



Productivity before and after COVID-19

Research paper



May 2025



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Disclosure of interests

The Productivity Commission Act 1998 specifies that where Commissioners have or acquire interests, pecuniary or otherwise, that could conflict with the proper performance of their functions they must disclose those interests. The Commissioner working on this report has no interests requiring disclosure.

Overview

Summary of the research

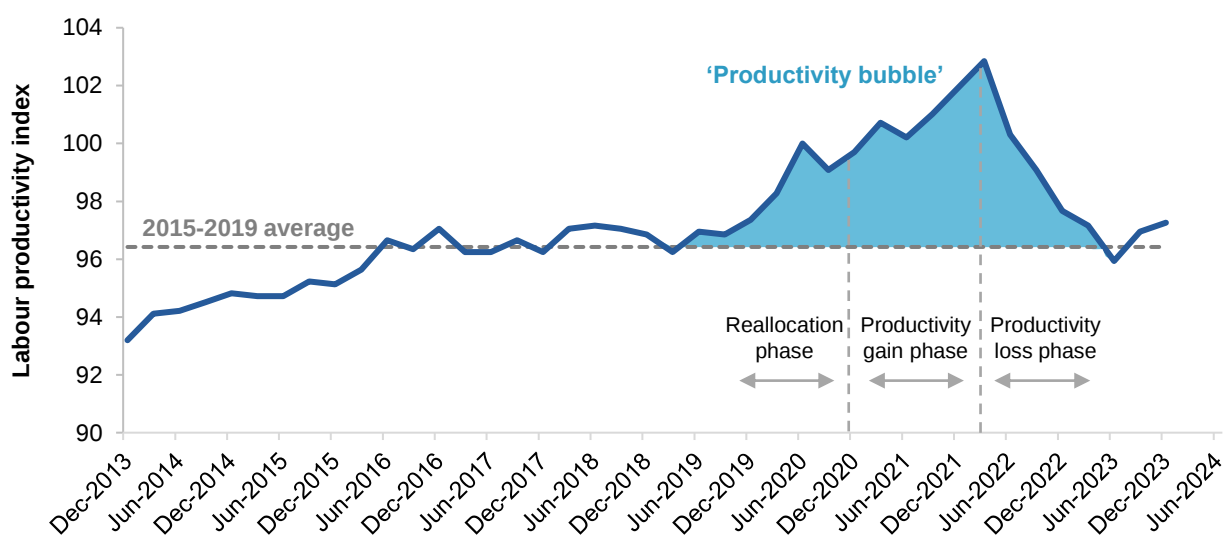
The COVID-19 pandemic led to much human suffering and the tragic loss of life in Australia and around the world. In response to the virus, governments restricted the movement of people and activity in parts of the economy. Combined with declines in peoples' health and wellbeing and the uncertainty of the pandemic itself, this had effects on real economic activity.

In Australia, a peculiar pattern in labour productivity – a labour productivity bubble – emerged during the pandemic. Labour productivity rose to a record high from the onset of the pandemic in January 2020 to March 2022 before declining and returning to its pre-pandemic level in June 2023. This bubble can be divided into three phases which this paper seeks to explain (figure 1).

- A 'reallocation' phase – the initial phase, between December 2019 and December 2020, where labour productivity rose as lockdowns were most severe, economic activity was curtailed, and labour was reallocated away from disrupted industries.
- A 'productivity gain' phase – the second phase, between December 2020 and March 2022, where labour productivity continued to rise as lockdowns eased and economic activity slowly rebounded
- A 'productivity loss' phase – the third phase, between March 2022 and June 2023, where labour productivity declined rapidly and returned to its December 2019 level.

Figure 1 – Labour productivity rose sharply at the onset of the pandemic, before quickly returning to pre-pandemic levels

Labour productivity index, June 2020 = 100



Source: PC estimates using ABS data (ABS 2024d table 1).

What happened to labour productivity during the COVID-19 pandemic is important to understand, as labour productivity have significant implications for living standards and economic prosperity. Even small movements in labour productivity have significant implications for wages and living standards – for example, a decline in productivity from 1.5% to 1.2% per year would reduce average income per capita by about \$11,000 in 40 years' time. Therefore, changes in labour productivity of the magnitude seen during the pandemic could have significant implications for Australia's long run prosperity, particularly if the trends were sustained over a number of years.

Given labour productivity had been stagnant in the years leading up to the pandemic, these large movements were naturally of great interest to the PC – first to determine whether the upswing was sustainable, and second to identify, and address, the reasons for the downswing. The motivation for this paper is therefore to understand the reasons for the changes in productivity during the pandemic, to inform productivity policy.

The initial rise in productivity – from December 2019 to December 2020 (the 'reallocation' phase) – can be explained almost entirely by the lockdowns during COVID-19 pandemic. Lockdowns did not affect all industries equally – the industries most affected by lockdowns (such as accommodation and food services or arts and recreation services) tended to also have the lowest levels of labour productivity. As these industries shut down, the composition of employment shifted to more productive industries. The policy implications from these initial gains in productivity are limited, as they are not actually reflective of people or firms producing more – they simply reflect the compositional changes that were forced on the workforce during lockdowns.

The changes in productivity *after* December 2020 are more reflective of real productivity gains and losses – in other words, these are predominantly due to workers producing more – and then less – in their existing industries, rather than shifts between industries.

The gains made between December 2020 and March 2022 (the 'productivity gain' phase) were broad-based across the economy – 15 out of 19 industries experienced a productivity gain. During this time, lockdowns were unwinding, economic activity was returning, and the labour market was recovering slowly. As output returned faster than employment grew in this period, labour productivity continued to rise.

But almost none of these gains were sustained. Only two industries (the information media and telecommunications sector and the administrative and support services sector) were able to hold onto their productivity growth. Every other industry which experienced productivity growth between December 2020 and March 2022 experienced a decline between June 2022 and June 2023 (the 'productivity loss' phase).

