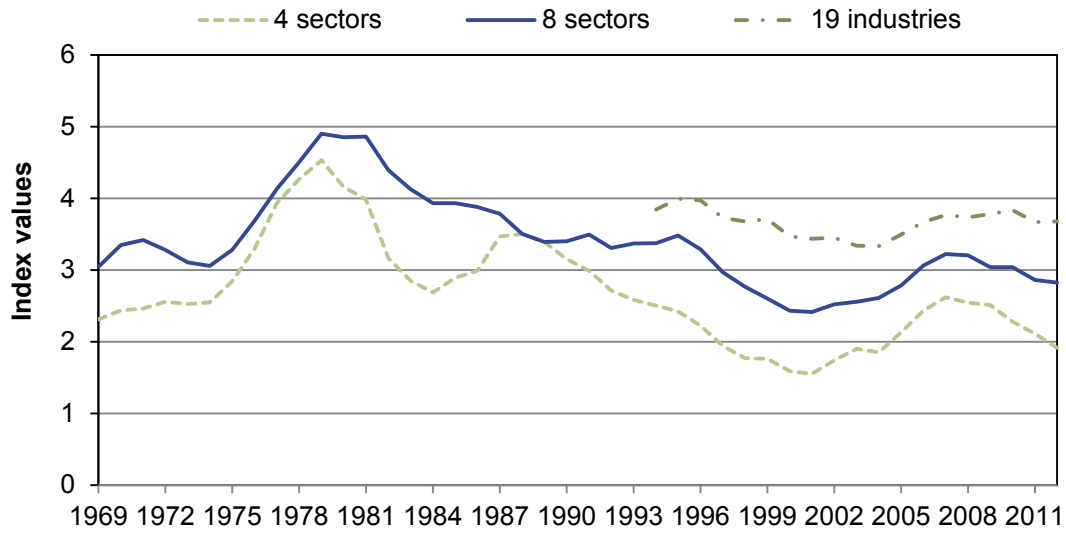
Figure B.1 **Real output structural change indexes, by level of sector disaggregation, 1969 to 2012[a, b]**



[a] Real output measured as gross value added by industry in chain volume terms (reference year 2010-11). [b] Appendix A provides information on the aggregation of industry divisions into sectors.

Sources: Productivity Commission estimates using ABS (*Australian System of National Accounts, 2011-12*, Cat. no. 5204.0) and E. Connolly (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

Figure B.2 **Employment structural change indexes, by level of sector disaggregation, 1969 to 2012[a, b]**



[a] Data are for financial years until 1985, and annual averages of quarterly data, ending in the May quarter of each year, from 1986 to 2012. Industries are at the ANZSIC 2006 division level. [b] Appendix A provides information on the aggregation of industry divisions into sectors.

Sources: Productivity Commission estimates using ABS (*Labour Force, Australia, Detailed, Quarterly,* Cat. no. 6291.0.55.003) and E. Connolly (RBA, Sydney, pers. comm., 13 August 2012, unpublished data).

As is apparent, the three indexes in figures B.1 and B.2 follow a similar trend, rising or falling together. However, there is usually a gap between them, due to the fact that indexes based on a greater number of categories allow more potential shifts between industries/sectors. For example, in figure B.2, equal but opposite changes in the employment shares of the Health care and social assistance and Education and training industries would be picked up by the 19-industry index, but not the 4- or 8-sector indexes, in which they are aggregated together. Similarly, equal but opposite changes in the employment shares of the business services and social services sectors would be picked up by the 8-sector index, but not the 4-sector index. Finally, changes in the employment shares of the broad services sector and the agriculture sector would be picked up by all three indexes.

Changes in the size of the gap between indexes reflect the extent to which structural change is occurring within aggregated sectors without affecting the overall share of those sectors in employment. For example, in 1984, share changes were taking place within the broad services sector that were not reflected in the overall share of services. Hence the large gap between the 8-sector and 4 sector indexes. This suggests that share changes within services at the time were occurring in opposite directions. Conversely, in 1988, there was no difference between these two indexes, indicating that all individual shares within services were changing in the same

direction. (The same reasoning can be applied to explain the existence or absence of a gap between the 8-sector and 19-industry indexes.)

