2020

RESEARCH PAPER

Queensland Productivity Update

2018–19

Foreword

Growth in productivity is important to the Queensland economy and the broader community. It drives real per capita income growth and supports an increase in living standards over the longer term.

This is the third paper in a series providing information on productivity trends in Queensland. The series informs decisions about how to realise Queensland's productivity potential, and forms part of the Commission's legislated function to promote public understanding of matters relating to productivity.

This update provides an overview of key productivity trends in Queensland, and places them in a national context. While Queensland has fared better than the rest of Australia in terms of productivity growth, slower growth in recent years should be of concern to policy makers. This is particularly the case for non-mining industries, where there is evidence of a slowdown in both labour and multifactor productivity growth.

In each productivity update, we include a short feature article on a topical issue. This year's article examines the relationship between growth in real wages and growth in labour productivity. Despite recent commentary arguing that this relationship has broken down, there is no compelling evidence that this has occurred in Queensland.

This update also expands on previous releases by presenting Commission-developed estimates for multifactor productivity at the industry level. These estimates are experimental in nature, and have been based on underlying component data published by the ABS.

We would welcome your feedback on this publication. This can be provided at https://www.qpc.qld.gov.au/contact-us/.

About the Queensland Productivity Commission

The Queensland Productivity Commission is an independent statutory body that provides policy advice on complex economic and regulatory issues.

The Commission has an advisory role and operates independently from the Queensland Government—its views, findings and recommendations are based on its own analysis and judgments.

Further information on the Commission and its functions can be obtained from the Commission's website www.qpc.qld.gov.au

Contents

Key points

- Productivity is key to improving the living standards of Queenslanders. Investments in productive capital, technological progress and decisions that lead to more productive use of the economy's labour and capital resources provide a means to produce goods and services at lower cost, increase real wages and generate additional income to satisfy the needs and wants of the broader community.
- Consistent with national and global trends, the data suggest that market sector productivity growth has slowed in Queensland. Between 2016–17 and 2018–19, both labour productivity and multifactor productivity (MFP) growth averaged 0.3 per cent per annum, down from 2.1 percent (labour productivity) and 0.71 per cent (MFP) over the last productivity cycle (2011–12 to 2016–17).
- When mining is excluded, a longer trend towards slowing productivity is evident. Across the past two productivity cycles (2006–07 to 2011–12 and 2011–12 to 2016–17) and the current incomplete cycle (2016–17 to 2018–19):
  - labour productivity fell from 2.4 per cent per annum, to 0.7 per cent and then to 0.3 per cent, respectively
  - MFP fell from 1.2 per cent per annum, to 0.5 per cent and then to 0.3 per cent, respectively.
- Key factors contributing to the slowdown include:
  - Declining investment levels—the contribution of capital deepening (the amount of available capital per worker) to labour productivity growth across market industries has been declining, and, like the rest of Australia, there is emerging evidence of capital 'shallowing' across the non-mining industries.
  - Declining productivity in the construction industry—following a decline in output of 3.8 per cent per annum over 2011–12 to 2016–17, output has continued to decline at 1.2 per cent per annum. In contrast, capital and labour inputs continued to increase, suppressing industry productivity.
  - Slowing output in the mining sector—while strong growth in mining output supported productivity growth over the last cycle, output growth is now slowing.
  - Drought contributed to recent weak productivity performance.
- Falling labour utilisation—the result of increases in both unemployment and underemployment, as well as contractions in labour force participation—was a compounding factor during the last complete productivity cycle (2011–12 to 2016–17), shaving around 0.2 per cent from market sector output growth each year. It is too early to tell if similar labour market results are occurring over the current incomplete cycle.
- Although productivity growth has slowed in Queensland, the state recorded stronger growth than the rest of Australia over the last two decades. As a result, there is evidence that productivity in Queensland has largely converged (that is, 'caught up') with levels in the rest of Australia. In 2018–19 labour productivity was approximately 2 per cent lower than the Australian average, narrowing the gap from around 8 per cent in 1998–99.
- This update provides an analysis of recent productivity trends in Queensland, including an overview of how the mining sector has influenced productivity and income over the last two decades. This update also expands on previous releases by including exploratory industry MFP estimates for Queensland.
- A feature article explores the relationship between labour productivity and wages. Despite some recent commentary, the Commission was unable to find any compelling evidence that wage growth has systematically decoupled from labour productivity growth in Queensland.

1. Introduction

Productivity growth is an important contributor to economic growth, wealth creation, and higher living standards. At an economy-wide level, improvements in productivity allow more to be produced for any given level of inputs, which in turn generates additional income. For businesses, productivity growth provides the opportunity for improved profitability and competitiveness. For workers, improvements in productivity provide a mechanism for generating higher wages as productivity growth enables business to offset the impact of higher wages on profits. For consumers, productivity growth provides an opportunity for business to lower prices without compromising wages or profits.

This paper forms part of an ongoing series that examines Queensland's productivity performance. It builds on the Commission's 2016–17 update (QPC 2018) by including exploratory industry-level estimates of multifactor productivity (MFP). It also includes a feature article that analyses the relationship between labour productivity and wages in Queensland.

Interpreting the estimates

This paper provides aggregate estimates of recent productivity trends. These high-level results are unlikely to be useful for developing specific policy recommendations, since they cannot provide details of the precise factors underpinning the State's productivity performance.[1]

Nevertheless, regular updates provide guidance on the general performance of the economy and, by decomposing the sources of economic growth, can help policymakers to better understand in a broad sense both the drivers and possible impediments to growth in the Queensland economy and signal the case for policy action. For example, successive years of poor outcomes might prompt concern that policy settings need to change, or that there is a need to dig deeper to understand poor performance.

Caution is required when interpreting annual movements in productivity estimates. Year-on-year growth estimates can vary significantly, reflecting unmeasured changes in capital utilisation, lags between investment and output, and measurement error. Furthermore, data revisions by the Australian Bureau of Statistics (ABS), which occur as more accurate underlying data become available, sometimes have an impact on previously published estimates of productivity growth (Appendix C).

For this reason, average growth rates for the most recent productivity cycle, 2011–12 to 2016–17, are presented alongside the annual growth rates for 2017–18 and 2018–19 to provide some perspective for Queensland's recent performance.

Some technical issues

The productivity measures in this paper have been developed to align with the ABS framework and approach to estimating productivity, set out in *Australian National Accounts: Concepts Sources and Methods* (ABS 2016). The measures also align with the OECD best practice guide to measuring productivity (OECD 2001).

Unless otherwise noted, the headline measures in this paper only include the market sector, consistent with ABS national productivity estimates. As such, Public administration and safety; Education and training; and Health care and social assistance are excluded from the analysis (except for some industry estimates presented later in the paper). Based on industry output, market sector industries accounted for 73 per cent of Queensland's gross value added (GVA) in 2018–19.

[1] This is because there is too much volatility in year-to-year industry estimates to provide meaningful policy guidance. Rather, industry analysis needs to be based on longer-term trends.

The ABS releases the core data used to construct state-level productivity estimates at the end of each year (ABS 2019a, 2019b, 2019c, 2019d, 2019e). The Commission has divided the time series of Queensland market sector MFP into productivity cycles, which are defined by successive peaks in measured MFP growth.[2] This allows the impact of cyclical and other transient factors to be mitigated, by averaging growth rates across each cycle. Since the previous update, the Commission identified a new peak in 2016–17 for Queensland, marking the end of the most recent productivity cycle.

Box 1.1 Productivity—key concepts

Productivity is, put simply, how efficiently inputs are used to produce outputs in the economy. It is expressed in terms of the amount of output produced per unit of input consumed. Productivity growth implies that either more output is produced from the same number of inputs, or fewer inputs are required to produce the same amount of output.

- **Labour productivity** is measured as output produced per unit of labour input (hours worked) and expresses how efficiently labour is being used to produce output. It is a **single-factor** (or partial) productivity measure because it considers the relationship between output and one input. Growth in labour productivity means that workers can produce more output per hour worked, increasing real wages and per capita income over time. Labour productivity growth is affected by changes in capital deepening and multifactor productivity.
- **Capital deepening**, is an increase in the amount of capital per worker, as measured by the amount of capital employed per hour worked. The opposite of capital deepening is described as 'capital shallowing'. Capital can augment labour and thus improve its productivity; for example, if a factory invests in more tools and machinery, workers will be able to produce more output in one hour of work than they were able to previously.
- **Multifactor productivity** (MFP), or the efficiency with which two inputs—labour and capital—are combined, is measured as output produced per unit of combined labour and capital inputs. This measure is not affected by the level of capital and labour used in production. Instead, it measures the influence of all other factors that might be influencing growth, such as new technologies or work practices. In other words, it is a residual measure that reflects the part of output growth that is not due to changes in inputs.
- **Total factor productivity** (TFP) is a comprehensive measure that takes account of the contribution from all inputs to the production of output. However, the use of TFP is limited in practice due to the difficulties associated with measuring all inputs in a production process, particularly intermediate inputs. Measures of TFP are therefore not provided in this paper.

The Glossary (Appendix B) explains other technical terms used in this paper. For further background on concepts and definitions, see QPC (2016b).

[2] Identified productivity cycles are 1998–99 to 2001–02, 2001–02 to 2006–07, 2006–07 to 2011–12, 2011–12 to 2016–17, and 2016–17 to 2018–19 (incomplete). Cycles were identified by comparing the market sector MFP index to a smoothed index (filtered using a Henderson 11-term moving average). A cycle is considered a peak (years where growth is above trend) and trough (years where growth is below trend) to peak. The Commission identifies the start of a new cycle at the first year above trend.

2. Recent productivity trends

Average annual market sector[3] output and productivity growth rates for Queensland and Australia are presented in Table 2.1 for the most recent completed productivity cycle (2011–12 to 2016–17), and the two years making up the current incomplete productivity cycle (2017–18 and 2018–19—for averages over the current cycle see Table A.1). Growth rates over other productivity cycles and for other states are presented in Table A.1 in the statistical appendix (Appendix A).

Table 2.1 Queensland and Australian market sector output and productivity growth rates

	Queensland			Australia		
	2011–12 to 2016–17	2017–18	2018–19	2011–12 to 2016–17	2017–18	2018–19
Output growth (GVA)	**1.9**	**3.8**	**0.3**	**2.5**	**3.1**	**1.3**
Combined labour and capital contribution	1.2	3.0	0.4	1.7	2.2	1.6
Labour contribution	–0.1	2.2	–0.3	0.4	1.3	0.8
Capital contribution	1.3	0.8	0.8	1.3	0.8	0.8
Multifactor productivity contribution	0.7	0.8	–0.1	0.8	0.9	–0.4
Multifactor productivity growth	**0.7**	**0.7**	**–0.1**	**0.8**	**0.9**	**–0.4**
Labour productivity growth	**2.1**	**–0.3**	**0.9**	**1.9**	**0.7**	**–0.2**
Capital deepening contribution	1.4	–1.0	1.0	1.0	–0.2	0.2
Multifactor productivity contribution	0.7	0.7	–0.1	0.8	0.9	–0.4
Other annual growth rates						
Labour input[(a)]	–0.2	4.1	–0.6	0.7	2.4	1.5
Capital input[(b)]	3.2	1.8	1.6	3.0	1.9	1.8

a Labour input is measured as hours worked. For the Australian growth rates, labour inputs are measured on an 'hours worked' basis with no quality adjustment to be consistent with the state data. Quality adjusted labour input indices are not available from the ABS for market sector industries at the state level.
b Capital is measured as 'capital services' (see the definitions of capital in the glossary).
Note: Growth rates are average annual percentage changes. Contributions are the percentage point contributions to a growth rate. For example, Queensland labour productivity growth was 0.9 per cent in 2018–19 with capital deepening contributing 1.0 percentage points and MFP contributing –0.1 percentage points (1.0 – 0.1 equals 0.9). Totals may not add due to rounding.
Source: ABS cat. no. 5260.0.55.002; QPC estimates.

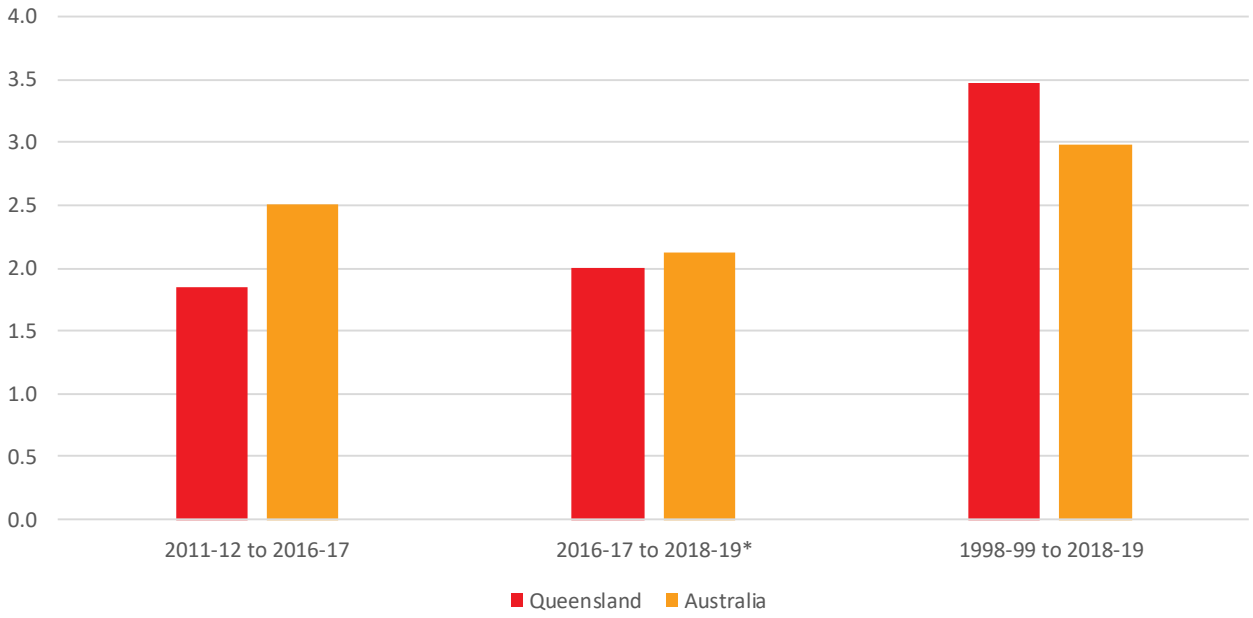
[3] The 'market sector' includes: Agriculture, forestry and fishing; Mining; Manufacturing; Electricity, gas, water and waste services; Construction; Wholesale trade; Retail trade; Accommodation and food services; Transport, postal and warehousing; Information media and telecommunications; Financial and insurance services; Rental, hiring and real estate services; Professional, scientific and technical services; Administrative and support services; Arts and recreation services; and Other services. It excludes: Public administration and safety; Education and training; Healthcare and social assistance; and Ownership of dwellings.

Queensland's market sector growth has slowed

Market sector output has grown more slowly than the national average

The Queensland economy has been growing more slowly than Australia's economy (Table 2.1). Over the last productivity cycle (2011–12 to 2016–17), market sector GVA grew at an average rate of 1.9 per cent per annum, compared to 2.5 per cent for the Australian economy (Figure 2.1). This difference is largely due to lower MFP growth and falling contributions from labour inputs in Queensland, as the number of hours worked fell over the most recent cycle.

Figure 2.1 GVA growth rates, market sector, Queensland and Australia



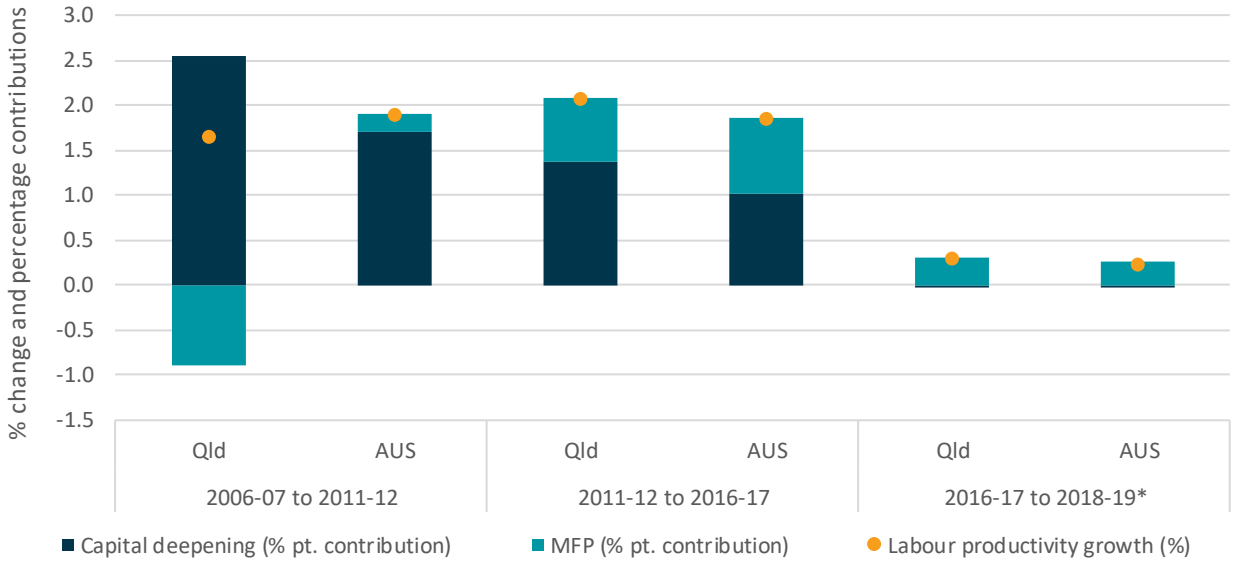
** Denotes incomplete productivity cycle.*
Source: ABS cat. no. 5260.0.55.002; QPC estimates.

Over the period 2016–17 to 2018–19, the output growth gap between the Queensland and Australian economies narrowed from 0.6 percentage points (growth in Queensland of 1.9 per cent per annum versus 2.5 per cent) to 0.1 percentage points (2.0 per cent per annum versus 2.1 per cent). Most of the narrowing occurred in 2017–18, with Queensland's output growth of 3.8 per cent eclipsing the national rate of 3.1 per cent. However, growth in Queensland slowed sharply in 2018–19 to 0.3 per cent—all states except South Australia and the Northern Territory experienced higher output growth during 2018–19. The deceleration in output growth has been more severe in Queensland than nationally; this is largely the result of larger contractions in output in Queensland in the agriculture, forestry and fishing industry due to drought, as well as a decline in the construction industry due to reduced demand. In contrast, the rest of Australia has experienced a much smaller contraction in agricultural output and has recorded growth in all other market sector industries.

Productivity growth appears to have slowed

While Queensland recorded reasonably robust productivity growth over the last cycle, recent data suggest growth has slowed (Figure 2.2). Over the two years of the current cycle (2017–18 to 2018–19), labour productivity growth has averaged 0.3 per cent per annum, which is significantly lower than the 2.1 per cent rate of average annual growth recorded during the last productivity cycle. By way of comparison, labour productivity growth has not fallen below 1.6 per cent in any of the last four completed productivity cycles.

Figure 2.2 Labour productivity growth, Queensland and Australia



** Denotes incomplete productivity cycle.*
Source: ABS cat. no. 5260.0.55.002; QPC estimates.

Slowing labour productivity in Queensland is the result of both slowing MFP growth and a slowing rate of capital deepening (capital can augment labour to make it more productive). MFP growth averaged 0.3 per cent over the two years to 2018–19, less than half of the average growth measured over the most recent productivity cycle (0.7 per cent). Over the current incomplete productivity cycle, capital deepening contributions have been close to zero (due to a negative contribution of –1.0 percentage points in 2017–18).

While there is no single industry-level driver behind this productivity slowdown, the effects of drought have had a large impact on the agriculture, forestry and fishing industry in Queensland, where falling output has been observed alongside increases in hours worked. A significant decline in output across the construction industry has also dragged on productivity growth. Both factors are outside the control of these industries and, as such, may not represent a slowing of technical progress (PC 2019, p. 12).

The productivity slowdown is not unique to Queensland. Slowing productivity growth has also been evident across the broader Australian economy and in advanced economies internationally since around 2005 (PC 2020). The most recent data for 2018–19 show national labour productivity fell by 0.2 per cent—the first measured fall in labour productivity since the time series began in 1994–95 (ABS 2019c)—contributing to slowing output growth for the market sector (the lowest rate on record at 1.25 per cent).

Falling labour utilisation has detracted from growth

Growth in per capita real gross state product[4] (real GSP) can be decomposed into its components to understand how changes in labour productivity and labour inputs (per capita utilisation) affect output growth. While labour productivity relates to making each hour of work more productive, labour utilisation is affected by the decision to participate in the labour market, the ability to find employment, the choice of how many hours to work and how

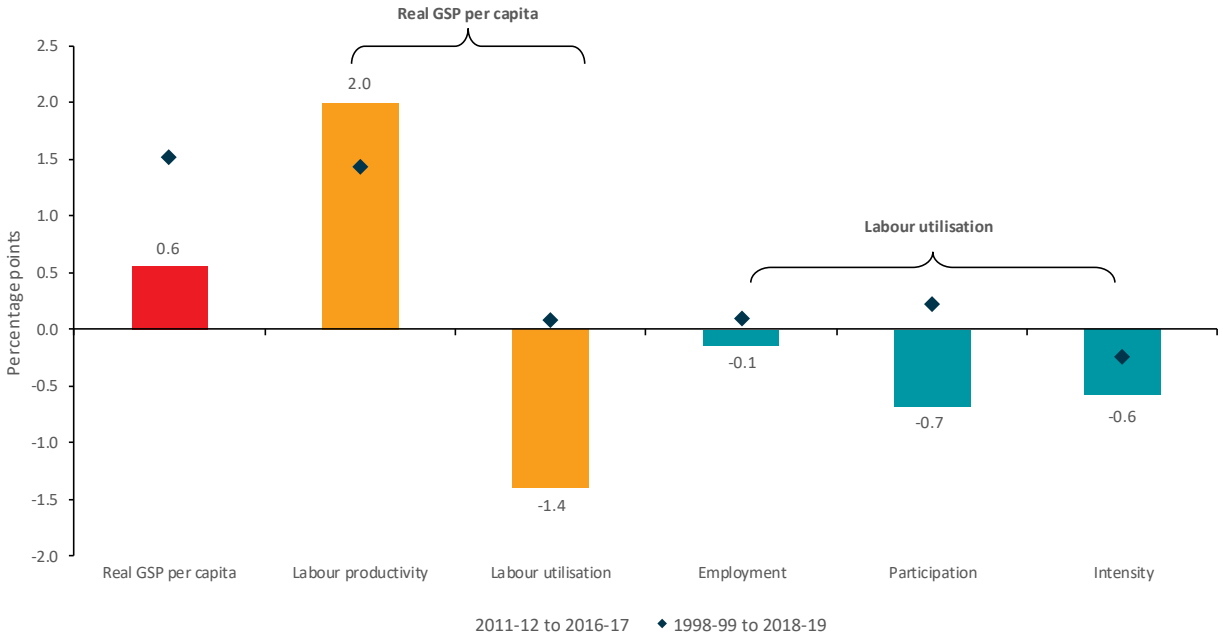
[4] GSP is a whole-of-economy measure of output derived (under the production approach to estimating GSP) by summing the output (gross value added) of market sector and non-market sector industries and including an adjustment for taxes less subsidies on products plus a statistical discrepancy (see Appendix B). Real GSP *per capita* is used for these decompositions because it provides a useful link from output to measures of productivity and other labour factors (OESR 2011, p. 5).

these factors combine to determine the total number of hours worked. Improvements to both productivity and utilisation can therefore lead to increases in output.

Real GSP per capita growth in Queensland has slowed considerably in recent productivity cycles, with falling labour utilisation dragging on growth. In Figure 2.3, growth rates and percentage point contributions are shown for the most recent completed productivity cycle 2011–12 to 2016–17 (bars), compared to the long-term average over 1998–99 to 2018–19 (diamond markers).