These declines predominantly reflected Australia's post-COVID-19 labour market. The strong post-COVID-19 economic recovery fuelled a labour market with record lows in unemployment, and record growth in hours worked. And while strong employment is undoubtedly a good thing for the economy (as more people are able to earn a living) the pace of growth in hours worked brought with it some downsides to labour productivity (which could have resulted in wages being slow to rise). There are two primary reasons for this.

First, the capital stock was simply unable to keep pace with the growth in hours worked. The capital stock is inherently slower to move than hours worked because many forms of capital (like equipment or infrastructure) are made for long-term use and cannot be easily acquired in response to short-term economic changes. Further, firms may delay purchasing new capital until they can determine whether increases in demand are permanent or temporary. And less capital available for workers tends to diminish productivity.

Second, with the record growth in hours worked, younger and less experienced workers joined the workforce.¹ This brought down the average quality of the workforce – at least temporarily – as these workers require time to learn the skills and competencies required to succeed in their job and match the output of their more experienced colleagues.

It is unlikely that both of these factors will lead to permanent changes to productivity – the capital to labour ratio should rise as firms’ respond to the labour market growth, and the workforce quality should rise as workers gain experience in their new jobs. This may even suggest some potential upside to the productivity outlook.

Policy choices matter too. The rise of the care economy – a sector with low *measured* productivity (although measurement challenges mean there is a substantial difference between measured and actual productivity) – has also dragged productivity down. And the rapid employment gains in this sector have reflected government funding and subsidies (such as the NDIS and childcare subsidy) being directed towards these sectors.

Australia also undertook a deliberate policy choice to support firms and workers in staying attached to specific jobs. This policy choice limited worker mobility, firm entry and exit, and the potential for a more dynamic economy. While this may not have led to a *decline* in productivity, it may have prevented the type of productivity-enhancing movements of firms and people observed in other economies, such as the US.² Conversely, it may also have prevented the significant decrease in employment rates observed in the US (where almost one in ten people lost their job during the pandemic). But these policy decisions underpinned economic resilience through the pandemic – it is a reminder that there are trade-offs to seeking productivity-enhancing policies.

All of this is to say: there are no obvious long-term implications arising from Australia’s productivity performance during the pandemic. And although the decline has been arrested, and productivity stabilised at its pre-COVID-19 level, this is not a cause for celebration. Productivity growth had been stagnant in Australia for the five years leading to the pandemic, and the 2010s produced the lowest decade of productivity growth since the 1960s. But our current predicament does not appear to be caused, or unduly exacerbated, by our experience during COVID-19. Rather, we need to address the long-term drivers of the decline, such as the long-term decline in investment and business dynamism, and improving the diffusion of ideas and innovation to move all firms closer to the productivity frontier. There might be some grounds for optimism as new workers benefit from the on-the-job learning and firms invest to improve the capital available to workers, but there is still a lot of work to do.

Our approach

Our approach involved identifying the challenges posed by the COVID-19 pandemic, and the post-pandemic recovery, which could explain changes in productivity. These challenges included employment shifting between industries, aggregate demand stalling, then surging, and new policies (such as Jobkeeper) introduced to ward off the biggest risks associated with the pandemic. These challenges led to a number of changes for our economy – how these factors possibly contributed to short-term changes in labour productivity has been the focus for this research.

We considered a series of nine factors to be of most importance to this paper – industries of employment changed, working from home became more prevalent, workplaces faced restrictions in how they operated,

¹ People also worked more hours, or worked second jobs, without a commensurate increase in output.

² The PC’s December productivity bulletin provided some insights into the productivity growth the US have enjoyed since the COVID-19 pandemic.

the care economy grew, our capital-to-labour ratio fell, the quality of our labour force changed, labour mobility declined, firm entry and exit declined and supply chains were disrupted.

This remainder of this paper comprises eight chapters, each considering one these factors in greater detail (the final chapter combines a discussion on working from home and workplace restrictions). Each chapter describes why these factors matter for labour productivity, sets out how the COVID-19 pandemic affected each factor, and determines the extent to which each factor contributed to the 'productivity bubble'.

Relying on desktop analysis of ABS datasets, the paper explores each factor in detail and determines what matters most in explaining Australia's recent productivity experience, and what implications there are (if any) for policy and labour productivity.

