



Australian Government
Productivity Commission

PC PRODUCTIVITY BULLETIN

MAY 2019 | ISSN 2652-1407

Features

Recent productivity trends

The mining boom
and investment cycle

Labour productivity
and wages

International perspective

© Commonwealth of Australia 2019

ISSN 2652-1407 (online)



Except for the Commonwealth Coat of Arms and content supplied by third parties, this copyright work is licensed under a Creative Commons Attribution 3.0 Australia licence. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/3.0/au>. In essence, you are free to copy, communicate and adapt the work, as long as you attribute the work to the Productivity Commission (but not in any way that suggests the Commission endorses you or your use) and abide by the other licence terms.

Use of the Commonwealth Coat of Arms

Terms of use for the Coat of Arms are available from the Department of the Prime Minister and Cabinet's website: <https://www.pmc.gov.au/government/commonwealth-coat-arms>.

Third party copyright

Wherever a third party holds copyright in this material, the copyright remains with that party. Their permission may be required to use the material, please contact them directly.

Attribution

This work should be attributed as follows, *Source: Productivity Commission, PC Productivity Bulletin, May 2019.*

If you have adapted, modified or transformed this work in anyway, please use the following, *Source: based on Productivity Commission data, PC Productivity Bulletin, May 2019.*

An appropriate reference for this publication is:

Productivity Commission 2019, *PC Productivity Bulletin*, May.

Publications enquiries

Media, Publications and Web, phone: (03) 9653 2244 or email: mpw@pc.gov.au

The Productivity Commission

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

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

Further information on the Productivity Commission can be obtained from the Commission's website (www.pc.gov.au).

Foreword

Welcome to the PC Productivity Bulletin 2019.

Each year, we provide an analysis of Australia's recent productivity performance, recognising that it is a key determinant of our long-run prosperity. While output growth in Australia is relatively buoyant, this has not translated into significant productivity growth because growth has reflected input growth rather than 'doing things better'. The result is that the labour and multifactor productivity performance of the market sector, where measurement of performance is most accurate, has deteriorated further from the previous two years. Economy-wide generalisations do not capture the fact that some industries have experienced strong productivity growth — a story that we emphasise in the Bulletin.

In addition to its usual analysis of current Australian productivity performance, and comparisons with global trends, this Bulletin also considers the linkage between growth in labour productivity and wages, and the far-reaching implications of the resources boom (and its end) on Australia's productivity outcomes.

Michael Brennan
Chair

Contents

Foreword	iii
Abbreviations and explanations	vi
Key points	1
Productivity at a glance	2
1 Recent productivity trends	5
2 The mining boom and the investment cycle	19
3 Labour productivity and wages	27
4 Australian productivity trends in an international context	37
A Data annex	49
References	55

Abbreviations and explanations

Abbreviations

ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
CPI	Consumer Price Index
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GVA	Gross Value Added
HILDA	Household, Income and Labour Dynamics in Australia
ICT	Information and communications technology
MFP	Multifactor productivity
OECD	Organisation for Economic Co-operation and Development
PC	Productivity Commission
PPP	Purchasing power parity
R&D	Research and Development
TED	Total Economy Database
UK	United Kingdom
US	United States

Explanations

Billion	The convention used for a billion is a thousand million (10^9).
---------	---

Key points

- Growth in labour and multifactor productivity for the 16 industry market sector in 2017-18 was sluggish at 0.4 per cent and 0.5 per cent, respectively.
 - This continues the recent trend of weakening productivity growth since the end of the investment phase of the mining boom in 2012-13.
 - Labour productivity growth is well below the market sector's long-run trend rate of 2.2 per cent per year from 1974-75 to 2017-18.
 - Corresponding to the market sector outcomes, productivity growth has also been weak at the economy-wide level.
- The current weakness in labour productivity can be partly attributed to a marked slowdown in investment in capital — so much so that the ratio of capital to labour has fallen — 'capital shallowing'.
 - This is troubling because investment typically embodies new technologies, which complement people's skill development and innovation. This is especially so for investment in research and development, where capital stocks are now falling.
- Increases in labour supply have increased the overall productive capacity of the economy, so that output *per capita* has exceeded output *per hour* in recent years. Labour supply growth has primarily reflected increased labour participation rates, which has many positive social and economic benefits for households beyond its effects on economic growth.
- There has also been a continued recovery in real net national disposable income per capita, the single best measure of prosperity, which had fallen steadily from 2011-12 to 2015-16.
- Real (consumer) wage growth — the degree to which nominal wages outpaces the prices of goods and services — has been low from 2011-12 and is the lowest since the mid-1980s. A puzzling gap has opened between labour productivity and real wage growth.
- However, no gap exists between labour productivity and real wages defined in terms of producer prices, a sign that producer price growth has deviated from consumer prices.
 - The breakdown in the usually strong relationship between consumer and producer prices is likely to have been partly driven by the different impacts of the commencement and ending of the resources boom, with some prospect that real consumer wages will grow more strongly.
 - Nevertheless, other factors — such as a poorer labour market dynamism and weaker than usual response of wages to labour demand — are also likely to be contributing to wage stagnation.
- Notwithstanding recent mediocre productivity growth, Australia has a high *level* of productivity compared with many economies and, as a result, a high standard of living by international standards.
 - Productivity levels, however, remain below the best performers.
- While Australia has experienced a productivity slowdown, it has been more persistent and extreme in many other countries.

Productivity at a glance

Annual change, 2017-18 (per cent)

Total economy

Labour productivity	+0.2%	
----------------------------	--------------	---

Market sector (16 industries)

Multifactor productivity	+0.5%	
Labour productivity	+0.4%	
Output	+2.6%	
Labour input	+2.3%	
Capital input	+2.0%	

Long-term growth rate, 1974-75 to 2017-18 (per cent per year)

Market sector (16 industries)

Multifactor productivity	+0.9%	
Labour productivity	+2.2%	
Output	+3.3%	
Labour input	+1.1%	
Capital input	+4.4%	

 increased since 2017  decreased since 2017  unchanged

Table 1 **Aggregate productivity statistics^a**

Per cent

	Long-term growth rate	Last complete cycle	Period since the last cycle	Latest years		
	1974-75 to 2017-18	2003-04 to 2011-12	2011-12 to 2017-18	2015-16	2016-17	2017-18
Economy						
Output (GDP)	3.1	2.9	2.6	2.8	2.3	2.8
Output (GVA)	3.1	3.1	2.6	2.6	2.3	2.7
Inputs	2.4	3.1	1.9	1.8	1.6	2.3
Labour inputs	1.4	1.9	1.3	1.7	1.4	2.6
Capital inputs	4.0	4.6	2.6	1.9	2.0	1.9
Labour productivity	1.7	1.1	1.2	0.9	0.9	0.2
Capital-labour ratio	2.6	2.6	1.3	0.2	0.5	-0.6
Capital deepening	1.0	1.1	0.5	0.1	0.2	-0.3
MFP	0.7	0.0	0.7	0.8	0.7	0.4
Market sector (12 industries)						
Output (GVA)	3.0	3.1	2.4	2.1	1.7	2.5
Inputs	2.1	3.1	1.8	1.1	1.3	2.5
Labour inputs	0.7	1.4	0.8	0.4	0.8	3.1
Capital inputs	4.1	5.0	2.8	1.8	1.9	1.9
Labour productivity	2.3	1.8	1.6	1.7	0.9	-0.6
Capital-labour ratio	3.3	3.6	2.1	1.4	1.1	-1.3
Capital deepening	1.4	1.8	1.0	0.6	0.5	-0.6
MFP	0.9	0.0	0.6	1.1	0.3	0.0
Market sector (16 industries)						
Output (GVA)	3.3	3.2	2.6	2.5	2.3	2.6
Inputs	2.4	3.2	1.8	1.3	1.4	2.2
Labour inputs	1.1	1.6	0.9	0.8	1.0	2.3
Capital inputs	4.4	5.2	2.9	1.9	2.0	2.0
Labour productivity	2.2	1.6	1.6	1.7	1.3	0.4
Capital-labour ratio	3.3	3.6	1.9	1.1	1.0	-0.3
Capital deepening	1.3	1.6	0.8	0.5	0.4	-0.1
MFP	0.9	0.0	0.8	1.2	0.9	0.5

^a Annex A provides the details on the data and methodology for estimating output, input and productivity at the economy-wide and 16-industry market sector levels. Gross value added (GVA) output is Gross domestic product (GDP) less taxes less subsidies on products and the statistical discrepancy. Labour productivity is the growth in output per unit of labour input. The capital-labour ratio is the growth in capital per unit of labour input, while capital deepening is the growth in the capital-labour ratio weighted by the capital income share. Multifactor productivity growth is the growth in labour productivity not accounted for by capital deepening.

Sources: Estimates based on: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 1, 5, 15, 46 and 58); ABS (2018, *Estimates of Industry Multifactor Productivity*, 2017-18, Cat. no. 5260.0.55.002, tables 1, 6 and 14); ABS (6291.0.55.003 *Labour Force, Australia, Detailed, Quarterly*, Aug 2018, table 11); and ABS (unpublished data).

Table 2 Industry productivity growth, 2017-18
Per cent

	Output (GVA)	Total inputs	Labour inputs	Capital inputs	Labour productivity	MFP
Market sector (16 industries)						
Agriculture, forestry and fishing	-5.2	2.1	6.8	0.4	-12.0	-7.3
Mining	2.8	1.9	3.2	1.6	-0.4	0.9
Manufacturing	3.0	-0.7	-0.7	-0.8	3.7	3.7
Electricity, gas, water and waste services	1.9	3.7	6.4	2.4	-4.5	-1.7
Construction	5.0	5.8	7.4	2.0	-2.4	-0.8
Wholesale trade	0.7	1.5	0.8	2.6	-0.1	-0.8
Retail trade	2.4	2.9	3.4	1.8	-1.0	-0.6
Accommodation and food services	4.0	0.4	0.2	1.1	3.8	3.6
Transport, postal and warehousing	0.8	3.8	4.5	2.7	-3.8	-3.0
Information media and telecommunications	2.7	3.5	1.4	5.1	1.3	-0.8
Financial and insurance services	3.4	0.5	-3.5	2.2	6.9	2.9
Rental, hiring and real estate services	1.0	1.7	-0.5	3.1	1.5	-0.7
Professional, scientific and technical services	4.3	0.6	0.1	3.3	4.1	3.7
Administrative and support services	3.9	-4.1	-4.3	1.3	8.2	8.0
Arts and recreation services	3.5	8.4	10.9	3.5	-7.4	-4.9
Other services	3.3	2.1	1.6	5.8	1.7	1.2
Non market sector (4 industries)						
Public administration and safety ^a	0.1	-2.3	-3.4	2.8	3.5	2.5
Education and training ^a	2.0	3.3	3.4	1.8	-1.4	-1.3
Health care and social assistance ^a	6.1	6.7	7.0	3.3	-0.9	-0.6
Ownership of dwellings ^{a,b}	2.4	1.5	0.0	1.5	2.4	0.8
All industries^c	2.7	2.3	2.6	1.9	0.2	0.4

^a Capital input growth estimated using the growth in published ABS net capital stock supplemented by unpublished data on land, inventories and ownership transfer costs (Annex A). ^b While it does not employ labour, *ownership of dwellings* makes a positive contribution to economy-wide labour productivity growth by virtue of its output growth. ^c Average capital input growth across all industries using capital income shares as weights.

Sources: Estimates based on: ABS (2018, *Australian System of National Accounts, 2017-18*, Cat. no. 5204.0, tables 1, 5, 15, 46 and 58); ABS (2018, *Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002, tables 1, 6 and 14); ABS (6291.0.55.003 *Labour Force, Australia, Detailed, Quarterly*, Aug 2018, table 11); and ABS (unpublished data).

1 Recent productivity trends

What parts of the economy are we measuring?

As in past productivity bulletins, this publication gives insights into the most recent productivity trends at a highly aggregated level. Such high-level productivity measures rarely provide guidance to policymakers about *specific* problems to target (for example, initiatives to address efficiency in mining exploration, transmission networks or airports), but they provide a ‘canary in the coal mine’ warning about whether an economy is dynamically improving or not. Successive years of poor outcomes — as has been typical in many OECD countries in the past decade — prompt reasonable concerns that something is awry in how technology and skills are translated into economic growth. Every new year of information is a signpost of whether we are seeing reversion to a longer-term more positive trend, or the maintenance of stagnation. This is why regular reporting is useful.

The most accurate estimates of productivity are for those industries — the market sector — where prices are set in markets, and where it is therefore easier to value output. This publication provides estimates for the two market sectors used by the Australian Bureau of Statistics (ABS) — the 12 and 16 industry sectors — the latter distinguished by the fact that less historical data are available.

However, it is useful to cast the statistical net a little wider. In its *Shifting the Dial* report (PC 2017), the Commission identified substantial opportunities to improve the wellbeing of Australians by improving the effectiveness and efficiency of the *healthcare and social assistance, education and training, and public administration and safety* industries. These fall outside the ABS definition of the market sector, because there is less evidence about the value of its outputs (for example, improved management of disease). Omitting such industries from the assessment of the overall economic performance of the economy is increasingly problematic given their increasing significance. Whereas the 16 market sector industries accounted for 80 per cent of hours worked in 1999-00, this had fallen to 74 per cent by 2017-18.

For these reasons, this edition of the *PC Productivity Bulletin* also considers an economy-wide perspective. It examines the contributions made by all industries and activities to national production, employment and labour productivity as measured by real Gross domestic product (GDP) per hour worked.¹ While this provides a useful overall picture of the productivity

¹ In addition to the three typical non-market industries described above, GDP also includes ‘ownership of dwellings’ (and taxes less subsidies on products and the statistical discrepancy). While not typically considered an industry as it has no associated employment, dwellings produce accommodation services (valued as imputed rent) and is included in the ABS measure of real GDP per hour worked. *Ownership of dwellings* accounted for 9 per cent of aggregate industry production (ABS Cat. no. 5204.0, table 5) and 36 per cent of the net capital stock in 2017-18 (ABS Cat. no. 5204.0, table 58).

performance of the economy, it should be noted that measures of productivity at the economy-wide level are less reliable than those for the market sector alone because of the difficulties in measuring outputs where market prices or proxies for them are only partly available. The same difficulties applies less to measures of capital deepening.

While this bulletin can only provide an incomplete picture about the performance of the non-market sector, the ABS is developing measures of output of some key parts of the non-market sector — with initial analysis on disease-based output measures for hospitals (Luo 2018). Accordingly, several years from now, there should be far richer insights into the performance of the non-market sector and therefore economy-wide productivity growth.

Output growth for the Australian economy continues to be robust ...

The Australian economy continues to perform well across a range of metrics by international standards. GDP grew by 2.8 per cent in 2017-18, and GVA by 2.7 per cent (table 1 and figure 1.1). This extends the run of uninterrupted growth for the Australian economy to 27 financial years, an enviable record by world standards. Our last recession was in 1990-91 financial year.

Against this backdrop, real GDP growth in 2017-18 was on par with the average annual rate of growth over the previous cycle from 2003-04 to 2011-12 (at 2.9 per cent) and slightly above the average over the current productivity cycle (at 2.6 per cent).

Growth in national output in 2017-18 came from a diverse range of industries (table 2). Growth was strongest in the *health care and social assistance, construction, professional, scientific and technical services, accommodation and food services, and administrative and support services* industries. The *manufacturing* industry recorded positive output growth for the first time since 2011-12. Reflecting the effects of the recent drought, the only industry to record negative output growth in 2017-18 was *agriculture, forestry and fishing* (-5.2 per cent).

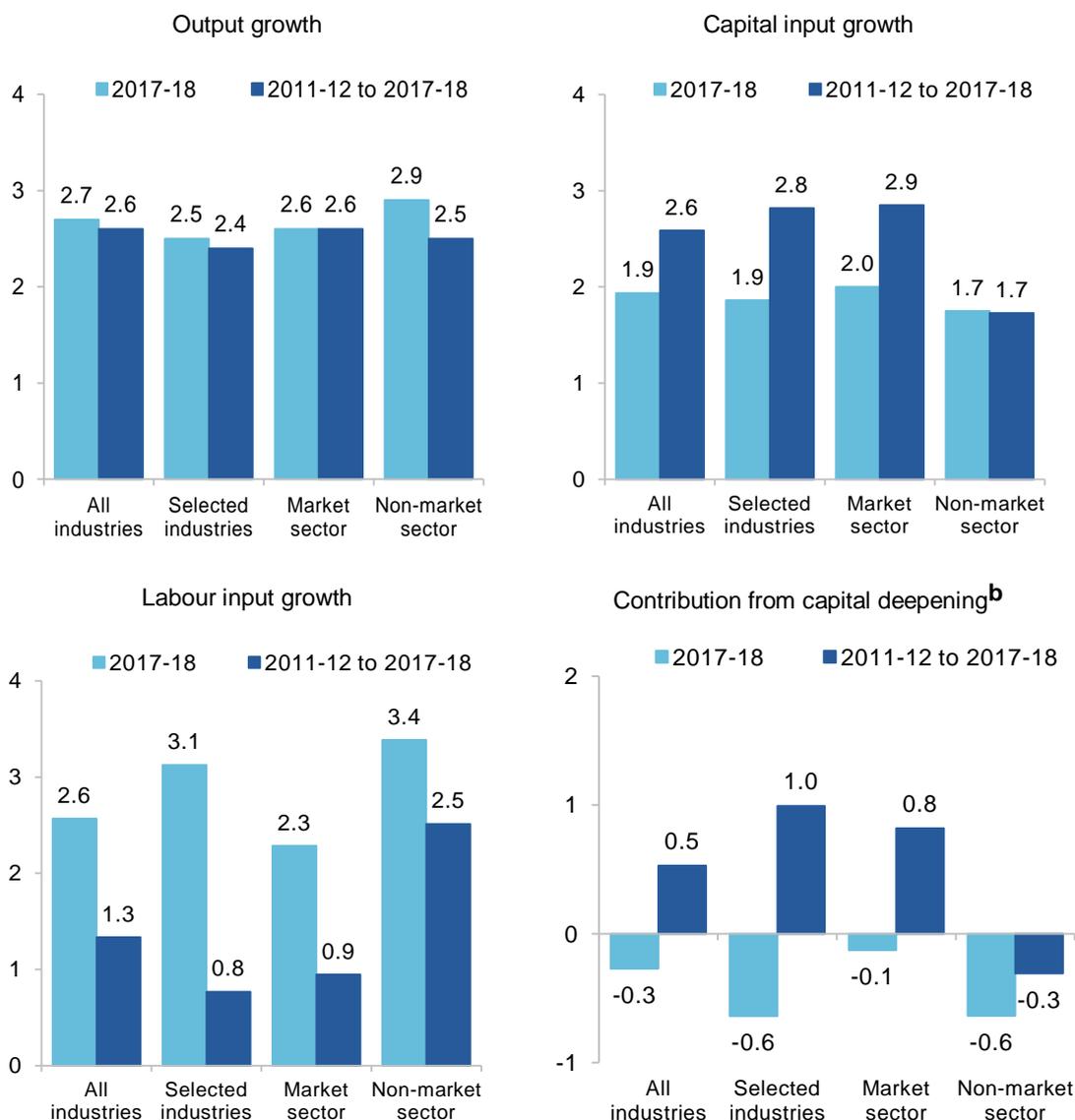
The 2.8 per cent growth in overall output primarily reflects the increase in inputs that occurs in an expanding economy, with the weighted inputs of labour and capital rising by 2.3 per cent.