Between 2011–12 and 2016–17, GSP per capita grew at an average annual rate of 0.6 per cent per annum. This can be decomposed into increases in labour productivity (contributing 2.0 percentage points to growth in GSP per capita—above the historical average) and a reduction in labour utilisation (detracting 1.4 percentage points from growth in GSP per capita—much below the historical average).[5]

Figure 2.3 Decomposition of growth in GSP per capita over the most recent completed productivity cycle, Queensland



Note: Sum of component contributions may not add due to rounding.
Source: ABS cat. nos 5260.0.55.002, 6202.0; QPC estimates.

The reduction in labour utilisation can be further decomposed into three components:

- *employment* (detracting 0.1 percentage points from growth)—reflected in an increase in the rate of unemployment from 5.3 per cent to 6.9 per cent

[5] Decompositions can be sensitive to the choice of start and end years, so it is preferable to base comparisons on completed productivity cycles. However, there is also interest in what the most recent data may be indicating, subject to potential revisions in the data. From 2016–17 to 2018–19, real GSP per capita increased at an average rate of 0.8 per cent per annum with labour productivity providing a negative contribution of 0.2 percentage points and increases in labour utilisation contributing a positive contribution of 1.0 percentage points (driven almost entirely by an increase in the participation rate).

- *participation* (detracting 0.7 percentage points from growth)—the ratio of the number of people either working or looking for work (who together make up the labour force) decreased as a share of Queensland's population. An ageing population may drag on labour force participation in the future[6]
- *intensity* (detracting 0.6 percentage points from growth)—average working hours per employed worker declined, caused principally by an increase in part-time employment relative to full-time employment. This may suggest underemployment, depending on the preferences of workers (Box 2.1). Over the last cycle, the number of full-time employed persons increased at 0.4 per cent per annum, while part-time employees increased at a faster 2.2 per cent per annum.

Box 2.1 What is underemployment?

- Underemployment data produced by the ABS refers to employees who would like to work additional hours and are available to do so—that is, time-related underemployment. It is an indicator of excess capacity in the labour market. Other aspects related to underemployment, such as a mismatch of skills, are not measured in underemployment statistics produced by the ABS. Some underemployed people may be experiencing both inadequate employment as well as time-related underemployment.
- Underemployment figures are based on the Monthly Population Survey. The rate is calculated as the proportion of employed persons aged 15 years or over who are either:
  - employed part-time and would like to, and are available to, work more hours either in the reference week or the four weeks preceding the survey
  - employed full-time but worked part-time hours in the reference week for economic reasons (being made redundant, or insufficient work being available).
- The ABS currently produces monthly figures for underemployment (before September 2018 these were only released quarterly). Both seasonally-adjusted and trend monthly underemployment rates are available from 1978, to enable comparisons with the unemployment rate.
- In June 2019, Australia's trend underemployment rate was high in historical terms at 8.4 per cent, but below the peak recorded in February 2017. Overall, underemployment has been trending upwards since it was first recorded in February 1978, with fluctuations around this trend resulting from market conditions. In particular, underemployment spikes in times of economic downturn, such as during the global financial crisis.
- The trend Queensland underemployment rate was 8.7 per cent in June 2019, compared to 7.4 per cent ten years earlier in June 2009.
- Across Australia, the youngest (aged 15–24) and oldest (aged 55 and older) age groups experienced the fastest growth in underemployment between September 1998 and September 2018.
- Females are also more likely to be underemployed than males, with 10.9 per cent (trend) of females in Queensland's labour force experiencing underemployment, compared to only 6.7 per cent of males in June 2019.
- In June 2019, Queensland's underemployment rate ranked fourth in Australia, with higher rates in South Australia, Western Australia and Tasmania.

Source: ABS cat. no. 6202.0.

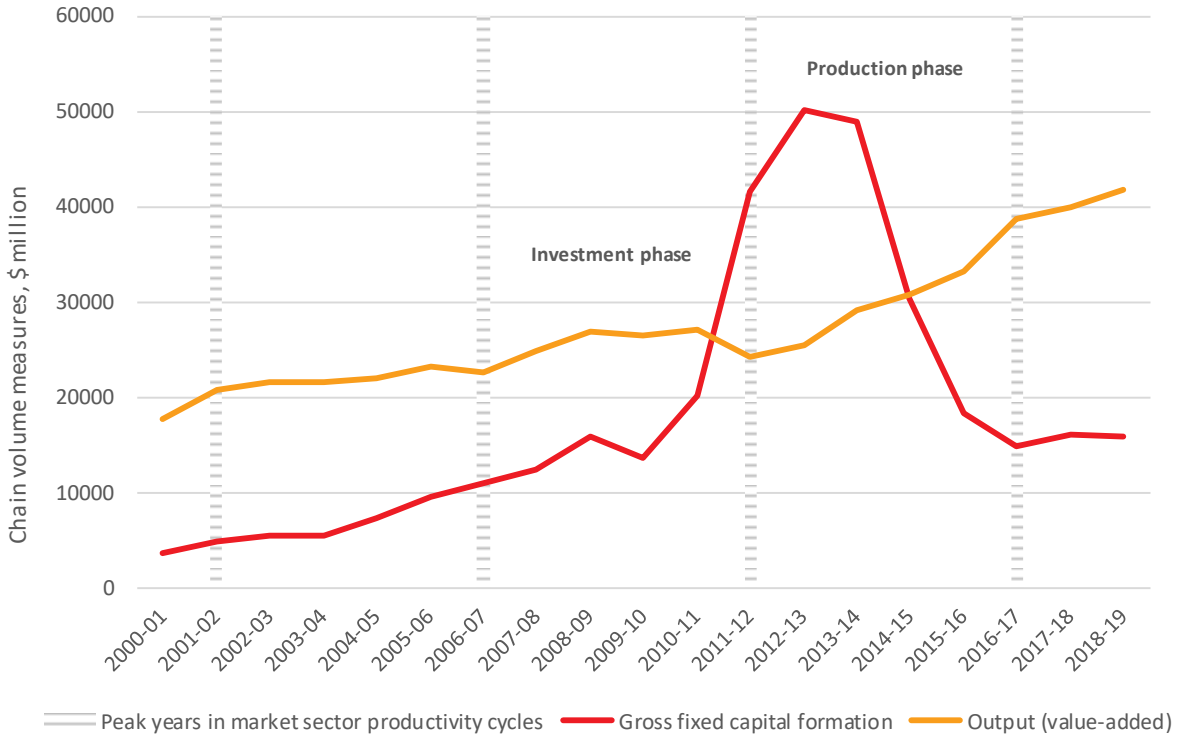
[6] There is some evidence to suggest that increasing labour force participation for men and women aged over 55 has at least partly offset the impact of population ageing on labour supply (Lowe 2018a).

Productivity cycles in Queensland are closely related to the investment and production phases in the mining industry

Mining investment and production occurred in two distinct phases

High commodity prices in the early 2000s saw significant increases in mining investment (Atkin et al. 2014, p. 57), with investment in Queensland increasing five-fold between 2006–07 and 2011–12 (Figure 2.4). As a result, net capital stocks for mining in Queensland are now close to double those of the next largest industry (QPC 2018, p. 11).

Figure 2.4 Mining industry gross fixed capital formation, Queensland



Note: Peaks were identified by observing turning points in the deviation between measured MFP and a measure of trend MFP for the market sector. Productivity cycles of the market sector align with the investment phase and production phase of the mining industry.
Source: ABS cat. no. 5220.0; QPC estimates.

As noted in previous updates, the mining industry in Queensland has transitioned from an 'investment phase' to a 'production phase' (QPC 2018, p. 11). These phases line up with two observed productivity cycles in the Queensland economy—2006–07 to 2011–12 and 2011–12 to 2016–17 (Figure 2.4).

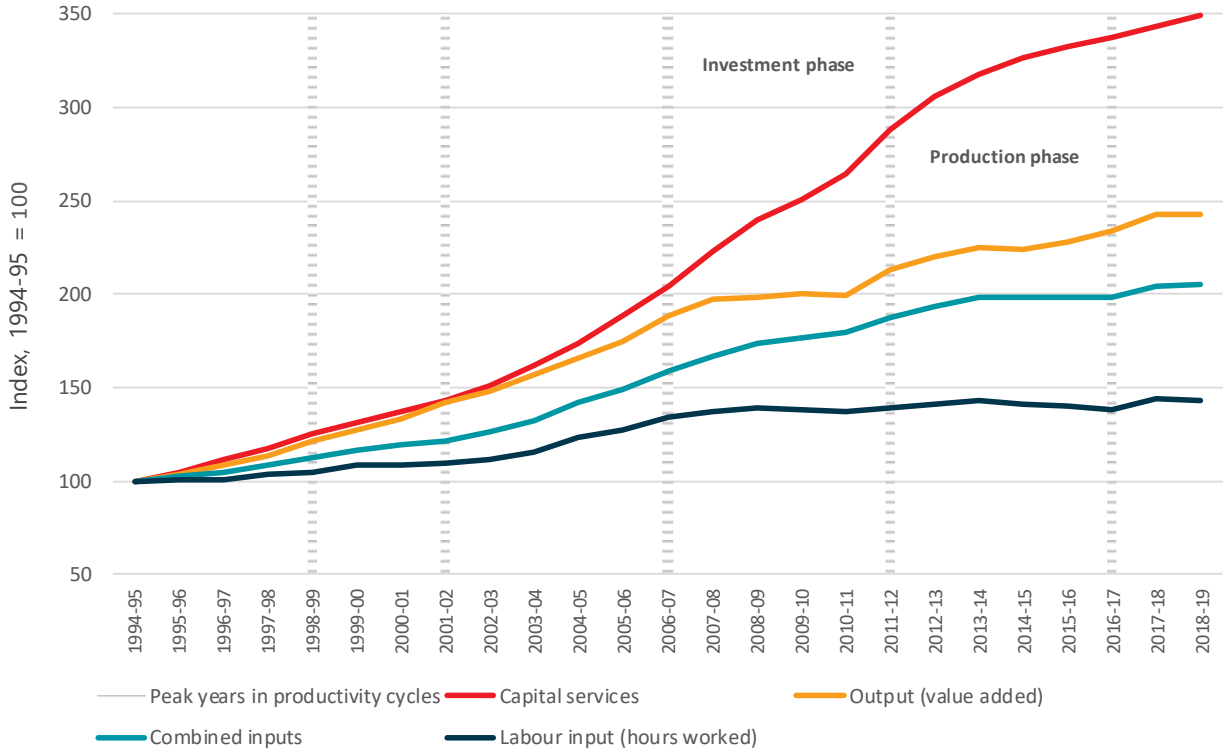
The investment phase (2006–07 to 2011–12) was characterised by increasing commodity prices and rapidly growing mining investment (including the beginning of construction of a new, export-focused LNG industry in Queensland). The average rate of growth in capital services was 12.5 per cent per annum for the mining industry, compared to 6.9 per cent per annum for the market sector over this period.

During this investment phase, mining output grew slowly despite the rapid growth in capital. Measures for output (value-added) suggest growth stalled due to lead times between making investments in capital and the production of output.

Over the production phase (2011–12 to 2016–17), mining industry investment fell at an average rate of 10.0 per cent per annum, with overall market sector investment growing at a 3.2 per cent per annum (half the rate of the preceding cycle). During the production phase, output from the mining sector began to grow rapidly (at an average rate of 9.5 per cent per annum, compared to only 0.8 per cent per annum over the previous phase), with the first shipments from the LNG industry commencing in January 2015.

The impact of the mining sector on the broader economy can be seen in Figure 2.5—it shows a large increase in capital services coupled with a much slower increase in output during the investment phase, and then output increasing during the production phase.

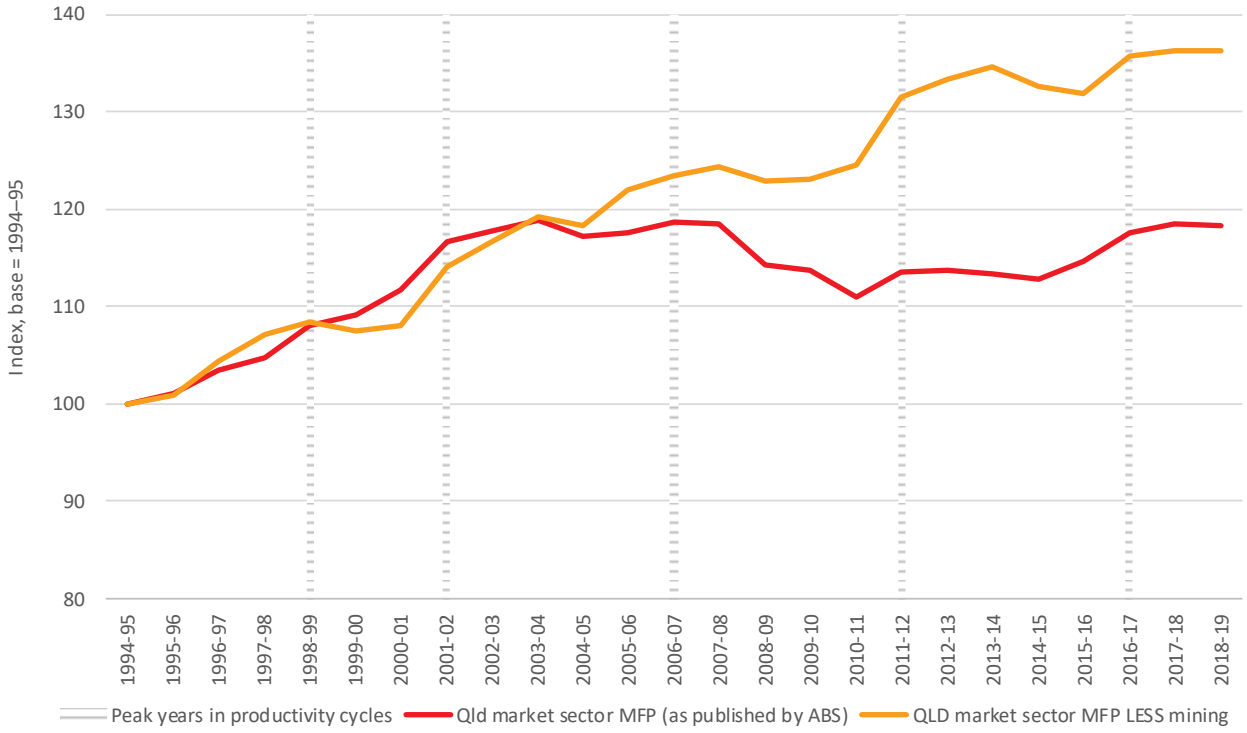
Figure 2.5 Growth in Queensland output and labour and capital inputs, 1994–95 to 2018–19



Note: All measures are for the Queensland market sector. Peaks were identified by the Commission by observing turning points in the deviation between measured MFP and a trend measure of MFP.
Source: ABS cat. no. 5260.0.55.002.

The impact of the mining sector on Queensland's productivity performance is demonstrated in Figure 2.6. From 2003–04 until 2010–11, large investments in the mining industry were not matched by coincident increases in output due to lead times. As a result, the industry detracted from aggregate MFP growth. Although a movement into the production phase has allowed mining MFP to grow, to date this has only been sufficient to bring the current level of aggregate market sector MFP back to 2003–04 levels.

Figure 2.6 Queensland market sector MFP, with and without mining



Note: Peaks were identified by observing turning points in the deviation between measured MFP and a measure of trend MFP.
Source: ABS cat. no. 5260.0.55.002; QPC estimates.

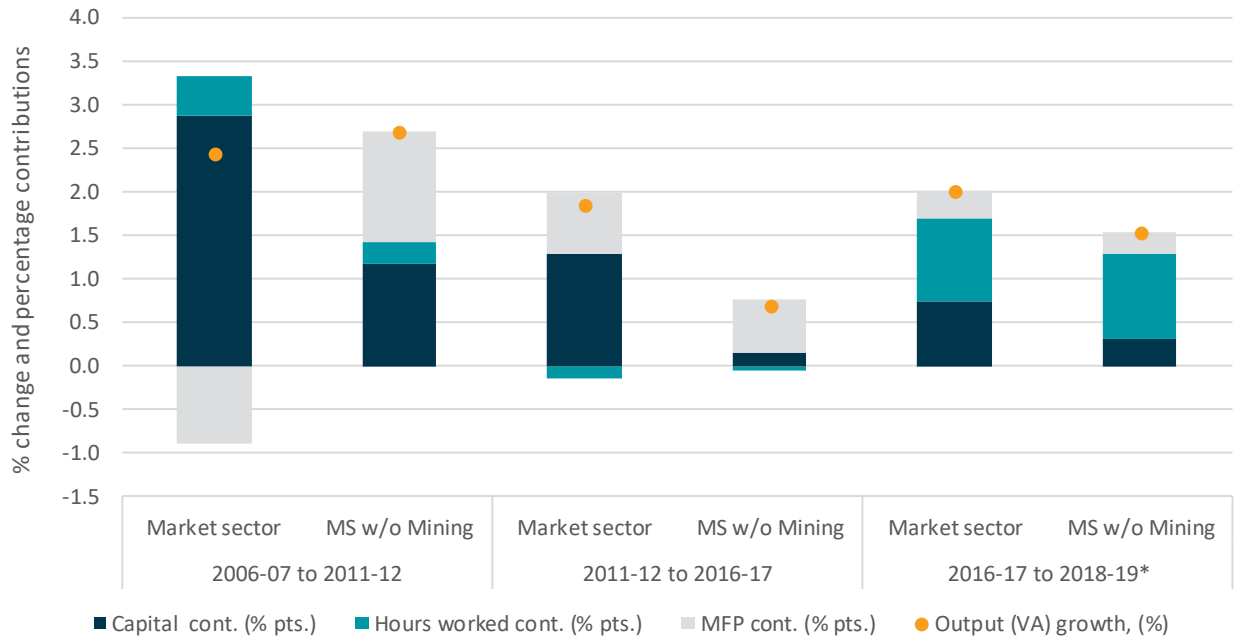
Productivity growth outside of mining seems to be slowing

Figure 2.7 decomposes output for the market sector with and without mining, showing the contributions made from growth in capital inputs, growth in labour inputs, and growth in MFP.

Over the period 2006–07 to 2011–12, output in the market sector was driven by increased capital and labour inputs. MFP detracted from growth over this period (0.9 percentage points). However, the decline in MFP was almost solely due to events in the mining industry—as shown in Figure 2.7, MFP in non-mining sectors *increased* over the same period.

After 2011–12, output from the non-mining market sector slowed considerably—growing at 0.7 per cent during the 2011–12 to 2016–17 productivity cycle. Output picked up during the current incomplete productivity cycle; however, this seems to be due to a single year spike in labour utilisation (in 2017–18) rather than from productivity gains.

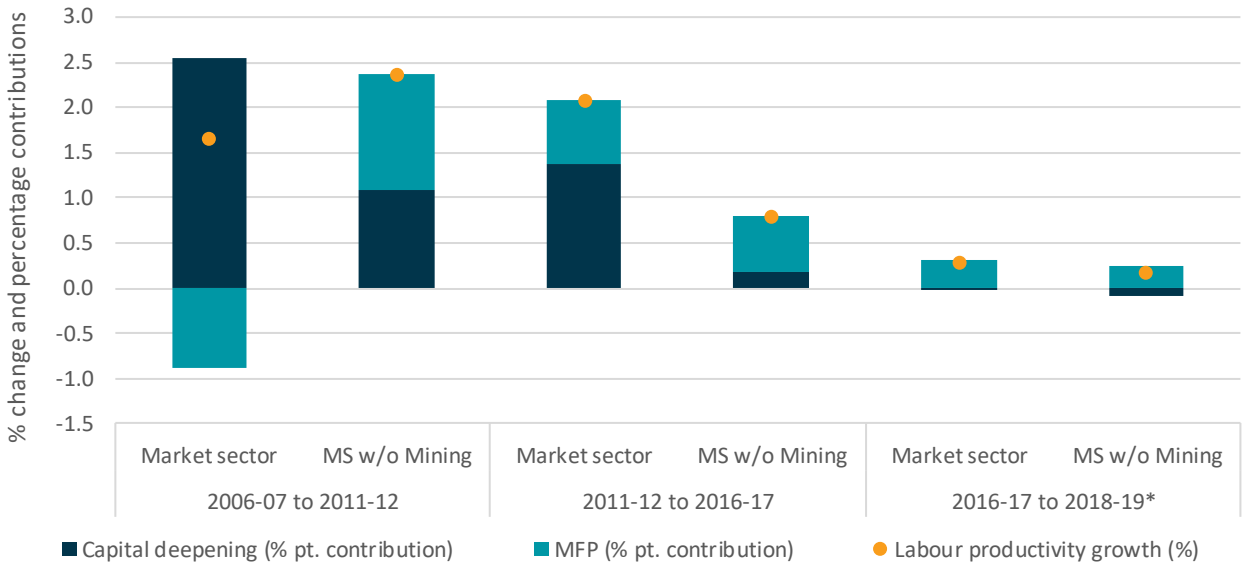
Figure 2.7 Queensland market sector output decomposition, with and without mining



** Denotes incomplete productivity cycle.*
Note: Market sector figures align with those presented in Table 2.1.
Source: ABS cat. nos 5220.0, 5260.0.55.002; QPC estimates.

Figure 2.8 decomposes labour productivity growth into contributions to growth from MFP and capital deepening. It shows that slowing labour productivity growth in the non-mining market sector is a result of both slowing MFP growth and slowing capital deepening (in the current cycle the data suggest there has been capital shallowing).

Figure 2.8 Queensland market sector labour productivity decomposition, with and without mining



** Denotes incomplete productivity cycle.*
Note: Market sector figures align with those presented in Table 2.1.
Source: ABS cat. nos 5220.0, 5260.0.55.002; QPC estimates.

During the mining investment phase (aligning with the productivity cycle 2006–07 to 2011–12), growth in capital deepening was the primary driver of labour productivity growth in Queensland's market sector, with MFP detracting from labour productivity growth. This outcome was largely due to the developments in the mining sector, which saw large declines in measured MFP as investment ramped up. In contrast, both MFP and capital deepening made positive contributions to labour productivity in the non-mining market sector.

In the productivity cycle 2011–12 to 2016–17, labour productivity growth was significantly weaker for the market sector when excluding mining. Over that cycle, labour productivity growth across non-mining industries fell to rates much lower than the long-term average, largely the result of low rates of capital deepening. This weakness was hidden in the aggregate statistics since mining productivity rose rapidly during this period—following periods of heavy capital investment, the mining industry entered its production phase armed with significant capital stocks with which to augment labour and improve its productivity.

Over the two most recent years, labour productivity growth was very low across both the market sector and the non-mining industries (averaging less than 0.3 per cent). Capital deepening made no contribution to labour productivity growth across all market industries, and there is evidence of capital shallowing across the non-mining industries. MFP growth was lower than the long-term average.

Capital shallowing is an issue also affecting the rest of Australia and is a concern for future labour productivity growth both nationally and in Queensland.