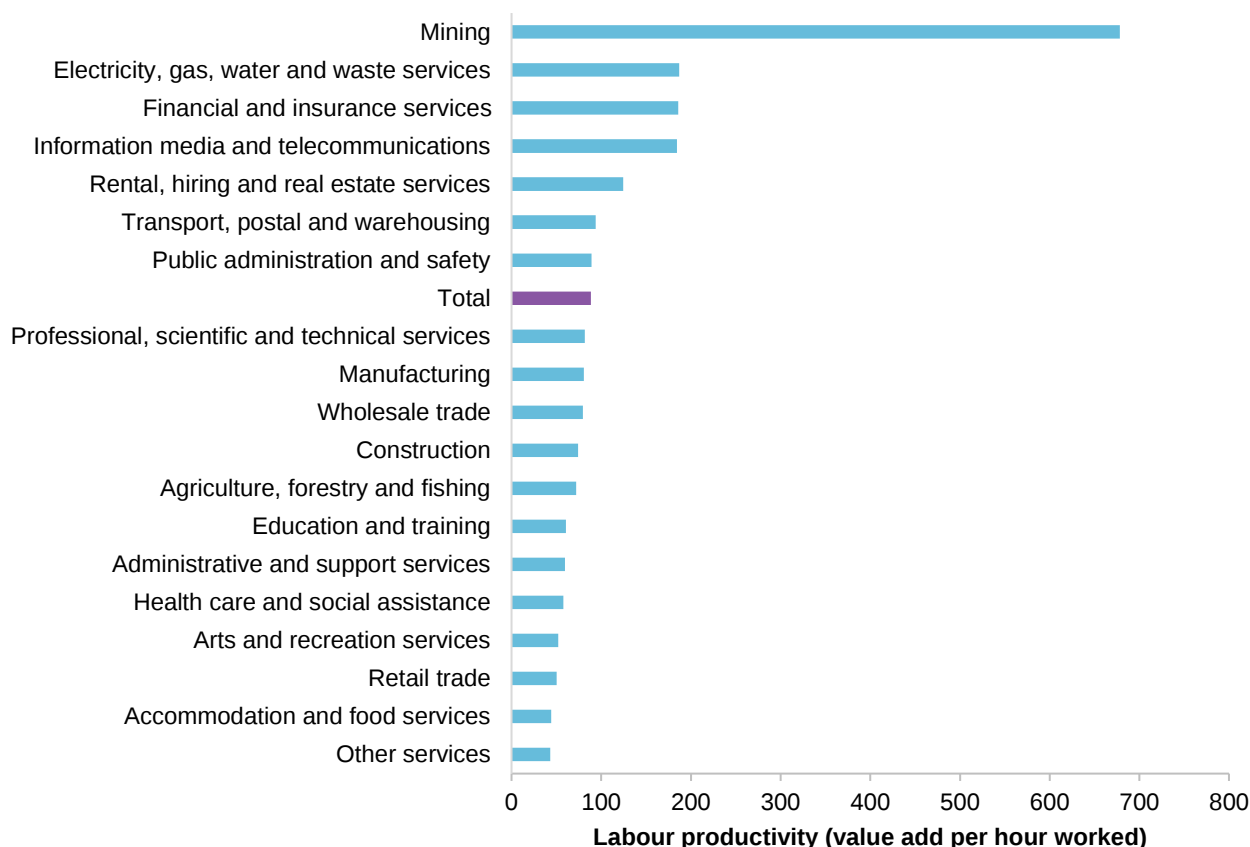
1. Industry composition

Key points

- * Lockdowns disproportionately affected industries with lower labour productivity, putting workers in these industries out of work and skewing the labour force to more productive industries.
- * The changes in labour productivity can be broken down into three phases.
 - The *initial rise* in labour productivity – between December 2019 and December 2020 – is attributable almost entirely to the change in the distribution of workers between industries, rather than workers and firms becoming more productive.
 - The *continued rise* in labour productivity – between December 2020 and March 2022 – was largely attributable to improvements in workers' productivity within industries.
 - Finally, the *fall* in labour productivity – between March 2022 and June 2023 – was largely attributable to the earlier improvements in workers' productivity within each industry reversing.

1.1 Why does industry composition matter to productivity?

Industries tend to have different levels of productivity, depending on (among other things): their capital intensity, their use of technology, their use of intermediate inputs and the market structure. For example, mining is capital intensive and tends to have high labour productivity; whilst services such as retail trade tend to focus more on quality of service delivered and therefore tend to have lower levels of measured productivity (figure 1.1). This does not mean that improvements cannot be made in each sector – changes in workforce quality, or new ideas unique to one sector will improve productivity in that sector relative to other sectors. But the *level* of labour productivity is still expected to be very different across sectors with different uses of technology, capital intensity and market structure, especially in the short term.

Figure 1.1 – Labour productivity differs across industries**Gross value add per hour worked, June 2024**

Source: PC estimates using ABS (2024d Table 6) and ABS (2024k Industry summary table)

National productivity is an aggregate of productivity within every industry. One implication is that changes in measured aggregate productivity may be due to changes in the composition of Australia's workforce and shifts in industries where people work, rather than changes in the productivity of workers in particular industries. For example, if workers moved so that a larger share of the workforce became employed in less productive industries, we would expect that observed aggregate productivity would fall in the short term, all else being equal. During the COVID-19 pandemic the workforce composition changed dramatically, first as lockdowns affected some industries more than others, then as the economy opened back up and people's preferences and spending adjusted after the pandemic.

1.2 Industry composition through the pandemic

Lockdowns changed the industries in which people were working ...

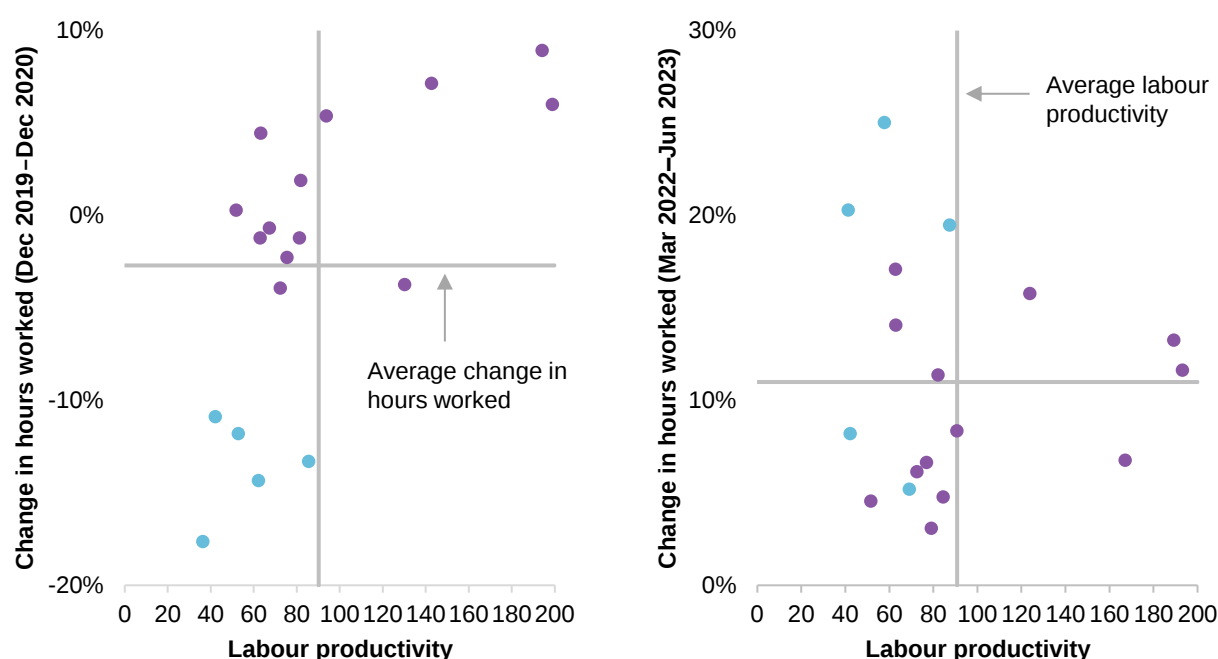
Previous work by the PC hypothesised that the COVID-19 productivity bubble could have been an outcome of lockdowns putting people out of work in industries such as hospitality (low-productivity industries), skewing the workforce towards higher-productivity industries, and therefore increasing aggregate productivity (PC 2023c). As the lockdowns unwound, the workforce profile went back to its pre-COVID-19 state, and productivity therefore returned to its pre-COVID-19 level.