Capital growth is much lower than the historical norm ...

Economy-wide capital input use increased by 1.9 per cent in 2017-18 (figure 1.1 and table 1), following similar increases in the previous two years, but this was well below the historical average of 4 per cent from 1974-75 to 2017-18 (table 1). This is troubling because investment typically embody new technologies, which complement people's skill development and innovation.

Figure 1.1 **Outputs, inputs and capital deepening**

Per cent per year^a



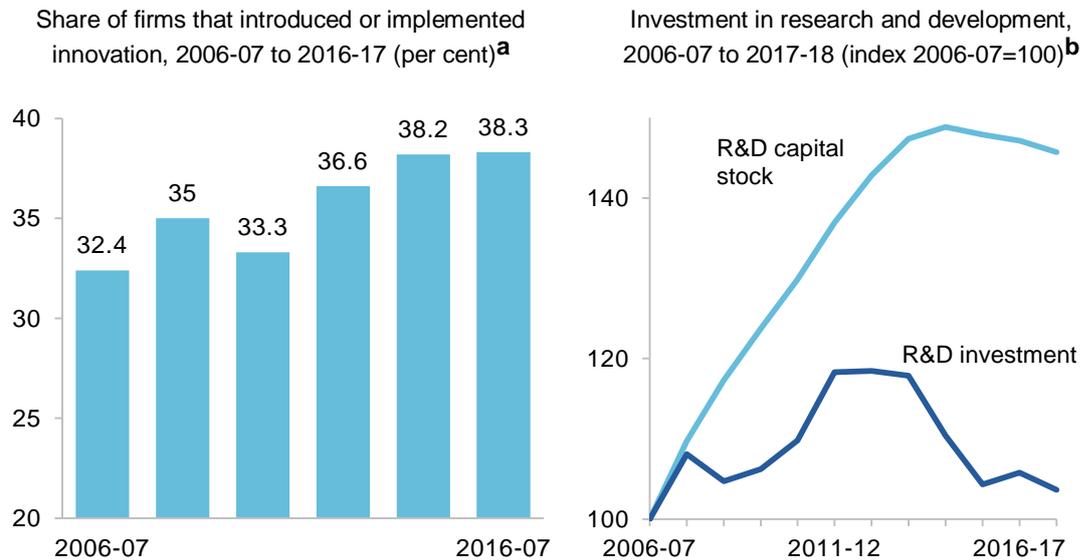
^a Selected industries comprise the ABS 12 industry market sector, while the market sector comprise the full ABS 16 industry market sector. All industry output is GVA not GDP. ^b The contribution from capital deepening is the effect on labour productivity growth from the change in the capital-labour ratio.

Sources: Estimates based on: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 1, 5, 15, 46, and 58); ABS (2018, *Estimates of Industry Multifactor Productivity*, 2017-18, Cat. no. 5260.0.55.002, tables 10 and 14); ABS (2018, *Labour Force, Australia, Detailed Quarterly*, Aug 2018, Cat no. 6202.0, table 11); and ABS (unpublished data).

This is especially so for investment in research and development, where capital stocks are now falling, and even more so, new investment (figure 1.2). Growth in R&D capital formation is even more subdued than capital formation generally, so that the R&D investment share of total investment has also fallen. The share of businesses that are innovators — which goes beyond R&D spending — is no longer growing. There is also

some evidence that investment in performance assessment within business — a key feature of good management — is also declining.²

Figure 1.2 Innovative activity appears to have stalled



^a Data for innovation were not available for 2017-18. ^b Chain volume estimates.

Sources: ABS (*Innovation in Australian Business*, various issues, Cat. no. 8158.0, table 1); and ABS (2018, *Australian System of National Accounts, 2017-18*, Cat. no. 5204.0, table 56).

The reasons for the general weakening of capital input growth and the contribution from capital deepening are explored in more detail in chapter 2.

... while labour inputs are buoyant

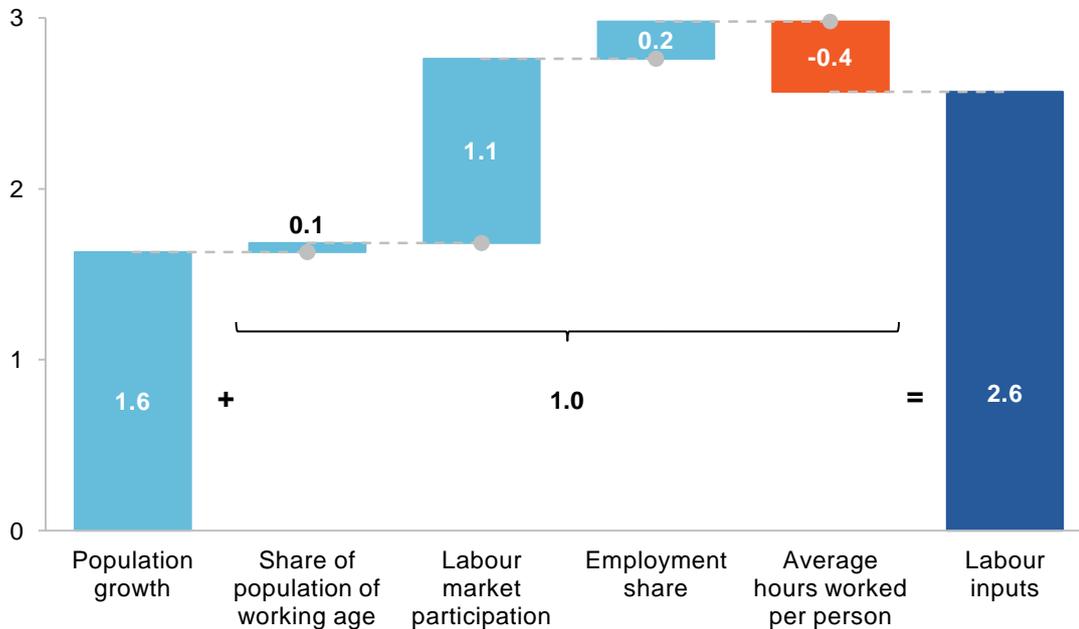
In contrast to subdued capital growth, a buoyant labour market has led to growth in aggregate labour inputs of 2.6 per cent in 2017-18, the highest growth rate since 2010-11. This reflected:

- continued strong population growth
- an increase in the labour force participation rate, from 64.7 per cent to 65.4 per cent (a change that was disproportionately affected by the continued strong growth in female and older age participation)
- a fall in the unemployment rate from 5.7 per cent to 5.5 per cent (figure 1.3).

² Based on information from ABS (*Selected Characteristics of Australian Business*, various issues, Cat. no. 8167.0, table 1).

Figure 1.3 **Contribution to labour input growth, 2017-18**

Percentage points^a



^a Share of population of working age is the share of population aged 15 years and over. Labour market participation is the share of the working-age population in the labour force. Employment share is share of the labour force that is employed. Labour inputs are total hours worked.

Sources: ABS (2018, *Australian Demographic Statistics*, Jun 2018, Cat. no. 3101.0, table 59); ABS (2018, *Australian System of National Accounts, 2017-18*, Cat. no. 5204.0, table 1); and ABS (2018, *Labour Force, Australia*, Sep 2018, Cat. no. 6202.0, table 1).

Labour productivity growth continues to be mediocre

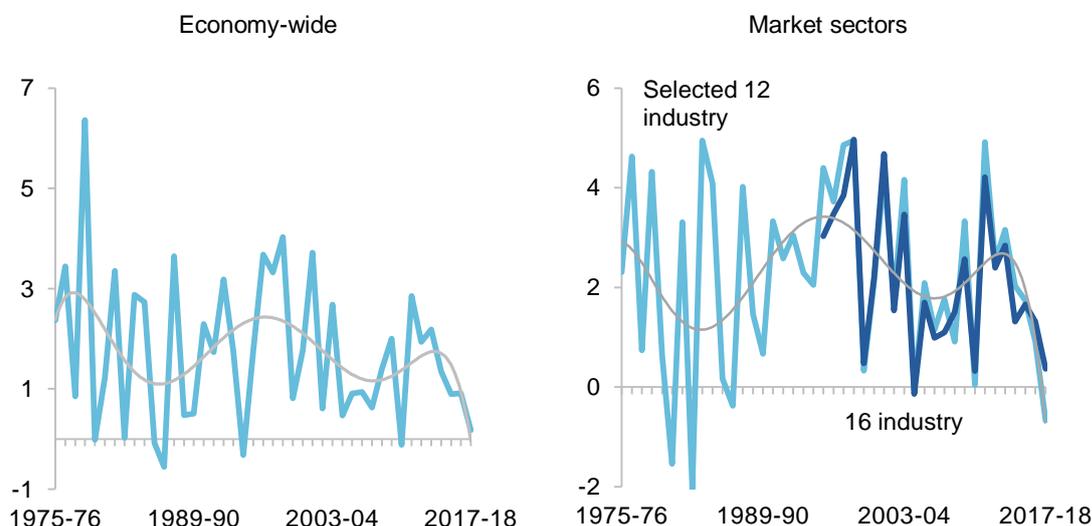
Economy-wide labour productivity growth has been weak and slowing compared with recent years — growing by only 0.2 per cent in 2017-18 (table 1 and figure 1.4) — in line with the most recent downward trend that commenced in 2011-12 and below the historical long-term trend. Similarly, weak recent performance is apparent for the more reliably estimated market sector productivity rates.

Labour productivity growth — or the increase in output per hour worked — reflects the change in the:

- capital-labour ratio — the quantity of capital inputs used per unit of labour input (referred to as ‘the contribution from capital deepening’)
- efficiency with which value-adding inputs are used in production (referred to as ‘the contribution from multifactor productivity growth’).

Figure 1.4 **Aggregate labour productivity^a**

Annual growth rates, 1975-76 to 2017-18 (per cent)^b



^a Labour productivity based on GVA. ^b The ABS growth cycle commences in 1973-74, but data are only uniformly available from 1974-75. Accordingly, the first growth rate is for 1974-75 to 1975-76.

Sources: Estimates for the economy (see annex); and ABS (2018, *Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002, table 6).

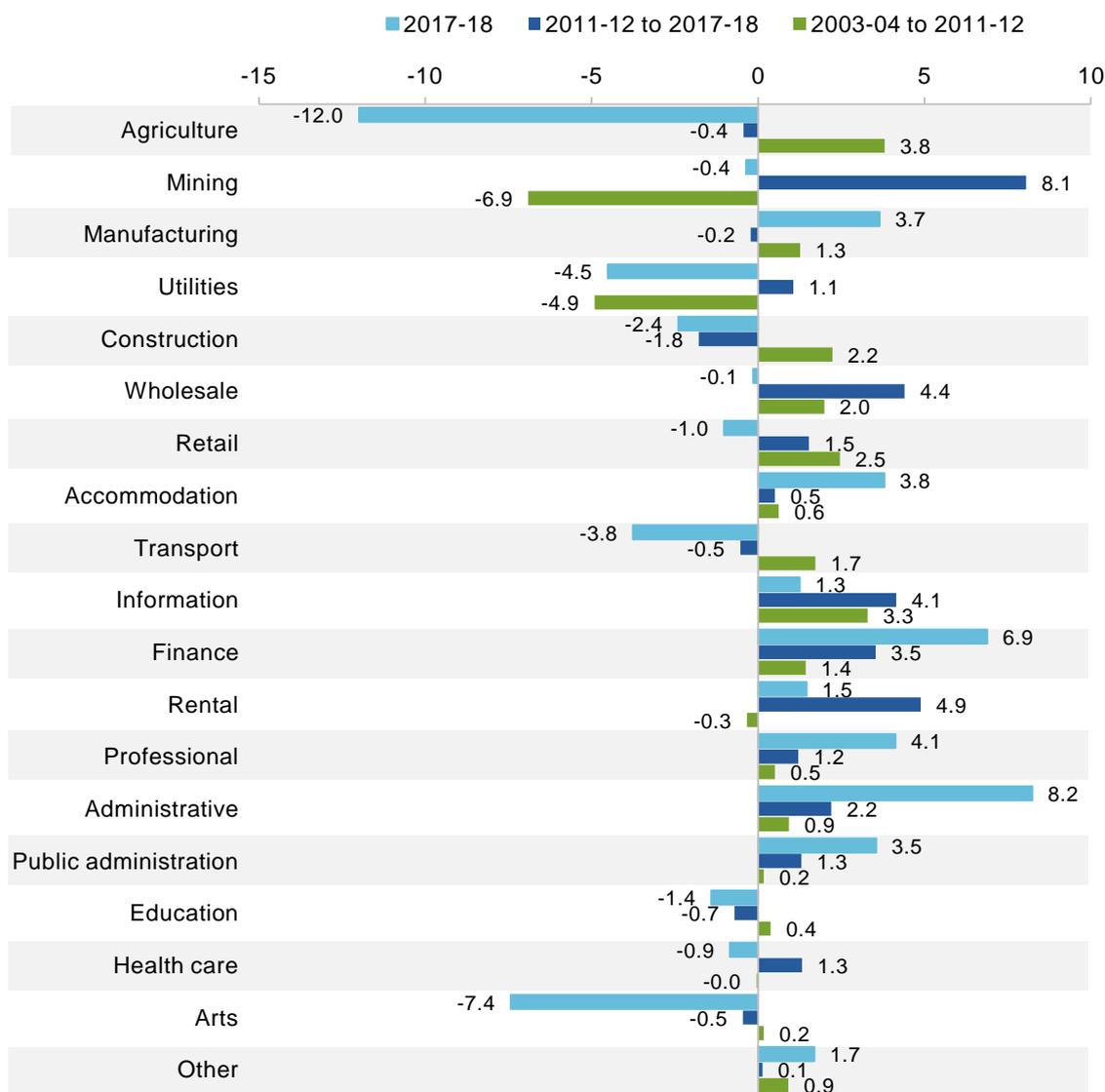
The first of these is the major factor underlying Australia’s recent low labour productivity growth (figure 1.1). While Australia’s long-run economic development has been characterised by capital deepening, this engine of growth has faltered, with progressively slowing contributions from capital deepening over the current productivity cycle, partly a reflection of the end of the mining investment boom. Indeed, in 2017-18, the economy-wide capital-labour share has fallen (‘capital shallowing’). This is not an artefact of the problems in constructing capital services for the whole economy because it is also apparent for the market sector, where capital services are better measured. In the 16 industry market sector, 2017-18 is the first year from the commencement of the series in 1994-95 that capital shallowing has occurred. The most recent data on private business gross fixed capital expenditure show that trend real spending has continued to drift down.³

The weak growth in economy-wide labour productivity is not common across all industries, with disproportionately negative effects from some key market sector industries — *agriculture, forestry and fishing, arts and recreation services* and *electricity, gas, water and waste services* (figure 1.5). The outcome for the agricultural sector is surprising as it reflects the coincidence of apparently *increased* hours and reduced output. While severe drought conditions affecting large areas of farmland can explain the latter (Hatfield-Dodds et al. 2018), it cannot explain why farms did not reduce labour input. Data errors may be present.

³ Based on ABS (2019, *Australian National Accounts: National Income, Expenditure and Product, Dec 2018*, Cat. no. 5206.0, table 2).

Figure 1.5 **Labour productivity growth by industry**

Per cent per year



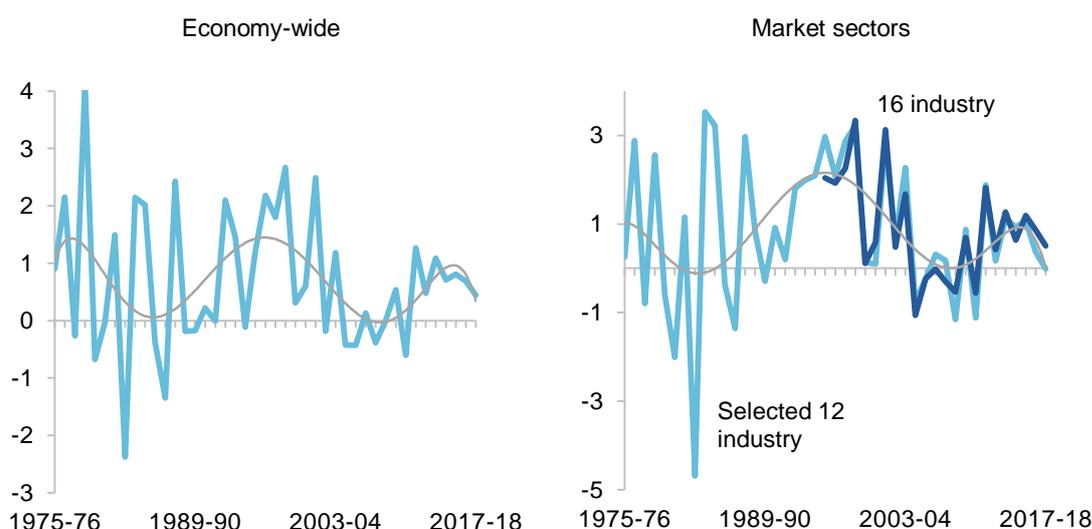
Sources: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 1, 5 and 15) and ABS (2018, *Labour Force, Australia, Detailed, Quarterly*, Aug 2018, Cat. no. 6291.0.55.003, table 11).

Multifactor productivity growth has been weaker than the previous few years

Labour and capital inputs explain much, but not all, of the economy's growth in output. The residual source of growth — MFP — captures all other factors that influence output, including improvements in dynamic efficiency, measurement error, and structural changes in the economy.

Economy-wide MFP grew by just 0.4 per cent in 2017-18 (table 1 and figure 1.6). This rate of growth is the lowest since 2010-11. It is, however, above the average rate for the last complete cycle from 2003-04 to 2011-12. Of bigger concern is that it is well below the rates achieved in the ‘golden’ productivity era between 1993-94 and 1998-99. As was the case for labour productivity, the MFP performance of the market sectors have also been relatively poor.

Figure 1.6 Multifactor productivity rates are entering the doldrums again
Annual growth rates, 1975-76 to 2017-18 (per cent)^a



^a Multifactor productivity based on GVA.

Sources: Estimates for the economy (see annex); and ABS (2018, *Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002, table 1).