Income has been heavily influenced by changes in the terms of trade

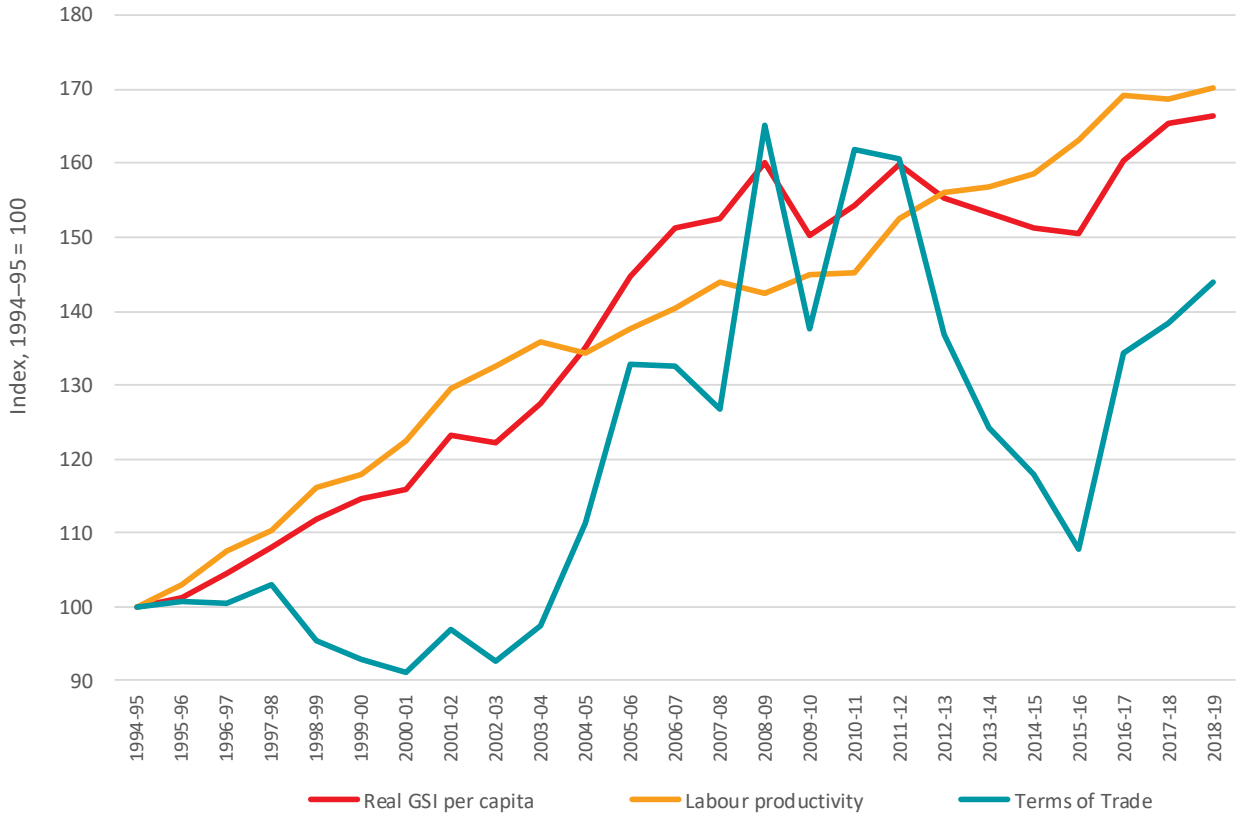
Productivity growth is key for driving increases in real income. Growth in labour productivity means that workers and businesses can produce more output for each hour worked, thereby increasing per capita incomes and wages (the relationship between productivity and real wages is explored in the feature article in Section 3).

Income growth, however, can deviate from productivity growth for several reasons, including changes in the terms of trade (the price of exports, relative to the price of imports).

Queensland is a strong exporting economy, particularly for metallurgical coal and liquefied natural gas (LNG). On a balance of payments basis, Queensland accounted for approximately 23 per cent, or $105 billion, of Australia's exports in 2018–19. If, for example, the price for metallurgical coal increases (an increase in the terms of trade), more income will be generated for the same volume of exports.

The period 2003 to 2011 marked a Queensland terms of trade boom (Figure 2.9). This was due to sharp rises in the price of commodities, such as coal, caused by surging demand for steel and energy from China and other industrialising economies (Atkin et al. 2014, p. 55). The terms of trade peaked in 2008–09 and declined from 2011–12 to 2015–16 (reflecting falling commodity prices), before rising again.

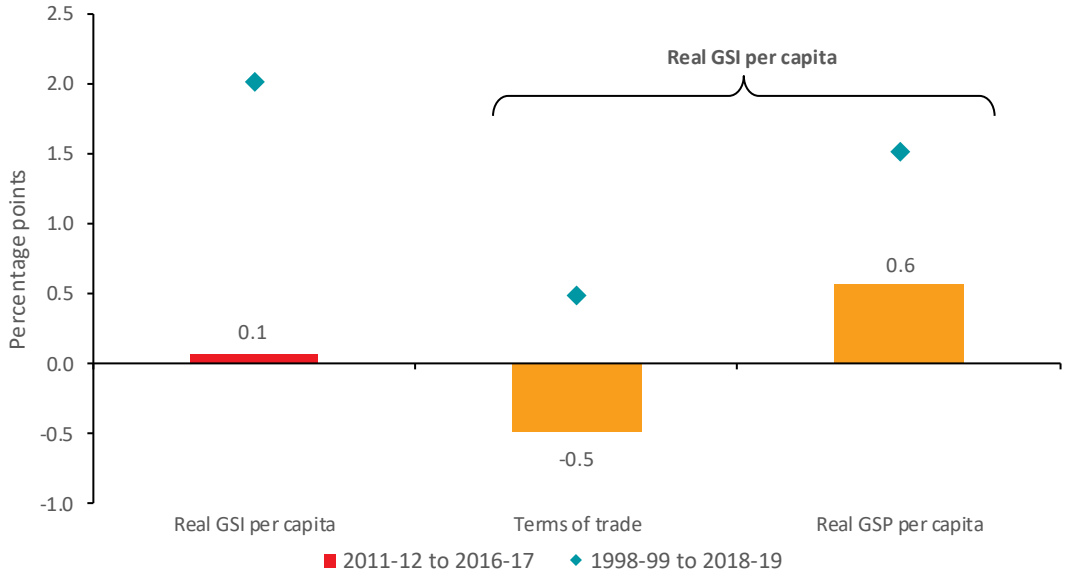
Figure 2.9 Queensland incomes and labour productivity growth, 1994–95 to 2018–19



Notes: Real gross state income (GSI) measures gross state product (GSP) adjusted for changes in the terms of trade. The Queensland terms of trade is the ratio of overseas export prices over overseas import prices for goods. GSP is the total market value of goods and services produced in Queensland within a given period after deducting the cost of goods and services used up in the process of production, but before deducting allowances for the consumption of fixed capital. Labour productivity is measured as output (gross value added) divided by hours worked. GSP measures the volume of goods and services produced in each state. If the terms of trade for a state changes significantly (i.e. the prices for a state's overseas exports and overseas imports change at different rates), then GSP will not accurately reflect the change in real purchasing power of the income generated within a state.
Source: ABS cat. nos 5206.0, 5220.0, 5260.0.55.022.

The effect of these movements in the terms of trade on income growth can be seen in Figure 2.10. Over the most recent productivity cycle (2011–12 to 2016–17) incomes grew more slowly than gross state product, with the terms of trade detracting around 0.5 percentage points from growth. As a result, real income declined relative to productivity.

Figure 2.10 Queensland real gross state income decomposition



Source: ABS cat. nos 5206.0, 5220.0, 5260.0.55.022; QPC estimates.

Over the past three years, real income growth per capita has increased by only 1.9 per cent, despite strong growth in the terms of trade (up 1.1 per cent). This reflects weak labour productivity growth over this period (–0.2 per cent).

3. Feature article: Labour productivity and wages

There is extensive evidence that, in the long run, labour productivity is the primary driver of wages growth, and by extension, improvements in living standards (see, for example, Australian Treasury 2017, p. 17; PC 2017a, pp. 39–44, 2020, p. 5). Recently, however, some commentators have stated that wages and labour productivity have decoupled in Australia, citing evidence that wages are growing more slowly than productivity (for example, see Dennis 2019), calling into question whether workers are receiving their 'fair share' and whether pro-productivity policies are the best means to increase household income and wellbeing.

This feature article examines at a high-level whether there is evidence to demonstrate that real wage growth has systematically decoupled from productivity growth in Queensland.

It is important to compare the right measures

Measuring labour productivity

Economy-wide labour productivity is a measure of output produced per hour worked (ABS cat. no. 5260.0.055.002). Changes in labour productivity reflect a wide range of factors, including capital deepening, upskilling of workers and changes in the composition of work. If workers shift to more productive jobs, labour productivity will increase, even if no one job is done more efficiently.

Because labour productivity is the average output per hour worked, it can be calculated wherever output and hours worked data are available. In this article, 'economy-wide' labour productivity[7] includes the output and labour inputs related to all workers in all industries (including the public sector) and in any capacity (including full-time workers, part-time workers and the self-employed).

Measuring wage growth

To assess whether wage growth has been lagging productivity growth, it is important to use a measure of wages that can be validly compared to labour productivity. The three most commonly used measures of wage growth are the wage price index, average weekly ordinary time earnings and average earnings in the national accounts.

The **wage price index** (WPI) is a measure of wage growth produced by the ABS (ABS cat. no. 6345.0). In the same way the consumer price index (CPI) tracks changes in a 'basket' of goods, the WPI tracks growth in wages for a fixed selection of jobs. By doing so, changes in the composition of 'work' (such as casualisation, or changes in occupation) are not reflected in the WPI (PC 2019, p. 29). However, as productivity growth and pay rates are influenced by the types of jobs performed in the economy (and the skills attached to these roles), the WPI does not provide a valid measure for comparing wage and productivity growth.

The **average weekly ordinary time earnings** (AWOTE) measures average gross weekly earnings based on business surveys. It captures the earnings of full-time workers over the age of 21 (see ABS cat. no. 6302.0). Full-time employees comprised only 68 per cent of the Queensland workforce and this proportion is not constant, falling by around 4.8 percentage points from September 1999 to September 2019 (ABS cat. no. 6302.0). As the AWOTE captures a subset of employees, whereas labour productivity captures the whole economy, these two growth rates cannot be validly compared.

Average earnings in the national accounts (AENA) is a measure of the average compensation received by workers in the economy and can be expressed as either 'per earner' or 'per hour worked'. It is calculated by dividing compensation paid to employees (ABS cat. no. 5220.0) by either the number of workers or the number of hours worked (ABS cat. no. 6202.0). Total compensation includes all payments to all employees, including overtime payments, in kind payments and contributions by employers to pension or superannuation funds (Australian

[7] This article examines 'whole-of-economy' variables since this accounts for the effect of non-market wage and productivity growth. The other parts of this paper examine labour productivity for the market sector only.

Treasury 2017, pp. 4, 8). To fully reflect all work done in the economy, an adjustment should be made to account for self-employment.[8]

When expressed as per hour worked, changes in AENA (labour income per hour worked) provide a valid comparison to changes in labour productivity, as it accounts for changes in the composition of the workforce, includes all components of wages and provides coverage across all workers. It is the measure used in the remainder of this article.

Adjusting for prices

To remove the impact of changes in the price level, both labour productivity and wages should be expressed in real terms. The relative prices that matter to workers and producers differ, however, which can lead to differences in the real value of wages to workers (consumers) and firms (producers).

For firms, the relevant prices are the costs of their non-labour inputs and the prices of their outputs. The real producer wage is therefore obtained by adjusting AENA for prices of goods and services produced across the economy using the GDP deflator. For consumers, the relevant prices are those of household goods and services such as food, housing and healthcare. The real consumer wage is therefore obtained by adjusting AENA for consumer inflation using the CPI.

The real producer wage focuses on the link between the costs of hiring a worker or having them work an additional hour and the benefit that is obtained in terms of increased output (income) per the additional hour of work (that is, labour productivity). The relationship between real producer wages and labour productivity affects the competitiveness of businesses and their employment decisions.

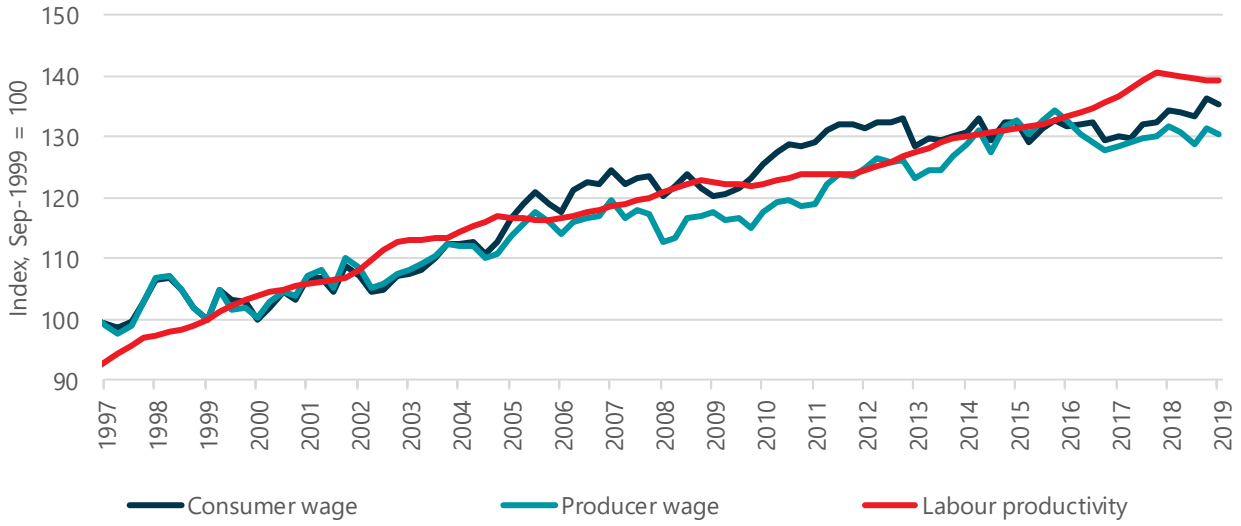
From a household perspective, the real consumer wage is a better indicator of the wage level received because it captures the link between the choice to work (and forego leisure) and the goods and services that can be purchased from working.

[8] The 'hours worked' published by the ABS includes work done by self-employed people (ABS cat. no. 6150.0), while the total compensation of employees excludes their labour income. The latter is adjusted using the market sector labour income share published in the productivity accounts (ABS cat. no. 5260.0.55.002). It is assumed that changes in the share of income accruing to self-employed workers have been the same in both market and non-market industries. The change to the growth rates is small—the difference in the adjustment between 2019 and 1999 was 2.6 percentage points.

Wages and productivity have tended to move together over the long term

Although real producer and consumer wages have deviated from productivity growth for short periods (including during recent history), growth rates over long time frames have largely kept pace (Figure 3.1).

Figure 3.1 Real wages and labour productivity, Queensland



Notes: Real consumer and producer wages are constructed using the AENA per hour and are based on compensation paid to employees in all sectors of the economy, adjusted to account for self-employment. Labour productivity is based on smoothed annual Gross State Product (without dwellings) divided by hours worked. CPI deflation is based on Brisbane prices.
Sources: ABS cat. nos 5206.0, 5260.0.55.002, 6202.0, 5220.0; QPC estimates.

Although they may deviate, real producer wages and productivity tend to move together because of labour market dynamics that begin at the firm level. A firm has an incentive to employ more labour if the additional production it achieves is greater than the wage (in real producer terms) it would have to pay. If the marginal product of a particular kind of labour increases for a firm (for example, because of a productivity-enhancing technology change), firms have an incentive to increase employment of that kind. This increases demand for that type of labour, putting upward pressure on that occupation's wages.[9]

While changes in labour productivity drive changes in wages at the occupation level, occupation-specific wage increases tend to influence whole-of-economy wages for two reasons. First, more productive work naturally tends to increase as a share of all work done, as firms employing workers of that type expand or as new firms enter those markets. Second, higher wages offered in industries experiencing productivity growth put upward pressure on wages in other occupations. Workers have an incentive to transition towards higher-paid occupations, and barriers to occupational change (skills, regulatory requirements and geography) become less significant over time (for example, workers can retrain or are more likely to relocate). Consequently, employers in other industries are forced to offer higher wages to attract or retain workers who might otherwise choose different jobs.[10]

[9] With a fixed labour supply, an increase in productivity allows firms to increase wages without increasing product prices.
[10] Baumol first observed this effect in classical musicians—though their output was essentially unchanged compared to when the music was first written, their wages had grown due to pressures from other occupations (Baumol & Bowen 1968, pp. 209–236).

However, wages can deviate from productivity growth

There are several reasons why real producer wages might diverge from productivity growth. It is beyond the scope of this article to discuss all of these in detail; the broad factors are discussed below.

Short-term deviations tend to be driven by labour market conditions, while a long-term divergence is caused by large-scale structural change.

Deviations can have wide-ranging impacts including on output prices, business profitability and employment decisions through changing unit labour costs—the ratio of average wage costs over labour productivity.[11] Unit labour costs remain unchanged if average wages and labour productivity grow at the same rate.

Labour market conditions

Spare labour capacity can absorb shifts in labour demand, reducing upward pressure on wages. Changes in spare capacity can reflect both structural shifts (for example, falling labour participation rates potentially caused by an ageing population) or short-term cyclical factors (Lowe 2018b).

In Queensland, there appears to be significant spare capacity in the labour market—in part, this is the result of a transition in the mining industry from the labour-intensive investment phase to the production phase. Both Queensland's unemployment and underemployment rates have been (and remain) relatively high over the period of low wages growth (see page 6). Lower labour demand is also reflected in job advertising rates—the 'Internet Vacancy Index', which tracks job advertisements, is well below its mining boom levels in Queensland (Department of Employment, Skills, Small and Family Business 2020).

Labour market frictions and change to labour dynamism (fluidity of labour markets) may exaggerate or diminish the impact of productivity on wages. If growth in labour productivity (and labour demand) is concentrated in sectors that employ highly skilled workers, wage growth might initially grow strongly, before falling off as more workers obtain those skills. Relatedly, national research suggests that a fall in the job-switching rate, which reflects cyclical and structural factors, is linked to lower wages growth (Deutscher 2019; Quinn 2019).

Technological change

The nature of a productivity-enhancing change affects the distribution of the additional income it creates. Some changes 'augment' the productivity of existing work without radically changing the nature of the work done. For example, new record-keeping software can improve the productivity of an accountant, but the accountancy work being done is fundamentally the same. Alternatively, a productivity change may be 'transformative', enabling something to be produced in an entirely new way. An example given by Lazear (2019) is the historic change to the work done by a cashier. A century ago, shop cashiering was a skilled occupation, requiring the memorisation of item prices and quick mental calculations of totals (in pre-decimal currency). With the advent of inexpensive calculators, cash registers and barcodes, the skill required to be a cashier changed, increasing the pool of potential workers and reducing cashiers' real wages. In a modern context, this concept may apply to work that is increasingly automated (Lazear 2019, pp. 6–10). There is little evidence to suggest that a rapid and transformative change in the nature of work is currently occurring in Queensland.

Other technological and structural changes, such as those that may occur through outsourcing, global supply changes or the rise of the ‘gig’ economy may also have affected the relationship between wages and productivity (Brown & Campbell 2002).

[11] See ABS (2016, pp. 456–9) for a discussion of how real unit labour costs are calculated. In short, average labour costs are deflated with the GDP deflator and then divided by labour productivity. The measure combines a measure of wage costs and labour productivity into a single indicator.

Real consumer wages have diverged from producer wages and productivity

Between 2005 and 2011, growth in consumer wages outstripped growth in producer wages and labour productivity (Table 3.2). Over this time, a high Australian dollar helped to constrain consumer prices, while strong domestic demand during the mining boom worked to keep producer prices high. Lower consumer prices, relative to producer prices meant that real wages could increase, relative to producer prices (and labour productivity).

Table 3.2 Growth in labour productivity, real producer wages and real consumer wages (%)

Period	Labour productivity	Real consumer wages	Real producer wages
1999–2000 to 2004–05	2.0	1.6	1.5
2004–05 to 2001–11	1.0	3.0	1.9
2010–11 to 2018–19	2.0	0.6	1.4

Sources: ABS cat. nos 5206.0, 5260.0.55.002, 6202.0, 5220.0; QPC estimates.

After 2011, labour productivity has grown more rapidly than real consumer wages, partially because of the return of the terms of trade (and a consequent decline in the Australian dollar) to pre-boom levels. This is evidenced by the 'catch-up' of real producer wages to real consumer wages (Figure 3.1). Slower consumer wage growth, compared with labour productivity growth, is consistent with declining terms of trade, because growth in wage income has been matched by growth in consumer prices (Australian Treasury 2011, p. 19).

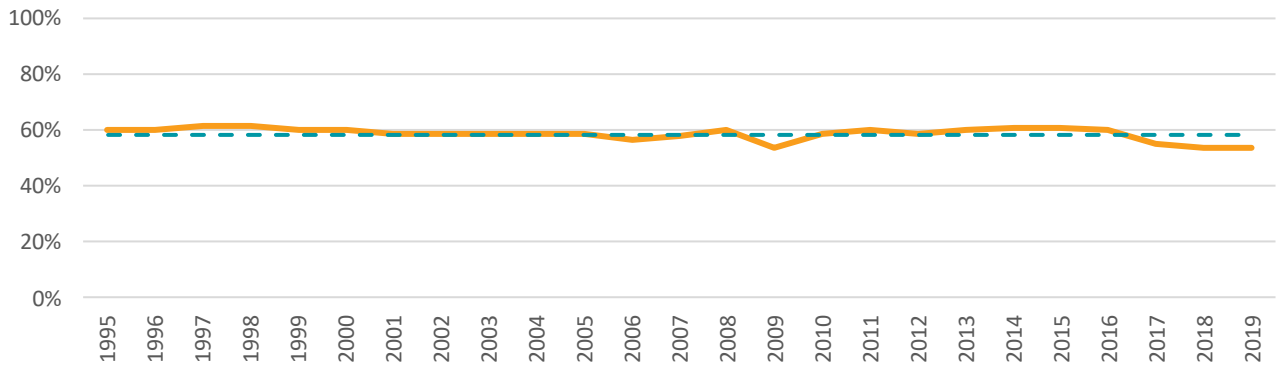
Changes in the labour share of income

A systematic departure of wage growth from labour productivity growth would be evidenced by a changing labour share of income[12], which would fall if wages were not keeping pace with income growth.

The share of income in Queensland has remained relatively consistent since 1994–95, though it has fallen to (and remained) around 5 percentage points below its 25-year average over the past 3 years (Figure 3.2). For Australia generally, growth in the capital share of income partly reflects strong increases in imputed rents (from rising house prices) and capital income growth in the financial services sector (La Cava 2019).

It remains to be seen whether there are any permanent structural changes in the labour share of income.

Figure 3.2 Labour share of income, Queensland



Note: This applies only to the ABS market sector industries.
Source: ABS cat. no. 5260.0.55.002.

[12] The labour share of income is the share of income accruing to labour and includes the returns to labour for the self-employed. The remainder is the income accruing to capital.

Summary

There is little evidence to suggest that wage and labour productivity growth have decoupled over the last 20 years in Queensland. While wage and labour productivity growth have diverged over the past 4–5 years (causing the decline in the labour share of income), this divergence is not exceptionally large in a historical context. While it is not possible to rule out other causes, our preliminary analysis suggests that slow wage growth is mainly the result of cyclical factors associated with the end of the mining boom, weak growth in labour productivity itself and weakened labour market dynamism.

The Australian Productivity Commission has also examined the relationship between wages and productivity growth (PC 2020). The Commission concluded that slower productivity growth explains just over half of the slow-down in national consumer wages growth since 2012–13, with relative consumer inflation (consumer prices growing more quickly than producer prices, due to the fall in the terms of trade) explaining almost a third. Apart from the small positive impact of reduced net taxes, the remaining fifth of the slowdown was explained by a decline in the labour share of income (PC 2020, pp. 25–26). The fall in the labour share of income was almost entirely explained by compositional changes in the economy—growth in the capital-intensive mining sector explained about 80 per cent of the change, with almost all the remainder being explained by improved profitability in the financial services and insurance sector (PC 2020, p. 28).