The initial industry compositional changes are highlighted by the left panel of figure 1.2, which shows changes in hours worked over the first 12 months of the pandemic (when lockdowns were at their most severe) on the vertical axis. The industries we would expect to be most affected by lockdowns (such as accommodation and food services, or arts and recreation services) experienced the largest decreases in hours worked (the light blue dots at the bottom of figure 1.2). They are also industries with well below average productivity levels – only the transport industry has a labour productivity close to the national average. In other words, lockdowns disproportionately affected industries with lower labour productivity, putting workers in these industries out of work. This increased measured aggregate labour productivity and contributed to the upswing in productivity observed at the onset of the pandemic.

However, the decline in aggregate productivity which followed this period does not appear to be strongly linked to the easing of lockdowns and workers returning to work. From March 2022, as lockdowns eased, aggregate demand surged and hours worked increased significantly across several industries, not just the low productivity industries which reopened after lockdowns. So, while the initial rise in labour productivity can be largely explained by a shift in the industries in which workers worked, it is unlikely that this same explanation fully accounts for the subsequent sharp decline.

Figure 1.2 – Industries most severely affected by lockdowns were more likely to be low-productivity industries

Labour productivity and change in hours worked; Dec 2019-Dec 2020 (LHS) and labour productivity and change in hours worked; Mar 2022-Jun 2023 (RHS)^{a,b}



a. Mining is not shown as it does not fit on the horizontal axis. **b.** The light blue dots show the industries with the biggest fall in hours worked between December 2019 and December 2020. The industries are accommodation and food services, administrative and support services, transport postal and warehousing, arts and recreation services and other services.

Source: PC estimates using ABS (2024d Table 6) and ABS (2024k Industry summary table).

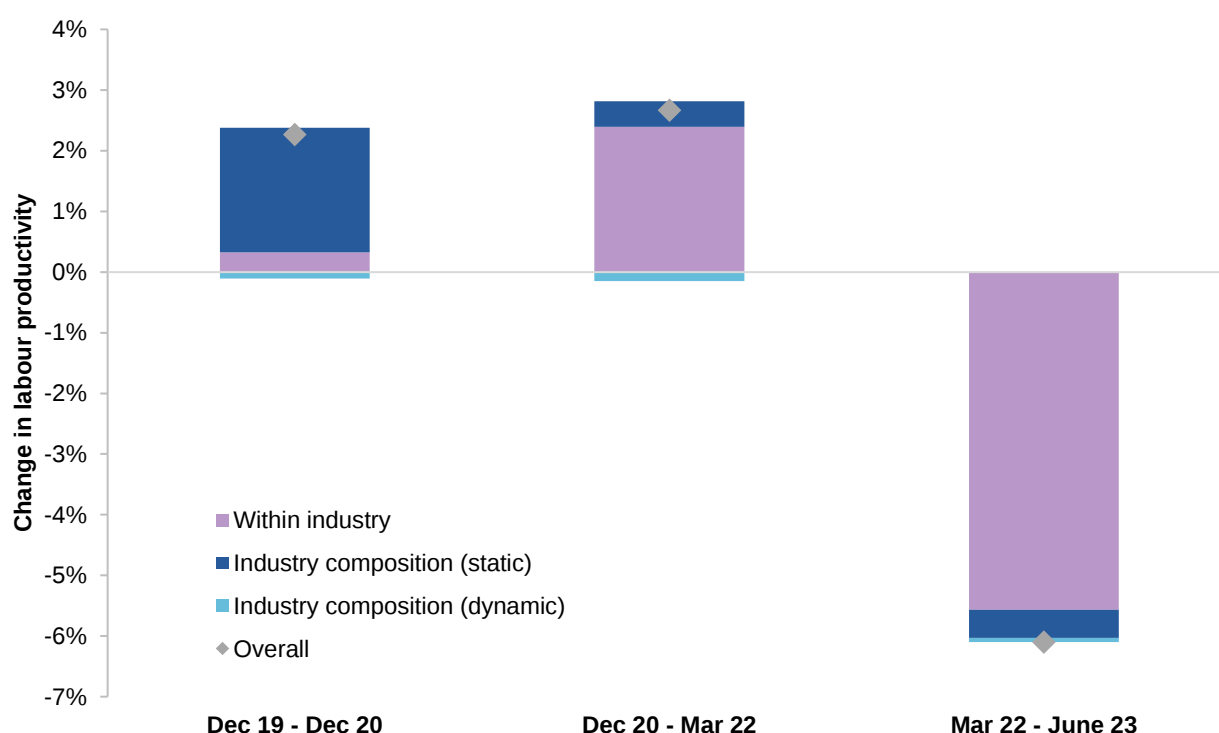
... but the changes to industry composition only explain the productivity changes at the beginning of the pandemic

To test this formally, changes in labour productivity can be decomposed into changes in productivity *within* industries, and changes due to shifts of workers *between* industries. If the productivity bubble is attributable to the lockdowns and the changing workforce composition, then the shifts *between* industries would dominate. If changes *within* industries dominate, this indicates that workers are actually producing more per hour of work. The decomposition in this paper follows Teo and Ong (2018), with labour productivity decomposed into three components.