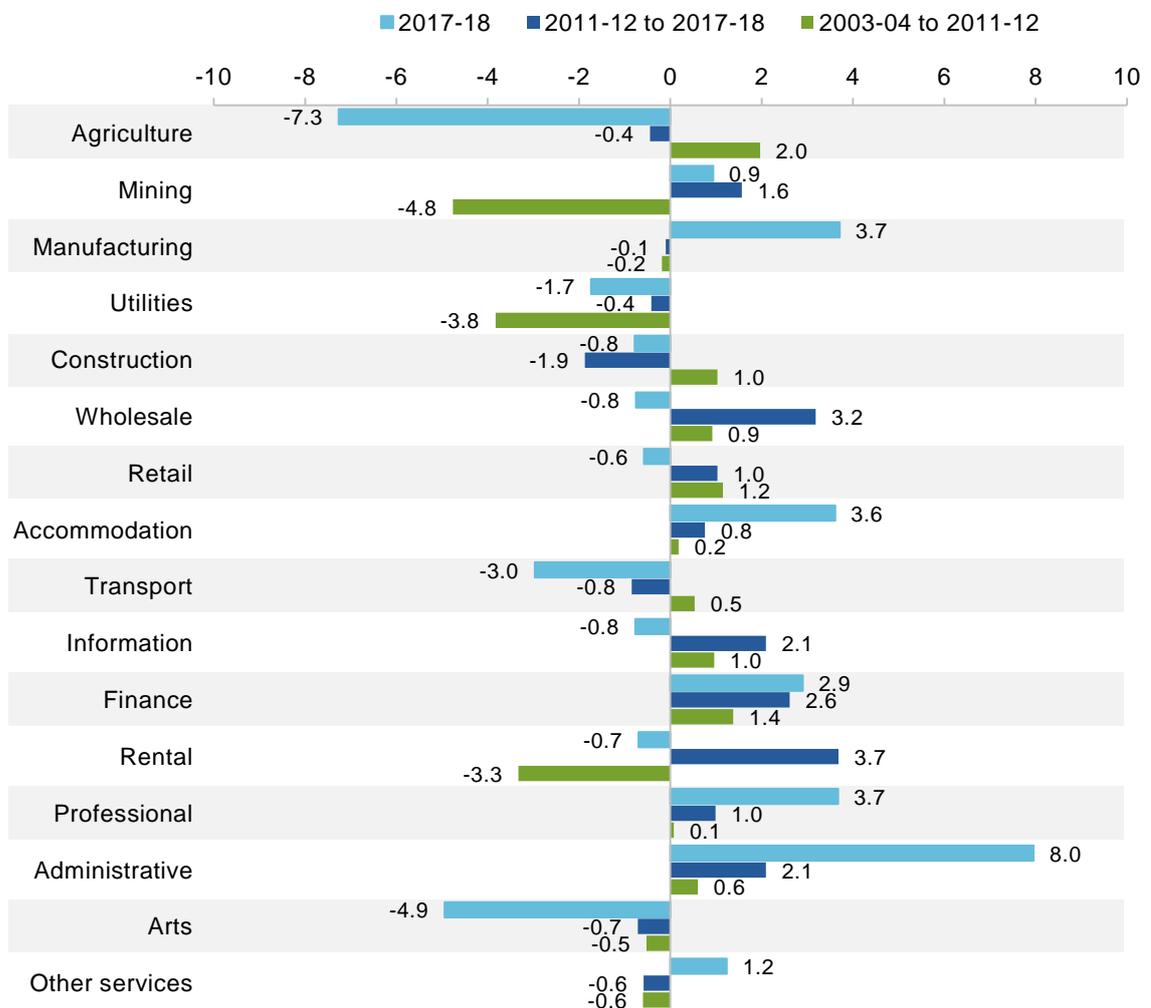
At the individual industry level, almost half recorded MFP growth in 2017-18 (figure 1.7). *Administrative and support services* recorded the strongest growth (8.0 per cent). Four industries recorded strong growth of about 3 to 4 per cent: *accommodation and food services*, *professional, scientific and technical services*, *finance and insurance services*, and *manufacturing*.

The *construction* industry recorded its fourth consecutive year of negative multifactor productivity growth (figure 1.7).

Of all industries, the *agriculture, forestry and fishing* and *arts and recreation services* recorded the largest falls in multifactor productivity growth in 2017-18. In the former case, rainfall conditions are probably the culprit as existing capital cannot be used as productively when there are drought conditions. It is unlikely that there has been any change in the inherent efficiency of the industry or its technical progress. Indeed, farmers’ adaptations to manage drought conditions would, if correctly measured, represent technical progress.

Figure 1.7 **Multifactor productivity growth by industry**

Per cent per year



Source: ABS (2018, *Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002, table 1).

Growing educational attainment — an important wrinkle in the multifactor productivity story

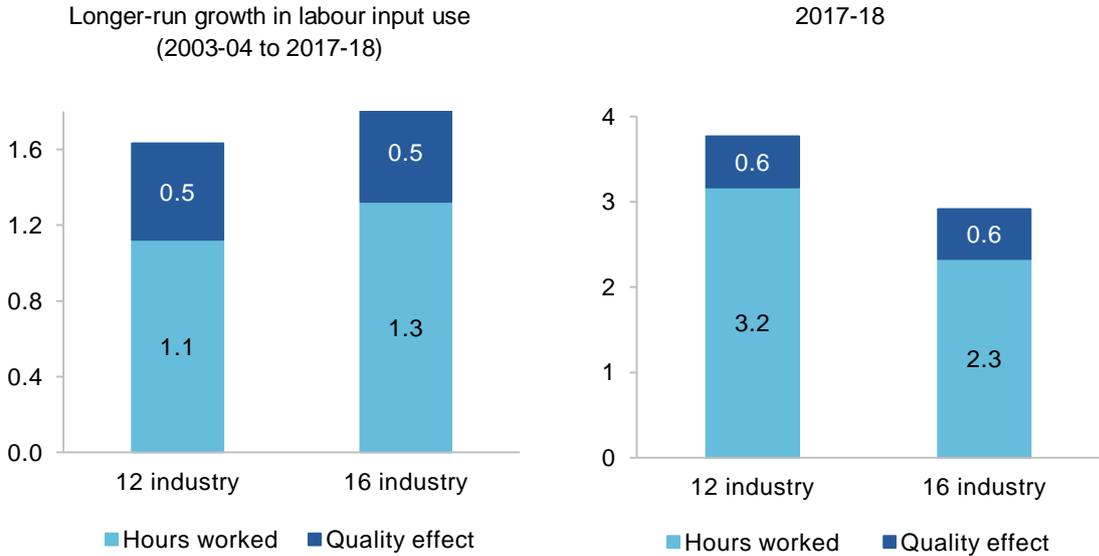
Australians have become increasingly educated, with the recognition that greater skills can improve productivity, wages and job satisfaction. Because of this, the sum of hours worked does not adequately cater for the changes in the composition of labour over time. The consequence will be that multifactor productivity will include an improvement in output that reflects the investment in education.

While the ABS does not publish quality-adjusted measures of labour for the economy as a whole, it does do so for market sector industries. Quality improvements in labour make a large

difference to the effective growth in labour inputs and these improvements vary considerably by industry. Over the last business cycle, about one third of the growth in quality-adjusted labour inputs in the 12 and 16 industry market sectors reflect changes in human capital, rather than hours worked (figure 1.8). MFP growth rates that take into account inputs of quality-adjusted labour are lower than those that only take into account hours (figure 1.9).

Figure 1.8 The importance of skill — a workforce is more than just hours worked

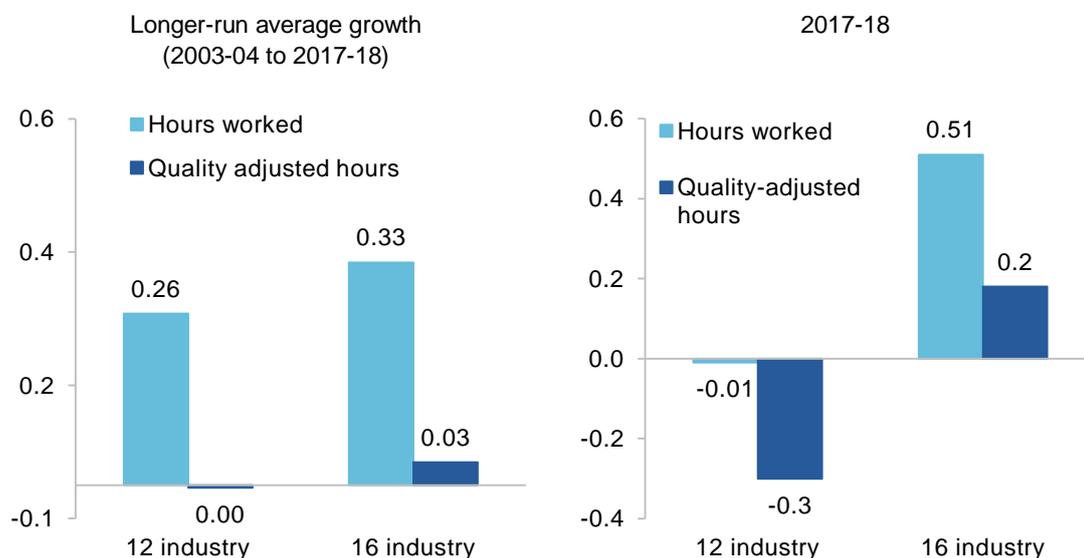
Annual log changes^a



^a Growth rates are calculated as $100 \cdot \Delta \log(\text{Hours worked})/T$ and $100 \cdot \Delta \log(\text{Labour quality})/T$ where T is the relevant period, noting that log changes in hours and quality sums to the total change in quality adjusted hours only if the calculations are expressed in log form. The values approximate to percentage changes annually.

Source: ABS (2018, *Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002, table 1).

Figure 1.9 Multifactor productivity with and without skill-augmented labour inputs
Per cent per year^a



^a The chart is intended to show the difference between MFP rates with and without labour quality adjustment, not to isolate the underlying MFP growth rate that takes account of the business cycle.

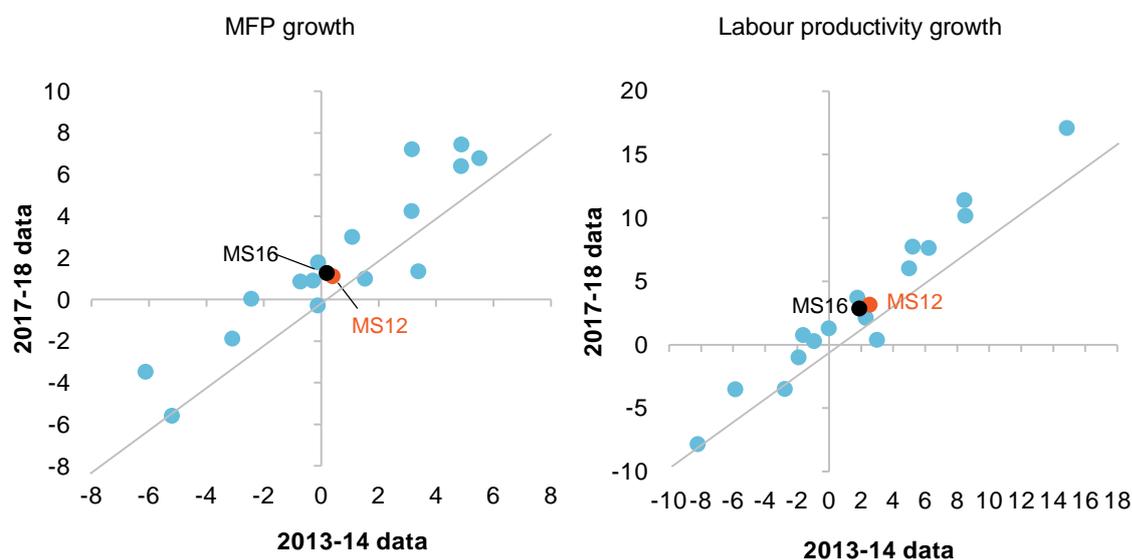
Source: ABS (2018, *Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002, table 1).

Another wrinkle — revisions, revisions, revisions

While each year of additional information helps to identify emerging trends, conclusions need to be tempered by revisions to MFP estimates (figure 1.10). The ABS routinely revisit their historical estimates in the National Accounts to ensure that they incorporate the most accurate data sources available. Annual revisions are generally small, but periodic historical revisions may be more substantive. For example, MFP growth for *financial and insurance services* in 2013-14 was 3.38 per cent when originally published. The revisions to output growth meant that the estimate for 2013-14 had fallen to 1.35 per cent in the 2017-18 dataset, about one third of the initial estimate.⁴ Fortunately, revisions are relatively small for aggregates such as the 12 and 16 industry sectors.

⁴ The revision for this industry reflected new output data from the Australian Prudential Regulation Authority after the ABS published its initial estimates.

Figure 1.10 There can be sizeable variations between initial and subsequent estimates of productivity by industry^a
 Percentage growth in 2013-14



^a The charts show the relationship between the estimates of the productivity growth rates for 2013-14 for each of the 16 industries making up the market sector, and for the aggregate 12 and 16 industry market sectors (denoted as MS12 and MS16, respectively). Were there no revision errors then all points would lie on the diagonal line. Labour inputs are based on hours (non-quality adjusted).

Source: ABS (2018, *Estimates of Industry Multifactor Productivity*, various years, Cat. no. 5260.0.55.002, table 1).

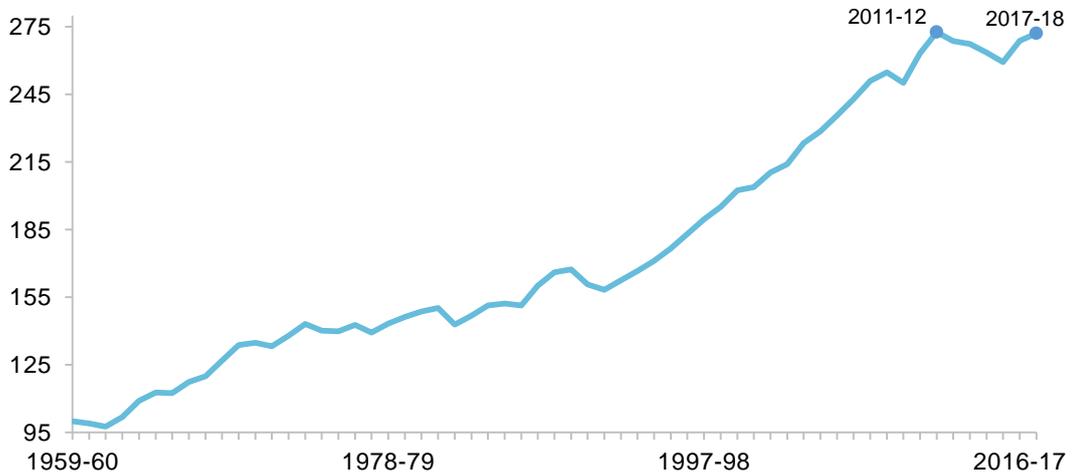
A broader perspective paints a somewhat better view

While growth in real GDP per hour was low between 2014-15 and 2017-18 (at about 2.2 per cent across the whole period), GDP per capita grew somewhat more strongly (by 3.3 per cent). This reflects the labour supply effects of rising labour force participation rates (rather than hours worked by those already employed), which in its own right, can have many positive social and economic benefits for households.

In addition, real net national disposable income — a better measure of overall prosperity — has recovered from its low in 2015-16, primarily a reflection of a higher terms of trade (figures 1.11 and 1.12), with no significant contribution by multifactor productivity.⁵

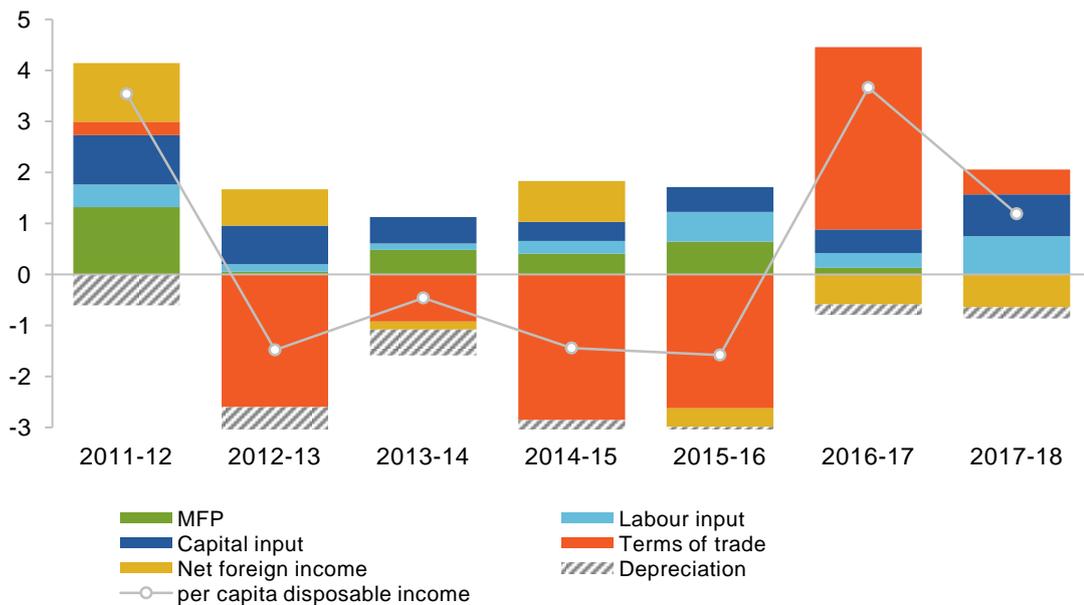
⁵ This measure excludes depreciation of assets and includes net transfers overseas.

Figure 1.11 Real net national disposable income per capita has improved in the past few years
Index (1959-60 = 100)



Source: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, table 1).

Figure 1.12 The terms of trade has been the big driver of changes in prosperity
Factors contributing to growth in per capita disposable income^a



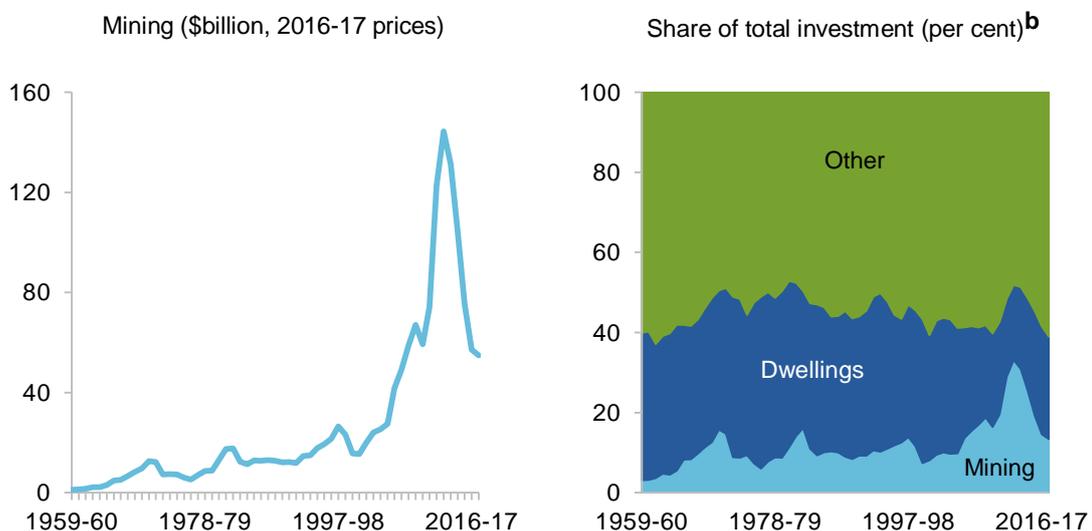
^a Per capita disposable income denotes net national disposable income per capita, and is an overall measure of economic prosperity as it measures the overall level of attainable consumption.

Sources: ABS (*Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 1, 2, 7, 16 and 65); and ABS (*Estimates of Industry Multifactor Productivity*, 2017-18, Cat. no. 5260.0.55.002, tables 4 and 13).

2 The mining boom and the investment cycle

The recent mining boom had a significant effect on the level and composition of investment in Australia. Strong world demand for selected mining commodities, most notably iron ore and coal, led to significant and sustained increases in the Australian dollar prices of these commodities from 2003-04 to 2011-12. The duration and scale of the terms of trade boom is unprecedented over the past 220 years. Its peak was only eclipsed once and that was 70 years ago during a short-lived spike in wool prices (Stapledon 2012).⁶ Mining resources price increases fuelled considerable mining investment. The development of three liquefied natural gas export facilities to link the existing east coast gas market to world markets and the development of new natural gas fields on both the east and west coasts also resulted in significant additional investment (figure 2.1). Overall, real mining investment grew nearly sixfold from \$25 billion in 2003-04 to a peak of \$144 billion in 2012-13.