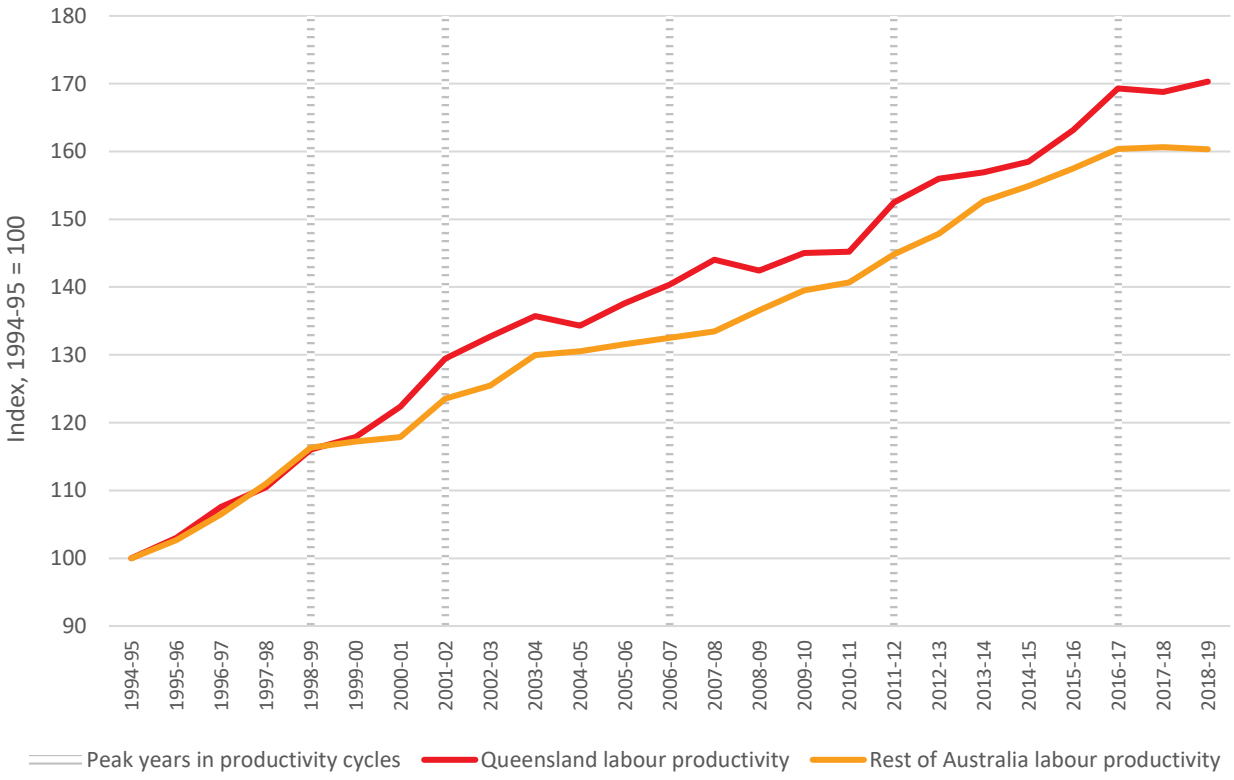
4. Queensland's performance in a national context

The relative productivity performance of a firm or economy can be measured by comparing their productivity with the 'technological frontier' or an average productivity level of other jurisdictions. The productivity gap will expand or contract over time, given differences in productivity growth rates.

Over time, Queensland's productivity has grown faster than the rest of Australia

Between 1998–99 and 2018–19, Queensland labour productivity for the market sector grew at 1.9 per cent per annum on average, while the rest of Australia increased at 1.6 per cent per annum (Figure 4.1). Queensland output also grew faster, recording an average annual growth rate of 3.5 per cent compared to 2.7 per cent for the rest of Australia. Hours worked in Queensland also grew more strongly at 1.6 per cent per annum compared to 1.2 per cent for the rest of Australia.

Figure 4.1 Queensland productivity growth versus the rest of Australia, market sector, 1998–99 to 2018–19



Note: The rest of Australia is measured relative to Queensland.
Source: ABS cat. no. 5260.0.55.002; QPC estimates.

Faster growth resulted in convergence in productivity levels

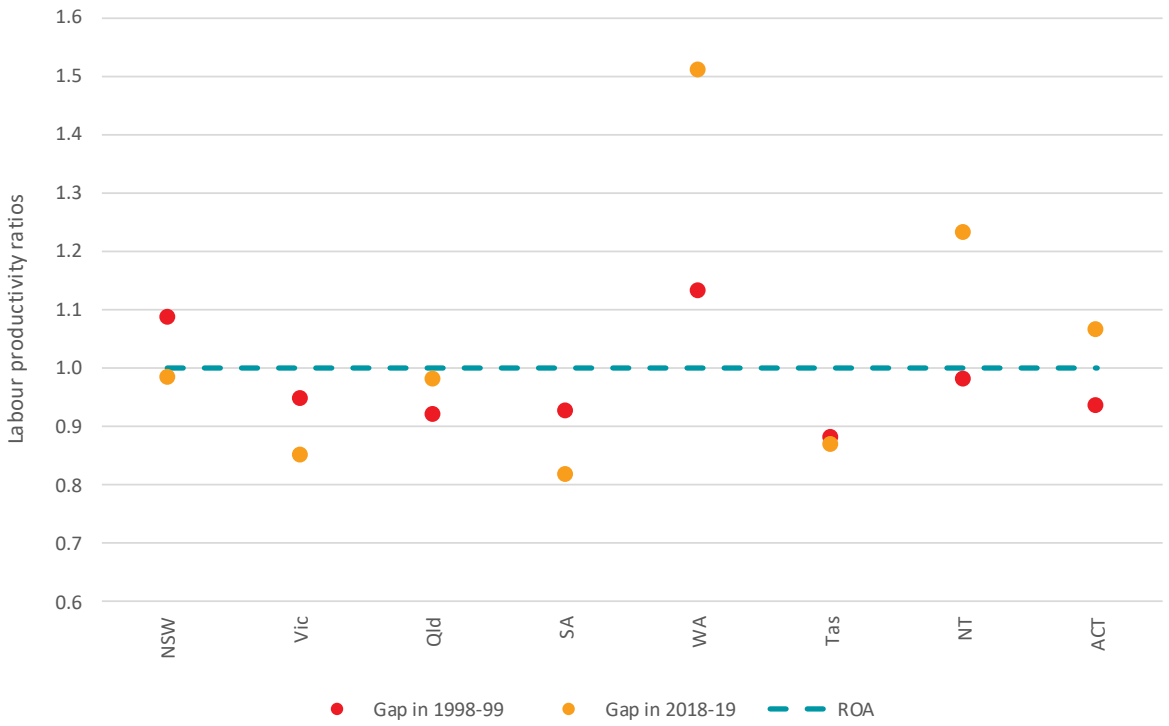
Queensland's stronger labour productivity performance since 1998–99 resulted in Queensland almost converging with the rest of Australia's labour productivity levels—the labour productivity gap narrowed from roughly 8 per cent behind the rest of Australia in 1998–99 to only 2 per cent in 2018–19 (Figure 4.2).

There is some evidence of greater dispersion in labour productivity levels across states and territories over the past ten years. Western Australia and the Northern Territory moved ahead of the rest of Australia (their labour

productivity ratios over the rest of Australia increased), while Victoria and South Australia fell further behind (their labour productivity ratios decreased relative to the rest of Australia).

Labour productivity in New South Wales grew at an average rate of 1.3 per cent per annum between 1998–99 and 2018–19, compared to 1.6 per cent for the rest of Australia. New South Wales' labour productivity was higher than the rest of Australia in 1998–99, but the difference in growth rates resulted in the rest of Australia catching up by 2018–19.

Figure 4.2 Change in state labour productivity gaps, market sector, 1998–99 to 2018–19



Notes: The rest of Australia is measured uniquely for each state or territory (e.g. for NSW it is the sum of states and territories less NSW; for Qld, it is the sum of states and territories less Qld). It is presented as a line at 1.0 as the labour productivity ratio of the Rest of Australia over itself will always be one. Labour productivity is a measure of the output or value added of an economy per hour worked (it includes only market sector industries).
Source: ABS cat. no. 5220.0; QPC estimates.

Understanding state differences requires industry-level comparisons

Within-industry productivity growth contributed the most to closing the gap

Queensland's labour productivity gap (Figure 4.2) can be decomposed into differences in within-industry productivity gaps (that is, differences between a given industry's level of labour productivity in Queensland and that of the same industry in the rest of Australia) and differences in industry structure.

In 1998–99, Queensland's labour productivity gap of –8.4 per cent was explained almost entirely by differences in within-industry productivity (contributing –8.1 percentage points) rather than differences in industry structure[13] (contributing –0.3 percentage points) (market sector totals in Table 4.2).

The labour productivity gap for market sector industries in Queensland narrowed from –8.4 in 1998–99 to –1.99 per cent in 2018–19 (improving 6.4 percentage points). The narrowing of this gap was largely due to improvements in within-industry productivity (contributing 4.5 percentage points to the improvement in the gap—from –8.1 to –3.6), with changes in industry structure towards industries with higher levels of labour productivity making a smaller contribution (2.0 percentage points—from –0.3 to 1.6).

The increase in labour productivity relative to the rest of Australia was broad-based across Queensland industry between 1998–99 and 2018–19. Significant improvements (relative to the rest of Australia) were made in Manufacturing, Electricity, gas and waste services, Rental, hiring and real estate services and Professional services. Labour productivity in Construction and Financial services fell relative to productivity in the rest of Australia.

Overall, 10 out of 16 market sector industries contributed to Queensland's improved relative labour productivity performance from 1998–99 to 2018–19:

- *industries that moved from a negative to positive contribution*: Manufacturing (an improved contribution of +1.4 percentage points[14] (–0.9 to +0.4)); Electricity, gas, water and waste services (+1.2); Transport, postal and warehousing (+0.6); Professional, scientific and technical services (+2.4); Arts and recreation services (+0.4); and Other services (+0.2)
- *industries that reduced their 'negative' contribution*: Agriculture, forestry and fishing (+0.1); Retail trade (+0.6); and Rental, hiring and real estate services (+2.0)
- *industries that increased their positive contribution*: Mining (+1.9)
- *industries that moved from a positive to negative contribution*: Construction (–1.3)
- *industries that increased their negative contribution*: Wholesale trade (–0.2); Accommodation and food services (–0.6); Information media and telecommunications (–0.2); Financial and insurance services (–1.9); and Administrative and support services (–0.1).

Industries that made a 'negative' contribution to Queensland's market sector labour productivity gap may still have achieved solid labour productivity growth (for example, Financial and insurance services). An industry's contribution to the gap is based on the industry's *relative* labour productivity level and *relative* labour shares compared to the rest of Australia. In the case of the within-industry contribution, a negative contribution can occur when labour productivity growth is rising but average productivity growth for the rest of Australia is rising faster.

Contributions from changes in industry structure were predominantly driven by an increase in the labour share of Mining in the Queensland economy. As Mining has high labour productivity compared to other industries, this effect contributed 1.8 percentage points to the narrowing in Queensland's labour productivity gap.

More detail on industry contributions to productivity growth are provided in Appendix D.

[13] Industry structure is measured as labour shares based on hours worked.
[14] Note that numbers may not add up due to rounding.

Table 4.2 Industry contributions to Queensland's labour productivity gap, market sector (% points)

Industry	1998–99			2018–19			2018–19 cont. less 1998–99 cont.
	Within industry productivity differences	Labour share differences	Contrib-ution to gap	Within industry productivity differences	Labour share differences	Contrib-ution to gap	
Agriculture, forestry and fishing	0.5	–0.8	–0.4	–0.1	–0.2	–0.3	0.1
Mining	–0.3	2.9	2.6	–0.3	4.7	4.5	1.9
Manufacturing	–1.3	0.4	–0.9	0.4	0.0	0.4	1.4
Electricity, gas, water and waste services	–0.2	0.0	–0.2	1.0	0.0	1.0	1.2
Construction	0.2	–0.0	0.2	–0.8	–0.3	–1.0	–1.3
Wholesale trade	–0.3	0.0	–0.3	–0.5	–0.0	–0.5	–0.2
Retail trade	–0.2	–0.5	–0.8	–0.1	–0.0	-0.1	0.6
Accommodation and food services	0.0	–0.3	–0.3	–0.1	–0.8	–0.9	–0.6
Transport, postal and warehousing	–0.5	–0.0	–0.5	0.2	–0.1	0.1	0.6
Information media and telecommunications	–1.2	0.0	–1.2	–1.2	–0.2	–1.4	–0.2
Financial and insurance services	0.7	–2.6	–1.9	–1.2	–2.5	–3.8	–1.9
Rental, hiring and real estate services	–3.0	0.6	–2.4	–0.5	0.1	–0.5	2.0
Professional, scientific and technical services	–1.8	0.4	–1.4	0.3	0.6	0.9	2.4
Administrative and support services	–0.4	–0.2	–0.6	–0.7	0.1	–0.7	–0.1
Arts and recreation services	–0.2	–0.1	–0.3	–0.0	0.1	0.1	0.4
Other services	–0.1	0.1	–0.1	0.2	–0.1	0.1	0.2
Market sector	**–8.1**	**–0.3**	**–8.4**	**–3.6**	**1.6**	**–2.0**	**6.4**

Notes: See Dolman et al. (2007) for an outline of the decomposition method. For each industry, the weighted industry productivity gap plus the weighted relative labour shares equals the percentage point contribution of the industry to Queensland's aggregate labour productivity gap.
Source: ABS cat. no. 5220.0; QPC estimates.

5. Queensland industry MFP

The ABS first released estimates of state and territory MFP for the aggregate market sector in 2017. The most recent update of that data includes estimates for 2018–19. The ABS does not publish state and territory industry MFP estimates for individual industries.

The industry MFP estimates presented in the following sections have been constructed by the Commission based on ABS-published component data (such as hours worked, output and net capital stocks). The estimates, which are presented for industries in both the market and non-market sector, are exploratory and, at least for some industries, may be subject to significant future revision. Appendix E assesses the quality of the estimates.

Industry MFP performance

Industry MFP growth varies highly within an industry across productivity cycles and across industries within a cycle. This heterogeneity is seen both in the direction of the change and in the magnitude of the change (Table 5.1).

Over the period 1998–99 to 2018–19, several service industries recorded solid average annual growth in MFP, particularly Wholesale trade (2.7 per cent per annum); Professional, scientific and technical services (2.3 per cent), Retail trade (1.7 per cent) and Information media and telecommunications (1.3 per cent). These growth rates are well above those recorded in Agriculture, forestry and fishing, Mining and Manufacturing industries, as well as Electricity, gas, water and waste services and Construction.

Table 5.1 Queensland industry MFP growth by productivity cycle, average annual growth rates (%)

Industry	Quality assessment	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Agriculture, forestry and fishing	H	–1.0	5.1	0.6	–11.6	0.1
Mining	H	–5.3	–12.0	2.8	1.3	–1.9
Manufacturing	H	–0.6	–0.5	0.3	0.3	0.4
Electricity, gas, water and waste services	H	–2.6	–9.2	3.5	–1.3	–2.3
Construction	H	–0.7	4.4	–5.0	–2.8	–0.5
Wholesale trade	H	4.6	–0.5	2.7	–0.8	2.7
Retail trade	H	0.5	2.6	0.2	2.6	1.7
Accommodation and food services	H	4.5	0.9	–0.5	0.1	0.6
Transport, postal and warehousing	H	0.9	–1.8	1.1	2.8	0.6
Information media and telecommunications	H	–0.0	3.7	2.6	1.5	1.3
Financial and insurance services	M	0.6	–0.4	3.2	–0.9	0.4
Rental, hiring and real estate services	M	–0.8	–1.6	4.1	3.3	0.8
Professional, scientific and technical services	H	2.0	2.7	0.5	2.9	2.3
Administrative and support services	M	2.3	–2.4	3.3	3.4	1.1
Public administration and safety	L	–3.9	0.8	0.5	–1.6	–1.4
Education and training	L	0.6	–2.2	1.4	–4.4	–0.3
Health care and social assistance	L	1.1	–1.0	2.4	2.1	1.1
Arts and recreation services	M	2.7	–1.3	0.2	5.6	0.6
Other services	M	–0.8	2.2	–0.9	4.3	0.7

** Denotes incomplete productivity cycle.*
Notes: Cycles are based on MFP cycles for the Queensland market sector. Industry cycles can differ from the aggregate market sector cycles. Quality assessment is high (H), medium (M) or low (L) (see Table E.7).
Source: ABS cat. no. 5220.0; QPC estimates.

Over the period 1998–99 to 2018–19, negative MFP growth rates were recorded in 5 of the 19 industries (comprising 16 market sector and 3 non-market sector industries). MFP is traditionally interpreted as being a measure of technological change. If this was strictly the case, then the results would suggest that there has been technological regress in these industries. However, MFP can change for reasons not directly related to technological change. Examples of non-technological influences that can be captured in measured MFP are:

- *Returns to scale and scope*—the MFP estimates are constructed using a growth accounting methodology which assumes a constant return to scale. This is a state of technology where increases in inputs lead to an increase in output by the same proportion. Where this assumption does not hold, measured MFP can include returns that should be attributed to changes in scale. Similarly, measured MFP can capture economies of scope (efficiency gains that occur when a firm produces a greater variety of products).
- *Changes in technical efficiency*—the construction of MFP estimates assumes that businesses produce efficiently. Changes in the average productive (or technical) efficiency of businesses within an industry can impact on industry outputs/inputs in a way that is captured in measured MFP. Businesses within an industry may have widely differing efficiency levels with the most efficient businesses forming the 'technological frontier'. Changes in the distribution of these efficiency levels—for example, when the efficiency of the average business moves towards the frontier—can influence measured MFP by either expanding outputs for a given level of inputs, or by conserving on inputs for a given level of output.
- *Changes in allocative efficiency*—the allocation or re-allocation of resources towards economic activities where resources are employed more efficiently can increase measured MFP.[15] For example, if the measurement of MFP occurs at a high level of industry aggregation (for example, for all of Manufacturing or Mining), then the re-allocation of resources within the industry may not alter the volume of measured inputs for that industry, as they have simply been reallocated. However, measured outputs may increase (as inputs have been allocated more efficiently) that contribute to an increase in measured MFP.
- *Mis-measurement of quality change*—ideal measures of industry output and inputs fully take account of changes in the quality of outputs and inputs. However, in practice, quality adjustment of the data used to construct MFP estimates is imperfect. National industry estimates of MFP are provided on an hours worked basis and a quality-adjusted hours worked basis. However, at the state level there are no quality-adjusted labour indices (QALI) for the market sector or by industry. Figure E.4 demonstrates the impact that quality adjustment of industry outputs can make to MFP estimates.

Other influences include the business cycle and environment-related factors, such as droughts and cyclones.

Growth in industry outputs and inputs

For value-added-based measures of MFP, the underlying component series used to construct estimates are output and the two inputs—capital services and labour services (preferably based on hours worked). The two inputs are combined using their respective income shares into a total inputs index. MFP growth is positive when the index of outputs grows faster than the total inputs index. MFP growth can also be positive when output declines if combined inputs decline at a faster rate.

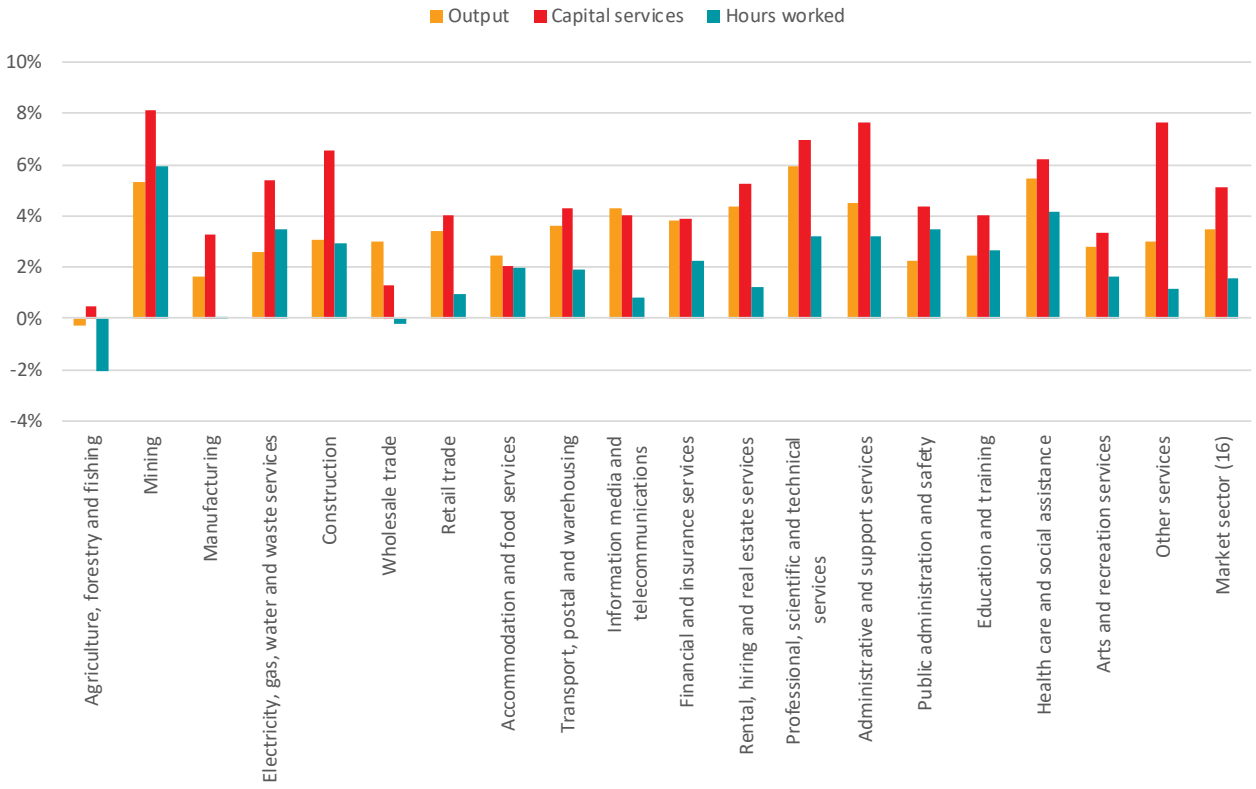
Between 1998–99 and 2018–19, Queensland industry output average annual growth rates ranged from –0.3 per cent for Agriculture, forestry and fishing to 5.9 per cent per annum for Professional, scientific and technical services (Figure 5.1). Output growth was positive for every industry other than Agriculture, forestry and fishing. However, as mentioned earlier, the choice of 2018–19 as the end-point for comparisons affects the growth rates of this industry because of the sharp drop in output associated with the drought. Comparing 1998–99 to 2016–17

[15] Allocative efficiency relates to the ability of a business or industry to use inputs in optimal proportions, given a set of input prices, or to produce outputs in optimal proportions, given a set of output prices.

provides a fairer comparison (both years being peaks in their respective productivity cycles).[16] Over this slightly shorter period, the industry's output increased at an average annual growth rate of 0.8 per cent per annum.

Between 1998–99 and 2018–19, capital inputs grew faster than hours worked in every industry, resulting in capital deepening (more capital in use per hour worked). Capital growth was particularly strong in Mining; Electricity, gas, water and waste services; and Construction; but also, in several service industries, such as Administration and support services; Professional, scientific and technical services; and Other services.

Figure 5.1 Average annual growth rates of industry outputs and inputs, 1998–99 to 2018–19



Source: ABS cat. nos 5220.0, 6291.0.55.003; QPC estimates.

Differences in the growth rates of output and hours worked between industries have resulted in some industries expanding or contracting relative to other industries. While shares for most industries did not change dramatically, hours worked shares increased strongly for Mining, Construction and Professional, scientific and technical services (Figure 5.2). For example, the construction industry's share of hours worked increased from 11.3 per cent of market sector hours worked to 15.0 per cent—an increase of 3.7 percentage points. Output shares increased significantly for some industries including Mining and Professional, scientific and technical services, with the shares for Agriculture, forestry and fishing and Manufacturing declining. As indicated earlier, the expansion and contraction of industries influences overall productivity growth as resources shift across industries with differing productivity levels and growth rates.

[16] Industry output growth rates by cycle are presented in Table A.4, where they are decomposed into capital services, hours worked and MFP contributions to output growth.

Figure 5.2 Industry output and hours worked shares, difference between 1998–99 and 2018–19

Notes: Change in shares is measured as the industry's 2018–19 share less its share in 1998–99. For example, Mining increased its share of market sector output from 12.2 per cent to 17.7 per cent—an increase of 5.5 percentage points. In contrast Manufacturing's share of output decreased 3.9 percentage points.
Source: ABS cat. no. 5220.0; QPC estimates.

MFP contribution to industry labour productivity growth

Over the period 1998–99 to 2018–19, measured labour productivity fell in four industries (Figure 5.4):

- Public administration and safety; and Education and training—both of these industries are classified as part of the non-market sector where output estimates are of lower quality compared to market sector industries and where there are no national industry capital services measures to assist with measuring capital inputs at the state/territory level
- Mining (see pp. 7–10)
- Electricity, gas, water and waste services (EGWW) (Box 5.1).