- **Within effect:** the changes in productivity due to changes in productivity within each sector.
- **Between industries (static shift effect):** the change in productivity due to changes in the composition of the workforce (the workforce moves to industries with a higher *level* of productivity).
- **Between industries (dynamic shift effect):** the change in productivity due to changes in the composition of the workforce (the workforce moves to industries with higher *growth* in productivity).

The analysis breaks down the bubble into three time periods – the first 12 months (December 2019 to December 2020), as lockdowns were most severe; the following 15 months (December 2020 to March 2022), as labour productivity continued to rise although lockdowns were easing; and the subsequent 15 months (March 2022 to June 2023), as all the gains in labour productivity were lost. The results are shown in figure 1.3.

Figure 1.3 – Changes in labour productivity are attributable to changes between industries prior to December 2020, but to changes within industries after that^a
Decomposing labour productivity across different time periods



a. The analysis stops at June 2023 as this is when labour productivity returned to its pre-pandemic levels.

Source: PC estimates using ABS (2024d Table 6) and ABS (2024k Industry summary table).

Figure 1.3 suggests that the initial rise in labour productivity over the first 12 months of the pandemic was largely due the composition of Australia's workforce – about 86% of the changes in productivity are attributable to changes in workforce composition. Simply put, the changes to Australia's workforce due to the COVID-19 pandemic (specifically, the lockdowns of less productive industries meaning workers were more likely to be employed in higher productivity industries), explain the rise in productivity, rather than individual workers improving their individual productivity.

However, these compositional effects only explain the changes to aggregate productivity over the first 12 months of the pandemic. Throughout the following 15 months (from December 2020), the continued rise in aggregate productivity was due to growth in productivity *within* individual industries (only 10% was due to changes between industries).

And from March 2022, when the bubble burst and the decline in aggregate productivity began, this was largely due to declines in productivity within individual industries (only 9% was due to changes between industries). The implication is that on average, individual workers became more productive over 2021, before these gains were reversed over 2022 and 2023.

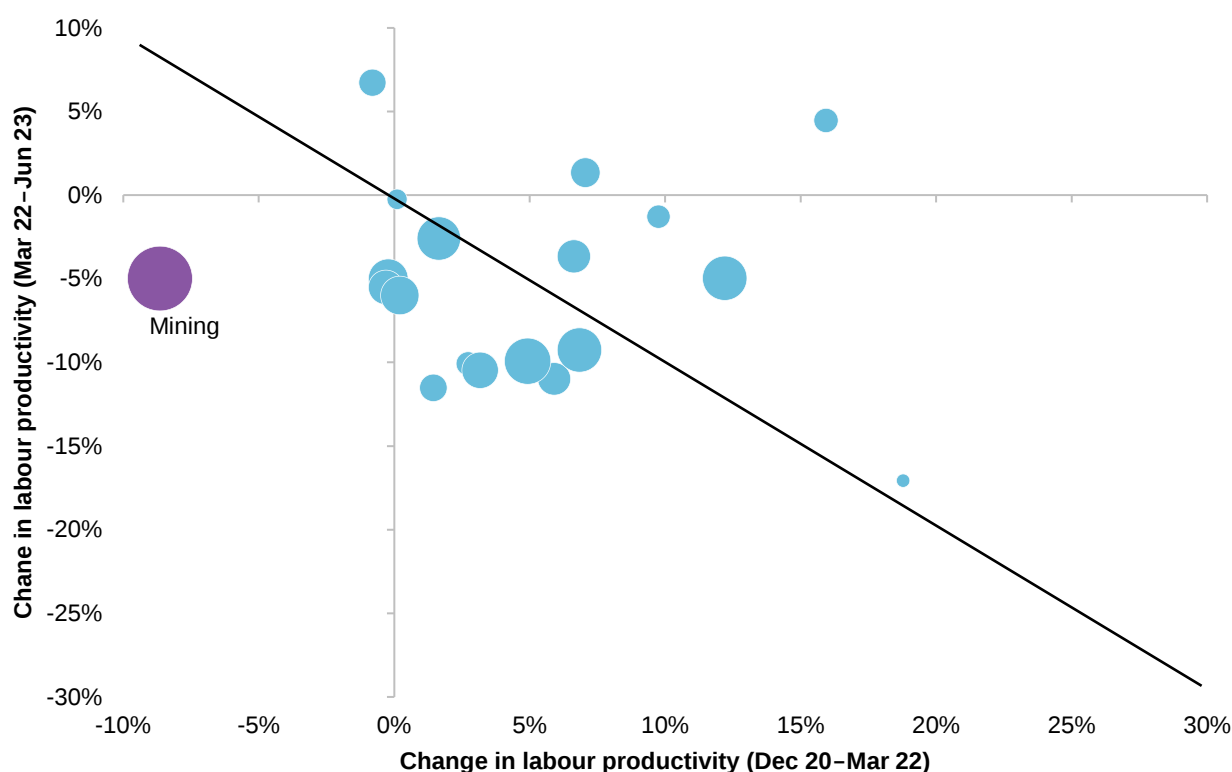
Nearly all industries shared a common trend in labour productivity during the bubble period

Since changes within individual industries dominate the changes to productivity after December 2020 (rather than movement across industries), it is worth identifying which industries contributed most significantly to the rise and decline in productivity. From a policy perspective, we want to identify if there are common trends causing labour productivity to rise and fall across all industries, or if there are differences between industries which are causing a significant divergence in labour productivity trends.