Figure 2.1 Investment, 1959-60 to 2017-18^a



^a Total public and private gross fixed capital formation. ^b Total investment excludes ownership transfer costs.

Source: ABS (2018, *Australian System of National Accounts, 2017-18*, Cat. no. 5204.0, table 58).

⁶ The terms of trade measures the price of Australian exports relative to the price of Australian imports (both expressed in Australian dollars).

The investment boom led to a substantial *initial* fall in mining productivity

The mining industry responds to higher commodity prices by installing productive capacity, which requires substantial inputs of capital and labour ahead of actual production. Accordingly, productivity is depressed during the transition to production, with the construction of new mines and major facilities often taking two to three years (Topp et al. 2008, pp. 75–77).

The dynamics and extent of the productivity effects vary by mining activity. Mining covers extraction, some processing and the sale of minerals, fossil fuel-based resources such as crude oil and natural gas and related products. The industry also engages in exploration for new deposits and fields and the construction of some, but not all, new mines, processing facilities and related infrastructure. The variations across mining activities in outputs, input needs, production lead times and efficiency collectively determine the productivity outcomes for the industry as a whole.

Some other factors also lead to this initially negative relationship between commodity prices and productivity. First, some less productive extraction technologies are able to be deployed more quickly in the urgency to exploit high prices, for example, trucks and shovels instead of draglines. Second, booms encourage the opening, or re-opening, of lower grade (more marginal) deposits, which require more inputs to extract.

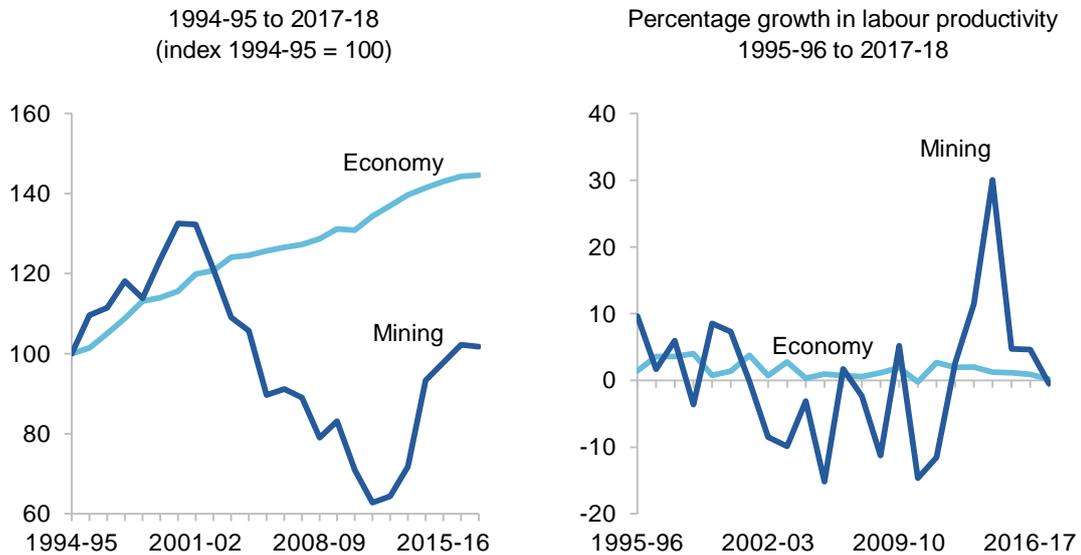
For these various reasons, labour productivity for the mining industry fell by over 40 per cent between 2003-04 and 2011-12, but then subsequently rose by more than 60 per cent between 2011-12 and 2017-18 (figure 2.2, left-hand panel). Capital and multifactor productivity also initially fell.

Falling commodity prices reduced mining investment, but other investment filled the void

The decline in the terms of trade from its recent highs reduced private mining investment (in current price terms) by 60 per cent or \$81 billion from 2012-13 to 2017-18. Other private investment has buffered the economy against this decline. Private dwelling investment increased by more than 50 per cent or \$37 billion over the same period and other private investment by about 30 per cent or \$39 billion.⁷ Overall, private non-mining investment increased as share of GDP, but this was not enough to cancel out the reduction in mining and public investment as a share of GDP after the peak of the resources investment boom (figures 2.3 and 2.4).

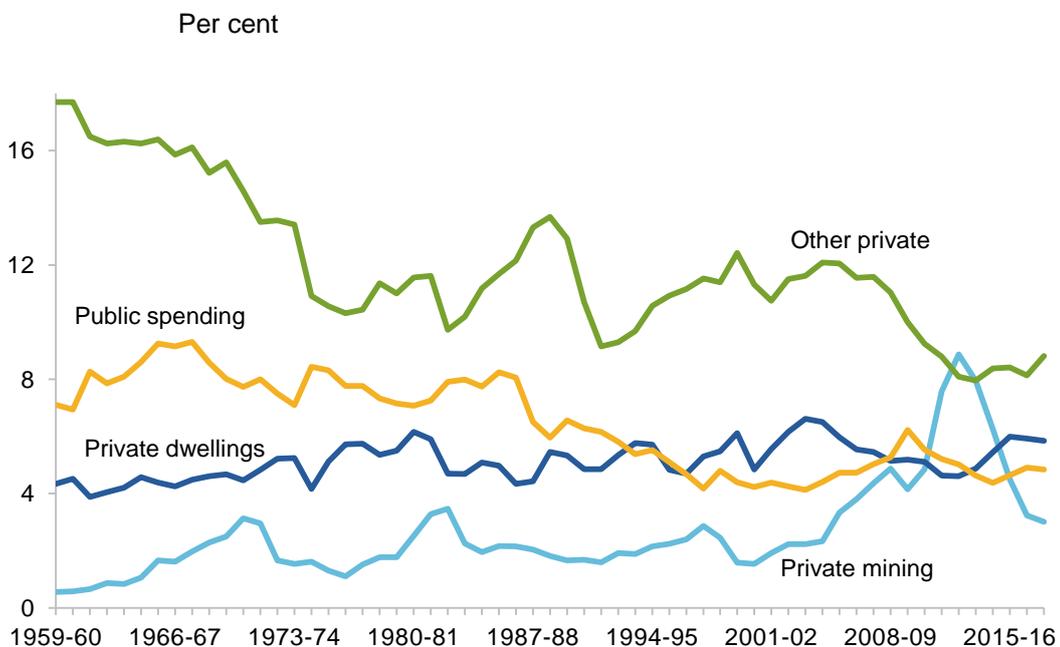
⁷ Sourced from ABS (2018, *Australian System of National Accounts, 2017-18*, Cat. no. 5204.0, tables 52 and 58). Investment excludes ownership transfer costs.

Figure 2.2 Mining and economy-wide labour productivity



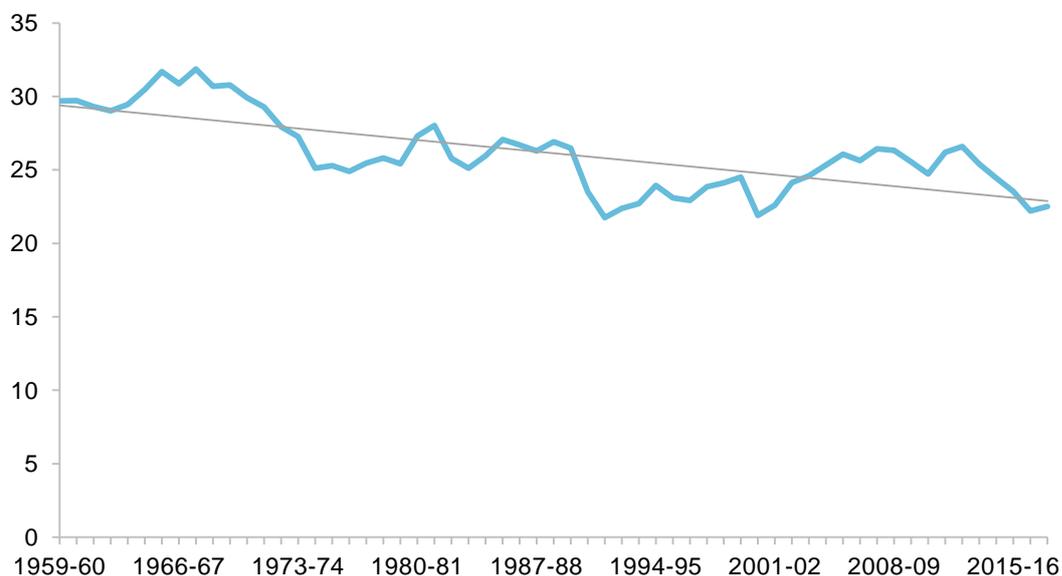
Source: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, table 15 for mining and table 1 for GDP per hour).

Figure 2.3 Investment as a share of GDP by investment type, 1959-60 to 2017-18



Source: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 1, 51 and 52).

Figure 2.4 Overall investment to GDP has trended down, 1959-60 to 2017-18
Per cent



Source: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 1 and 51).

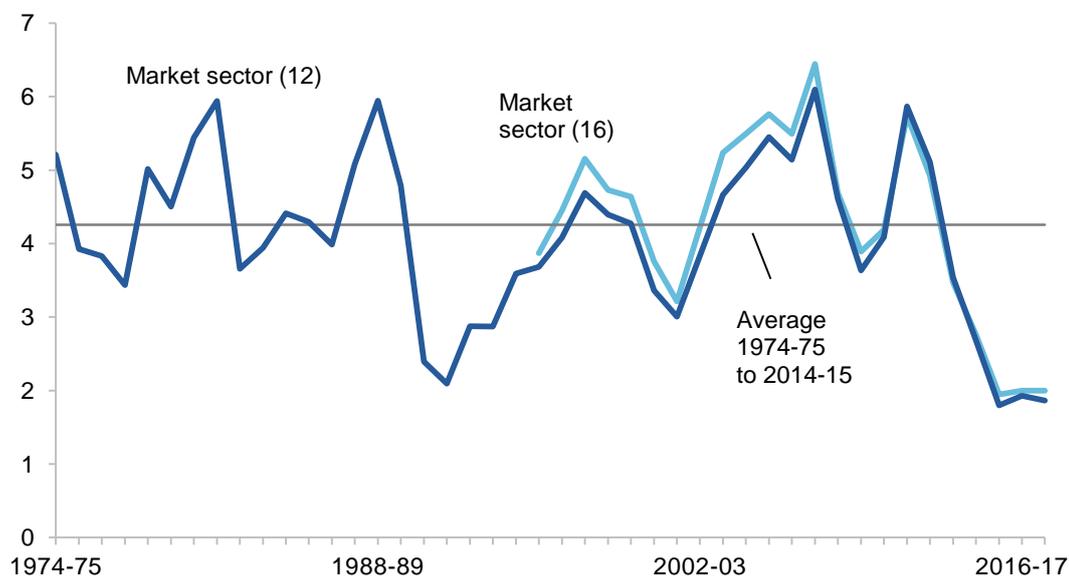
The contribution from capital deepening to output has weakened appreciably

The annual growth in capital services has fallen markedly since the peak of the mining boom in 2011-12 (figure 2.5 and table 2.1). The annual rate of growth in capital services fluctuates between years, but averaged just over 4 per cent *before* the boom. It is now just under 2 per cent per year. This highlights that, while there is a coincidence between the end of the mining boom and weak investment, it is unlikely to be the direct cause since otherwise a return to the long-run growth in capital services could have been expected.

Part of the story is that capital services is proportional to the productive capital stock, with that proportion being determined by the degree to which the stock depreciates. There has been a marked increase in the significance of non-dwelling and dwelling construction in the economy-wide capital stock. As these assets are very long-lived, their depreciation is, by definition, relatively low, which affects the overall level of capital services.

From a longer-term perspective, future capital services and capital deepening rely on augmentation of the capital stock through investment. However, compared with the long-run pattern of capital accumulation, stagnation is now prominent among many industries (figure 2.6). There is no simple narrative explaining recent investment trends. While structural shifts in the economy away from highly capital-intensive sectors like manufacturing towards less intensive service sectors helps to explain the long-run secular decline in investment to GDP ratios, it does not explain recent stagnation.

Figure 2.5 **Growth in capital services index, 1974-75 to 2017-18**
Per cent



Source: ABS (2018, *Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002, table 10).

Some indirect links to the mining sector may play a role for industries that must invest in capacity to supply goods and services to the mining industry (as in construction). The terms of trade are also still comparatively high, and as a result so too is Australia's trade weighted exchange rate, which will reduce the competitiveness of exporting industries like manufacturing (van der Merwe et al. 2018).

It is too early to tell whether the recent low rates of capital input growth will continue as a constraint on Australian productivity growth (and possibly future output growth). In the shorter run, there are some, albeit imperfect, indications of more buoyant future private capital investment, with expected investment for 2018-19 being 3.6 per cent higher than the comparable investment expectation in the previous year, and expected investment in 2019-20 being 11 per cent higher than the corresponding expected investment for 2018-19.⁸ These ABS forecasts also suggest a particularly high short-term recovery in mining expenditure. If this is subsequently followed by output increases, it will likely improve labour productivity (with some delay), as in previous periods of strong investment. As noted above, the decline in the relative importance of capital-intensive sectors in favour of the service sector implies long-run weakening of capital deepening, meaning that labour productivity improvements will increasingly need to be driven by innovation and greater efficiency.

⁸ Sourced from ABS (2019, *Private New Capital Expenditure and Expected Expenditure, Australia, Dec 2018*, Cat. no. 5625).

Table 2.1 **Capital services shares and growth, 1974-75 to 2017-18**

Per cent

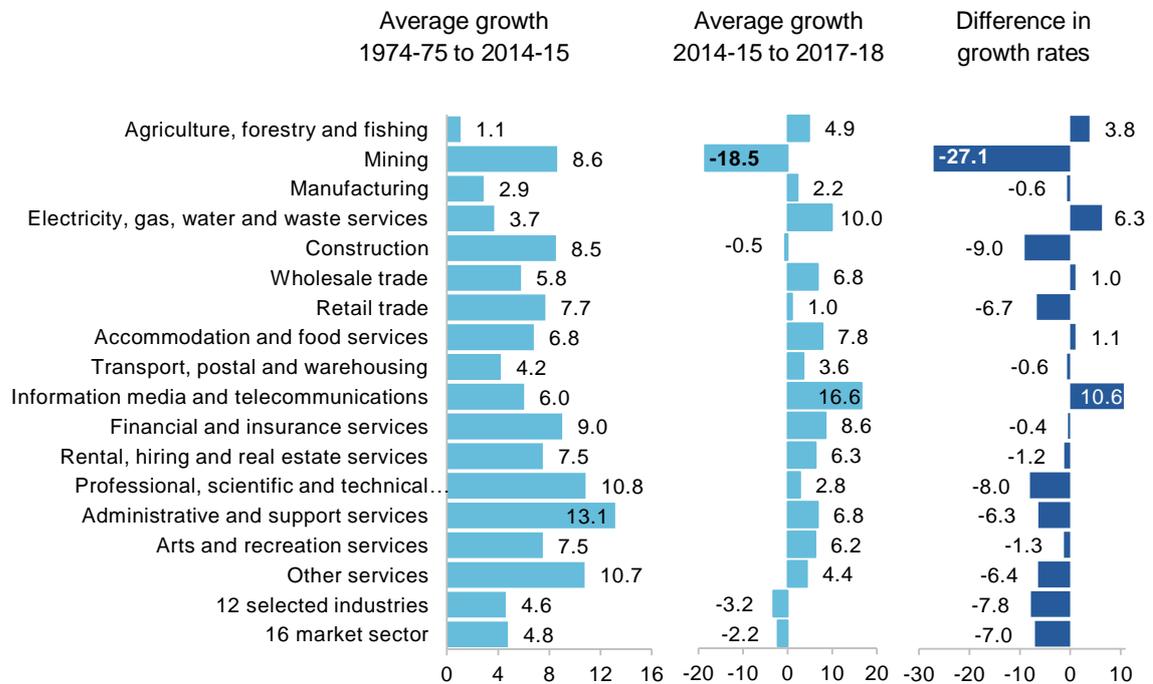
	Weight (Share of capital income)		Average annual growth in capital services		
	1974-75	2017-18	Long-term ^a	Last cycle ^b	Past 3 years
Agriculture, forestry and fishing	6.1	2.8	0.5	0.1	0.1
Mining	4.2	9.0	5.6	6.8	2.5
Manufacturing	19.2	6.2	2.1	-1.2	-1.4
Electricity, gas, water and waste services	3.4	2.6	2.6	1.9	1.8
Construction	7.8	8.2	5.8	3.0	2.6
Wholesale trade	5.7	4.1	3.9	1.8	2.6
Retail trade	5.5	4.6	5.1	2.9	2.2
Accommodation and food services	2.3	2.4	5.0	0.7	0.9
Transport, postal and warehousing	8.3	4.9	3.4	2.8	2.5
Information media and telecommunications	3.7	2.6	5.7	3.4	4.7
Financial and insurance services	3.8	9.5	5.8	1.4	1.8
Rental, hiring and real estate services	2.0	2.9	6.5	2.3	2.7
Professional, scientific and technical services	2.9	7.3	9.4	3.7	3.2
Administrative and support services	1.4	3.5	11.6	1.9	1.5
Public administration and safety	8.0	5.5	3.2	2.6	2.5
Education and training	4.0	5.2	2.8	1.6	1.4
Health care and social assistance	4.4	7.5	4.3	3.8	3.2
Arts and recreation services	0.7	0.9	5.8	3.3	3.3
Other services	1.8	1.9	7.7	6.8	6.0
Ownership of dwellings	4.7	8.3	3.0	1.5	1.7
All industries	100.0	100.0	4.0	2.6	1.9

^a 1974-75 to 2017-18. ^b 2011-12 to 2017-18.

Sources: Estimates based on: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 46 and 58); ABS (2018, *Estimates of Industry Multifactor Productivity*, 2017-18, Cat. no. 5260.0.55.002, tables 10 and 14); and ABS (unpublished data).

Figure 2.6 **Average real investment is slumping for many industries^a**

Per cent per year



^a Does not include real investment undertaken by industries in the non-market sector.

Source: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, table 58).

3 Labour productivity and wages

While recent labour productivity growth has been sluggish by long-run standards, it has still been positive. However, this productivity improvement has not translated into comparable real wage growth over the period from 2011-12, with employees' nominal hourly wages just keeping up with consumer prices. This has sometimes been referred to as 'the wage growth puzzle'. Given the importance of wages to household income, real growth in consumption, and to shared prosperity, real wage stagnation has attracted concern in Australia and the numerous other countries where the same trends appear to be at work.

An in-depth examination of this issue is beyond the scope of this Bulletin, but an important framing issue rests on how wages are defined and how different parties view them (box 3.1). Unlike workers who are interested in the purchasing power of their wages (the real consumer wage), producers' decision making rely, amongst other factors, on the degree to which nominal wages exceed *producer* prices — the real producer price. Where they are out of step, it can affect labour hiring and investment. If stubbornly slow real wage growth is remarkable when compared with that over the past few decades, recent trends in wages are less so when viewed through a business lens. Indeed, from the employer's perspective, there is little evidence of a contemporary slow wage 'puzzle'.⁹

Over the medium term, wages increase in line with labour productivity measured in terms of the *prices of output*. This occurred in Australia during and after the mining boom (figure 3.1). Indeed, the association between real product wages and labour productivity has been more stable from the 1990s to 2017-18, including the recent decade, than it was for the period from the mid-1970s to the early 1980s, when there was a pronounced 'real wage overhang' (Russell and Tease 1991).