A fall in MFP was the cause of the decline in labour productivity over this period in all four industries.

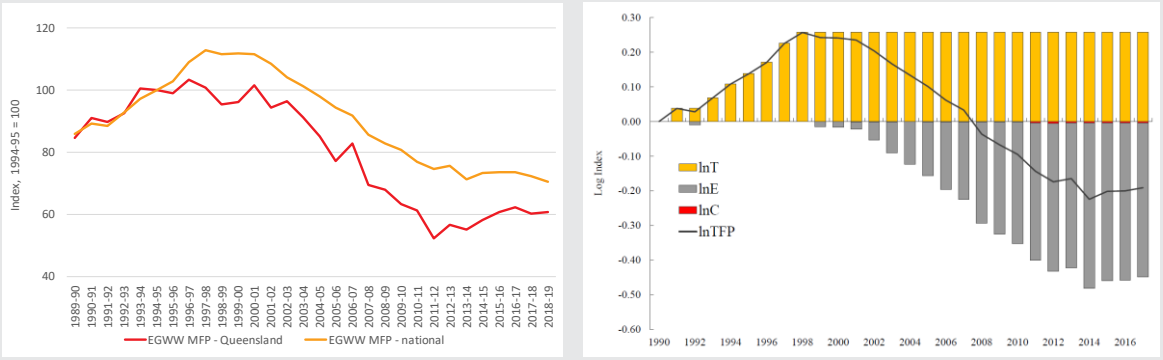
Box 5.1 Productivity performance of Electricity, gas, water and waste services

The poor long-term MFP performance of the Electricity, gas, water and waste services (EGWW) industry in Queensland is consistent with performance trends for the industry at the national level, where MFP increased from the mid-1980s up until the mid- to late-1990s and has since declined steadily (left-hand panel of Figure 5.3). After 2011–12, Queensland EGWW MFP began to rise, mainly due to a sharp decline in hours worked relative to output.

Both electricity supply and water supply, sewerage and drainage services contributed to the overall poor performance of the national EGWW industry (Topp & Kulys 2012).

A decomposition of national industry productivity suggests that the decline in productivity is due to reductions in efficiency levels (the grey bars in the right-hand panel) (Zeng et al. 2018).[17]

Figure 5.3 MFP trends (LHS) and Queensland productivity decomposition (RHS)



Sources: ABS cat. nos 5220.0, 5260.0.55.002; Zeng et al. 2018; QPC estimates.

Studies based on firm-level datasets as part of regulatory processes also find that the national industry's productivity performance has been poor (for example, in relation to electricity transmission and distribution see Lawrence et al. 2019a and 2019b).[18]

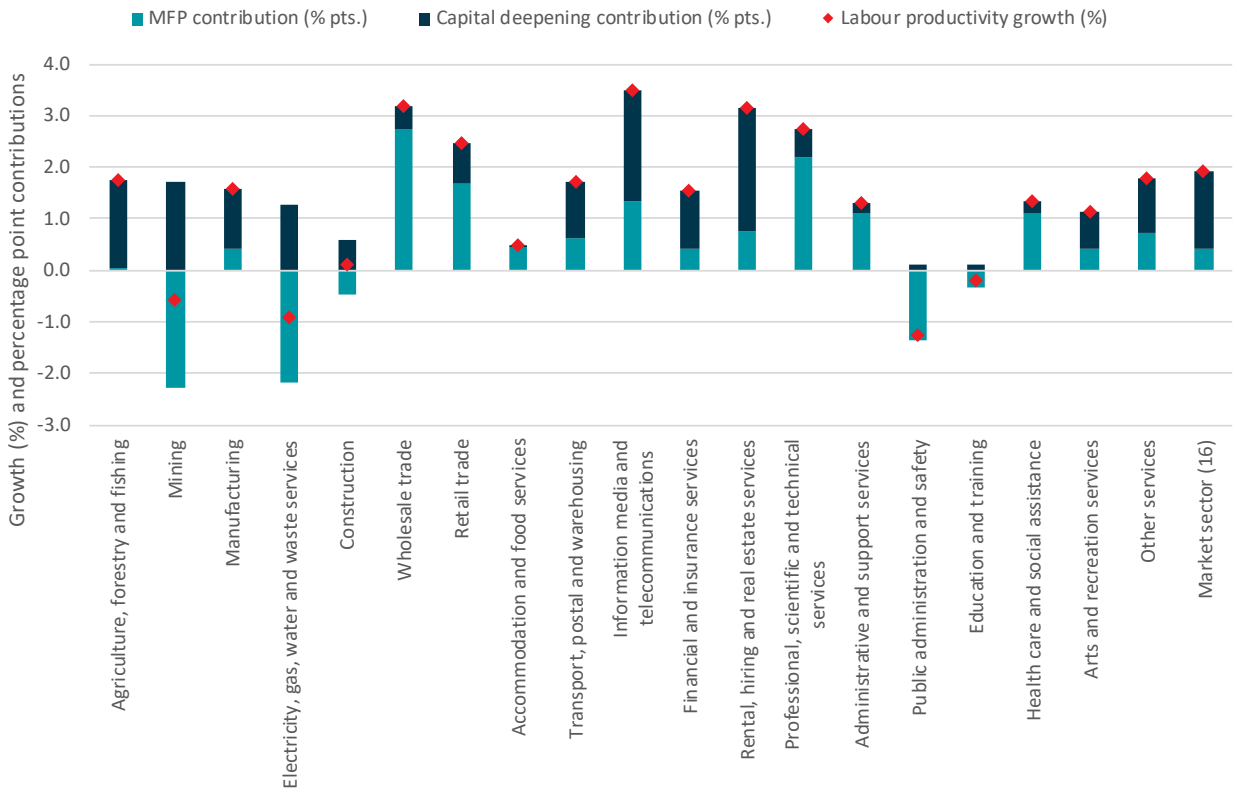
These studies estimate that, for Queensland, Energex's total factor productivity growth over the periods 2006–18 and 2006–12, was –0.5 and –1.1 per cent per annum, respectively. Over the more recent period of 2012–18, growth improved to 0.2 per cent per annum. Ergon Energy's total factor productivity grew at an average annual rate of 0.5 per cent per annum in each of the above periods.

Some of the influences on the productivity performance of electricity supply include increasing technical standards; renewable energy policies increasing the costs of energy production and increasing network costs; and an increase in the ratio of peak to average electricity demand, which lowered average rates of capacity utilisation, and is largely attributable to rapid growth in household use of air conditioners (QPC 2016a, pp. 44–45; Topp & Kulys 2012).

[17] The chart accumulates growth rates and is specified in logs so that contributions are additive. Total factor productivity (lnTFP) is decomposed into an index of technology (lnT), an index of technical and allocative efficiency (lnE), and an index representing changes in the mix of inputs (lnC). The combined contributions of technology, efficiency and input mix changes equal the measured TFP index.
[18] The technical methods used in the studies differ significantly to growth accounting estimates and decompositions of aggregate industry data. For example, output for electricity distribution businesses includes five components: ratcheted maximum demand; circuit length; customer numbers; minutes of supply; and energy throughput.

As well as large variations in labour productivity growth rates, the contributions of capital deepening and MFP also varied significantly across industries. Capital deepening contributed positively to growth in every industry but made only a minor contribution in Accommodation and food services; Public administration and safety; and Education and training (with the estimates less robust for the latter two industries due to the difficulties involved with measuring inputs and outputs in non-market sectors[19]).

Figure 5.4 Labour productivity growth decomposition for Queensland industries, 1998–99 to 2018–19



Source: ABS cat. nos 5220.0, 6291.0.55.003; QPC estimates.

Over the most recent completed cycle from 2011–12 to 2016–17, labour productivity increased across all Queensland industries, except in Construction and Accommodation and food services (Table A.3). Labour productivity grew very strongly in both Mining (12.1 per cent per annum) and Electricity, gas, water and waste services (12.5 per cent per annum) due largely to capital deepening.

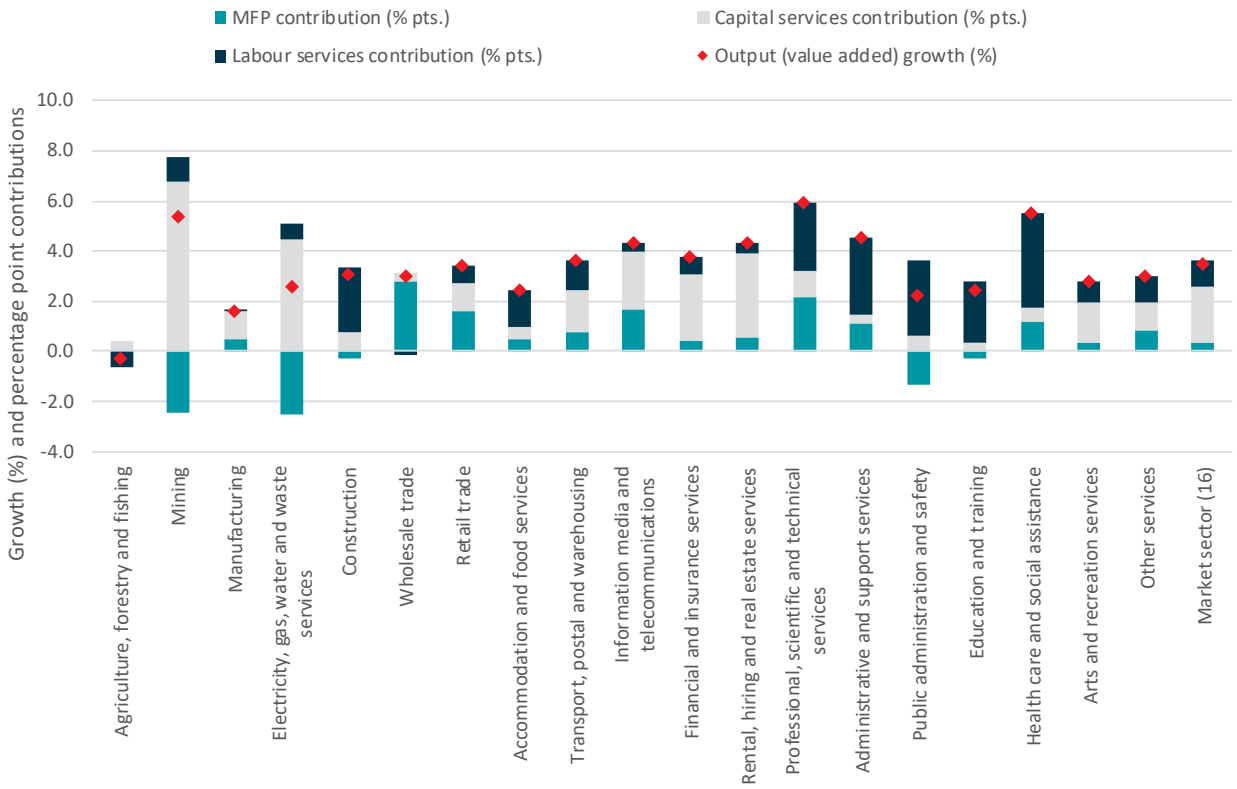
[19] The average growth rates in capital income shares for non-market industries are low compared to most market sector industries. From 1998–99 to 2018–19, the average growth in the capital share of Public administration and safety income was 0.1 per cent, Education and training was 0.1 per cent, and Health care and social assistance was 0.1 per cent. Market sector industries with low capital share growth include Administrative and support services (0.0 per cent) and Professional, scientific and technical services (0.1 per cent). Mining had the highest capital share of income at 0.8 per cent.

MFP contribution to industry output growth

Growth in industry output can be decomposed into contributions to growth from capital services, labour services (hours worked) and MFP.

For most market sector industries, the largest contribution to output growth occurred from growth in capital services (Figure 5.5). For non-market sector industries, as well as Construction; Professional, scientific and technical services; and Administrative and support services, the largest contribution was from increased labour inputs.

Figure 5.5 Output growth decomposition for Queensland industries, 1998–99 to 2018–19



Source: ABS cat. nos 5220.0, 6291.0.55.003; QPC estimates.

Improving the industry MFP estimates

Based on the available published data, it would be difficult to improve the growth accounting estimates of value-added based MFP. With access to unpublished ABS data, the main improvement to the estimates would come from:

- replacing the capital allocation methodology with a more detailed allocation methodology at the level of individual assets by industry
- possibly adjusting for capital capacity utilisation levels (for example, to address phases where capital investment is very strong and expected output increases occur with a delay)
- allowing rental prices[20] to differ by state/territory

[20] Rental prices represent the price per unit of capital.

- allowing the adjustment for labour's share of gross mixed income to vary by state/territory rather than applying the national adjustment ratio for each industry.

For non-market sector industries, continued improvements to output measurement are needed, as well as the construction of capital services indices.

There are a range of empirical tools that could be used on state data to decompose growth and better isolate the contributions of technological change from other influences, such as changes in efficiency, and scale and scope economies.[21]

[21] See Sickles & Zelenyuk (2019) and Coelli et al. (2005).

6. Conclusion

There are signs that market sector productivity growth in Queensland has slowed. Labour productivity growth has slowed to 0.3 per cent per annum over the last two years, significantly lower than the 2.1 per cent growth over the last productivity cycle (2011–12 to 2016–17). Multifactor productivity (MFP) growth has also slowed, relative to the most recent productivity cycle, averaging 0.3 per cent per annum over the last two years.

While the non-mining sector has supported labour productivity growth in previous cycles, there is evidence that this is no longer the case. In the most recent productivity cycle (2011–12 to 2016–17), average annual labour productivity growth in the non-mining sector fell to 0.7 per cent (from 2.4 per cent in the previous cycle). In the current incomplete cycle (2016–17 to 2018–19) labour productivity has fallen further, averaging less than 0.3 per cent per annum. Of particular concern is declining investment in the non-mining sector, with evidence of capital shallowing emerging over the current incomplete cycle.

The slowdown in productivity growth in Queensland is largely consistent with national and international trends—Australia recorded its first fall in labour productivity in 2018–19 since the time series began (in 1994–95).

More positively, there is evidence that labour productivity in Queensland has converged with levels in the rest of Australia as a result of stronger growth over the longer term. In 1998–99, labour productivity was approximately 8 per cent lower than the Australian average—in 2018–19 it was only 2 per cent lower. These gains were the result of both within-industry labour productivity improvements and changes to industry composition towards industries with higher than average labour productivity.

Despite some recent commentary, the Commission was unable to find any compelling evidence that wage growth has systematically decoupled from labour productivity growth in Queensland. Given this, it is likely that slow wages growth will persist until productivity growth improves.

This productivity update also provided experimental estimates of Queensland industry MFP. These estimates indicate significant variance in MFP performance by industry across productivity cycles in both the direction and magnitude of change. Some caution should be used when using these estimates since measured MFP captures more than just technical change. The results for some industries are likely to reflect other influences on MFP, such as changes in industry efficiency (for example, in Electricity, gas, water and waste services), mismeasurement of the contribution of capital (for example, in the case of Mining) and shocks to output (for example, droughts).

Appendix A: Statistical appendix

Table A.1 Market sector productivity growth by state and period, average annual growth rate (%)

Jurisdiction	1998–99 to 2001–02	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Labour productivity (value added per hour worked)						
Queensland	3.65	1.62	1.66	2.09	0.30	1.92
New South Wales	1.00	1.25	1.92	1.80	–0.64	1.33
Victoria	2.68	1.47	0.78	1.24	–0.29	1.24
South Australia	3.36	–0.20	1.65	1.24	–1.24	1.05
Western Australia	2.47	2.73	3.13	3.81	1.03	2.89
Tasmania	0.78	1.16	2.48	0.53	4.17	1.57
Australia	2.40	1.51	1.90	1.86	0.23	1.70
Multifactor productivity						
Queensland	2.53	0.34	–0.87	0.71	0.31	0.45
New South Wales	0.20	0.04	0.99	1.42	–0.30	0.61
Victoria	1.11	0.06	–0.10	0.99	–0.20	0.38
South Australia	2.23	–1.41	0.75	0.12	–0.92	0.11
Western Australia	1.64	1.23	–0.52	0.35	0.94	0.61
Tasmania	–0.06	0.47	0.53	0.01	3.03	0.54
Australia	1.26	0.17	0.20	0.83	0.26	0.52
Output (value added)						
Queensland	5.21	5.68	2.44	1.86	2.01	3.48
New South Wales	2.72	1.97	2.53	2.79	2.03	2.43
Victoria	3.18	3.28	2.11	2.63	2.67	2.75
South Australia	3.66	1.47	2.29	0.23	0.89	1.63
Western Australia	3.50	6.02	6.00	2.94	1.99	4.46
Tasmania	0.73	3.45	2.26	0.55	3.56	2.03
Australia	3.42	3.51	3.00	2.51	2.13	2.98
Combined inputs						
Queensland	2.68	5.34	3.31	1.14	1.71	3.02
New South Wales	2.52	1.93	1.54	1.38	2.34	1.82
Victoria	2.07	3.21	2.21	1.64	2.88	2.36
South Australia	1.43	2.87	1.53	0.11	1.82	1.52
Western Australia	1.86	4.78	6.51	2.59	1.05	3.86
Tasmania	0.79	2.98	1.73	0.55	0.53	1.48
Australia	2.16	3.34	2.80	1.67	1.88	2.46
Labour input (hours worked)						
Queensland	1.56	4.07	0.78	–0.23	1.71	1.56
New South Wales	1.71	0.71	0.61	1.00	2.67	1.10
Victoria	0.50	1.81	1.33	1.40	2.96	1.50
South Australia	0.30	1.66	0.64	–1.01	2.13	0.58
Western Australia	1.04	3.29	2.87	–0.86	0.95	1.57
Tasmania	–0.05	2.29	–0.22	0.02	–0.61	0.45
Australia	1.02	2.00	1.10	0.65	1.90	1.28
Capital services						
Queensland	4.31	7.15	6.88	3.20	1.68	5.12
New South Wales	3.99	3.96	2.96	1.93	1.86	3.00
Victoria	4.51	5.40	3.56	2.00	2.74	3.69
South Australia	2.93	4.49	2.69	1.59	1.40	2.77
Western Australia	2.64	6.14	9.49	5.74	1.16	5.86
Tasmania	1.75	3.80	3.91	1.10	1.78	2.64
Australia	3.87	5.24	5.02	3.03	1.83	4.08

** Denotes incomplete productivity cycle.*
Note: Periods are based on Queensland productivity cycles and peak-to-peak comparisons.
Source: ABS cat. no. 5260.0.55.002; QPC estimates.

Table A.2 Queensland Industry MFP components by productivity cycle, average annual growth rate (%)

Industry	Measure	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Agriculture, forestry and fishing	**Labour productivity**	**4.03**	**6.33**	**6.25**	**–23.86**	**1.76**
	MFP	–1.01	5.06	0.63	–11.57	0.14
	Output	–2.09	5.65	–1.64	–9.46	–0.26
	Capital services	1.77	1.06	–0.20	–1.48	0.50
	Labour services	–6.12	–0.69	–7.89	14.40	–2.02
Mining	**Labour productivity**	**–8.80**	**–11.82**	**12.06**	**–4.79**	**–0.57**
	MFP	–5.30	–12.00	2.78	1.26	–1.89
	Output	2.85	0.62	8.74	4.20	5.34
	Capital services	7.31	12.45	9.98	2.06	8.15
	Labour services	11.65	12.44	–3.32	8.99	5.91
Manufacturing	**Labour productivity**	**2.65**	**1.28**	**0.28**	**–0.70**	**1.57**
	MFP	–0.55	–0.47	0.31	0.30	0.35
	Output	3.93	0.33	–1.21	0.90	1.63
	Capital services	10.02	3.53	–1.62	–1.33	3.28
	Labour services	1.28	–0.95	–1.48	1.60	0.06
Electricity, gas, water and waste services	**Labour productivity**	**–0.69**	**–13.43**	**12.48**	**–7.54**	**–0.92**
	MFP	–2.63	–9.16	3.48	–1.33	–2.26
	Output	3.64	1.14	1.79	2.43	2.58
	Capital services	7.53	7.94	1.30	2.44	5.38
	Labour services	4.34	14.58	–10.68	9.97	3.50
Construction	**Labour productivity**	**–0.90**	**5.54**	**–4.42**	**–2.56**	**0.11**
	MFP	–0.72	4.40	–4.97	–2.83	–0.46
	Output	9.53	5.69	–3.84	–1.24	3.08
	Capital services	8.13	10.36	3.74	3.73	6.58
	Labour services	10.43	0.15	0.58	1.32	2.97
Wholesale trade	**Labour productivity**	**6.47**	**–0.42**	**2.87**	**–2.99**	**3.18**
	MFP	4.61	–0.45	2.69	–0.76	2.73
	Output	4.93	1.37	0.61	3.13	3.00
	Capital services	4.46	1.73	–1.70	–1.46	1.27
	Labour services	–1.54	1.78	–2.26	6.13	–0.18
Retail trade	**Labour productivity**	**0.72**	**4.13**	**0.58**	**3.98**	**2.47**
	MFP	0.51	2.61	0.18	2.58	1.67
	Output	6.46	2.07	1.18	1.80	3.44
	Capital services	6.66	3.66	1.99	2.87	4.01
	Labour services	5.74	–2.06	0.60	–2.18	0.96
Accommodation and food services	**Labour productivity**	**5.13**	**1.13**	**–1.35**	**–0.59**	**0.48**
	MFP	4.46	0.91	–0.47	0.12	0.56
	Output	5.06	1.22	1.57	2.21	2.47
	Capital services	4.25	1.09	–0.95	–0.01	2.06
	Labour services	–0.08	0.09	2.92	2.80	1.99
Transport, postal and warehousing	**Labour productivity**	**1.00**	**1.38**	**1.51**	**3.17**	**1.71**
	MFP	0.89	–1.76	1.14	2.79	0.59
	Output	6.27	2.29	1.93	3.82	3.62
	Capital services	5.38	7.82	1.38	1.64	4.34
	Labour services	5.28	0.90	0.42	0.66	1.91
Information media and telecommunications	**Labour productivity**	**–3.11**	**7.83**	**2.53**	**4.73**	**3.50**
	MFP	–0.03	3.71	2.62	1.49	1.30
	Output	5.87	3.90	4.44	4.26	4.30
	Capital services	4.77	2.52	1.75	5.02	4.05
	Labour services	8.99	–3.93	1.90	–0.47	0.79

Industry	Measure	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Financial and insurance services	**Labour productivity**	**2.92**	**–0.36**	**3.81**	**0.33**	**1.55**
	MFP	0.57	–0.36	3.23	–0.86	0.43
	Output	8.24	2.01	3.16	0.39	3.80
	Capital services	8.71	2.37	0.22	1.79	3.91
	Labour services	5.32	2.37	–0.65	0.06	2.25
Rental, hiring and real estate services	**Labour productivity**	**1.34**	**1.30**	**4.99**	**9.02**	**3.14**
	MFP	–0.83	–1.61	4.14	3.30	0.79
	Output	9.61	0.68	3.69	1.00	4.34
	Capital services	11.63	5.25	0.06	0.97	5.27
	Labour services	8.27	–0.62	–1.30	–8.01	1.20
Professional, scientific and technical services	**Labour productivity**	**2.44**	**3.36**	**0.51**	**3.32**	**2.74**
	MFP	2.01	2.70	0.51	2.88	2.34
	Output	9.64	5.87	2.54	3.03	5.92
	Capital services	11.62	7.00	2.70	2.45	7.00
	Labour services	7.20	2.52	2.03	–0.29	3.19
Administrative and support services	**Labour productivity**	**2.41**	**–1.91**	**3.52**	**3.27**	**1.29**
	MFP	2.30	–2.35	3.33	3.40	1.11
	Output	8.14	–0.18	3.68	7.84	4.52
	Capital services	8.72	11.97	5.08	1.65	7.68
	Labour services	5.74	1.74	0.16	4.57	3.23
Public administration and safety	**Labour productivity**	**–4.02**	**1.18**	**0.80**	**–1.70**	**–1.25**
	MFP	–3.88	0.79	0.46	–1.62	–1.36
	Output	1.94	3.92	1.10	1.55	2.25
	Capital services	4.42	5.97	2.84	2.89	4.34
	Labour services	5.96	2.74	0.30	3.26	3.49
Education and training	**Labour productivity**	**0.79**	**–2.00**	**1.55**	**–4.88**	**–0.20**
	MFP	0.62	–2.20	1.40	–4.43	–0.30
	Output	3.21	2.10	2.33	1.82	2.45
	Capital services	4.66	6.28	2.22	1.14	4.06
	Labour services	2.42	4.10	0.78	6.69	2.65
Health care and social assistance	**Labour productivity**	**1.27**	**–0.73**	**2.79**	**1.87**	**1.34**
	MFP	1.09	–0.99	2.40	2.08	1.08
	Output	6.10	5.38	4.84	7.67	5.50
	Capital services	6.09	8.22	5.34	3.54	6.20
	Labour services	4.83	6.11	2.05	5.80	4.16
Arts and recreation services	**Labour productivity**	**3.91**	**–1.06**	**–0.17**	**6.42**	**1.14**
	MFP	2.73	–1.28	0.23	5.57	0.57
	Output	6.77	0.85	1.34	5.89	2.81
	Capital services	6.07	2.76	0.43	1.31	3.35
	Labour services	2.87	1.91	1.50	–0.54	1.67
Other services	**Labour productivity**	**1.12**	**3.50**	**–0.67**	**5.25**	**1.80**
	MFP	–0.84	2.20	–0.94	4.29	0.70
	Output	3.40	2.68	1.55	4.25	2.99
	Capital services	11.84	6.96	5.37	6.04	7.65
	Labour services	2.28	–0.82	2.22	–1.00	1.18

** Denotes incomplete productivity cycle.*
Notes: Periods are based on Queensland market sector productivity cycles. Cycles for individual industries may differ. Totals may not add due to rounding.
Source: ABS cat. nos 5220.0, 5260.0.55.002, 6291.0.55.003; QPC estimates.