The first thing to note is that while the mining industry is Australia's most productive sector, it has been a drag on productivity growth throughout the pandemic, with measured productivity falling by over 20% since December 2019. The mining industry was the only industry to experience a fall in labour productivity over both the upswing and downswing periods of the productivity bubble (the purple dot in figure 1.4).

Figure 1.4 – Labour productivity in nearly every industry increased during the bubble upswing, and decreased during the bubble downswing

Change in labour productivity between Dec 20 and Mar 22 (x-axis) and Mar 22 and Jun 23 (y-axis)^a



a. The size of the circles indicates each industry's relative contribution to labour productivity in December 2020.

Source: PC estimates using ABS (2024d Table 6) and ABS (2024k Industry summary table)

Excluding mining from the productivity figures, the rise in the labour productivity would have been 7.3% during the upswing of the bubble (up from 5.0%), and the decline would have been -5.8% during the downswing (up from -6.1%).

While the fall in labour productivity in the mining sector should be the subject of further investigation, it is worth noting that labour productivity in this sector tends to fluctuate significantly (as the sector moves between investment and production phases, as high quality resource deposits are uncovered and used, and as production responds to international price signals). The changes observed in mining productivity over this period, while significant, are consistent with the variable nature of productivity in the sector and not necessarily linked to pandemic-specific factors.

Turning to the non-mining economy, nearly every industry that drove the labour productivity increase during the bubble upswing experienced a fall in labour productivity during the bubble downswing. Only the administrative and support services industry and the information media and telecommunications industry were able to maintain positive labour productivity growth throughout both these periods – nearly every other

industry experienced an initial rise in productivity, before these gains were lost over the subsequent five quarters³ (figure 1.4).

1.3 Conclusion and potential for future work

The compositional changes to Australia's workforce that occurred at the onset of the COVID-19 pandemic only explain the initial changes to aggregate labour productivity. From December 2020, the rise in aggregate productivity was due to growth in productivity *within* individual industries, and from March 2022, the decline in aggregate productivity was also largely due to declines in productivity *within* individual industries.

Further, figure 1.4 shows that nearly every industry experienced a similar productivity pattern during the productivity bubble (first a rise from December 2020 to March 2022, then a decline from March 2022 to June 2023). It is also worth noting that, looking back to 1994, it is unprecedented for so many industries to simultaneously observe decreases in labour productivity over a five-quarter window. Overall, this suggests that there were common policies or macroeconomic events which were shaping productivity trends within industries. An exploration of the unique productivity response of each industry (and the possible causes of these responses) is beyond the scope of this paper, although it may be instructive to consider the labour productivity outcomes – and the reasons for these outcomes – in specific industries of interest.⁴

³ The only industry which experienced the opposite trend – a fall in productivity followed by a rise in productivity – was the agricultural sector. Short-term productivity changes in the agricultural sector are often not driven by policy, but by external factors, such as the weather.

⁴ The PC (2025) released a research paper examining productivity growth in the housing construction sector.

2. The capital-to-labour ratio

Key points

- * **Capital matters for productivity because more capital (the machines, equipment and other durable goods that are used as inputs in production) means workers can produce more goods and services.**
 - The capital-to-labour ratio has been a key driver of increases in labour productivity over the past 25 years.
- * **Changes to the capital-to-labour ratio throughout the pandemic were a significant part of the growth and subsequent decline in labour productivity that occurred during the COVID-19 pandemic.**
 - As the pandemic hit, hours worked declined as 'non-essential' industries were restricted.
 - After the pandemic, pent-up demand, record levels of workforce participation and increased supply of migrant workers fuelled a record surge in hours worked.
 - Changes in the capital stock were unable to match the fluctuations in hours worked, leading to an initial rise, and subsequent decline, in the capital-to-labour ratio.

2.1 Why does capital matter for productivity?

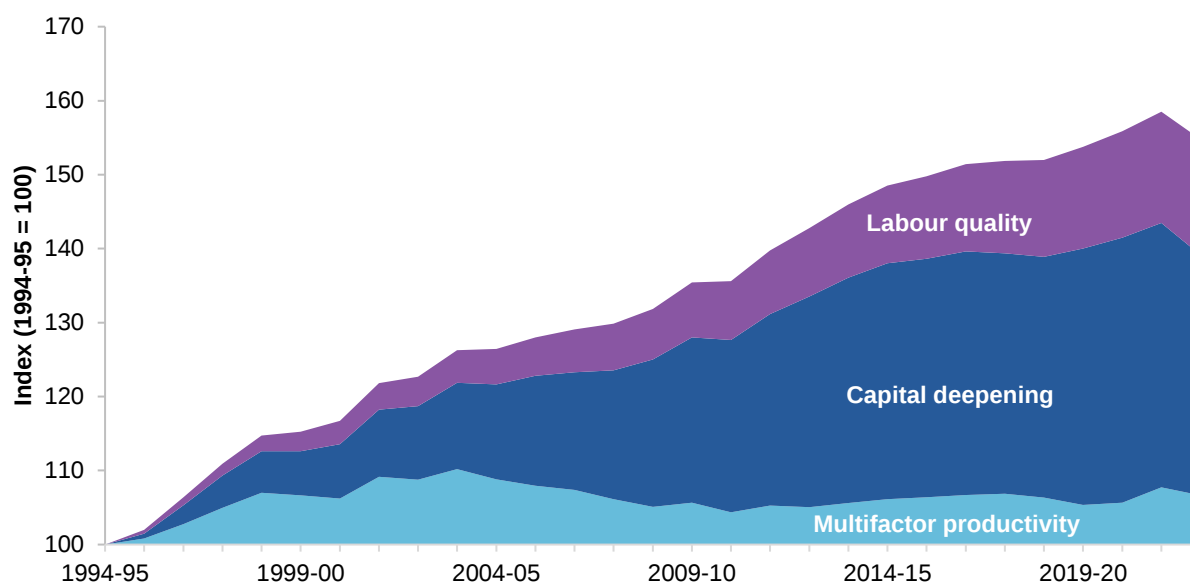
More capital means workers can produce more