The comparison of indexes based on varying levels of disaggregation highlights an interesting fact. With the proportion of workers employed in the broad services sector now reaching almost 90 per cent of total employment, the rate of relative growth of this sector has declined, compared with the 1970s, and with it, the rate of change measured by the 4-sector index in figure B.1.[67] This can be regarded as an inevitable outcome, since the share of the broad services sector in the economy cannot expand indefinitely, that is, it cannot grow beyond one hundred per cent of employment. By contrast, the change in the distribution of employment among the disaggregated services sectors or industries is not bound in this way. As a case in point, between 2007 and 2012, the 19-industry index in figure B.1 remained relatively stable, while both the 4- and 8-sector indexes fell.

Choice of time periods

The period of time between *t* and *t-1* also impacts on SCI values, and the extent to which they fluctuate over time. Short-term changes in sectoral shares of economic activity can be driven by both cyclical and structural factors. Therefore, if a short time period is chosen, the SCI may simply reflect cyclical changes in economic activity, rather than a long-term change in the nature of that activity. Intuitively, by viewing plots of industry shares over time, it becomes apparent whether shares exhibit noisy variability or reflect longer-term changes. SCIs, by their nature, cannot distinguish between the two.

To minimise the effect of short-term variability on SCIs, Connolly and Lewis (2010) measure the share of sector *i* in the economy as the five-year average to year *t.* They then calculate the index by differencing with the five-year average to year *t-1*. This approach has been employed throughout this report (with the exception of figure 4.9, for which sufficient data were not available).

[67] The time path of the 4-sector SCI in Australia is very similar to that recorded by its OECD average counterpart. From a value of around 4 in the early 1980s, that multi-country index declined to around 2.5 in the late 1990s, before rising to around 3 by the mid-2000s (data not shown).

B.2 Interpretation: what drives changes in a structural change index?

In order to correctly interpret an SCI, it is important to be explicit about the economic events that might drive — or, alternatively, might fail to drive — changes to the value of a computed index.

An SCI reacts to both job reallocation and to differing rates of net job creation across sectors. Both the movement of workers and differences in employment growth rates between sectors can lead to 'movement' in employment shares — the share of a static industry will decline in the presence of positive growth in another industry, all else equal. More generally, an SCI will be positive in the presence of differential employment growth rates between sectors, even if no workers physically change industries. Although it is unlikely that precisely zero individuals change industries in any given period, the ongoing entry of young people and new migrants into the labour market cautions against the interpretation of an SCI as reflecting solely the movement of individuals between industries (or regions).

Conversely, it is also possible for many individual workers to have moved jobs and sectors, but for the employment shares of industries to remain unchanged — an SCI only captures *net* movement in employment shares. For example, it may be that there is gross employment 'churn' between industries that is not captured by an SCI because approximately the same number of individuals is moving between two industries in both directions.

These examples highlight that an SCI should be interpreted as a convenient summary measure of the global change in employment shares of all industries/sectors, not as an indicator of the extent of movement of individuals between specific industries.

C Supporting data and analysis

This appendix presents a selection of supplementary data and analyses that support the discussion contained in chapters 5 and 6.

C.1 Use of HILDA Survey data

Much of the labour market analysis presented in chapter 5 (and in parts of chapter 6) uses data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Survey tracks the year-to-year movements of individuals from a nationally representative sample of households. This supplement uses HILDA Survey data from 2001 to 2010.