Table A.3 Queensland industry labour productivity (LP) decomposition by productivity cycle

Industry	Measure	Unit	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Agriculture, forestry and fishing	**LP growth**	**%**	**4.03**	**6.33**	**6.25**	**–23.86**	**1.76**
	K/L	% pts.	5.12	1.16	5.67	–12.24	1.71
	MFP	% pts.	–1.09	5.17	0.59	–11.63	0.04
Mining	**LP growth**	**%**	**–8.80**	**–11.82**	**12.06**	**–4.79**	**-0.57**
	K/L	% pts.	–3.34	0.01	9.30	–5.77	1.72
	MFP	% pts.	–5.46	–11.83	2.77	0.98	–2.29
Manufacturing	**LP growth**	**%**	**2.65**	**1.28**	**0.28**	**–0.70**	**1.57**
	K/L	% pts.	3.17	1.74	–0.04	–0.99	1.16
	MFP	% pts.	–0.52	–0.45	0.32	0.29	0.41
Electricity, gas, water and waste services	**LP growth**	**%**	**–0.69**	**–13.43**	**12.48**	**–7.54**	**–0.92**
	K/L	% pts.	2.13	–4.10	9.13	–6.26	1.27
	MFP	% pts.	–2.82	–9.33	3.34	–1.28	–2.19
Construction	**LP growth**	**%**	**–0.90**	**5.54**	**–4.42**	**–2.56**	**0.11**
	K/L	% pts.	–0.33	1.16	0.46	0.27	0.58
	MFP	% pts.	–0.58	4.37	–4.88	–2.83	–0.47
Wholesale trade	**LP growth**	**%**	**6.47**	**–0.42**	**2.87**	**–2.99**	**3.18**
	K/L	% pts.	1.79	–0.01	0.16	–2.23	0.43
	MFP	% pts.	4.68	–0.40	2.71	–0.77	2.75
Retail trade	**LP growth**	**%**	**0.72**	**4.13**	**0.58**	**3.98**	**2.47**
	K/L	% pts.	0.25	1.56	0.40	1.39	0.80
	MFP	% pts.	0.47	2.58	0.18	2.59	1.67
Accommodation and food services	**LP growth**	**%**	**5.13**	**1.13**	**–1.35**	**–0.59**	**0.48**
	K/L	% pts.	0.90	0.20	–0.89	–0.71	0.01
	MFP	% pts.	4.23	0.94	–0.45	0.12	0.46
Transport, postal and warehousing	**LP growth**	**%**	**1.00**	**1.38**	**1.51**	**3.17**	**1.71**
	K/L	% pts.	0.05	2.94	0.37	0.39	1.10
	MFP	% pts.	0.95	–1.55	1.14	2.77	0.61
Information media and telecommunications	**LP growth**	**%**	**–3.11**	**7.83**	**2.53**	**4.73**	**3.50**
	K/L	% pts.	–2.77	4.18	–0.10	3.13	2.15
	MFP	% pts.	–0.35	3.65	2.63	1.60	1.35
Financial and insurance services	**LP growth**	**%**	**2.92**	**–0.36**	**3.81**	**0.33**	**1.55**
	K/L	% pts.	2.31	0.00	0.59	1.19	1.13
	MFP	% pts.	0.61	–0.36	3.22	–0.86	0.42
Rental, hiring and real estate services	**LP growth**	**%**	**1.34**	**1.30**	**4.99**	**9.02**	**3.14**
	K/L	% pts.	1.95	3.12	0.85	5.72	2.39
	MFP	% pts.	–0.62	–1.82	4.14	3.30	0.76
Professional, scientific and technical services	**LP growth**	**%**	**2.44**	**3.36**	**0.51**	**3.32**	**2.74**
	K/L	% pts.	0.69	0.64	0.13	0.43	0.55
	MFP	% pts.	1.75	2.72	0.38	2.89	2.19
Administrative and support services	**LP growth**	**%**	**2.41**	**–1.91**	**3.52**	**3.27**	**1.29**
	K/L	% pts.	0.11	0.40	0.19	–0.13	0.18
	MFP	% pts.	2.29	–2.31	3.33	3.40	1.11
Public administration and safety	**LP growth**	**%**	**–4.02**	**1.18**	**0.80**	**–1.70**	**–1.25**
	K/L	% pts.	–0.20	0.44	0.33	–0.05	0.11
	MFP	% pts.	–3.83	0.74	0.46	–1.65	–1.35
Education and training	**LP growth**	**%**	**0.79**	**–2.00**	**1.55**	**–4.88**	**–0.20**
	K/L	% pts.	0.20	0.20	0.14	–0.45	0.12
	MFP	% pts.	0.59	–2.20	1.41	–4.42	–0.32

Industry	Measure	Unit	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Health care and social assistance	**LP growth**	**%**	**1.27**	**–0.73**	**2.79**	**1.87**	**1.34**
	K/L	% pts.	0.15	0.24	0.35	–0.21	0.24
	MFP	% pts.	1.12	–0.97	2.44	2.07	1.10
Arts and recreation services	**LP growth**	**%**	**3.91**	**–1.06**	**–0.17**	**6.42**	**1.14**
	K/L	% pts.	1.38	0.39	–0.48	0.86	0.72
	MFP	% pts.	2.52	–1.45	0.31	5.56	0.42
Other services	**LP growth**	**%**	**1.12**	**3.50**	**–0.67**	**5.25**	**1.80**
	K/L	% pts.	1.53	1.33	0.37	1.04	1.07
	MFP	% pts.	–0.41	2.18	–1.04	4.21	0.74

** Denotes incomplete productivity cycle.*
Notes: Capital deepening is represented by the capital–labour ratio (K/L). Periods are based on Queensland market sector productivity cycles. Cycles for individual industries may differ. Totals may not add due to rounding.
Source: ABS cat. nos 5220.0, 5260.0.55.002, 6291.0.55.003; QPC estimates.

Table A.4 Queensland industry output growth decomposition by productivity cycle

Industry	Measure	Unit	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Agriculture, forestry and fishing	**Output**	**%**	**–2.09**	**5.65**	**–1.64**	**–9.46**	**–0.26**
	Capital	% pts.	1.15	0.70	–0.15	–1.14	0.34
	Labour	% pts.	–2.15	–0.23	–2.08	3.30	–0.65
	MFP	% pts.	–1.09	5.17	0.59	–11.63	0.04
Mining	**Output**	**%**	**2.85**	**0.62**	**8.74**	**4.20**	**5.34**
	Capital	% pts.	5.64	10.30	6.98	1.71	6.78
	Labour	% pts.	2.67	2.15	–1.00	1.51	0.99
	MFP	% pts.	–5.46	–11.83	2.77	0.98	–2.43
Manufacturing	**Output**	**%**	**3.93**	**0.33**	**–1.21**	**0.90**	**1.63**
	Capital	% pts.	3.64	1.37	–0.53	–0.45	1.11
	Labour	% pts.	0.81	–0.58	–0.99	1.06	0.04
	MFP	% pts.	–0.52	–0.45	0.32	0.29	0.48
Electricity, gas, water and waste services	**Output**	**%**	**3.64**	**1.14**	**1.79**	**2.43**	**2.58**
	Capital	% pts.	5.02	4.90	0.99	2.03	4.47
	Labour	% pts.	1.44	5.57	–2.53	1.68	0.59
	MFP	% pts.	–2.82	–9.33	3.34	–1.28	–2.49
Construction	**Output**	**%**	**9.53**	**5.69**	**–3.84**	**–1.24**	**3.08**
	Capital	% pts.	1.15	1.18	0.54	0.42	0.75
	Labour	% pts.	8.95	0.13	0.50	1.17	2.63
	MFP	% pts.	–0.58	4.37	–4.88	–2.83	–0.30
Wholesale trade	**Output**	**%**	**4.93**	**1.37**	**0.61**	**3.13**	**3.00**
	Capital	% pts.	1.33	0.51	–0.49	–0.43	0.37
	Labour	% pts.	–1.08	1.26	–1.61	4.33	–0.13
	MFP	% pts.	4.68	–0.40	2.71	–0.77	2.76
Retail trade	**Output**	**%**	**6.46**	**2.07**	**1.18**	**1.80**	**3.44**
	Capital	% pts.	1.78	1.00	0.57	0.79	1.10
	Labour	% pts.	4.20	–1.50	0.43	–1.58	0.70
	MFP	% pts.	0.47	2.58	0.18	2.59	1.63
Accommodation and food services	**Output**	**%**	**5.06**	**1.22**	**1.57**	**2.21**	**2.47**
	Capital	% pts.	0.89	0.22	–0.22	0.00	0.52
	Labour	% pts.	–0.06	0.07	2.25	2.09	1.49
	MFP	% pts.	4.23	0.94	–0.45	0.12	0.46
Transport, postal and warehousing	**Output**	**%**	**6.27**	**2.29**	**1.93**	**3.82**	**3.62**
	Capital	% pts.	2.38	3.32	0.53	0.65	1.73
	Labour	% pts.	2.94	0.52	0.26	0.40	1.15
	MFP	% pts.	0.95	–1.55	1.14	2.77	0.75
Information media and telecommunications	**Output**	**%**	**5.87**	**3.90**	**4.44**	**4.26**	**4.30**
	Capital	% pts.	3.13	1.63	1.06	2.86	2.31
	Labour	% pts.	3.09	–1.38	0.75	–0.20	0.34
	MFP	% pts.	–0.35	3.65	2.63	1.60	1.65
Financial and insurance services	**Output**	**%**	**8.24**	**2.01**	**3.16**	**0.39**	**3.80**
	Capital	% pts.	5.93	1.60	0.15	1.23	2.68
	Labour	% pts.	1.70	0.78	–0.21	0.02	0.71
	MFP	% pts.	0.61	–0.36	3.22	–0.86	0.41
Rental, hiring and real estate services	**Output**	**%**	**9.61**	**0.68**	**3.69**	**1.00**	**4.34**
	Capital	% pts.	6.77	2.79	0.04	0.62	3.35
	Labour	% pts.	3.46	–0.29	–0.49	–2.92	0.44
	MFP	% pts.	–0.62	–1.82	4.14	3.30	0.55

Industry	Measure	Unit	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Professional, scientific and technical services	**Output**	**%**	**9.64**	**5.87**	**2.54**	**3.03**	**5.92**
	Capital	% pts.	1.82	0.99	0.52	0.39	1.10
	Labour	% pts.	6.07	2.16	1.63	–0.24	2.69
	MFP	% pts.	1.75	2.72	0.38	2.89	2.14
Administrative and support services	**Output**	**%**	**8.14**	**–0.18**	**3.68**	**7.84**	**4.52**
	Capital	% pts.	0.33	0.47	0.19	0.07	0.34
	Labour	% pts.	5.52	1.67	0.15	4.37	3.08
	MFP	% pts.	2.29	–2.31	3.33	3.40	1.09
Public administration and safety	**Output**	**%**	**1.94**	**3.92**	**1.10**	**1.55**	**2.25**
	Capital	% pts.	0.56	0.82	0.37	0.41	0.61
	Labour	% pts.	5.20	2.36	0.26	2.80	3.00
	MFP	% pts.	–3.83	0.74	0.46	–1.65	–1.37
Education and training	**Output**	**%**	**3.21**	**2.10**	**2.33**	**1.82**	**2.45**
	Capital	% pts.	0.42	0.58	0.21	0.09	0.33
	Labour	% pts.	2.20	3.72	0.71	6.15	2.43
	MFP	% pts.	0.59	–2.20	1.41	–4.42	–0.31
Health care and social assistance	**Output**	**%**	**6.10**	**5.38**	**4.84**	**7.67**	**5.50**
	Capital	% pts.	0.70	0.94	0.57	0.32	0.57
	Labour	% pts.	4.27	5.41	1.83	5.27	3.78
	MFP	% pts.	1.12	-0.97	2.44	2.07	1.15
Arts and recreation services	**Output**	**%**	**6.77**	**0.85**	**1.34**	**5.89**	**2.81**
	Capital	% pts.	2.62	1.25	0.19	0.61	1.57
	Labour	% pts.	1.63	1.04	0.83	–0.28	0.89
	MFP	% pts.	2.52	–1.45	0.31	5.56	0.35
Other services	**Output**	**%**	**3.40**	**2.68**	**1.55**	**4.25**	**2.99**
	Capital	% pts.	1.89	1.19	0.63	0.89	1.13
	Labour	% pts.	1.91	–0.68	1.96	–0.85	1.01
	MFP	% pts.	–0.41	2.18	–1.04	4.21	0.85

** Denotes incomplete productivity cycle.*
Notes: Capital deepening is represented by the capital–labour ratio (K/L). Periods are based on Queensland market sector productivity cycles. Cycles for individual industries may differ. Totals may not add due to rounding.
Source: ABS cat. nos 5220.0, 5260.0.55.002, 6291.0.55.003; QPC estimates.

Table A.5 Experimental Queensland industry MFP indices, 1994–95 to 2018–19

Year	Agriculture	Mining	Manufacturing	Utilities	Construction	Wholesale	Retail	Accommodation	Transport	Information	Finance	Rental	Professional	Administrative	Public admin.	Education	Health care	Arts	Other
1994–95	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1995–96	120.8	100.9	100.5	98.9	94.4	105.7	95.6	92.4	101.2	101.6	107.8	110.5	99.5	87.2	87.4	94.3	100.7	95.1	97.0
1996–97	137.0	98.7	103.7	103.3	101.7	109.8	97.9	92.6	103.5	103.0	111.7	107.4	98.8	99.9	94.4	103.1	100.5	81.6	96.6
1997–98	146.9	90.0	105.2	100.9	107.0	114.1	104.4	103.6	100.5	109.3	111.2	102.8	95.9	92.6	105.8	102.4	102.2	89.8	97.6
1998–99	150.6	107.1	105.1	95.3	102.5	114.4	99.2	114.8	101.4	109.3	114.2	100.3	108.3	105.6	107.2	102.9	99.9	88.0	101.8
1999–00	149.0	128.3	100.7	96.2	107.3	122.6	102.0	109.4	100.3	100.8	112.2	104.8	101.6	95.1	107.3	110.9	102.6	88.2	103.4
2000–01	164.3	151.5	105.6	101.6	100.0	128.8	103.2	104.8	99.8	101.8	106.2	91.5	104.4	84.4	95.5	104.4	98.6	84.6	108.0
2001–02	154.4	147.9	116.3	94.4	105.5	142.3	111.7	100.2	106.4	100.4	106.6	101.1	125.6	104.6	96.3	106.8	105.1	81.2	105.1
2002–03	140.2	142.6	115.7	96.4	108.6	154.1	109.9	111.3	115.9	97.1	106.5	108.6	126.1	95.1	76.8	107.3	105.1	81.8	112.8
2003–04	158.0	135.1	112.1	91.4	100.5	154.1	117.0	114.5	114.0	100.6	104.9	108.0	138.5	101.2	81.2	109.5	102.6	92.1	117.2
2004–05	174.4	132.4	105.3	85.1	97.9	160.6	114.1	111.0	117.2	98.7	102.4	100.5	128.4	113.0	88.6	103.9	105.0	96.0	113.1
2005–06	170.6	110.4	112.0	77.2	98.8	167.9	113.8	118.5	117.4	102.1	102.5	102.3	133.0	117.0	83.7	100.1	109.9	90.0	107.7
2006–07	146.7	113.5	113.1	82.7	101.8	179.2	114.6	125.2	111.2	100.3	109.7	97.0	138.9	117.3	79.3	110.1	111.0	93.1	100.7
2007–08	151.9	112.6	111.9	69.4	104.7	181.2	117.4	122.9	112.7	102.8	110.5	94.4	137.5	124.9	84.6	100.3	116.1	81.5	107.3
2008–09	177.9	97.4	103.2	67.9	106.7	178.1	113.8	120.3	100.1	108.4	105.4	92.4	131.0	127.4	85.4	100.9	114.8	99.0	102.1
2009–10	173.9	95.8	104.2	63.4	105.1	155.3	122.1	120.7	101.8	123.5	106.1	91.0	143.3	105.9	84.2	109.5	115.1	89.0	108.7
2010–11	184.2	74.9	106.1	61.2	104.6	160.4	126.1	121.2	99.2	121.6	107.0	81.5	150.5	111.5	87.5	101.9	112.2	87.1	108.5
2011–12	189.0	62.3	110.5	52.3	126.9	175.3	130.5	131.1	101.9	120.7	107.7	89.5	159.0	104.3	82.5	98.6	105.6	87.3	112.5
2012–13	186.1	57.8	118.2	56.7	125.4	171.7	129.5	126.8	101.8	123.7	116.1	94.7	151.4	105.0	80.4	99.8	109.1	90.5	107.2
2013–14	184.3	52.8	108.3	55.0	134.8	185.2	124.9	144.3	104.3	128.5	117.3	106.0	147.5	103.5	80.4	109.2	105.8	89.9	93.1
2014–15	194.8	58.8	113.2	58.1	123.5	181.2	129.9	126.2	101.9	138.1	115.6	103.6	140.4	108.0	82.0	107.2	112.8	86.7	98.8
2015–16	181.4	69.5	109.4	60.8	110.6	185.2	129.5	142.7	100.1	142.2	119.8	108.3	146.0	107.0	85.5	102.4	109.8	86.9	102.2
2016–17	195.1	71.6	112.2	62.3	99.0	200.5	131.7	128.0	107.9	137.5	126.6	110.1	163.1	123.2	84.4	105.8	119.1	88.3	107.3
2017–18	184.7	73.0	112.5	60.2	100.2	205.3	130.5	132.9	107.9	158.3	125.9	112.4	165.5	126.2	88.2	100.6	116.2	91.6	105.2
2018–19	154.8	73.4	112.8	60.6	93.5	197.5	138.7	128.3	114.1	141.7	124.5	117.6	172.8	131.9	81.7	96.8	124.1	98.8	116.9

Note: Index base year equals 1994–95.
Sources: ABS cat. nos 5220.0, 5260.0.55.002, 6291.0.55.003; QPC estimates.

Appendix B: Glossary

Term	Definition
Capital deepening	Capital deepening refers to an increase in the ratio of quantities of capital to labour—the amount of capital employed per hour worked. The opposite is described as 'capital shallowing'.
Capital services	Capital services are the preferred capital measure for productivity analysis. Capital services reflect the amount of 'service' each asset provides during a period. For each asset, the services provided in a period are directly proportional to the asset's productive capital value in the period. As an asset ages and its efficiency declines, so does the productive capital value and the services the asset provides. In equilibrium, the value of capital services is equal to the gross returns (or rentals) to owners of capital—that is, the sum of consumption of fixed capital (COFC) during the period and a return on the net capital stock of assets. Capital services indices are published by the ABS at a national level for the market sector as a whole and for each market sector industry. In January 2018, the ABS began publishing a capital service index for each state's market sector as a whole, but not for the individual industries that form the market sector.
Consumption of fixed capital (COFC)	COFC represents the value of a capital asset that is 'used up' in a period. The real consumption of fixed capital of an asset in a period is the difference between the real economic value of the asset at the beginning of the period and at the end of the period. COFC is based on the concept of the expected economic lifetime of an asset and is designed to cover the loss in value due to normal wear and tear, foreseen obsolescence, and the normal amount of accidental damage that is not made good by repair. Unforeseen obsolescence is treated as a capital loss rather than as COFC. COFC is always less than the value of capital services, since the return to the owner of the asset must also cover the interest (or capital) cost of holding the asset. The value of the service must not only cover depreciation but also provide a return to the owner of the asset sufficient to cover the interest cost.
Employment rate	The employment rate is given by the proportion of the labour force that are currently employed.
Gross capital stock	The value of all fixed assets in the economy currently in use. It is obtained by valuing each asset at the current price of a new asset of the same type (that is, it does not depend on the actual age of assets). It is calculated as the sum of investment flows less retirements at 30 June each year, before deducting allowances for the consumption of fixed capital (see net capital stock).
Gross fixed capital expenditure	Expenditure on fixed capital (e.g. machinery and equipment) is recorded in the national accounts as gross fixed capital formation. It does not take account of the consumption of fixed capital (COFC).
Gross state income (GSI)	Real gross state income (GSI) measures the aggregate value of gross primary incomes for all sectors (including net primary income receivable from non-residents).

Gross state product (GSP)	GSP can be estimated using the production approach (GSP(P)) or the income/expenditure approach (GSP(I/E)). The ABS also publishes a headline measure (GSP(A)) which is an average of the production and income/expenditure estimates. The production approach sums the output (gross value added (GVA)) of market and non-market sector industries, plus makes an adjustment for taxes less subsidies on products. It also includes a statistical discrepancy so that the volume measure of GSP(P) equals GSP(A).
Gross value added (GVA)	GVA measures the market value of goods and services produced by subtracting the value of intermediate consumption from the value of output.
Intermediate inputs	Intermediate inputs are goods or services that are consumed as part of the process of producing other goods or services—such as energy and raw materials—instead of being used for final consumption. For example, bauxite would be an intermediate input if used to produce aluminium ingots instead of being sold for final consumption.
Labour intensity	Labour intensity refers to average working hours per employed worker.
Labour productivity	Labour productivity is a partial productivity measure, as it considers the relationship between output and a single input—labour. It is measured as output (value added) per hour worked. It provides an indication of how efficiently labour is being used to produce outputs.
Labour utilisation	Labour utilisation is measured as hours worked per capita (not per worker). It is made up of three components: labour force participation (closely tied to population growth and changing demographics), changes in employment rates, and changes in the intensity with which each worker is working (e.g. part-time or full-time). Increasing labour utilisation occurs when the population works more hours, rather than when each hour worked is more productive.
Market sector	The market sector is made up of 16 selected industries: Agriculture, Forestry and Fishing; Mining; Manufacturing; Electricity, Gas, Water and Waste Services; Construction; Wholesale Trade; Retail Trade; Accommodation and Food Services; Transport, Postal and Warehousing; Information, Media and Telecommunications; Financial and Insurance Services; Rental, Hiring and Real Estate Services; Professional, Scientific and Technical Services; Administrative and Support Services; Arts and Recreation Services; and Other Services.
Multifactor productivity (MFP)	MFP can be defined as the efficiency with which capital and labour are combined to produce outputs. It is measured in terms of output per unit of combined inputs. The MFP measures in this paper are all value-added based measures of MFP since output is based on value-added and the set of inputs includes capital and labour. For national market sector industries, the ABS produce both value-added based MFP measures and gross output-based MFP measures where the set of inputs includes capital, labour, energy and materials (KLEM measures).
Net capital stock (NKS)	Net capital stock estimates are the written down values of an economy's gross capital stocks. They represent the net present values of the future capital services to be provided by the assets. The difference between the net and gross value of an asset is accumulated depreciation. Net capital stock is essentially a measure of wealth and is shown on an economy's balance sheet.