More capital⁵ (the machines, equipment and other durable goods that are used as inputs in production) helps workers to produce more goods and services. For example, a baker is much more productive if they have an oven, utensils, and an automatic mixer to help them bake bread. Construction workers are more productive if they dig with shovels, rather than spoons. All else being equal, an increase in the capital-to-labour ratio (known as capital deepening) enables workers to produce more output per hour – and has been a key driver of increases to labour productivity over the past 25 years (figure 2.1).

⁵ Productive capital (used in calculations of market sector productivity) includes assets such as machinery and equipment; non-dwelling construction; intellectual property products; orchards, plantations and vineyards; livestock; and land. Dwelling constructions (including residential investment properties) are excluded (ABS 2021f).

Figure 2.1 – Capital deepening has had an increasing contribution to labour productivity growth in the long run

Factors accounting for labour productivity growth since 1994-95



Source: PC (2023) based on ABS (2023d table 2).

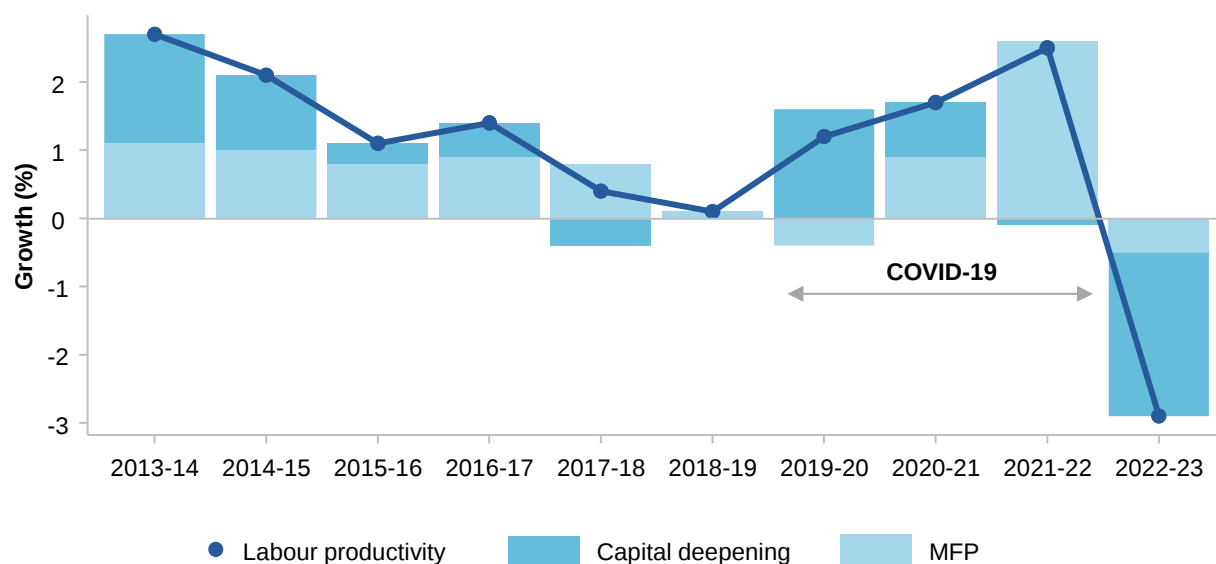
2.2 Capital and investment growth through the pandemic

Changes to the capital-to-labour contributed to changes in labour productivity during the pandemic ...

Changes to the capital-to-labour ratio between 2019 and 2023 were a significant part of the growth and subsequent decline in labour productivity that occurred during the COVID-19 pandemic (figure 2.2). (As set out in box 2.1, the magnitude of the changes in the capital-to-labour ratio may be overestimated due to mismeasurement of the usage of capital.) The capital-to-labour ratio increased during the initial phase of the pandemic, spurring productivity growth in 2019-20 and 2020-21. This was reversed as the economy recovered from the pandemic and the capital-to-labour ratio declined (known as capital shallowing) in 2021-22 and 2022-23. Although labour productivity continued to grow in 2021-22 (driven by significant multifactor productivity (MFP) growth), labour productivity declined in 2022-23, largely due to the capital shallowing.

Figure 2.2 – Capital deepening significantly influenced COVID-19 productivity trends in the market sector

Contribution of capital deepening and multi-factor productivity growth to market sector labour productivity growth



a. The 2023-24 vintage of the annual national accounts data has revised the estimation of the contribution of MFP growth to labour productivity growth in 2022-23 and indicates that MFP growth contributed positively to labour productivity growth in this time period. Capital shallowing is still the primary source of the decline in productivity in 2022-23.

Source: PC estimates using ABS (ABS 2023b table 13).

Box 2.1 – Mismeasurement of capital during COVID-19

Capital utilisation rates measure the intensity with which businesses use their capital. For example, if a factory used their machinery for most of the day, this would translate to a high capital utilisation rate; whereas if their machinery was mostly sitting idle, this would translate to a low capital utilisation rate. When the Australian Bureau of Statistics (ABS) estimates labour productivity and the labour-capital ratio, they assume that the capital utilisation rate is constant over the life of a capital asset.