In using the HILDA Survey data to describe year-to-year changes in individuals' employment characteristics, some limitations to the analysis are acknowledged:

- Employment data in the HILDA Survey refer to workers' main job only, at the time of the survey. Hence, the analysis does not capture the effects of workers holding multiple jobs at the same time or changing jobs several times during a given year.
- The HILDA Survey sample could be subject to attrition bias in a way that affects measurements of labour mobility. Individuals who move location might be more difficult for data collectors to track and are, therefore, more likely to drop out of the survey. This could result in an underestimate of the rate of geographic mobility. However, the analysis focuses on transitions between consecutive pairs of years (rather than longer-term changes from a base year), which limits the potential impact of this attrition bias.
- The HILDA Survey design is not fully representative of new migrants to the country. For most years of the survey, new migrants can only be incorporated into the survey if they join a household which is already part of the sample.
- RBA researchers — after observing that some workers appeared to change industry without having changed employer — have raised the possibility that 'spurious industry reclassifications' exist in the HILDA Survey dataset (D'Arcy et al. 2012, p. 11). (Analysis presented in footnote 10 of chapter 5, however, suggests that it possible for a worker to change industry without

changing employer. This conclusion is supported by data presented in section C.5 of this appendix.)

The sample of respondents used to compute the estimates presented in the analyses of chapters 5 and 6 was limited to the working-age population (aged between 15 and 64 years), for the following reasons:

- The upper age bound to 64 years controls for the effect of workers' retirement on patterns of exit from the workforce. From age 65 onwards, workers are more likely to be exiting the workforce due to their age and eligibility for retirement benefits, rather than due to structural or cyclical changes in the economy.
- The lower age bound to 15 years is based on the legal minimum working age in Australia (depending on the jurisdiction, conditions of employment and industry). Many people who enter the workforce at this age do so while still enrolled in compulsory education. Thus, their motivation for joining the workforce may be due to reasons other than structural changes in the economy. Nonetheless, the fact that the intake of young workers is higher in some industries than in others may partly explain differences in industry expansion and contraction.

C.2 Detailed analysis: mobility between sectors

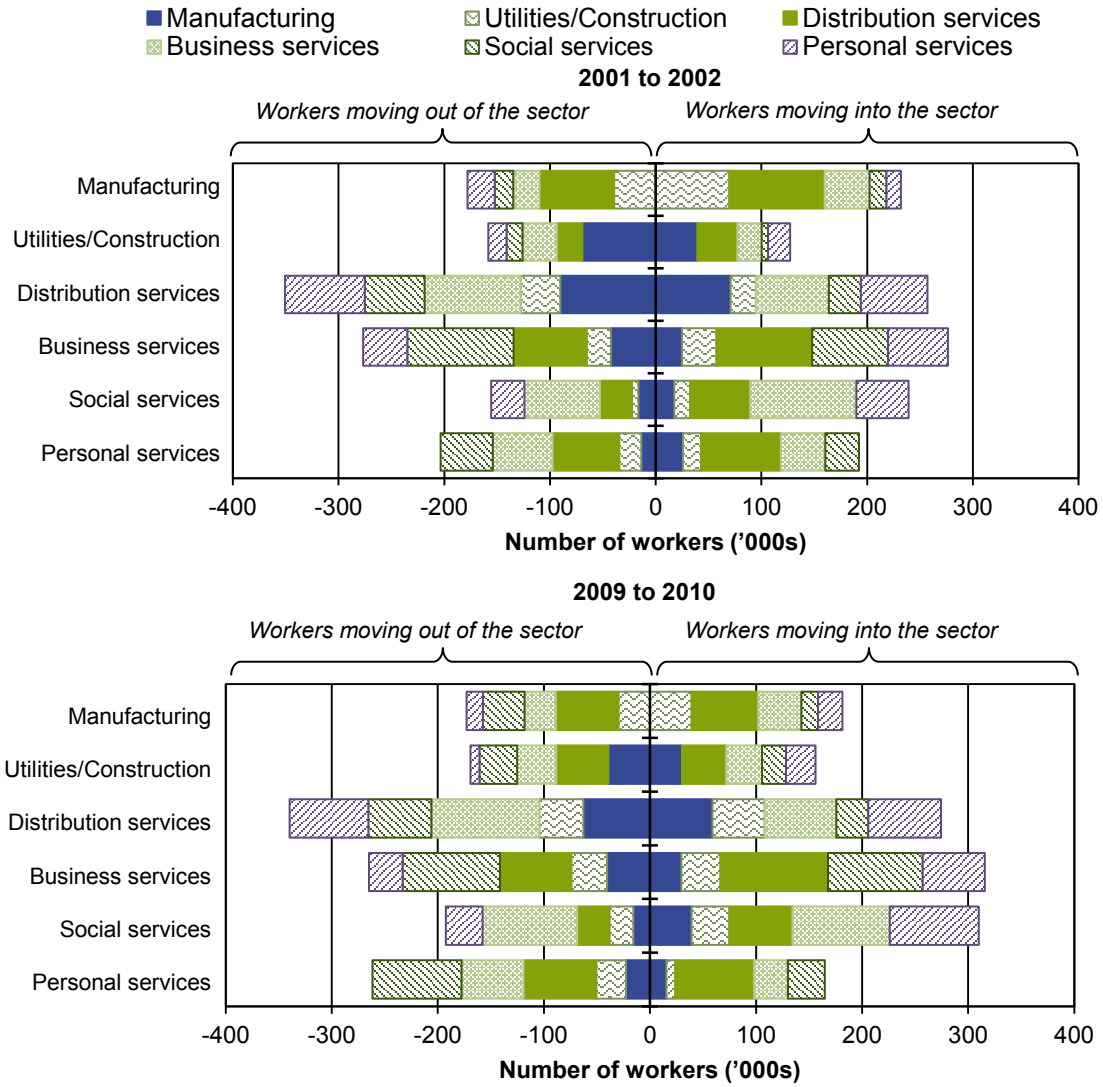
Building on chapter 5's analysis of workers' mobility between sectors, the following analysis looks in more detail at the individual transitions of workers who changed sectors from one year to the next.