Non-market sector	Includes Public Administration and Safety; Education and Training; Health Care and Social Assistance; and Ownership of Dwellings. Goods and services in these government-dominated industries fall within the production boundary of national accounts but are not sold at full market prices or are not sold. Ownership of dwellings is considered non-market because it has no employment related to it.
Participation rate	The participation rate is usually defined as employed persons as a proportion of the working age population. For the purpose of the decomposition of GSP per capita, it is defined as employed persons as a proportion of the estimated resident population.
Productive capital stocks (PKS)	Productive capital stock estimates are derived by writing down each asset in accordance with its decline in efficiency due to age. If, for example, an asset is 75 per cent as efficient as a new asset of the same type, then the productive value of that asset is 75 per cent of the value of the new asset. Efficiency tends to decline with age, as older assets require more frequent and extensive maintenance and more replacement parts. Productive capital stock estimates are a measure of productive capacity and they form the basis for the measure of capital services required for productivity analyses. The productive capital stocks underpinning Queensland's market sector capital services index are not separately published.
Productivity cycle	Annual productivity estimates may overstate or understate actual underlying productivity trends depending on business cycles. In a downturn, firms will respond by reducing their output, underutilising their labour and capital and thereby decreasing their measured productivity. In an upturn, the reverse will occur as firms increase their output and reach full capacity. It is therefore common practice to divide MFP into productivity cycles, as measuring average productivity over a cycle is more reliable than comparing measured MFP growth in years that may be at different points in the business cycle.
Terms of trade	The ratio of overseas export prices to overseas import prices. If the prices of a state's exports rise faster than those of its imports, this is an improvement in the terms of trade, because fewer exports are required to pay for a given number of imports.
Total factor productivity (TFP)	TFP is a comprehensive measure that takes account of the contribution from all inputs to the production of output.

Source: ABS 2016; QPC 2016b.

Appendix C: The impact of ABS revisions

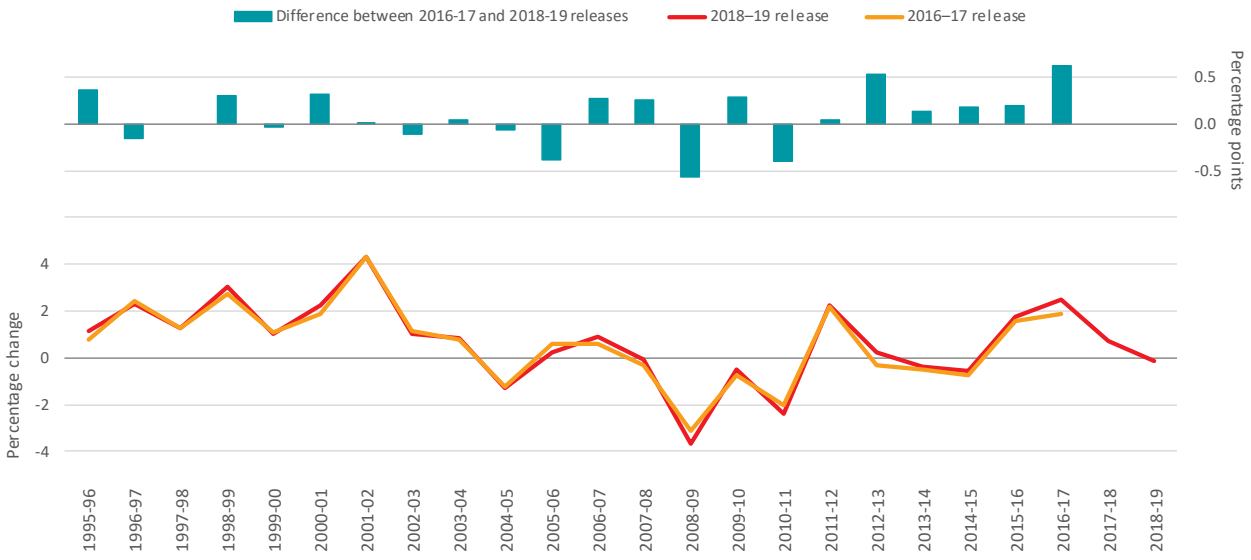
There are several issues related to the construction of national accounts statistics, outlined in the *Australian System of National Accounts, Concepts, Sources and Methods* (ABS 2016) and the information paper *Quality Dimensions of the Australian National Accounts* (ABS 2007). National statistics combine information from various internal and external data sources, and their construction requires numerous mathematical transformations, such as seasonal adjustment, and assumptions must therefore be made (ABS 2007, p. 1). While the ABS prioritises accuracy in its quality control, it is impossible to produce a measure for accuracy (ABS 2007, p. 1). Further, while a series may be reliable (that is, it is consistent), this does not necessarily entail accuracy if the underlying data or assumptions are not accurate (ABS 2007, p. 2).

As more accurate data become available, or methodological techniques improve, the ABS periodically updates its historical estimates. This means that previously published estimates are often revised, even for previous years. While revisions may be small for aggregates, such as the market sector (PC 2019, p. 15), more disaggregated estimates such as those for Queensland or by industry may be more susceptible to change in revisions.

The first experimental estimates for state MFP were published in the 2016–17 release (ABS 2018a), using state output and experimental capital stock data from the national accounts and labour data from quarterly labour force releases. To generate these estimates, a number of assumptions were made. In particular, where state-level data was unavailable, national industry proportions are used to impute the missing data. In the 2016–17 publication, the ABS noted that the estimates are experimental, and will be improved over time by, for example, by developing state-specific rental prices to improve the estimation of capital services (ABS 2018a).

In 2016–17, the Commission reported MFP growth of 1.9 per cent in Queensland, the highest growth in the state since 2011–12 (QPC 2018, p. 2). However, in the 2018–19 release, the ABS revised this figure to an even higher 2.5 per cent, surpassing the 2011–12 figure. The figure reported in the 2016–17 productivity update (QPC 2018) has therefore increased by 0.6 percentage points between ABS publications (Figure C.1).

Figure C.1 ABS revisions to GVA based MFP index for Queensland, market sector industries aggregate



Source: ABS cat. no. 5260.0.55.002; QPC estimates.

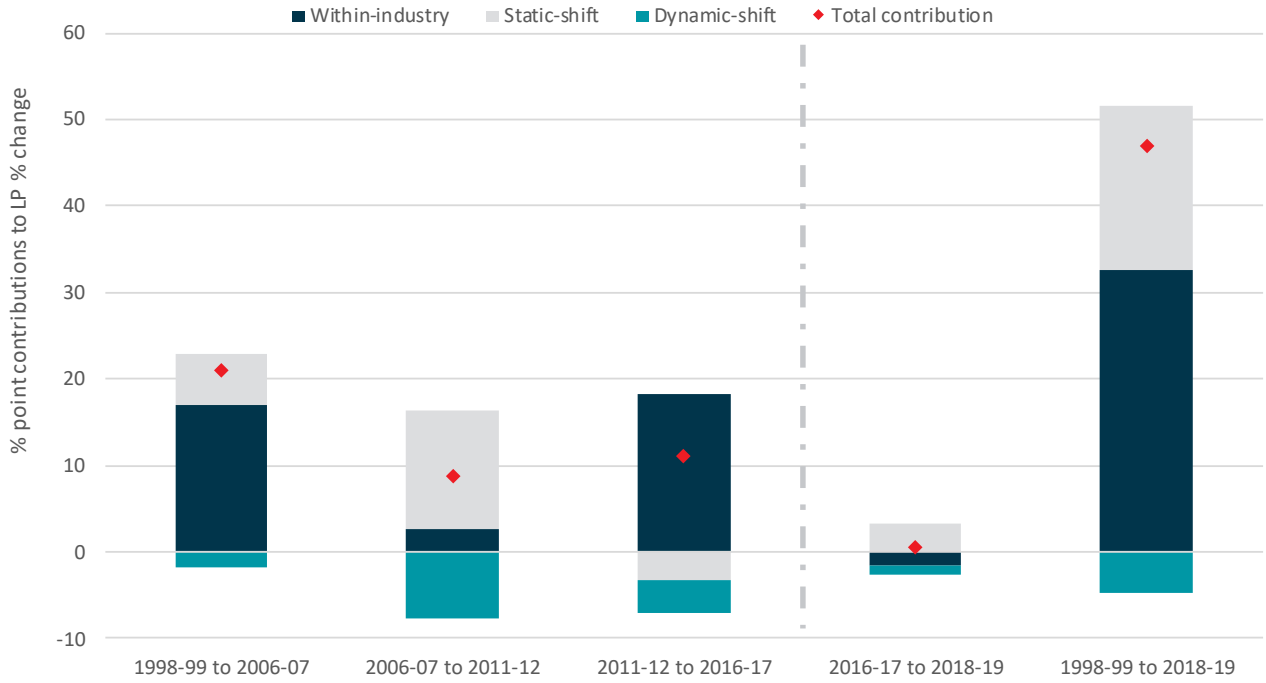
Despite these revisions, MFP estimates published by the ABS in different releases closely track each other in terms of general trends. Annual productivity figures, especially at the state level, may therefore give a good idea of general trends in the economy, but their actual values should be treated with caution.

Appendix D: Industry contributions to labour productivity growth

Queensland market sector labour productivity increased 46.8 per cent between 1998–99 and 2018–19 in real terms. The increase in labour productivity can be decomposed into three separate effects:

- *within-industry effect*—changes to within-industry productivity contributed 32.6 percentage points of the 46.8 per cent increase, with most industries contributing positively. Within-industry productivity growth contributed positively over each of the productivity cycles (Figure D.1)
- *static-shift effect*—shifting industry labour shares (based on hours worked) from lower to higher productivity industries contributed 19.1 percentage points. The shift of labour resources towards Mining made a strong contribution
- *dynamic-shift effect*—this is a residual term capturing the dynamic component of structural change. It contributed –4.8 percentage points to aggregate market sector labour productivity growth and has tended to detract from labour productivity growth in all prior cycles.

Figure D.1 Contributions to market sector labour productivity growth over productivity cycles



Note: Periods after the vertical dashed line are not productivity cycles.
Source: ABS cat. no. 5220.0; QPC estimates.

The dynamic-shift effect attempts to measure correlations in an economy between productivity and employment changes, with positive/negative efficiency gains interacting with the expansion/contraction of specific industries. The interaction term is positive when the first two effects (that is, the within-industry and static-shift or 'structural' effects) are complementary (that is, productivity growth is positive in expanding industries and negative in contracting industries). The interaction effect is negative when the first two effects are substitutes (that is, within-industry productivity growth is positive in contracting industries, or negative in expanding industries) (Molnar & Chalaux 2015). This interaction is obscured by the summing of contributions across industries for each period but can be seen more clearly in the industry data in Figure D.2.

All industries made some contribution to labour productivity growth between 1998–99 and 2018–19, except Agriculture, forestry and fishing, which experienced a sharp drop in labour productivity in 2018–19 due to the drought. Mining made the single largest net contribution to labour productivity growth over the period.

Figure D.2 Industry contributions to market sector labour productivity growth, 1998–99 to 2018–19

Source: ABS cat. no. 5220.0; QPC estimates

The strongest negative dynamic effects contributions came from Agriculture, forestry and fishing, Mining, Manufacturing and Wholesale trade. For these industries—with the exception of Mining—positive productivity growth was achieved while the industry contracted in relative terms (as measured by a reduction in the share of total hours worked). For Mining, the within-effect provided a negative contribution, while there was a large expansion in the industry.

Appendix E: Queensland MFP estimates by industry

This appendix sets out the basic methodology and data sources used to construct industry MFP estimates for Queensland. It assesses the quality of the estimates and provides productivity performance information for each industry.

Methodology

The standard growth accounting methodology is employed to produce industry MFP estimates for Queensland and ROA. The methodology is described in QPC (2016b, Appendix A), and ABS (2015, chapter 19).

Industry scope

MFP estimates are constructed for each of the industries defined by the ABS as part of the market sector (16 industries), plus the three non-market sector industries—Public administration and safety; Education and training; and Health care and social assistance (Table E.1). The ownership of dwellings industry is excluded.

Table E.1 Scope of industries

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

Methods and data sources

Labour inputs are measured on an hours worked basis with data available from ABS publications. Labour inputs are not quality adjusted.

Output is measured as industry value added. Data is readily available from ABS publications.

The measurement of the contribution of capital to production is significantly more difficult both conceptually and in terms of actual data availability at the state level. Ideally, capital is measured using the full capital measurement framework that underpins the ABS's national productivity estimates for the market sector as a whole and for each

market sector industry.[22] However, the data to implement such an approach is not available at the state level. Therefore, industry MFP estimates were constructed and compared using four capital methodologies (discussed further below). Capital services is the preferred capital input measure and is used for market sector industries (Table E.2).[23]

Labour shares for productivity analysis are measured as compensation of employees (COE) as a share of total factor income (TFI). The ABS publishes estimates of COE and TFI for both national and state industries. However, a proportion of COE is not included in the published COE estimates but is subsumed within estimates of combined gross operating surplus and gross mixed income (GMI). This occurs due to measurement difficulties associated with apportioning the income unincorporated entities (ABS 2016, pp. 436–37). The ABS employs a methodology to estimate labour's share of GMI and this compensation is added to the published estimates of COE, increasing labour's share of TFI. The same procedure cannot be applied at the state level as the data is not published. Therefore, the ratios between the national labour share pre- and post-adjustment by industry is applied to the labour shares of each state's/territory's industries (increasing them).

Table E.2 Data used to construct Queensland industry MFP estimates

Measure	Source	Description
Labour input	ABS cat. no. 6291.0.55.003	Labour input is based on hours worked data published by the ABS.
Capital input	ABS cat. nos 5260.0.55.002; 5220.0	The preferred capital input measure is the allocation of national industry productive capital stocks (PKS) using state industry net capital stock (NKS) shares. For non-market sector industries, capital growth is based on the mid-point of the growth rates of the NKS and consumption of fixed capital (COFC) series.
Output	ABS cat. no. 5220.0	Output is based on industry value added (chain volume measures) published by the ABS.
Labour shares	ABS cat. nos 5220.0; 5260.0.55.002	Labour shares are calculated as compensation of employees over total factor income. An adjustment is made to account for labour's share of gross mixed income. The capital share is 1 minus the labour share (constant returns to scale is assumed).

The measurement of capital

MFP estimates were constructed with capital inputs based on four alternative approaches:

- industry net capital stock (NKS)
- industry consumption of fixed capital (COFC)
- the mid-point of the growth rate of the two above methods
- capital services.

Capital services is conceptually the preferred measure. Industry capital services were constructed by allocating national productive capital stocks (PKS) by industry and asset type to states/territories. Allocations were made on the basis of NKS industry shares. For a particular industry, a state with a larger share of the national NKS for that industry received an equivalently larger share of the national industry PKS. As industry NKS are only available as a

[22] See ABS (2016) for a discussion of the construction of capital measures (chapter 14) and the construction of productivity estimates (chapter 19).
[23] See QPC (2016) for a description of the different capital measures (Box 1.2), and growth rate comparisons for NKS, capital services and COFC (Box 1.3). The definitions are reproduced in the Glossary in Appendix B of this paper.

total (not by asset type), the same share allocates the PKS of all asset types. The allocation procedure results in a PKS by asset type for each industry. The PKS are aggregated into a capital services index using national rental prices by asset type. Rental prices are assumed to be uniform across states and territories.

The capital services indices for Electricity, gas, water and waste services, and Financial and insurance services, are based on an allocation of their respective national capital data for the incorporated sector only as unincorporated sector data is not published.

PKS growth rates display significant variation by asset type (Table E.3). For example, the growth rates for computer software and computer equipment were much greater than for other assets in the mining and professional, scientific and technical services industries.

Growth rates can also vary significantly across periods for individual assets. For example, the growth in the computer equipment PKS occurred entirely over the period 2001–02 to 2011–12. From 2011–12, the computer equipment PKS declined in the case of Mining and grew slightly in the case of Professional, scientific and technical services.

Table E.3 Capital growth rates by PKS asset type and productivity cycle, average annual growth (%)

Asset type	2001–02 to 2006–07	2006–07 to 2011–12	2011–12 to 2016–17	2016–17 to 2018–19*	1998–99 to 2018–19
Mining					
Intellectual property products— Computer software	18.9	27.2	9.8	12.6	20.2
Intellectual property products—Mineral and petroleum exploration	3.0	7.1	5.0	1.3	4.4
Intellectual property products—Research and development	8.5	11.5	–0.1	–9.7	4.9
Inventories—Non-farm	3.2	9.1	5.5	–1.2	4.5
Land	5.6	10.1	8.4	1.1	6.5
Machinery and equipment—Computers	25.1	24.4	–2.5	–8.3	12.1
Machinery and equipment—Electrical and electronic equipment	15.3	11.2	5.9	1.0	8.9
Machinery and equipment—Industrial machinery and equipment	6.1	10.9	5.0	1.0	5.9
Machinery and equipment—Other plant and equipment	5.5	8.8	4.0	–0.3	5.0
Machinery and equipment—Other transport equipment	2.5	4.5	4.0	2.9	3.6
Machinery and equipment—Road vehicles	3.2	11.6	6.3	2.8	5.7
Non-dwelling construction	8.7	15.8	13.9	3.2	10.5
Ownership transfer costs	7.3	9.9	8.2	–0.6	6.9
Professional, scientific and technical services					
Intellectual property products—Computer software	17.7	12.8	7.2	9.1	12.1
Intellectual property products—Research and development	6.4	5.8	4.7	2.7	4.9
Land	2.2	3.0	0.5	0.1	1.5
Machinery and equipment—Computers	23.5	13.0	1.3	–0.1	13.1
Machinery and equipment—Electrical and electronic equipment	17.7	5.2	2.2	–0.1	7.8
Machinery and equipment—Industrial machinery and equipment	8.6	5.1	2.1	–0.5	4.9
Machinery and equipment—Other plant and equipment	7.5	3.2	0.8	–1.0	4.0
Machinery and equipment—Other transport equipment	3.4	–0.9	–0.1	3.2	2.2
Machinery and equipment—Road vehicles	5.3	5.7	3.6	2.2	4.5
Non-dwelling construction	3.2	5.0	1.8	2.3	3.1
Ownership transfer costs	1.8	–0.8	–3.9	–1.4	–0.5

** Denotes incomplete productivity cycle.*
Notes: In this table, each asset type includes the PKS of the incorporated sector only.
Source: ABS cat. no. 5260.0.55.002.

Quality of the estimates

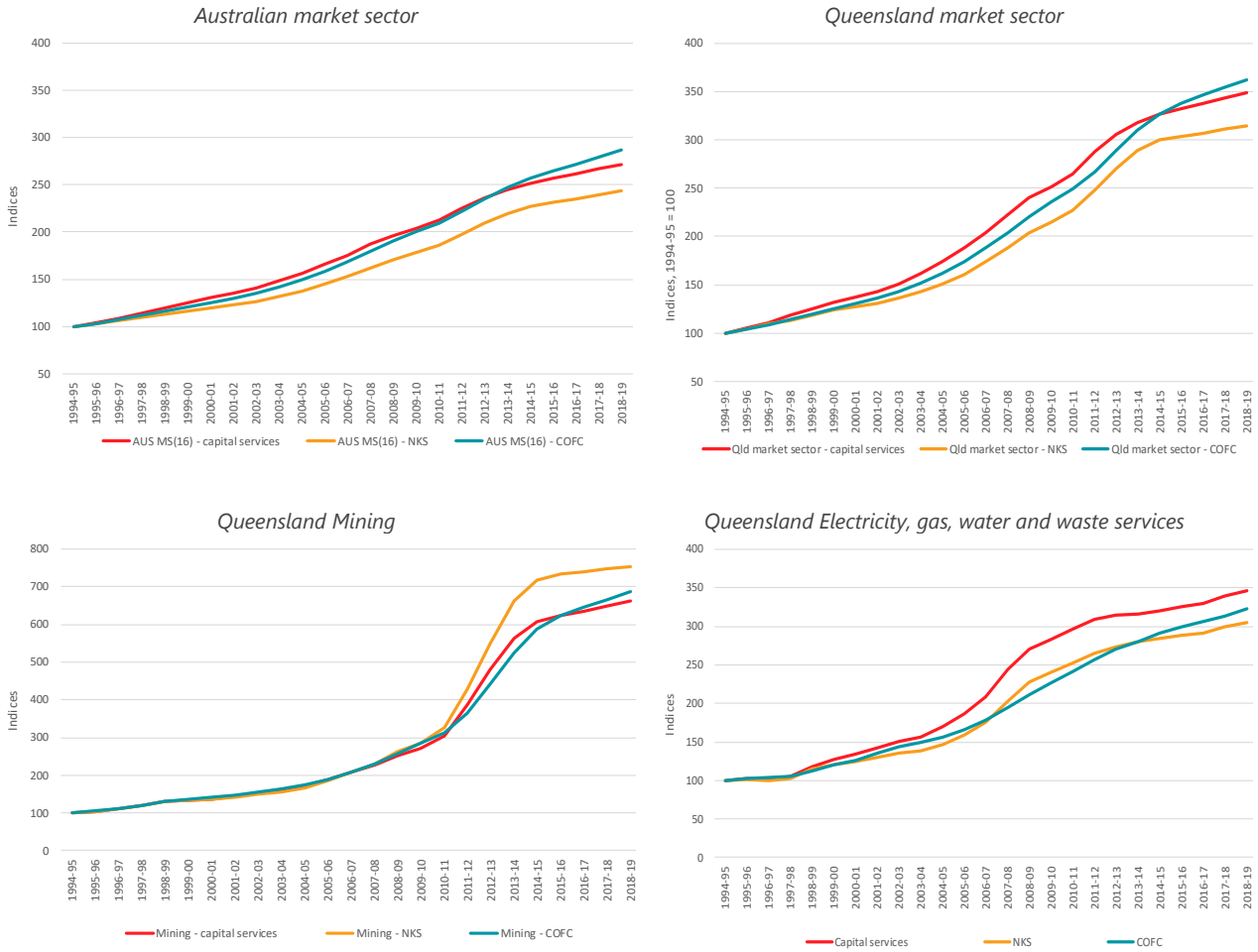
Errors from the capital allocation methodology

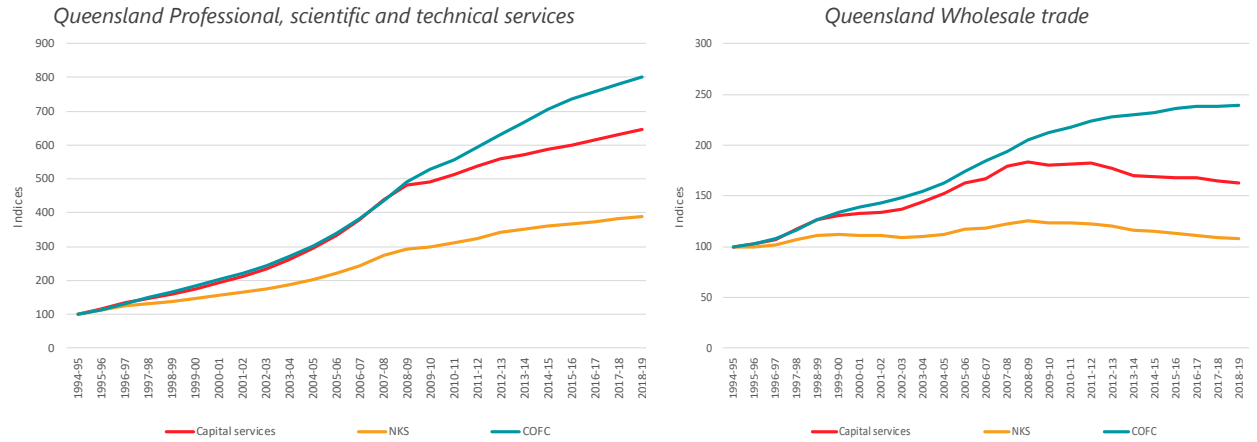
The ABS publishes Queensland industry NKS data as a total for each industry. The total is not broken down by asset type. The ABS does not publish state level PKS data. Therefore, for each industry, a single NKS share is applied to all asset types when allocating the national PKS to states and territories.