Over the very long run, the wages measured in terms of their capacity to meet workers' needs *as consumers* have also grown by about the same as productivity growth, though this is more of a stylised fact rather than an inevitability. However, the relationship between real consumer wages and productivity has been far less stable than that between real product wages and productivity. The current disparity is not unique, with other periods of divergence over the past 60 years, with growth in real consumer wages sometimes above productivity and sometimes below.

⁹ Employers also take into account the additional costs associated with employing labour, such as superannuation and payroll tax.

Box 3.1 Defining real wages is not as easy as may be thought

The analysis presented here is largely couched in terms of average labour income per hour worked. Compensation of employees comprises wages and salaries (in cash and in kind) and employers' social contributions. It does not include any unpaid work undertaken voluntarily or any taxes payable by the employer on the wage and salary bill such as payroll tax (ABS 2016). It includes an imputation for the labour income of the self-employed, which requires differentiating between their income from providing labour and that from the returns on capital. Wage income of the self-employed is based on the labour income shares in the ABS *Estimates of Industry Multifactor Productivity* (ABS 2018a). The overall wage rate excludes any taxes payable on labour income, and so is not a measure of disposable income.

There are other measures of wages — such as the wage price index (which controls for shifts in the quality and quantity of work performed) and various measures of average weekly earnings, inclusive or not of overtime hours (Stanford 2018). These measures ignore the self-employed. However, all measures show recent stagnation of real consumer wages, though to a different degree (table 3.1).

The GDP deflator is used as a proxy for output prices to determine the real producer wage, while the Consumer Price Index (CPI) is used in the construction of the real consumer wage.

There is some debate about the validity of the CPI as a measure of the buying power of income. The CPI is the most commonly used and internationally recognised measure of the prices of consumption goods and services (and from a macroeconomic perspective, inflation). However, it is not strictly speaking a 'cost of living' measure, and the basket of goods and services used to estimate it cannot cater for the different expenditure patterns of sub-groups of people.

As noted by the ABS, expenditure on housing raises a particular dilemma because it comprises a dual investment in an asset (with investments in assets appropriately excluded from the CPI) and a payment for housing services (ABS 2019, *Consumer Price Index: Concepts, Sources and Methods, 2018*, Cat. no. 6461.0). Accordingly, some aspects of housing (most notably the costs of acquiring land) are excluded from the measure, while other costs, such as rent, purchase of the dwelling, and maintenance charges are included. The change in prices measured by the CPI and households' impressions of the cost of living (which for many, will include the costs of buying land) can therefore be at odds, a reflection of a different framework for assessing cost pressures facing households, rather than a conceptual flaw in the CPI.

We have used the CPI as the deflator for wages, but recognise that cost of living measures will capture other aspects of the buying power of wages, such as total housing purchase costs (including land and mortgage costs). The ABS publishes a range of living cost indexes (ABS 2019c), but these have not been used in the figures shown in this Bulletin. Nevertheless, the ABS selected living cost index for employees rose by 7.2 per cent between 2012-13 and 2017-18 — a period of particular nominal wage stagnation — while the CPI increased by 9.8 per cent over the same period. To the extent that the living cost index adequately captures living costs of employees, real wage changes over this period have been slightly higher than suggested by the CPI.

More recently, two distinct wage growth episodes can be distinguished — buoyant increases during the mining boom, and in its aftermath, listless growth. Notwithstanding relatively high inflation, in the first wage growth phase from 2002-03 to 2012-13, nominal wage growth was about 5 per cent per year, well above the average increase in consumer prices of about 2.8 per cent (and growing more rapidly than productivity). This pattern was common

across the economy, though it was far stronger in those industries most stimulated by the resources boom — the *mining, construction, and professional, scientific and technical services* industries, the latter including people with specialist technical skills relevant to mining (figure 3.2).

Table 3.1 All real consumer wage measures show a slowdown, but by varying degrees

Average annual growth (per cent), 2002-03 to 2017-18^a

Wage measure	2002-03 to 2012-13	2012-13 to 2017-18	Change
1. Growth in real wage price index including bonuses	1.0	0.4	-0.6
2. Growth in adult male full time real ordinary time earnings	1.9	0.2	-1.7
3. Growth in adult male full time real total earnings	1.9	0.2	-1.7
4. Growth in male real total earnings	1.8	-0.5	-2.3
5. Growth in adult female full time real ordinary time earnings	1.7	0.9	-0.8
6. Growth in adult female full time real total earnings	1.6	0.9	-0.8
7. Growth in female real total earnings	1.5	0.9	-0.7
8. Growth in adult full time real ordinary time earnings	1.8	0.4	-1.4
9. Growth in adult full time real total earnings	1.8	0.3	-1.5
10. Growth in real total earnings	1.6	0.0	-1.6
11. Growth in real adjusted hourly compensation of employed	2.0	0.1	-1.8

^a Measure no. 11 corresponds to that used in figure 3.1. It is the most comprehensive measure of actual earnings in all sectors and by *all* of the employed, but includes all changes in labour income that reflect changes in the composition of jobs and pay changes due to different takeup of overtime and penalty rates. In contrast, the methodology underpinning the real wage price index (measure 1) is like that of the CPI, and controls for changes in the ‘basket’ of jobs, for example reductions in overtime use or switches between casual and part or full time work. The first indicates what has happened to labour income per hour over time (which is what determines the overall purchasing power of one hour of work), while the second measures better the wage growth that a worker would experience if there were no changes in their job.

Sources: ABS (2019, *Average Weekly Earnings, Australia*, Dec 2018, Cat. no. 6302.0, table 3); ABS (2019, *Wage Price Index, Australia*, Dec 2018, Cat. no. 6345.0, table 7b); and for measure 11, as specified in figure 3.1.

In the second phase until 2017-18, the outcomes were reversed, with average nominal wage rate growth at only about 2 per cent (table 3.2), which with inflation running at just 1.9 per cent per year, meant real consumer wage growth of about 0.1 per cent per year. Wage growth slowed particularly in those industries linked to the resources boom, but the slowdown affected most (but not all) industries. This period of flat real consumer wages growth in this second phase is the longest since the wage stagnation experienced in the late 1980s and early 1990s, a time coinciding with the Prices and Income Accord (when unions agreed to trade off real wages growth to contain inflation) and a recession.

Table 3.2 Real consumer wages and real producer wages are following different trajectories

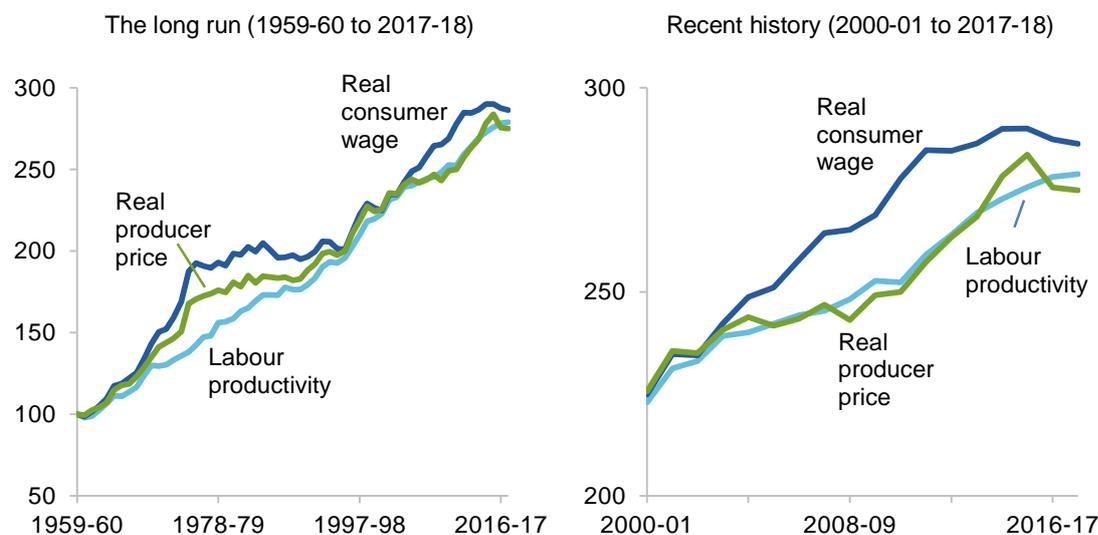
Average yearly growth rates (per cent), 2002-03 to 2017-18^a

	Real consumer wage	Real producer wage	Labour productivity	Nominal wage	Consumer price index	Producer price index
2002-03 to 2012-13	2.0	1.0	1.2	5.0	2.8	4.0
2012-13 to 2017-18	0.1	1.1	1.2	2.0	1.9	0.9
Change	-1.8	0.1	0.0	-3.0	-0.8	-3.1

^a The nominal wage rate is labour income per hour of all employed people (including the self-employed). The producer price index is the implicit price deflator for GDP. Labour productivity is real GDP per hour worked. The real consumer wage is the nominal wage deflated by the consumer price index, while the real producer wage is deflated by the producer price index (proxied by the GDP implicit price deflator).

Source: As specified in box 3.1 and figure 3.1.

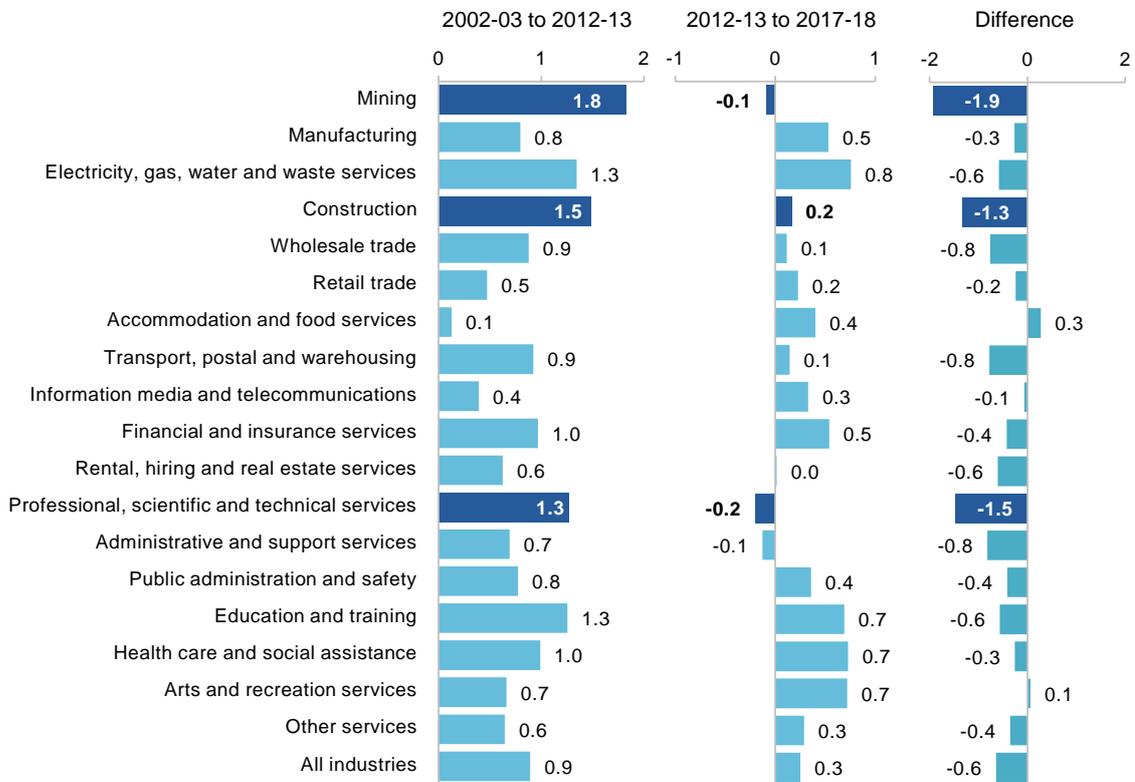
Figure 3.1 Current wage stagnation is only rivalled by the mid-1980s
Index (1959-60 = 100)^a



^a Wages comprise compensation of employees from the National Accounts, plus imputed labour income of the self-employed, calculated using the approach described in the data annex.

Sources: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, tables 1 and 6); ABS (2018, *Estimates of Industry Multifactor Productivity*, 2017-18, Cat. no. 5260.0.55.002, table 14); ABS (2018, *Labour Force, Australia, Detailed, Quarterly*, Aug 2018, Cat. no. 6291.0.55.003, table 11); and ABS (2019, *Consumer Price Index, Australia*, Dec 2018, Cat. no. 6401.0, tables 1 and 2).

Figure 3.2 Wage stagnation varied markedly by industry
Average annual real wage growth by industry by period (per cent per year)^a



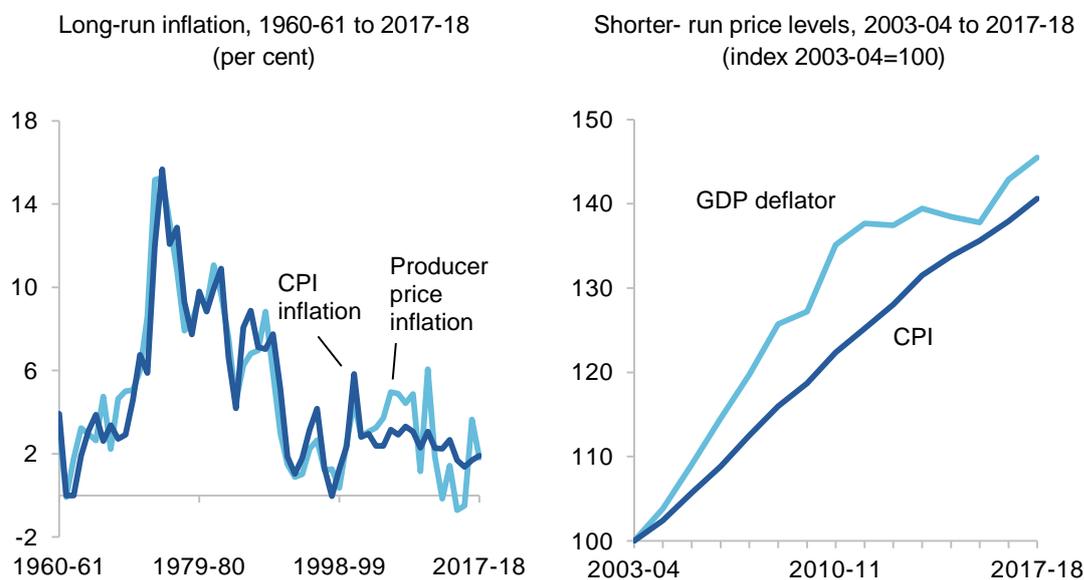
^a The wage measure shown here relates to non-agricultural industries and uses the wage price index (WPI) (box 3.1) and is therefore a different measure of wage stagnation from that shown in figure 3.1 and table 3.2. The ABS only reports data on the WPI at the industry level for the combined public and private sector with bonuses excluded, which is why there is a small difference between the value shown for all industries in this chart compared with the WPI measure used in table 3.1.

Sources: ABS (2019, *Wage Price Index, Australia*, Dec 2018, Cat. no. 6345.0, table 9b) and ABS (2019, *Consumer Price Index, Australia*, Dec 2018, Cat. no. 6401.0, tables 1 and 2).

By definition, the fact that real producer wages follow labour productivity in recent years, while real consumer wages do not, must reflect differences in the pathways for producer and consumer prices (Kirchner 2019). For much of the period from the 1960s to 2017-18, consumer and producer price changes followed a very similar pattern. This broke down in the early 2000s as commodity prices boomed, with a more protracted response of consumer to producer prices (figure 3.3).¹⁰

¹⁰ For the period from 1959-60 to 2004-05, the movement of consumer prices can be characterised by an error-correction model of the form $\Delta \log PC_t = 0.015 + 0.668 \Delta \log PP_t - 0.32 (\log PC_{t-1} - \log PP_{t-1})$ (with $R^2=0.92$), where PC are consumer prices and PP are producer prices. The coefficients on this simple model were stable for sub-periods within that period. However, for the period from 2005-06 to 2017-18, the estimated model changed abruptly to $\Delta \log PC_t = 0.015 + 0.259 \Delta \log PP_t - 0.098 (\log PC_{t-1} - \log PP_{t-1})$, which has a different type and degree of dependence between the two prices, and slower adjustment.

Figure 3.3 The big divergence — the dynamics of producer and consumer prices



Sources: ABS (2018, *Australian System of National Accounts*, 2017-18, Cat. no. 5204.0, table 1); and ABS (2019, *Consumer Price Index, Australia*, Dec 2018, Cat. no. 6401.0, tables 1 and 2).

Therefore, one interpretation of recent real wage pathways is that, with the unprecedented shift in the terms of trade during the resources boom, producer prices were disproportionately affected by the prices of commodities (and by the prices of inputs into the resources sector), which did not carry through to consumer prices to any great extent (a break from the past). Households consume relatively modest amounts of these commodities. This raised the real consumer wage. When the commodity boom subsided, producer price growth flattened, while consumer prices continued to grow, weakening nominal and real consumer wages. As noted in a recent Reserve Bank of Australia paper:

Seen over a longer timeframe, the divergence between consumer wages and labour productivity appears to have been a temporary phenomenon and some of the stagnation in consumer wages over recent years is part of the adjustment process to the unwinding of the mining boom. (La Cava 2019, pp. 5–6)

While the coincidence of the stagnation in the growth in nominal and real consumer wages and the end of the resources boom lends substantial weight to this perspective, it may only partly explain recent wage and consumer price movements. Other countries have experienced low wage growth without any terms of trade shocks as their triggers. And real consumer wage growth in Australia has not shown any sign yet of a resurgence. Given this, various other explanations have been given for weak real wage growth (box 3.2). While some may add explanatory power for real wage developments, it seems likely that, in an Australian context, the resources boom and its aftermath have played a major contributing role.