Using HILDA data, figure C.1 illustrates which sectors workers were moving into, and out of. For presentational purposes, transitions between 2001 and 2002 are compared only to the transitions that took place between 2009 and 2010. For each sector, represented by a horizontal bar, positive values (on the right side of the vertical axis) refer to the number of workers moving *into* that sector, while negative values (on the left side of the vertical axis) refer to the number of workers moving *out* of that sector. Within each positive or negative bar, individual segments indicate the industry that workers are arriving from or moving to, respectively. Movements into or out of agriculture and mining are excluded due to low sample counts for these sectors.

For both time periods under consideration, the sectors that workers were most commonly moving *to* were distribution, business and social services. Most of the workers joining these sectors had come out of other service sectors. The most common sectors that workers were moving *from* were distribution, business and

personal services. This is indicative of the large amount of employment 'churn' that characterises some of the services sectors.

Figure C.1 **Number of workers changing sectors between consecutive years, 2001 to 2002 and 2009 to 2010[a, b, c, d, e]**



[a] Positive values indicate the number of workers moving into the sector, in which case the legend denotes the *previous* sector that workers worked in. Negative values indicate the number of workers moving out of the sector, in which case, the legend denotes the subsequent sector that workers moved into. Hence, the sum of all the positive and negative values (across sectors) sum to zero. [b] Agriculture and mining sectors are excluded due to the low sample count and high standard errors associated with these estimates. [c] Estimates exclude workers who were not employed before or after their move. [d] Estimates refer to the working-age population. All estimates are population-weighted. [e] Sectors are defined in appendix A.

Source: Productivity Commission estimates using HILDA Survey 2001–2010, Unconfidentialised Release 10.1.