The allocation procedure introduces potential measurement errors, which can bias measured capital inputs either upwards or downwards and, therefore, can bias MFP estimates. These errors result from a combination of the different growth rates by asset type (shown above) and because NKS and PKS growth patterns and rates can differ which means that levels/changes in asset type shares can also differ (Figure E.2).

The allocation procedure imposes the same technology or mix of assets that applies nationally. If, for example, a Queensland industry's capital structure was weighted relatively more towards slower growing assets compared to nationally, then measured capital inputs for the Queensland industry would be distorted upwards, resulting in an underestimate of MFP growth.

Figure E.2 Patterns of growth in NKS and PKS, index base year 1994–95





Sources: ABS cat. nos 5220.0, 5260.0.55.002; QPC estimates.

Aggregation of the capital estimates and improved consistency

One way to assess the quality of the state industry capital estimates is to aggregate the estimated individual market sector industries to a single capital services index and compare that index to the official index published by the ABS.

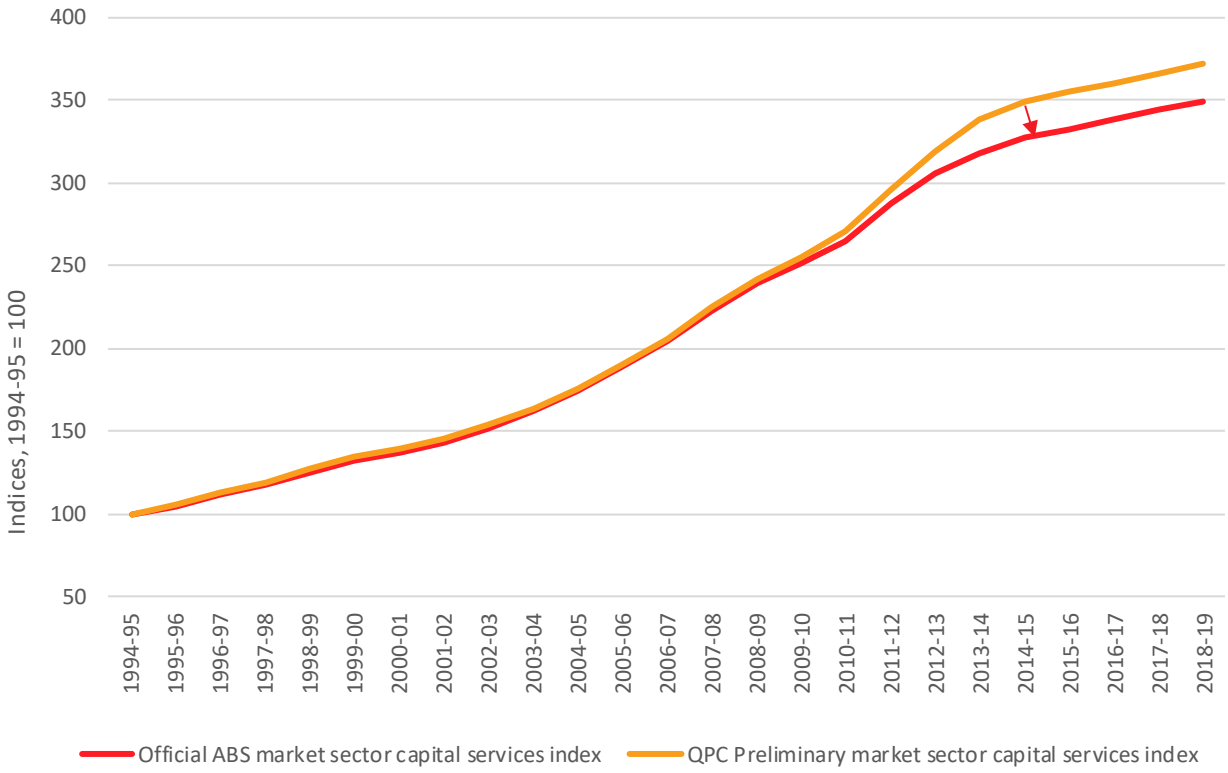
Preliminary Commission capital indices for market sector industries were aggregated using their respective PKS–rental price weighted shares to form an estimate of capital services for the market sector.

The official ABS and preliminary Commission market sector capital services indices grow very similarly, with deviations only occurring from roughly 2011–12 (Figure E.3). From 1994–95 to 2011–12, the official index grew at an average annual rate of 6.22 per cent per annum and the QPC index at 6.40 per cent per annum. Extending the timeframe to 2018–19, the official index grew at 5.21 per cent per annum and the QPC index at 5.47 per cent per annum.

If used to construct an MFP estimate, the preliminary Commission capital index would result in a slightly lower MFP estimate in the latter years of the index as capital inputs to production are growing faster than under the official capital estimate.

To constrain the potential size of the error from the capital allocation methodology, and to maintain consistency between an aggregation of the individual industry capital services indices and the official ABS market sector index for Queensland, a procedure was employed that uniformly adjusted the growth rates of the industry indices. The adjustment resulted in the final index for the market sector being exactly equal to the ABS index. Any presentation of the Queensland market sector capital services index in this paper, or its use in estimates (for example, in decompositions), is fully consistent with both the official ABS index and an aggregation of the individual market sector industry indices.

Figure E.3 Official ABS versus QPC preliminary index of Queensland market sector capital services



Notes: The QPC index shown in the chart is a preliminary index prior to making a final adjustment to ensure full consistency between an aggregation of the individual market sector capital services indices and the official ABS market sector capital services index for Queensland.
Source: ABS cat. no. 5260.0.55.003; QPC estimates.

Comparisons of MFP growth rates by industry

Comparing the average annual growth rates in MFP over the period 1998–99 to 2018–19, the combined Queensland and rest of Australia growth rates appear consistent with the Australian industry estimates (Table E.4). For example, Queensland mining MFP decreased 1.89 per cent per annum, the rest of Australia decreased 1.24 per cent per annum and the official industry estimates decreased at a rate of 1.36 per cent per annum.

Table E.4 Jurisdictional comparison of average annual growth for MFP and components, 1998–99 to 2018–19 (%)

	MFP			Output			Capital inputs			Labour inputs		
Industry	Qld	ROA	AUS	Qld	ROA	AUS	Qld	ROA	AUS	Qld	ROA	AUS
Agriculture	0.14	1.36	1.18	–0.26	1.18	0.96	0.50	0.31	0.35	–2.02	–1.18	–1.37
Mining	–1.89	–1.24	–1.36	5.34	4.43	4.66	8.15	5.90	6.44	5.91	5.07	5.24
Manufacturing	0.35	0.12	0.20	1.63	–0.24	0.14	3.28	0.70	1.15	0.06	–1.10	–0.89
Utilities	–2.26	–2.44	–2.35	2.58	0.78	1.11	5.38	3.26	3.59	3.50	3.08	3.14
Construction	–0.46	0.04	–0.14	3.08	3.64	3.48	6.58	4.63	5.00	2.97	3.06	3.00
Wholesale Trade	2.73	2.05	2.17	3.00	2.78	2.79	1.27	3.27	2.90	–0.18	–0.60	–0.52
Retail Trade	1.67	1.31	1.33	3.44	3.37	3.34	4.01	5.22	4.98	0.96	1.00	0.99
Accommodation	0.56	0.37	0.38	2.47	1.98	2.08	2.06	3.08	2.88	1.99	1.32	1.44
Transport	0.59	0.48	0.44	3.62	2.82	2.93	4.34	3.70	3.86	1.91	1.57	1.62
Information	1.30	0.74	0.78	4.30	3.85	3.86	4.05	4.72	4.62	0.79	0.71	0.72
Finance	0.43	1.71	1.53	3.80	3.88	3.83	3.91	2.70	2.81	2.25	1.40	1.50
Rental	0.79	–2.02	–1.51	4.34	2.43	2.71	5.27	6.20	6.01	1.20	2.34	2.07
Professional	2.34	0.88	0.99	5.92	4.24	4.42	7.00	6.88	6.89	3.19	3.07	3.06
Administrative	1.11	1.37	1.27	4.52	2.76	3.01	7.68	4.81	5.26	3.23	1.15	1.51
Public Admin.	–1.36	–	–	2.25	2.38	–	4.34	4.09	–	3.49	2.58	–
Education	–0.30	–	–	2.45	1.90	–	4.06	3.64	–	2.65	2.09	–
Health	1.08	–	–	5.50	4.67	–	6.20	5.26	–	4.16	3.37	–
Arts	0.57	–0.18	–0.01	2.81	3.52	3.39	3.35	5.46	4.99	1.67	2.90	2.64
Other Services	0.70	–0.07	0.07	2.99	1.86	2.07	7.65	8.62	8.45	1.18	0.61	0.71

Note: 'ROA' is 'rest of Australia', with estimates constructed by QPC. AUS estimates are the official national productivity estimates published by the ABS. To improve comparability to the Queensland and ROA estimates, the Australian industry estimates are based on labour inputs that do not include an adjustment for changes in labour quality.
Sources: ABS cat. nos 5220.0, 5260.0.55.002, 6291.0.55.003; QPC estimates.

The impact of revisions to industry data

Revisions to Queensland industry data between the 2016–17 and 2018–19 releases of ABS cat. no. 5260.0.55.002 can have insignificant to modest impacts on productivity growth rates (Table E.5). For example, for Agriculture, forestry and fishing the impact of revisions to output, hours worked and NKS data had a combined effect of reducing the industry's labour productivity growth rate from 1998–99 to 2016–17 by 0.3 percentage points. Data from the 2016-17 release provided a labour productivity growth rate of 5.0 per cent per annum, but revisions incorporated in the 2018–19 release lowered labour productivity growth to 4.7 per cent per annum. The revision comprised a reduction in output growth of 0.25 percentage points and an increase in hours worked growth of 0.05 percentage points. For most industries, revisions had a smaller impact on labour productivity growth estimates.

However, revisions can have larger impacts on growth rates calculated over shorter time frames. For example, for the 2011–12 to 2016–17 cycle, industries with labour productivity growth estimates that were revised by greater than 1.0 percentage points included Agriculture, forestry and fishing (–1.3 percentage points); Rental, hiring and real estate services (–1.4); Administrative and support services (+1.6); and Other services (+1.2).

Table E.5 Revisions to market sector industry data between the 2016–17 and 2018–19 data releases, percentage point differences in average annual growth rates, 1998–99 to 2016–17

Industry	Labour productivity	Output	Hours worked	Net capital stocks (NKS)
Agriculture, forestry and fishing	–0.30	–0.25	0.05	–0.01
Mining	0.14	0.14	–0.01	–0.10
Manufacturing	0.24	0.10	–0.14	0.03
Electricity, gas, water and waste services	–0.13	–0.01	0.12	–0.09
Construction	–0.03	0.04	0.06	0.02
Wholesale trade	–0.04	–0.06	–0.02	–0.03
Retail trade	–0.14	–0.08	0.05	–0.09
Accommodation and food services	0.02	–0.02	–0.04	–0.04
Transport, postal and warehousing	0.16	0.24	0.08	0.02
Information media and telecommunications	0.02	0.13	0.11	0.03
Financial and insurance services	0.14	0.10	–0.05	0.02
Rental, hiring and real estate services	–0.38	–0.38	0.01	–0.05
Professional, scientific and technical services	0.12	0.00	–0.12	0.07
Administrative and support services	0.43	0.50	0.06	–0.33
Arts and recreation services	–0.15	–0.10	0.05	0.03
Other services	0.34	0.38	0.04	0.00

Note: Queensland industry capital services measures have not been constructed based on the earlier 2016–17 data, so NKS revisions are examined in the table.
Source: ABS cat. no. 5260.0.55.002.

Output measurement

Accurate output measurement has historically been more difficult for service industries than for goods producing industries.

The ABS produces productivity estimates for two definitions of the market sector—the older definition is based on 12 industries (and has a longer time series), and the newer definition has a broader industry coverage with the addition of four service industries:

- Rental, hiring and real estate services
- Professional, scientific and technical services
- Administrative and support services
- Other services.

One of the reasons these industries were late additions to the official productivity estimates was concerns over the quality of measured industry outputs.

At least in terms of the revisions that occurred between the 2016–17 and 2018–19 datasets (Table E.5), the longer-run growth rate in output for three of four of these industries (excluding professional, scientific and technical services) was significantly revised.

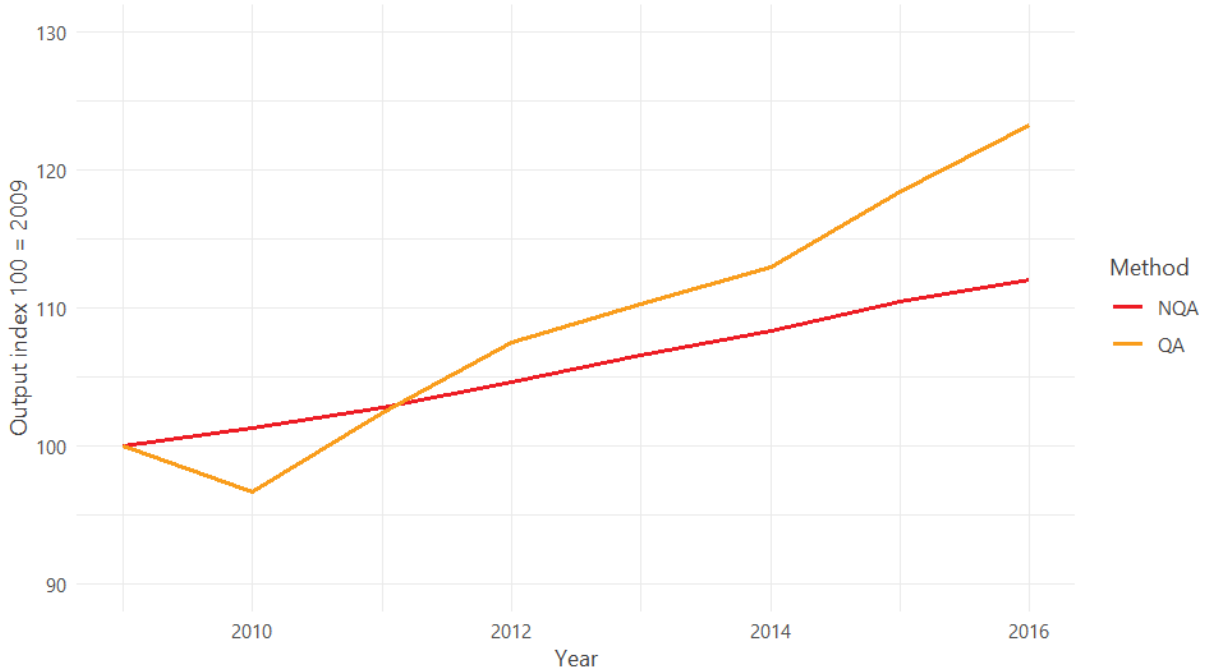
Output measurement remains a significant challenge for non-market sector industries and this is an important reason why the ABS does not produce MFP estimates for these industries. Issues include: an absence of reliable price information where services are not traded in markets so that transaction prices cannot be observed; outputs can be difficult to define; and quality adjustment can be challenging (QPC 2018, p. 13).

Adjusting non-market sector outputs for quality change can have a significant impact on MFP estimates (Cornell-Farrow 2019; QPC 2018, pp. 17–19). For example, for the Queensland school education sector adjusting output for quality change—proxied by changes in NAPLAN scores and senior secondary certifications—tends to increase the rate of growth (Figure E.4).

The ABS historically measured non-market sector industry output using the 'outputs = inputs' method. Growth in input volumes have often been used to proxy for growth in the volume of industry output in the absence of independent output measures (QPC 2018, pp. 12–14; PC 2017b, p. 4). While progress has been made for some sub-industries within the non-market sector industries, output growth is still largely tied to input growth.

Other issues confronting the estimation of MFP in non-market sector industries include the quality of capital measurement and the applicability of some of the assumptions underlying the growth accounting framework in the context of industries dominated by non-market transactions.

Figure E.4 Quality-adjusted output for the school education sector, Queensland



Notes: The school education sector covers Prep (or its equivalent in other states) to Year 12. NQA refers to non-quality-adjusted output and QA refers to quality-adjusted output.
Sources: Cornell-Farrow 2019, p. 21; ACARA data.

Shares and the unincorporated sector

Labour and capital income shares are used to weight the growth in the hours worked and capital services indices to form a combined inputs index. MFP is the difference in the growth of an output index and the combined inputs index.

The adjustment method used to increase labour's share of total factor income (discussed above) introduces a degree of measurement error into the MFP estimates, but is an improvement compared to not making an adjustment. Ideally, the adjustments would be calculated from specific state data to capture any differences in the labour share of GMI across states by industry.

Summary

Overall, the Queensland industry estimates are consistent with national industry estimates, with comparisons over the longer time frames more reliable (Table E.6). Comparisons should be based on peak-to-peak comparisons over cycles, rather than year-to-year changes. Output estimation remains a significant challenge in some industries, especially non-market sector industries. The capital allocation methodology introduces some level of error into MFP estimation. Improving the capital estimates requires ABS unpublished data by industry by asset type and possibly an improved treatment of rental prices.

The MFP estimates for each industry are assessed as being of high (H), medium (M) or low (L) quality relative to the estimates of other Queensland industries (Table E.7). They are also assessed against the national industry estimates as a benchmark in the sense that a Queensland industry is not assessed as having a lower rating if the same issue also applies to the national estimates. For example, Mining is given a high rating, even though the estimates are known to be significantly affected by both the earlier surge in capital investment, and resources depletion, as these issues also apply to the national estimates.

Table E.6 Assessment of the likely quality of the Queensland industry MFP estimates

Criterion	Assessment
Qld-ROA combined consistency with national industry estimates	Consistency is high for most industries. Inconsistencies over cycles are greater than over the longer-run (from 1998–99 to 2018–19)
Scale of data revisions	Revisions to underlying data series can affect productivity estimates, particularly annual growth rates for the most recent years. Comparisons should focus on peak-to-peak comparisons over productivity cycles. Estimates for the most recent completed market sector cycle (2011–12 to 2016–17) are not expected to be significantly affected by further revisions
Quality of output estimates	Compared to other Queensland industries, the quality of output estimates is considered lower for agriculture, forestry and fishing, the four new service industries, and non-market sector industries
Quality of capital input estimates	The NKS allocation methodology introduces distortions to the measurement of capital inputs, but provides the best option given data constraints. It provides a better solution than using NKS or COFC data as a proxy for capital services. The industry estimates aggregate to be exactly equal to the official ABS market sector capital services index helping to reduce the scale of potential measurement errors
Input shares	The national adjustment to industry labour shares to account for labour's share of gross mixed income by is used to adjust state/territory industry labour shares. The potential distortion to MFP estimates is unlikely to be significant

To the extent possible, priority was given to producing Queensland MFP estimates consistent with the national official growth accounting-based MFP estimates. The Queensland estimates can be used in future work that compares the estimates to those produced using different methodologies (for example, methodologies that allow for scale/scope and/or efficiency effects) or adjustments to data. All of the Queensland industry estimates would be of lower quality relative to national industry estimates mainly due to the limitations of the capital (PKS) allocation methodology.

Table E.7 Summary ranking of the quality of Queensland industry MFP estimates

Industry	Rating	Industry	Rating
Market sector industries		Financial and insurance services *	M
Agriculture, forestry and fishing	H	Rental, hiring and real estate services	M
Mining	H	Professional, scientific and technical services	H
Manufacturing	H	Administrative and support services	M
Electricity, gas, water and waste services *	H	Arts and recreation services	M
Construction	H	Other services	M
Wholesale trade	H		
Retail trade	H	**Non-market sector industries**	
Accommodation and food services	H	Public administration and safety	L
Transport, postal and warehousing	H	Education and training	L
Information, media and telecommunications	H	Health care and social assistance	L

** Capital services for these industries is based on an allocation of PKS for the incorporated sector only.*

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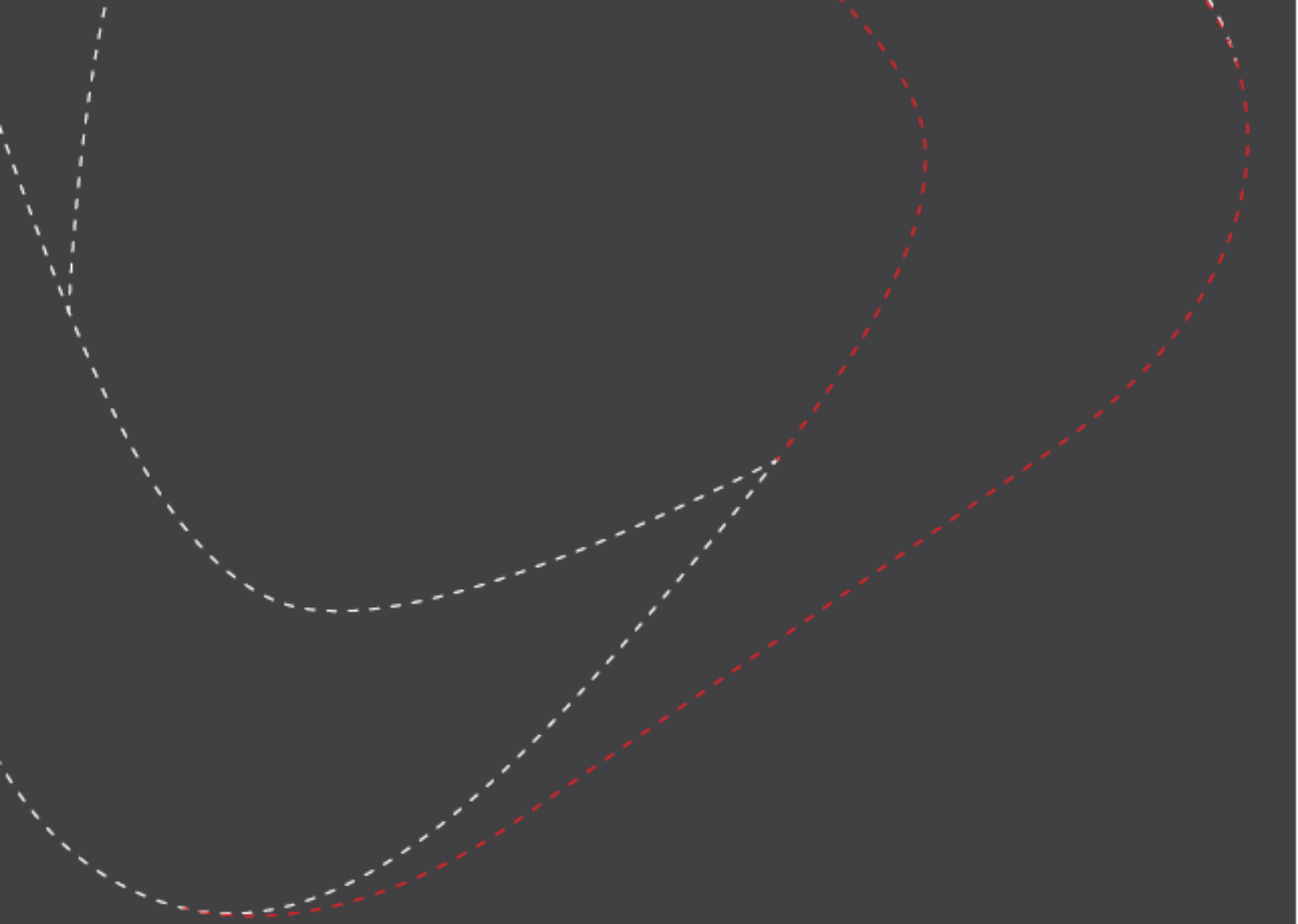


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