Box 3.2 Additional explanations for slow wages growth

Many explanations have been put forward to explain the recent weakness in wages growth. These include:

- spare capacity in the labour market (Department of the Treasury 2017; Heath 2018; Jacobs and Rush 2015; Lowe 2018), particularly given that the gap between the unemployment and underemployment rate (which used to be positive) has become negative since 2002 and has widened in the more recent period from November 2013 (ABS 2019b). However, overall underutilisation rates have been trending downwards, while labour force participation rates have been rising, suggestive of less discouraged workers and a tighter labour market. Vacancy rates at the end of 2018 are higher than any time over the last decade (ABS 2019a). Nevertheless, it may be that the level of labour utilisation that creates wage pressures has shifted upwards, which would imply that increased aggregate demand could lift wage growth without raising inflation. The Reserve Bank of Australia has overestimated wages since 2011 because the historically stable relationships used for forecasts have broken down (Cassidy 2019)
- declining inflationary expectations affecting negotiated wage outcomes (though this seems unlikely to explain the full observed magnitude of real wage growth stagnation) (Department of the Treasury 2017; Jacobs and Rush 2015)
- globalisation, increased import competition, outsourcing and a lower terms of trade putting pressure on firms to constrain costs and the need for the real exchange rate to adjust to improve international competitiveness of Australian firms (though these factors would need to be reconciled with stable or increasing business profitability) (Weir 2018)
- the effects of structural change and increased employment in lower productivity activities. While this may be an explanator for longer-term slower wage growth, the recent decline in wage growth appears to be more a within-industry than between-industry outcome (Weir 2018), which is not consistent with a standard structural change argument (Coelli and Borland 2016)
- the large expansion in the number of immigrant workers, especially temporary migrants (including working students). The evidence to date does not suggest that this has played a major role (Brell and Dustmann 2019; Breunig, Deutscher and To 2017)
- increasing casualisation of the workforce, part-time employment and job insecurity (whether actual or perceived) (Department of the Treasury 2017; Lowe 2018; Weir 2018). In fact, part-time employment trends aside, labour job tenure has increased, casualisation rates are stable, as are self-employment trends, and perceptions of insecurity have fallen (Borland 2017; PC 2019, p. 91). The trend in part-time work, while still broadly upwards, has slowed noticeably for the period from mid-2003 to February 2019. Econometric analysis does not find any impacts (Lass and Wooden 2019)
- weaker labour market dynamism as measured by slowing rates of job-to-job transition. Such transitions often reflect employee job changes to better use their skills (or to acquire them) or the shift from lower to higher productivity firms, with associated wage increases. There is good evidence of wage pressures through this mechanism for the United States (Danninger 2016; Moscarini and Postel-Vinay 2017) and some OECD countries (Engbom 2017). However, ABS data suggest small changes in the share of people with less than 5 years tenure with businesses from 1972 to 2018, and no change since 1994 (ABS 2018b). That said, the employer-to-employer transition rate *did* fall during the recent period of wage stagnation, while the frequency of wage changes in the economy has fallen, also consistent with the impact of lower transition rates (Cassidy 2019)

(continued next page)

Box 3.2 (continued)

- changes to workplace relations laws that weaken employee bargaining and declining union membership (Weir 2018). However, the union wage growth premium — an indication of union bargaining power — has not declined (Bishop and Chan 2019). That finding would not rule out weaker bargaining power by workers generally — whether represented by unions or not
- changes in the quality and composition of labour services, suggested by the fact that the stagnation evident from the wage price index (which controls for these changes) is less than for other wage measures that do not.

Other economies have also experienced an appreciable slowing in real wages growth over recent years (OECD 2018b), though a (partly) shared pattern across countries does not imply a shared explanation. Nor should there be an expectation that one factor lies behind wage stagnation. For instance, adaptation of prices to the resources boom may be a part explanation in the Australian context, but the boom may have masked other longer-run trends.

As yet there is no consensus about the causes of the stagnation or its likely persistence. While aggregate data of the kind described in this Bulletin provides some insights, data obtained from longitudinal firm and employee-based surveys will ultimately shed most light on the sources of wage stagnation and its incidence among different types of employees and firms. In Australia, the most promising insights will likely arise from analysis of the Linked Employer-Employee Database (LEED), and the Business Longitudinal Analysis Data Environment (BLADE).

Accordingly, the degree to which slow wage growth will persist is unclear, though the historical experience suggests that over the long run, an ever *widening* gap between real consumer wages, real producer wages and labour productivity is improbable.

The slow pace of real hourly wages has not translated into significant increases in household income inequality.¹¹ To some extent, this reflects that the resources boom favoured relatively high-income households, and so these households were also more affected by its end (PC 2018 p. 45). Consistent with this, the lower the relative weekly earnings of an industry relative to mining, the less was the slowdown in wage rates from the boom to the bust years (figure 3.4).¹² Real wage rates actually accelerated after the resources boom for both the *accommodation and food services* and *arts and recreation services* industries, which had the two lowest wage relativities to *mining* (with, respectively, average weekly earnings of 22 and 33 per cent of mining earnings in May 2013). Another contributing factor to this pattern is that many employees in low-wage industries have their wage levels determined by the minimums specified in industrial awards.¹³ In contrast, in industries like mining, wages

¹¹ Based on equivalised household income from ABS (2017, *Household Income and Wealth, Australia, 2015-16*, Cat. no. 6523.0, table 1).

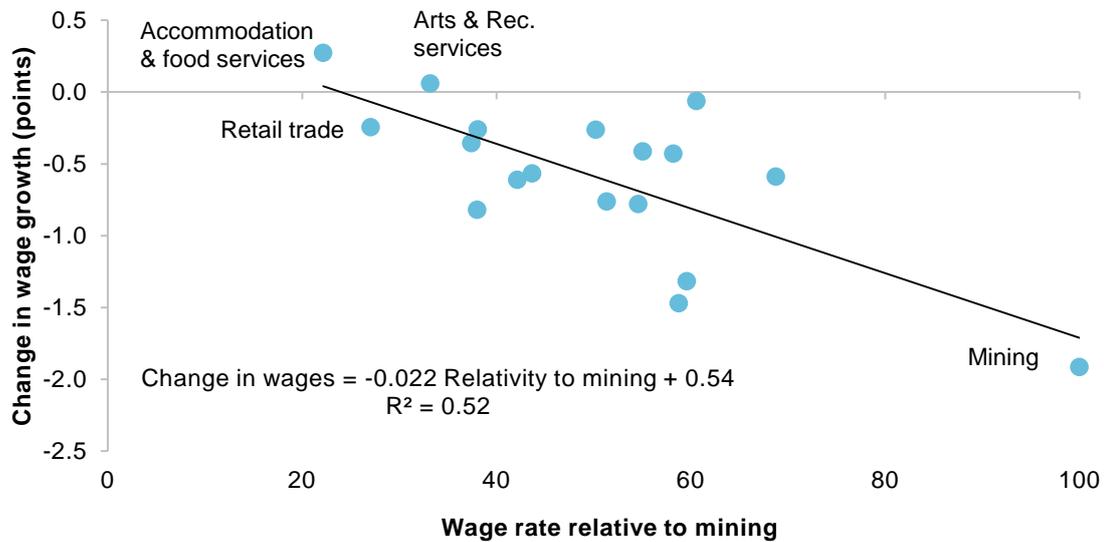
¹² The average weekly earnings are from ABS (2019, *Average Weekly Earnings, Australia, Nov 2018*, Cat. no. 6302.0) using the relativities for May 2013, while the data on changes in wage rates by industry are from figure 3.2. The industry wage relativities explained about 50 per cent of the differences in industry wage growth rates between the periods 2003-04 to 2012-13 and 2013-14 and 2017-18.

¹³ The RBA found that wage growth varies by wage-setting method, with the least stagnation for award-determined wages and the greatest for those determined in enterprise agreements and individual agreements (Cassidy 2019).

were often well above the award during the resources boom, and so the floors set in industrial awards did not constrain the wage reductions that followed after the end of the boom.

Regardless, while labour productivity and real consumer wage growth are not always closely tied to one another, the fact that they ultimately tend to converge is encouraging, so long as labour productivity growth itself is adequate.

Figure 3.4 The slowdown in wage growth rates is greater for industries with high relative wages^a



^a The change in wage growth (in percentage points) is defined as the difference between the average wage growth rate from 2012-13 to 2017-18 and that from 2002-03 to 2012-13. This measures the acceleration or deceleration of wage growth. The growth in wage rates are based on wage price indexes for ordinary time hourly rates of pay excluding bonuses. The wage relativity is the average total weekly earnings in any given industry in May 2013 relative to mining expressed in index form.

Sources: Estimates based on: ABS (2019, *Average Weekly Earnings, Australia*, Cat. no. 6302.0, table 10I); ABS (2019, *Wage Price Index, Australia*, Dec 2018, Cat. no. 6345.0, table 9b); and ABS (2019, *Consumer Price Index, Australia*, Dec 2018, Cat. no. 6401.0, tables 1 and 2).

4 Australian productivity trends in an international context

This chapter puts recent Australian productivity trends into an international context to identify commonalities and differences with broadly comparable developed economies.

4.1 Current productivity levels

Australia has relatively high productivity levels by international standards

Australian labour productivity in 2017 (the latest available) was over US\$52 per hour worked in 2010 prices (figure 4.1).¹⁴ This value adjusts for the differences in purchasing power across countries (so-called purchasing power parity or PPP). This placed Australia 15th highest among the 36 OECD economies, making it one of the more productive (and affluent) economies in the world.

Comparative productivity performance from a broader perspective

Productivity measured as output per hour is not necessarily reflected in output per *person*. A country where the labour force is relatively low or unemployment relatively high, could achieve high productivity per hour, but fail to mobilise many people in the economy. France falls into this group. In contrast, Australia has relatively high aggregate engagement in employment compared with several G7 economies that have higher output per hour (figure 4.2).¹⁵ Accordingly, Australia's overall output per person is better than might be suggested by focusing on hourly measures.

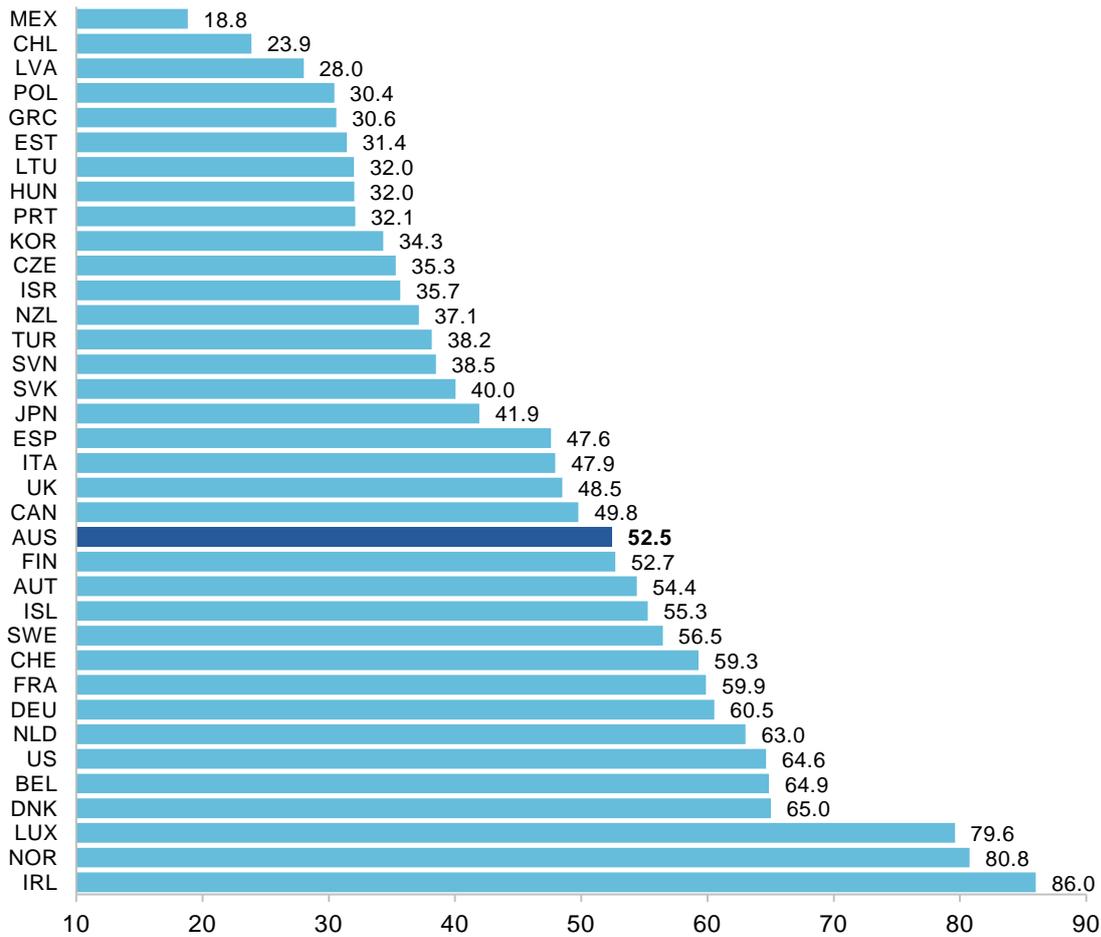
On face value, the US performs well on all counts from this broader perspective, as it has high productivity per hour, higher participation rates and lower unemployment rates than some other G7 countries. However, there is significantly more dispersion in wages across workers in the United States than Australia. Wages for lower skilled workers in the United States are generally lower than in Australia. Low paid workers, the unemployed and those unable to work in Australia have the benefit of a relatively more generous income and social safety net than their counterparts in the United States (PC 2018).

¹⁴ The OECD data are detailed on a 'calendar-year' basis. The Australian data are for the financial year that begins in that calendar year, such that the data for 2017 relate to the Australian financial year 2017-18.

¹⁵ The G7 consist of Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

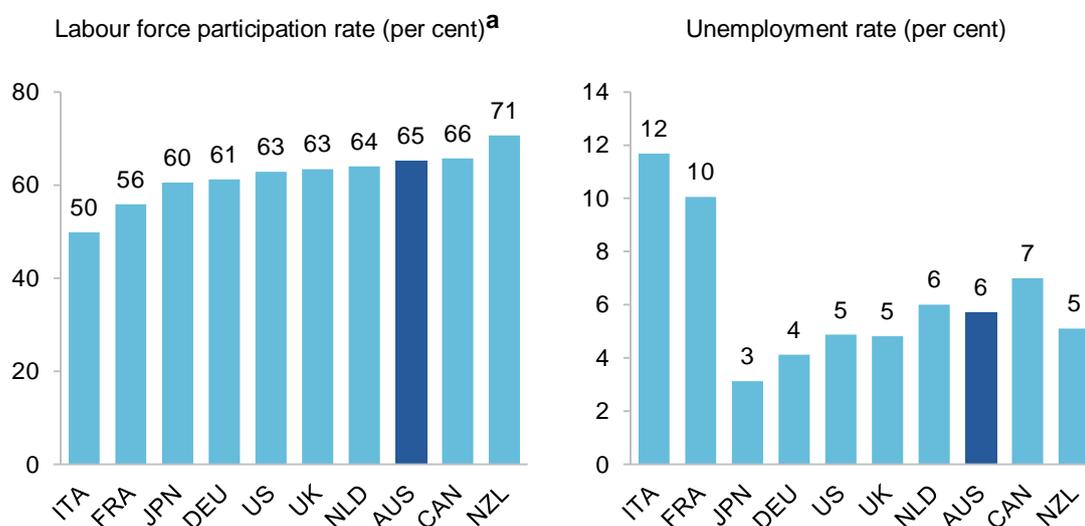
This highlights the need to consider a country’s productivity performance within a broader economic context, given the potential economic trade-offs involved (such as between productivity growth and the extent of labour market participation, the level of unemployment, average working hours, job security, wage levels and income dispersion).

Figure 4.1 Level of labour productivity, 2017
 \$US per hour worked (2010 prices, PPP-based)



Source: Based on the standardised international productivity data published by the OECD in the OECD.Stat database.

Figure 4.2 **Involvement of the population in work, 2017**



^a Percentage of the population of working age engaged in employment or looking for work.

Source: OECD.Stat database.

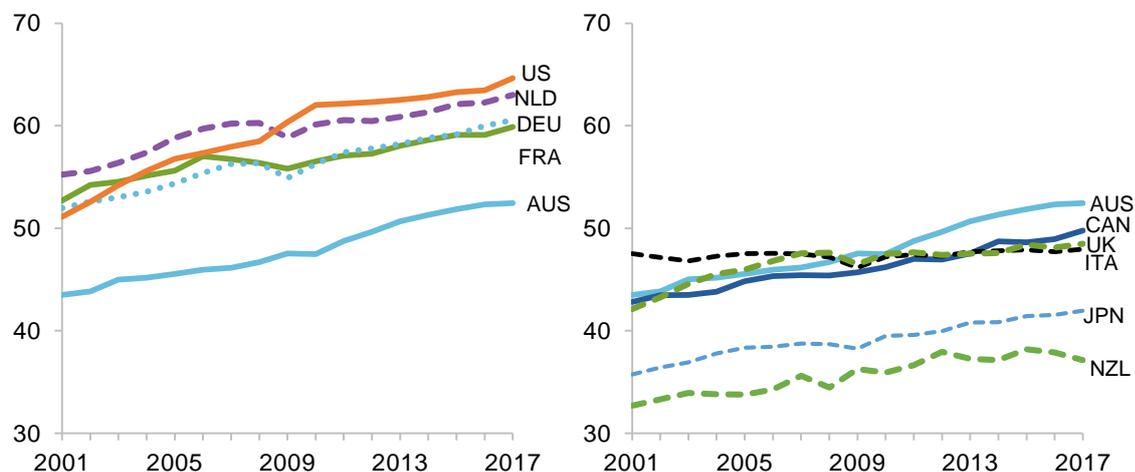
4.2 Recent global productivity trends

Productivity *levels* at any time encapsulate the relative fortunes of each economy up to that point. All economies' productivity levels have waxed and waned to differing degrees and over different periods, such that no one OECD economy always outperforms the others (figures 4.3 and 4.4).

Australia had relatively poor productivity levels (measured as GDP per hour) in 2001, but relative to its peers, it grew faster in the ensuing period (figure 4.5). Australian productivity growth over this period exceeded all G7 economies other than the United States.

The United States had a similar acceleration that led to it overtaking several countries, but more than anything else, the business cycle and the state of the labour market, underpinned its performance. The steep rise at the time of the global financial crisis (GFC) for the United States primarily emanated from the labour shedding that saw the unemployment rise quickly. The result was that the United States generally managed to achieve weak, but positive, real GDP growth from substantially fewer hours worked. In the recovery phase after the GFC, productivity performance was weak reflecting relatively strong and stable real GDP growth accompanied by lower unemployment and increases in labour supply.

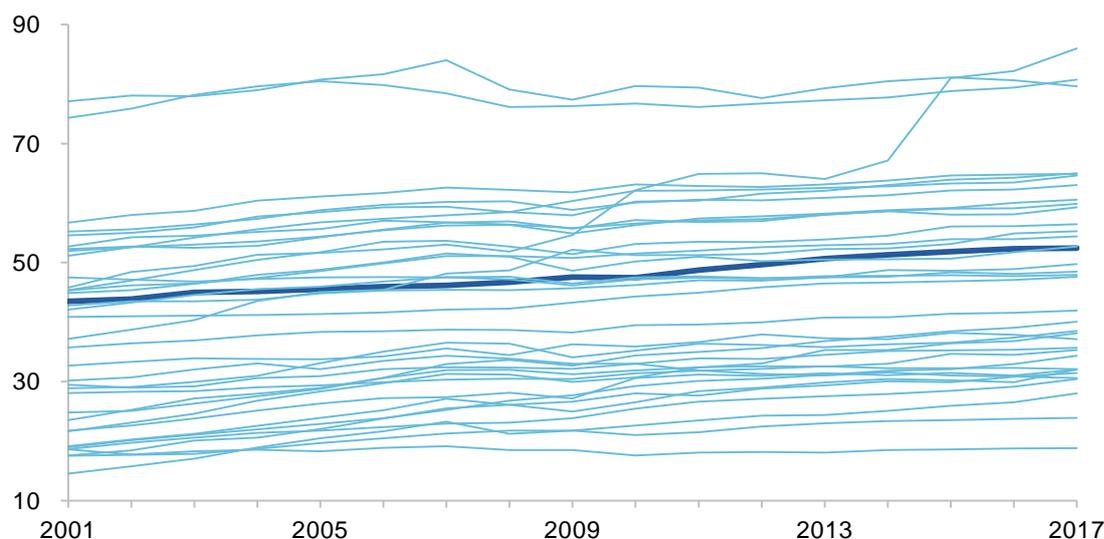
Figure 4.3 Recent trends in labour productivity, 2001 to 2017^{a,b}
 G7 and selected other countries, \$US per hour worked (2010 prices, PPP-based)



a Labour productivity is expressed as GDP per hour worked. **b** The data for Australia uses the OECD's estimate for the level of productivity in dollar terms for 2017, and backcasts this using ABS growth rates in constant price GDP per hour worked. This is to overcome anomalies between the OECD and the ABS data. This backcasting applies to all estimates below, unless otherwise specified.