Some comparisons in workers' transitions between the different time periods point towards some key structural shifts in the composition of the economy between the two transition periods. For instance:

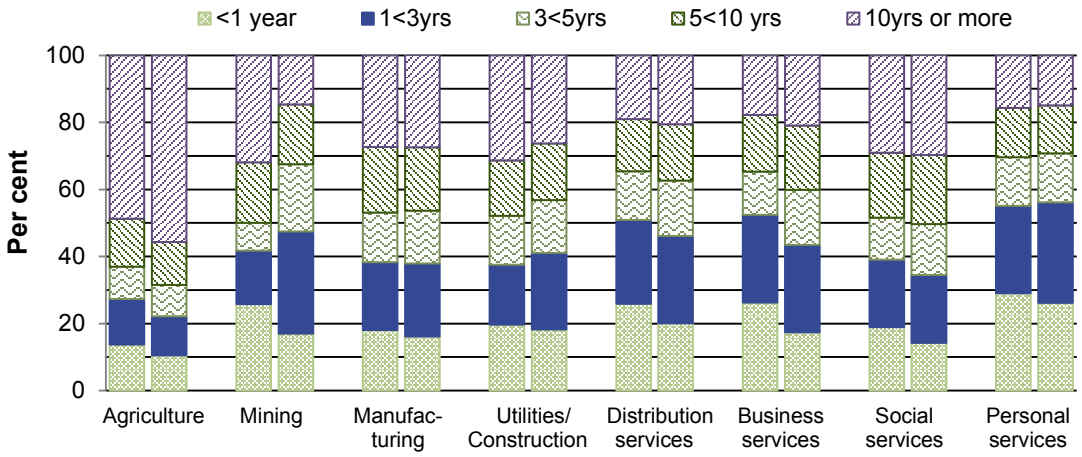
- The sector which experienced the largest jump in the number of workers it attracted from other sectors was social services (and, within this sector, especially Health care and social services).
- Between 2001–02 and 2009–10, the number of workers moving *out* of manufacturing and into another sector barely changed. However, the number moving *into* manufacturing from other sectors fell considerably. The lower inflow of workers into manufacturing in the most recent period helps to explain that sector's contraction.

Given the pronounced relative decline of the manufacturing sector over time, it is of interest to identify the sectors that manufacturing workers were mainly moving to. For both time periods under consideration, distribution services was the most common destination (and, within this sector, particularly Construction and Wholesale trade (data not shown)). Utilities and construction used to be a common destination also, but this was less so during the most recent period.

C.3 Detailed analysis: workers length of tenure

Figure C.2 compares the composition of workers within each sector in 2002 and 2010, according to their length of tenure with their current employer.

Figure C.2 **Tenure with current employer, by sector, 2002 and 2010[a, b]**



[a] For each sector, the first vertical bar refers to 2002 and the second vertical bar refers to 2010. [b] Sectors are defined in appendix A.

Source: ABS (*Labour Mobility, Australia*, Cat. no. 6209).

C.4 Detailed analysis: workers joining the resources sector

Table C.1 uses HILDA Survey data to look at the previous industry of employment of workers who were joining the resources sector[68] (from another industry) each year from 2002 to 2010. It is emphasised that these estimates should be treated as indicative only, due to the small size (and consequential high standard errors) of the sample under analysis.

Table C.1 **Previous industry of workers joining the resources sector, 2002 to 2010, indicative estimates[a, b]**

Per cent of joining workers, by previous industry

Previous industry	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Manufacturing	29.0	34.5	49.8	31.2	20.4	29.8	16.5	25.7	13.4
Electricity, gas, water & waste services[c]	9.8	–	–	8.5	–	–	10.0	–	4.7
Construction[c]	10.4	17.0	6.5	15.5	11.0	12.6	27.1	20.8	21.7
Wholesale trade[c]	–	20.1	5.7	2.5	10.4	2.2	1.8	3.7	18.1
Transport, postal & warehousing[c]	–	7.8	–	8.3	7.3	2.2	6.9	8.1	3.4
Professional, scientific & technical services[c]	25.8	3.4	11.9	16.1	16.3	9.5	17.9	23.1	13.8
All other industries	25.0	17.2	26.1	17.9	34.6	43.7	19.8	18.6	24.9
All industries	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

a Years in column headings refer to the second year of the transition. For example, 2003 refers to the industry of origin of workers having moved to the resources sector between 2002 and 2003. **b** Sectors are defined in appendix A. **c** Estimates in these rows should be interpreted as indicative only, due to the high standard errors in some years. – Nil or negligible. All estimates are population-weighted.