Source: OECD.Stat database.

Figure 4.4 Trends in labour productivity for all OECD countries^{a,b}
 \$US per hour worked, 2001 to 2017 (2010 prices, PPP-based)



a Labour productivity is expressed as GDP per hour worked. **b** Australia shown in darker blue.

Source: OECD.Stat database.

Figure 4.5 **Average labour productivity growth, 2001 to 2017**
G7 and selected other countries (per cent per year)



Source: OECD.Stat database.

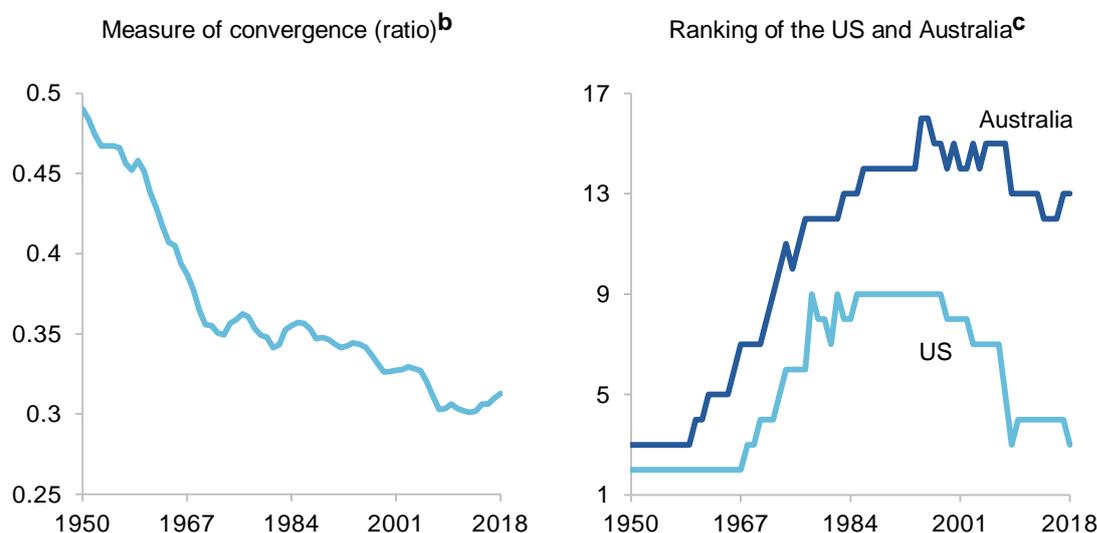
More generally, Australia's rank among the 23 OECD countries for which long series of labour productivity are available shows that the slow decline in Australia's ranking reversed in 2000s (as did that of the United States). Notwithstanding that relative productivity levels between countries shift backwards and forwards over time, over the very long run, there has been convergence — though this slowed in the 1970s, and vanished in 2008 (figure 4.6). Australia was one of those countries whose relative 'outperformance' contributed to the disappearance of convergence.

Sources of growth in productivity vary by country

While many OECD economies had broadly similar average growth rates, the sources of this growth varied markedly (figure 4.7). Unsurprisingly given the mining boom, Australia had the highest contribution from capital deepening. In contrast, the United Kingdom and Germany had the highest relative contributions from multifactor productivity growth.

Nevertheless, considering trends rather than year on year changes, *some* contribution by capital deepening was ubiquitous across the relevant OECD countries, and was particularly steep during the GFC, prior to its stagnation as economies recovered. The dispersion in MFP growth rates for the entire period from 2000 to 2017 was much greater, and indeed, a few countries aside, they do not seem noticeably higher before compared with after the GFC. One of the common features, however, is the near universal increase in MFP in 2017, whose origin is unclear.

Figure 4.6 Incomplete convergence in labour productivity levels^a
Selected OECD countries, 1950 to 2018



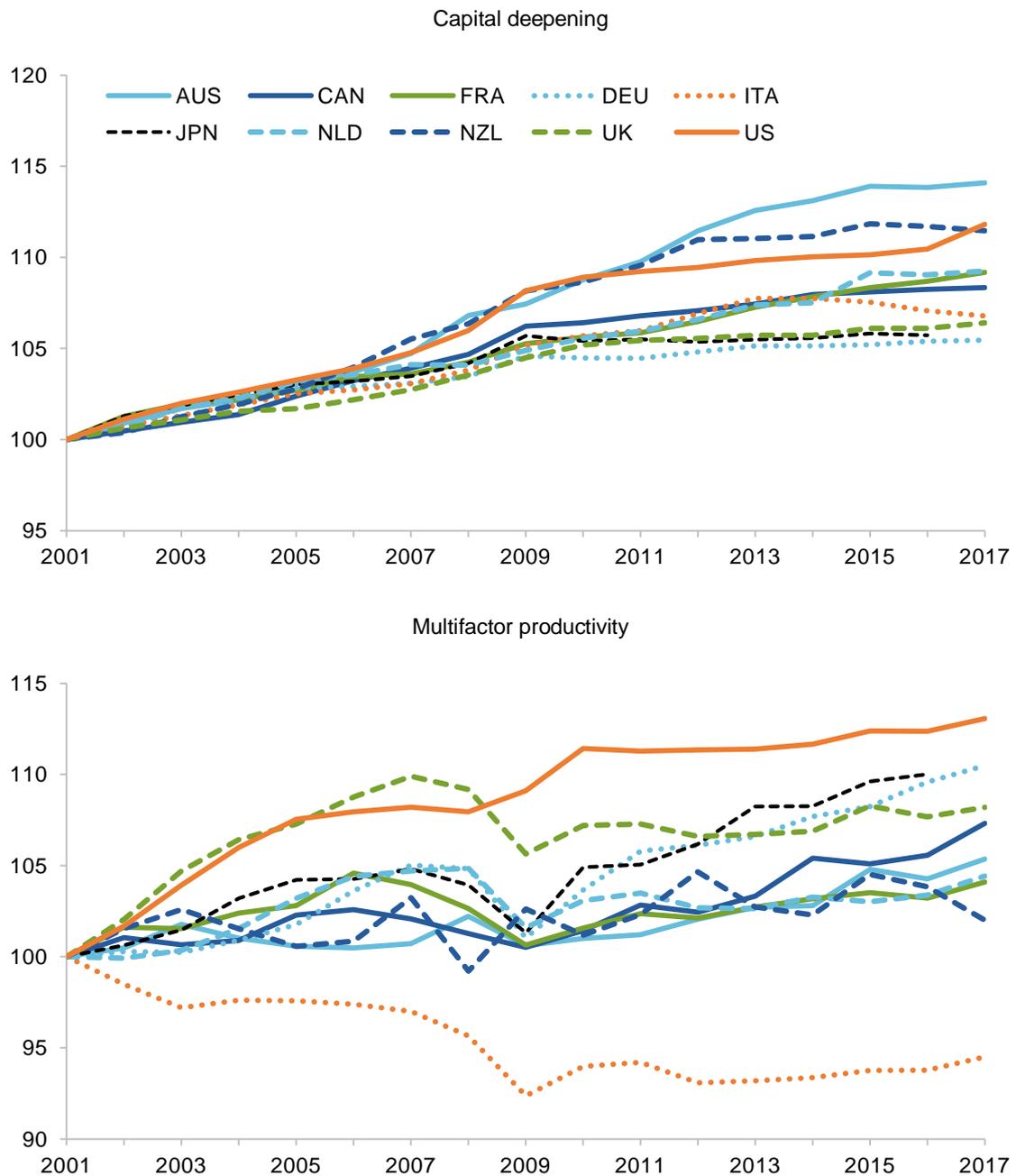
^a The data used is sourced from the Conference Board. Although broadly similar, the Conference Board data cover far more years than the OECD data and, hence, are used here. The Conference Board adjusts for reductions in ICT prices that are not incorporated in the GDP deflator. ^b Convergence is measured as the coefficient of variation (referred to as sigma convergence). It is calculated as the ratio of the standard deviation to the mean at each point in time of labour productivity levels across the 23 OECD countries for which complete data are available. A lower coefficient indicates a fall in the dispersion of productivity levels across countries. ^c The rank of Australian and US labour productivity among the 23 OECD countries, with 1 being the highest.

Source: TED 2018 database (ICT adjusted data).

The short-run rising contribution of capital deepening during the GFC among many OECD countries is largely an artifice of the statistics, labelled by the European Central Bank (2017, p. 53) as “‘artificial’ capital deepening”, and not an indicator of real trend shifts in the long-run capital-labour ratio. The severity of the economic downturns in the United States, European economies and elsewhere resulted in reductions in labour inputs (through unemployment and reduced hours of work) and lower utilisation of capital. While the former is recorded in national statistics, lower utilisation of capital is not, and by definition, this raises apparent capital deepening. Had the numbers included weakening capital utilisation, the story would have been quite different, with lower capital deepening, and given its calculation as a residual, higher MFP growth. This is why analysis across peaks in the business cycle is preferable for identifying underlying productivity and capital deepening trends. It is for this reason that productivity analysis typically focuses on productivity cycles where fluctuations in capacity utilisation can be thought of as being broadly similar.

Figure 4.7 **Contributions to labour productivity growth by economy, 2001 to 2017**

Indexes (2001=100)^a



^a Estimates of MFP and capital deepening for Australia are based on ABS not OECD data.

Source: OECD.Stat database.

4.3 The great productivity slowdown

Most developed economies experienced a marked slowing in labour productivity growth during the 2000s compared with the previous 30 years. This slowdown is frequently referred to as ‘the great productivity slowdown’ or ‘secular stagnation’. This slowdown dominated the productivity landscape after 2000.

The extent, timing and the duration of the slowdown varied across economies and industries (figure 4.8 and OECD 2018a, p. 56). For example, Italy was the first major economy to experience significant productivity stagnation, with growth slowing precipitously from 2001 compared with past decades. The global slowdown predated the GFC in most countries, though the crisis accentuated it.

There are a multiplicity of conjectures for the slowdown, but the evidence about which matters most remain fragmentary (box 4.1). While the fact that most countries experienced a slowdown at much the same time points to some common factors, this downplays the diversity of experiences about the exact timing, the affected industries and severity of the slowdown across different countries. Some country-specific factors must be at work, illustrated by the Australian experience — where there has been a slowdown, but not as extreme as other countries. Australia’s productivity growth rates have been more consistent over time than some of its peers, in part a reflection of the relatively low growth rate in the 1971–1990 period.

Box 4.1 Hypotheses explaining the great productivity slowdown

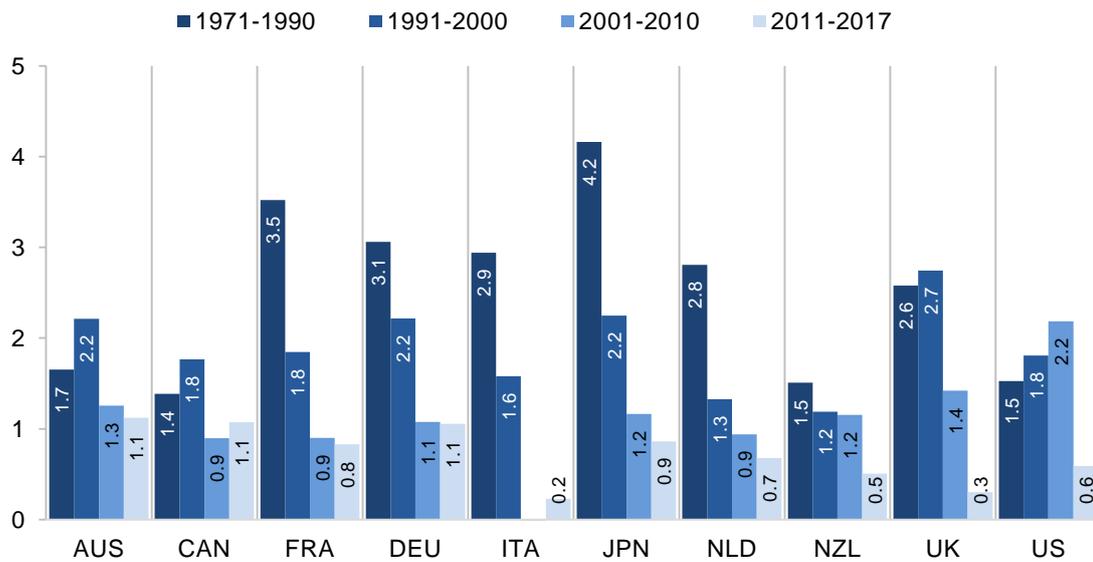
There has been much analysis and debate on the causes of the great productivity slowdown. These include:

- recent innovations being more incremental in nature compared with earlier innovations that were more transformative (Fernald 2015; Gordon 2012, 2016)
- output measurement error associated with the adoption of new technologies (Mokyr 2014)
- the weaker corporate balance sheets, cost cutting and short-term profitability being put ahead of the investment in research, development and innovation needed for longer term growth
- increasing economic uncertainty and lower business investment
- the slowing in the rate at which new knowledge and technologies is disseminated from frontier firms to non-frontier firms (Andrews, Criscuolo and Gal 2015)
- changing market structures (such as the growing importance of knowledge-based capital and winner-takes-all dynamics or mismatches between and deficiencies in skills) (Bloom, Sadun and Van Reenen 2016; McGowan and Andrews 2015a, 2015b)
- the growing importance of non-market service industries such as health and education, which have lower measured productivity
- the ageing of the population (Feyrer 2007; 2008)
- the slowing pace of structural reform and global trade integration (Adler et al. 2017).

Of course, greater consistency in outcomes is not necessarily good if it entails reproducing mediocrity. The most interesting feature of Australia’s historical labour productivity performance is the transitory peak growth in the 1990s (an era where there was large-scale uptake of ICT and significant microeconomic reforms).

Figure 4.8 Time has wearied many economies

Average labour productivity growth rates over successive eras (per cent)^a



^a Productivity growth rates are based on averages of annual changes in real GDP per hour (PPP adjusted) for each year in the span shown. For example, the average growth rate for 1971–1990 is the average of the growth rates of 1970-71 to 1989-90. ABS data are used for Australian growth rates.

Source: OECD.Stat database.

While many of the factors that might explain a global productivity slowdown also apply to Australia, the high reliance on commodity exports in Australia is likely to have counteracted these. Australia’s advantage in mining in particular has enabled it to complement the fast growing Chinese and Indian economies more so than most developed economies. The higher growth rates in these economies increased demand for Australian iron ore, coal, natural gas and other commodities. This has benefited national production and, through a higher terms of trade, national income.

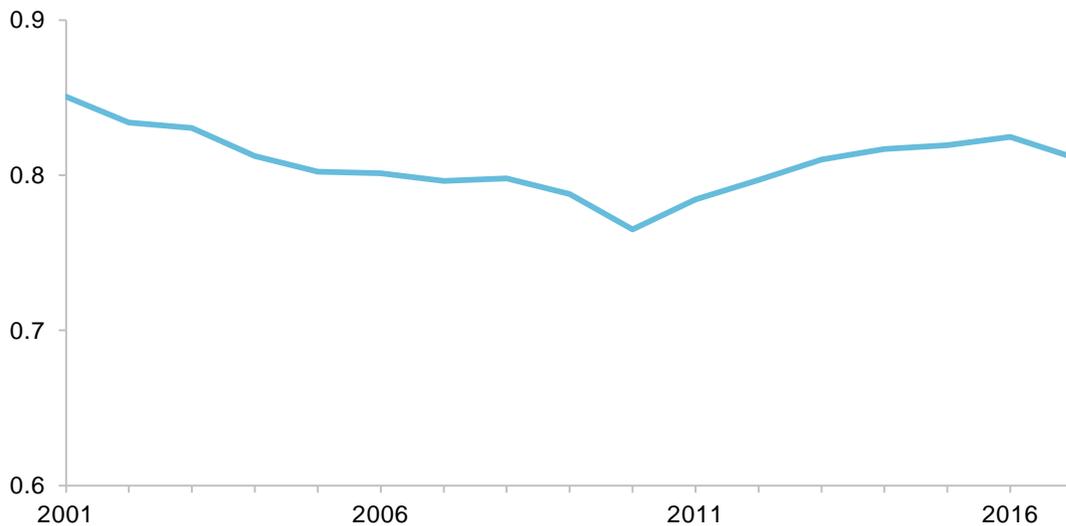
4.4 Potential for productivity catch up

It will be difficult for Australia to achieve the same productivity levels as better performing economies

Notwithstanding the increase in recent years, over the longer run, Australia's productivity level has still fallen further behind the global frontier as measured by US performance (figure 4.9).

Figure 4.9 Australia's long-run productivity performance is taking it further below the global productivity frontier

2001 to 2017 (ratio of Australia/US real 2010 PPP-adjusted labour productivity)^a



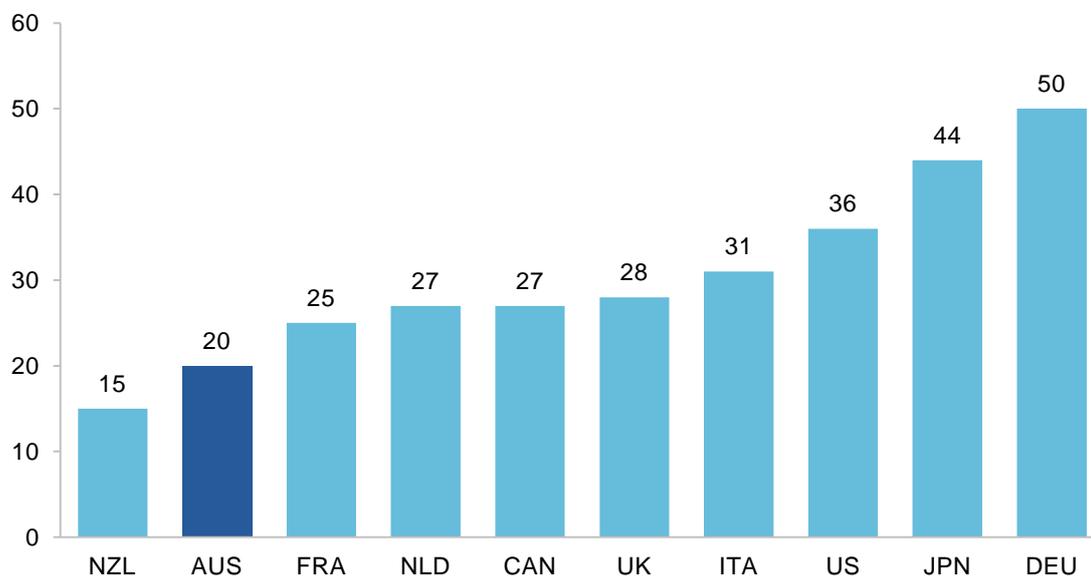
^a The data for Australia use the OECD's estimate for the level of productivity in dollar terms for 2017, and has back cast these using ABS growth rates in constant price GDP per person. This reflects anomalies between the OECD and the ABS data.

Source: OECD.Stat database.

Several factors suggest that the Australian economy is unlikely to achieve the same *level* of productivity as the United States. Some studies have attributed part of the persistent productivity gap with the United States to differences in historical and geographic circumstances (Battersby 2006; Boulhol, Serres and Molnar 2008; PC 2017). Australia's relatively small population prevents it from achieving the same economies of scale and scope in production as the United States. Australia is also further away from many major world markets.