Source: Productivity Commission estimates using HILDA Survey 2001–2010 Unconfidentialised Release 10.1.

C.5 Detailed analysis: inter-industry movements by firms

Structural adjustment can involve the reallocation of labour, capital and land between firms (chapter 1). As some firms become less profitable and eventually contract or shut down, resources are freed up for use by other, more profitable enterprises.

68 The terms 'natural resources sector', 'Mining industry', and 'mining sector' are used interchangeably in this supplement. Appendix A provides a definition of the natural resources sector and of the industries and commodities it comprises.

However, some firms can undergo structural adjustment without physically closing down, moving location or shedding employees. As the Industries Assistance Commission observed:

> … not all adjustment to structural change involves movement by workers between firms and industries. An important type of adjustment to change takes place when firms change their activities without changing their employees. In response to pressures for change, firms may be able to specialise or rationalise their production lines entirely (which may involve changing industry classification). In these cases, employees retained by the firm may change their industry or occupation classification, without actually changing firms … [C]onfining the discussion of labour adjustment to movements between firms must significantly understate the adjustment capacity of the labour force … (1977, pp. 55–56)

Thus, the reallocation of labour, capital and land across industries can take place simply through the industry reclassification of some firms that have changed their main activity. Evidence of such reclassification would, therefore, indicate that structural adjustment of this type does occur in the Australian economy.[69]

Evidence of inter-industry movements by firms

To investigate whether firms change industry classification over time (that is, are inter-industry 'movers'), longitudinal firm-level data are required. In Australia, the two publicly-accessible such data sources are the Australian Bureau of Statistics' Business Longitudinal Survey (BLS), covering the period 1994-95 to 1997-98, and the earlier Australian Workplace and Industrial Relations Surveys (AWIRS), commissioned by the then-Department of Education, Employment and Workplace Relations in 1989-90 and again in 1995.[70] The AWIRS surveys are primarily cross-sectional surveys, but they are linked by a panel element. Both the BLS and AWIRS offer only partial coverage of the entire firm population, but their scope is sufficiently broad to shed light on the wider prevalence of inter-industry movements (table C.2).

[69] This form of reclassification excludes the possibility that the same firm became reclassified by the ABS from one industry to another purely as the result of the adoption of a new taxonomy of productive activities.

[70] Although more recent, the ABS's Business Longitudinal Database is not useable for the purpose of tracking firm inter-industry movements.

Table C.2 **Frequency of firm inter-industry movements over time[a]**
Number of businesses that changed ANZSIC divisions

	Movers	*Non-movers*	*Percentage of movers*
Business Longitudinal Survey	n	n	%
1995–96	33	4 019	0.81
1996–97	39	3 976	0.97
1997–98	28	3 833	0.73
Australian Workplace and Industrial Relations Surveys			
1989-90 to 1995[b]	15	683	2.15

a Unweighted estimates. **b** Total firm movements over a five-year period. **n** Number of firms.

Source: Productivity Commission estimates based on BLS data and AWIRS panel survey data.

As is apparent from the table, a very small proportion of firms changes industry each year. Those firms tend to share a number of characteristics (data not shown). In both surveys, movers were much more likely to report a major change in their range of products and services (whether a decrease or an increase) than non-movers. Also, AWIRS movers reported considerably more changes in their main activity, between 1989-90 and 1995, compared to non-movers. In both surveys, manufacturing firms were most prone to moving industries, predominantly towards wholesaling and retailing. This might reflect the decision of some manufacturers to offshore their activities, in order to focus on importing and distribution. Other common firm industry pathways were more conventional, such as from property to finance, and from retail to wholesale.

Implications for labour

In both the BLS and AWIRS datasets, movers were invariably smaller, employment-wise, than non-movers, by a factor ranging from about one third to one half. This implies that movers tend to 'carry' fewer employees with them across industries. Although the imperfect coverage of the data precludes definitive figures for the total number of workers concerned, a rough estimate is that between 0.31 per cent and 0.77 per cent of the whole workforce may undergo this type of transition each year, on average.

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