Australia also has a very different industrial structure to most developed economies, with weaker capabilities in high value-added manufacturing industries such as aerospace, automotive design and assembly and computer design. Australian manufacturing is orientated towards lower value-added manufacturing such as food and beverage processing (figure 4.10).

Figure 4.10 **Share of manufacturing in high value-adding activities, 2015^a**
Per cent



^a High value-adding manufacturing is defined as: pharmaceuticals; organic and inorganic chemical manufacturing; plastics manufacturing; semiconductors; computer manufacturing; communications equipment manufacturing; surgical and medical instruments manufacturing; automotive parts; and aviation parts. This definition is based on US Department of Commerce, *1997 Economic Census Manufacturing Summary Series, General Summary*.

Source: OECD.Stat database.

... but scope exists for Australia to narrow the productivity gap

There is likely to be scope for catch-up for some industries (Dolman, Parham and Zheng 2007; PC 2017). Given the widespread dispersion in productivity levels across otherwise comparable firms (Andrews, Criscuolo and Gal 2015), improved diffusion of existing technologies and knowledge offers a cost-effective way for Australian firms and industries to narrow the gap with global leaders. Indeed, it has been already possible for individual Australian industries and firms to reach the global productivity frontier. Australian mining and, notwithstanding the difficulty in measuring its output, financial services have been found to lie on the global frontier (PC 2017).

Many economies face similar challenges to Australia

It is worth noting that many of the actual and potential challenges affecting productivity growth and living standards in Australia that have been identified throughout this Bulletin are shared by many other developed economies. These challenges include, but are not limited to, slowing economic growth, structural change away from goods producing industries towards service industries, slowing labour productivity growth, an ageing population, weak or slow real wages growth and weak investment. Indeed, many of these challenges are potentially more pressing in other economies.

A Data annex

This annex provides details on the methods and productivity data used in this Bulletin.

A.1 Industry coverage

Given the economy-wide focus of this edition of the *Productivity Bulletin*, the industry classification used covers the entire Australian economy (box A.1). It is the classification used by the Australian Bureau of Statistics (ABS) in its *Australian System of National Accounts* (Cat. no. 5204.0), a key source of industry-level productivity data (discussed in section A.2). This classification comprises the 19 divisions that make up the Australian and New Zealand Standard Industry Classification (ANZSIC), as well as *ownership of dwellings*, which also forms part of national production and national labour productivity.

These industries are grouped to aid the understanding of structural change in the Australian economy and to enable comparisons with previous *Productivity Bulletins* (box A.1).

Box A.1 Industry coverage used	
Market sector (12 industries)	Market sector (16 industries)
Agriculture, forestry & fishing	Market sector (12 industries) plus
Mining	Rental, hiring & real estate services
Manufacturing	Professional, scientific & technical services
Electricity, gas, water & waste services	Administrative & support services
Construction	Other services
Wholesale trade	
Retail trade	Non-market sector (4 industries)
Accommodation & food services	Public administration & safety
Transport, postal & warehousing	Education & training
Information media & telecommunications	Health care & social assistance
Financial & insurance services	Ownership of dwellings
Arts & recreation services	

Source: ABS (2015, *Australian System of National Accounts: Concepts, Sources and Methods*, Cat. no. 5216.0, pp. 427–28).

A.2 Australian data (chapters 1 to 3)

The primary source of productivity data — ABS (*Estimates of Industry Multifactor Productivity, 2017-18*, Cat. no. 5260.0.55.002) — focuses on industries in the market sector, where prices are observable. However, the economy-wide estimates of this Bulletin requires data for *all* industries in the Australian economy on a consistent basis. Given this, much of the data used in this Bulletin is sourced directly from the ABS *Australian System of National Accounts* (Cat. no. 5204.0), which cover all 20 industries in the Australian economy (box A.1).¹⁶

There are several data challenges in estimating long-run economy-wide estimates of productivity.

First, published data for some industries does not extend back to the same starting year as other industries. This is particularly problematic for the four industries recently added by the ABS to the market sector. Historical estimates for these industries are derived using the growth rates from a proxy series, typically the closest corresponding industry in an earlier published ABS series. Gabbitas and Salma (2016) provides a complete description of the backcasting approach, with its most important details set out below.

Second, the ABS does not publish any measure of capital services for the aggregate economy and the non-market sector (but does do so for net capital stocks). Consequently, the Commission has estimated these capital services to decompose labour productivity growth into the contributions made by capital deepening and multifactor productivity. The method used to estimate capital inputs is described below.

Output

Industry output is chain volume gross value added (GVA). It is published in the National Accounts for all industries back to 1974-75. Gross value added output is Gross domestic product less taxes less subsidies on products and (in early years in the data and the latest year) the ‘statistical discrepancy’. The growth rates of the two measures are very close. In most instances, this Bulletin uses GVA as its measure of output (chapters 1 and 2). However, given its common usage in analysis of wage growth, GDP per hour is used to measure labour productivity in chapter 3.

Labour inputs

The ABS does not publish the number of hours worked by each industry in the National Accounts or, for industries in the market sector, in its *Estimates of Industry Multifactor Productivity*.

¹⁶ The productivity data for market-sector industries published in the ABS *Australian System of National Accounts* are consistent with that published in ABS *Estimates of Industry Multifactor Productivity*. The former publishes more limited productivity data than the latter, but covers all industries in the economy.

Instead, the ABS publishes an index of hours worked for all industries in the National Accounts from 1985-86 to 2017-18. This series for each industry was extended back to 1974-75 using the growth rate in ABS hours worked data for the corresponding ANZSIC 1993 division supplied to the Commission by the ABS.

To enable aggregation of these series, each index of industry hours worked was converted into the number of hours worked using a three step process. First, the number of hours worked in each industry in 2016-17 (the reference year of the published index), was calculated by using the published levels in *ABS Labour Force, Australia, Detailed, Quarterly* (Cat. no. 6291.0.55.003). This required averaging of the four published quarterly values for hours worked per week for each industry to get a weekly average. Each weekly estimate was then scaled to give an annual estimate by multiplying by 52.14. Second, this level was applied to the published indexes for each industry to give the number of hours worked in each industry in each financial year. Third, the resulting estimate of hours worked in each industry was scaled proportionately to ensure that the total number of hours worked across the Australian economy aligned with the index published in the National Accounts in each year.

Capital inputs

For the 16 industries that comprise the expanded ABS market sector, the capital inputs are from the *ABS Estimates of Industry Multifactor Productivity* (Cat. no. 5260.0.55.002).

As noted above, the ABS does not publish a measure of capital services for the non-market sector and the economy as a whole. Instead, the growth in capital inputs for the remaining four industries — *public administration & safety, education & training, health care & social assistance* and *ownership of dwellings* — are proxied by the growth in their respective net capital stocks published in the National Accounts, adjusted to include the additional asset classes that form part of the ABS productivity capital stocks (land, ownership transfer costs and inventories).¹⁷

All of the industry capital input aggregations reported are the average of the industry growth rates weighted by their capital income share (technically, their rental value), which is the same methodology used by the ABS.

Labour productivity growth

Labour productivity growth is the growth in output less the growth in labour inputs.

¹⁷ The net capital stock should be highly correlated with capital services for these industries. This is because short-lived assets — the source of the bias from using net capital stocks as the capital input — tend to make up a relatively small share of their total capital stock. Moreover, apart from ownership of dwellings, which does not employ any labour, the three remaining industries use less capital than most industries as they are highly labour intensive.

Contributions to labour productivity growth

In line with the ABS approach, the contribution of capital deepening to labour productivity growth is calculated as the growth in the capital–labour ratio for each industry multiplied by the two-period average capital income share, where the growth in the capital–labour ratio is the growth in capital inputs less the growth in labour inputs.

The capital income shares exclude the implied labour incomes of the self-employed, which forms part of gross mixed income published by the ABS.¹⁸ This imputed labour income is derived using the difference between the published capital income shares for each industry that exclude the imputed labour income and those derived from the published factor income components that do not. This process is outlined in Gabbitas and Salma (2016).

The contribution from multifactor productivity is residually calculated as labour productivity growth not accounted for by capital deepening.

A note on business cycles

In general, productivity growth rates are calculated between productivity peaks (referred to as ‘a productivity cycle’), though it is common to use the most recent year as the end point for the current incomplete cycle. The last complete cycle was from 2003-04 to 2011-12, and productivity estimates for this period are used throughout this Bulletin. The last (incomplete) cycle in ABS productivity data is from 2011-12 to 2017-18, and is also used in this Bulletin and by the ABS in its reporting of recent trends. Since output growth has been relatively strong in 2017-18, the use of an incomplete cycle is unlikely to bias estimates of recent productivity trends.

The ABS indicates that the business cycle in the 1970s began with 1973-74, but data for this year are not available for all of the industries in the 16-industry market sector or the economy as a whole. Consequently, the growth rates are calculated from the 1974-75 index value. This makes little difference. Data for 12 selected industries in the market sector, which extends back further, show that the average growth rate for the full cycle from 1973-74 to 2017-18 was 2.23 per cent, while it was 2.21 per cent for 1974-75 to 2017-18 — a negligible difference.

A.3 International data (chapter 4)

International productivity comparisons require a common metric that adjusts for the different currencies used in each economy. They should also take into account differences in the extent to which a country’s production levels translate into consumers’ purchasing capacity,

¹⁸ In the National Account, gross mixed income is the income from production that accrues to the owners that comprise the unincorporated sector (the self-employed). It implicitly covers the return for the use of their labour (equivalent to wages received by workers) and the return for the use of their capital (equivalent to profits or dividends).

as higher prices effectively reduce the purchasing power of local production. ‘Purchasing power parity’ (PPP) adjustments to output and productivity addresses such price differences.

The international comparisons presented in chapter 4 are largely based on productivity estimates produced by the Organisation for Economic Co-operation and Development (OECD) and sourced from the *OECD.Stats* on-line database. These data have three advantages:

1. as far as possible, they have been standardised across countries
2. the constant price GDP and wages data adjust for differences in purchasing power across countries for a given base year. Values for other years are extrapolated using each country’s constant price measures of GDP
3. they can be linked to other economic data (such as population, employment and labour market data) to enable a richer story to be told.

The OECD data cover its 36 members and two non-OECD countries (Russia and South Africa). Most of the international comparisons in this Bulletin concentrate on the G7 economies, Australia, New Zealand and the Netherlands. This removes a variety of countries that are either not at the same level of economic development (primarily Eastern European countries, Turkey, Mexico and Chile), are similar to those included anyway, or have other differences that make them weak comparators (as in oil-rich Norway). As much as it would have been desirable to use the OECD data for Australia, the Commission found year-on-year growth rates in key OECD measures were not consistent with official ABS data (though long-term trends were generally well-aligned). Given this, the Commission has adapted the OECD data for Australia, using the OECD’s latest PPP-adjusted level of productivity, and backcasting using ABS growth rates. The reasons for the discrepancies are being investigated further.

In addition to the above global data, the Commission has used the Conference Board’s Total Economy Database (TED) for analysis that extends back further in time, though generally the OECD data is preferred.

References

- ABS (Australian Bureau of Statistics) 2016, *Australian System of National Accounts: Concepts, Sources and Methods, 2015*, Cat. no. 5216.0 2015, Canberra.
- 2018a, *Feature Article — Trends in the Labour Income Share in Australia*, Feature Article, Cat. no. 5260.0.55.002, Canberra.
- 2018b, *Participation, Job Search and Mobility, Australia, 2018*, Cat. no. 6226.0, Canberra.
- 2019a, *Job Vacancies, Australia, November 1018*, Cat. no. 6354.0, Canberra.
- 2019b, *Labour Force, Australia, Jan 2019*, Cat. no. 6202.0, Canberra.
- 2019c, *Selected Living Cost Indexes, Australia, Dec 2018*, Cat. no. 6467.0, Canberra.
- Adler, G., Duval, R.A., Furceri, D., Çelik, S.K., Koloskova, K. and Ribeiro, M.P. 2017, *Gone with the Headwinds; Global Productivity*, IMF Staff Discussion Notes 17/04, International Monetary Fund, Washington, DC.
- Andrews, D., Criscuolo, C. and Gal, P.N. 2015, *Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries*, OECD Productivity Working Paper no. 2, Organisation for Economic Co-operation and Development, Paris.
- Battersby, B. 2006, ‘Does Distance Matter? The Effect of Geographic Isolation on Productivity Levels’, *Treasury Working Paper*, Department of the Treasury, Canberra.
- Bishop, J. and Chan, I. 2019, *Is Declining Union Membership Contributing to Low Wages Growth?*, Research Discussion Paper RDP 2019-02, Reserve Bank of Australia, Sydney.
- Bloom, N., Sadun, R. and Van Reenen, J. 2016, *Management as a Technology?*, Working Paper 22327, National Bureau of Economic Research, Cambridge, MA.
- Borland, J. 2017, ‘Workers are Actually Feeling Less Insecure in Their Jobs’, *The Conversation*, 1 August.
- Boulhol, H., Serres, A. de and Molnar, M. 2008, *The Contribution of Economic Geography to GDP Per Capita*, OECD Economics Department Working Paper no. 602, Organisation for Economic Co-operation and Development, Paris.
- Brell, C. and Dustmann, C. 2019, ‘Immigration and Wage Growth: The Case of Australia’, Presented at Reserve Bank of Australia Low Wage Conference, 4–5 April, Sydney.
- Breunig, B., Deutscher, N. and To, H. 2017, ‘The Relationship between Immigration to Australia and the Labour Market Outcomes of Australian-Born Workers’, *Economic Record*, vol. 93, no. 301, pp. 255–76.
- Cassidy, N. 2019, ‘Low Wages Growth — An Introduction’, Presented at Reserve Bank of Australia Low Wages Conference, 4–5 April, Sydney.

-
- Coelli, M. and Borland, J. 2016, 'Job Polarisation and Earnings Inequality in Australia', *Economic Record*, vol. 92, no. 296, pp. 1–27.
- Danninger, S. 2016, *What's Up with U.S. Wage Growth and Job Mobility?*, IMF Working Paper no. 16/122, International Monetary Fund, Washington, DC.
- Department of the Treasury 2017, *Analysis of Wage Growth*, Working Paper, November, Department of the Treasury, Canberra.
- Dolman, B., Parham, D. and Zheng, S. 2007, *Can Australia Match US Productivity Performance?*, SSRN Scholarly Paper ID 1018881, Social Science Research Network, Rochester, NY.
- ECB (European Central Bank) 2017, 'The Slowdown in Euro Area Productivity in a Global Context', *ECB Economic Bulletin*, vol. 2017, no. 3, pp. 47–67.
- Engbom, N. 2017, *Worker Flows and Wage Growth over the Life-Cycle: A Cross-Country Analysis*, Working Paper, Princeton University.
- Fernald, J.G. 2015, 'Productivity and Potential Output Before, During, and After the Great Recession', *NBER Macroeconomics Annual*, vol. 29, no. 1, pp. 1–51.
- Feyrer, J. 2007, 'Demographics and Productivity', *Review of Economics and Statistics*, vol. 89, no. 1, pp. 100–09.
- 2008, 'Aggregate Evidence on the Link between Age Structure and Productivity', *Population and Development Review*, vol. 34, pp. 78–99.
- Gabbitas, O. and Salma, U. 2016, *VUMR Modelling Reference Case, 2009-10 to 2059-60*, Staff Working Paper, Productivity Commission, Canberra.
- Gordon, R.J. 2012, *Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds*, Working Paper no. 18315, National Bureau of Economic Research, Cambridge, MA.
- 2016, *The Rise and Fall of American Growth*, Princeton University Press, Princeton.
- Hatfield-Dodds, S., Hughes, N., Cameron, A., Miller, M. and Jackson, T. 2018, 'Analysis of 2018 Drought', *ABARES Insights, Department of Agriculture and Water Resources*, no. 2, pp. 1–7.
- Heath, A. 2018, 'The Evolving Australian Labour Market', Presented to Business Educators Australasia 2018 Biennial Conference, 5 October, Canberra.
- Jacobs, D. and Rush, A. 2015, 'Why is Wage Growth So Low?', *Reserve Bank Bulletin*, June Quarter, pp. 9–18.
- Kirchner, S. 2019, *Unbroken: Productivity and Worker Compensation in Australia and the United States*, United States Studies Centre, University of Sydney, Sydney.
- La Cava, G. 2019, 'The Labour and Capital Shares of Income in Australia', *Reserve Bank Bulletin*, March Quarter, pp. 1–22.
- Lass, I. and Wooden, M. 2019, 'Non-standard Employment and Wages in Australia', Presented at Reserve Bank of Australia Low Wage Growth Conference, 4–5 April, Sydney.
- Lowe, P. 2018, 'Productivity, Wages and Prosperity', Presented to the Australian Industry Group, 13 June, Melbourne.

-
- Luo, Q. 2018, *Disease Based Output Measures for Hospitals*, Australian Bureau of Statistics, Canberra.
- McGowan, M.A. and Andrews, D. 2015a, *Labour Market Mismatch and Labour Productivity*, OECD Economics Department Working Paper no. 1209, Organisation for Economic Co-operation and Development, Paris.
- 2015b, *Skill Mismatch and Public Policy in OECD Countries*, OECD Economics Department Working Paper no. 1210, Organisation for Economic Co-operation and Development, Paris.
- van der Merwe, M., Cockerell, L., Chambers, M. and Jääskelä, J. 2018, ‘Private Non-mining Investment in Australia’, *Reserve Bank Bulletin*, June Quarter, pp. 1–20.
- Mokyr, J. 2014, ‘The Next Age of Invention: Technology’s Future is Brighter than Pessimists Allow’, *City Journal*, vol. 24, no. 1, pp. 12–21.
- Moscarini, G. and Postel-Vinay, F. 2017, ‘The Relative Power of Employment to-Employment Reallocation and Unemployment Exits in Predicting Wage Growth’, *American Economic Review*, vol. 107, no. 5, pp. 364–68.
- OECD (Organisation for Economic Co-operation and Development) 2018a, *OECD Compendium of Productivity Indicators 2018*, Paris.
- 2018b, *OECD Economic Outlook 2018*, Issue 1, Paris.
- PC (Productivity Commission) 2017, *Shifting the Dial: 5 Year Productivity Review*, Report no. 84, Canberra.
- 2018, *Rising Inequality? A Stocktake of the Evidence*, Commission Research Paper, Canberra.
- 2019, *Superannuation: Assessing Efficiency and Competitiveness*, Inquiry Report 91, Canberra.
- Russell, B. and Tease, W. 1991, ‘Employment, Output and Real Wages’, *Economic Record*, vol. 67, no. 1, pp. 34–45.
- Stanford, J. 2018, ‘Charting wage stagnation in Australia’, in Stewart, J., Stanford, J. and Hardy, T. (eds), *The Wages Crisis in Australia: What It Is And What To Do About It*, University of Adelaide Press, Adelaide.
- Stapledon, N. 2012, ‘Australia’s Major Terms of Trade and Resource Shocks, 1800–2012: Sources and Impacts’, Presented at Conference on Commodity Price Volatility, Past and Present, Centre for Economic History and Centre for Applied Macroeconomic Analysis Research School of Economics and the Crawford School of Public Policy, Australian National University, 29–30 November, Canberra.
- Topp, V., Soames, L., Parham, D. and Bloch, H. 2008, *Productivity in the Mining Industry: Measurement and Interpretation*, Staff Working Paper, Productivity Commission, Canberra.
- Weir, G. 2018, *Wage Growth Puzzles and Technology*, Research Discussion Paper RDP 2018-10, Reserve Bank of Australia, Sydney.