In practice this assumption does not always hold. During COVID-19, for example, many businesses were forced to temporarily close or shift to remote working arrangements. In these cases, capital utilisation rates would have been lower than usual, as large amounts of capital were left idle. As a result, capital usage - and therefore capital deepening - during the pandemic was likely overestimated.

Knowing the exact extent of the mismeasurement is difficult, because capital utilisation is not directly observed. The ABS has produced alternate capital utilisation estimates during the pandemic using labour utilisation as a proxy for capital utilisation. These alternate estimates indicate that capital utilisation was lower than expected in 2019-20 (which would mean capital deepening was overestimated), but they do not allow us to reach a conclusive result regarding the role of capital utilisation during the pandemic recovery period. Indeed, some estimates indicate that capital utilisation was higher than the official index between 2022-23, while others indicate it was lower.

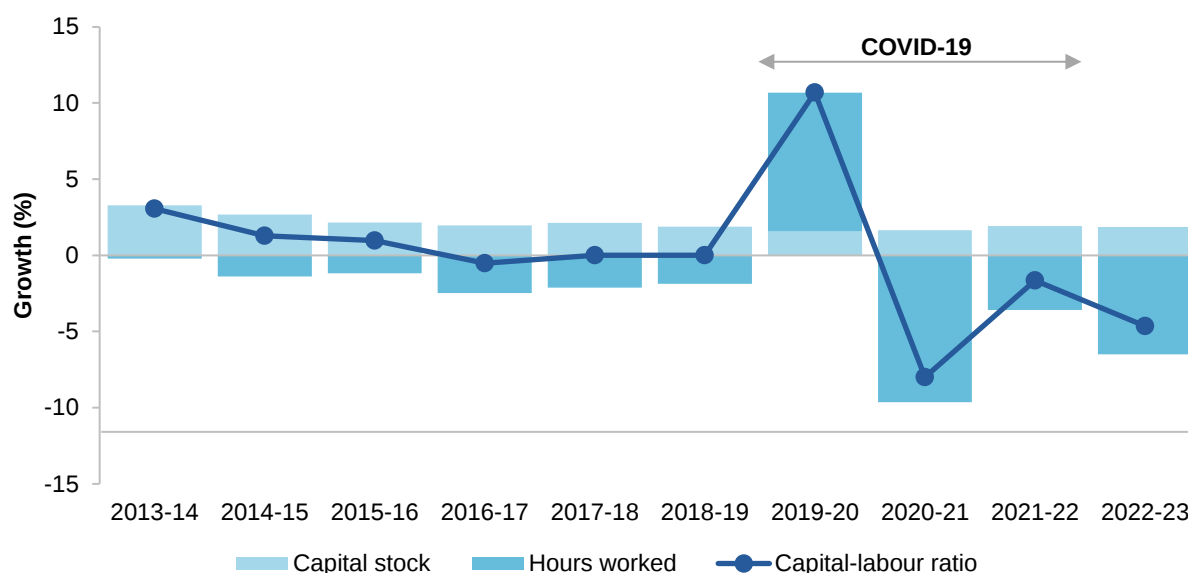
While the general direction of capital deepening and shallowing trends are likely to be accurate, these trends may have been overstated in official estimates. This does not have implications for labour productivity – only how labour productivity is divided between capital deepening and multifactor productivity.

Source: ABS (2023e).

... but trends in the capital-to-labour ratio were mainly due to changes in hours worked

Changes in the capital-to-labour ratio during the pandemic were mainly due to changes in hours worked rather than shifts in the capital stock (figure 2.3). Prior to the pandemic, the capital-to-labour ratio was relatively stable, as increases in hours worked were matched by increases in the capital stock. As the pandemic hit, hours worked became particularly volatile as first 'non-essential' industries were restricted, decreasing total hours worked across the economy; and then, as pent-up demand, record levels of workforce participation and an increased supply of migrant workers fuelled a record surge in hours worked between September 2021 and June 2023. It is worth noting that the total supply of migrant workers since the start of the pandemic is broadly as expected. The rapid increase in migrant workers occurred after migration had slowed drastically as borders closed during the pandemic. This rapid increase, from a low base, affected total hours worked during the 'productivity loss' phase of the bubble. Changes in the capital stock were unable to match the fluctuations in hours worked.

Figure 2.3 – Changes in the capital-to-labour ratio were driven by labour rather than capital
Growth in the capital-to-labour ratio broken down by contribution of capital stock and
hours worked^{a,b,c}



a. Changes in natural logarithm values are used as an approximation for percentage changes. **b.** Growth in the capital-to-labour ratio is expressed as growth in net capital stock (chain volume measure) minus growth in hours worked. While the contribution of capital stock to growth in the capital-to-labour ratio represents *positive* growth in capital stock, the contribution of hours worked to the capital-to-labour ratio growth represents *negative* growth in hours worked. **c.** The capital-to-labour ratio is calculated as the ratio of net capital stock to hours actually worked in all jobs. The capital-to-labour ratio used in the calculation of capital deepening uses a measure of capital services (capital services provided by an asset is the amount of productive capital stock multiplied by the capacity utilisation rate of that asset) rather than capital stock.

Source: PC estimates using ABS (2023b table 63) and ABS (2024k table 1).

The capital stock is inherently slower to move than hours worked because many forms of capital (like equipment or infrastructure) are made for long term use and cannot be easily reduced or increased in response to short term economic changes. Further, firms may delay purchasing new capital until they can determine whether increases in demand are permanent or temporary. Thus, there are sound economic reasons why fluctuations in hours worked were not matched by changes to the capital stock in the short term. The capital-to-labour is likely to stabilise and may even return to pre-pandemic levels as firm investment decisions reflect the strong economic conditions post- COVID-19, and as hours worked moderate (as wages increase and aggregate demand tapers).

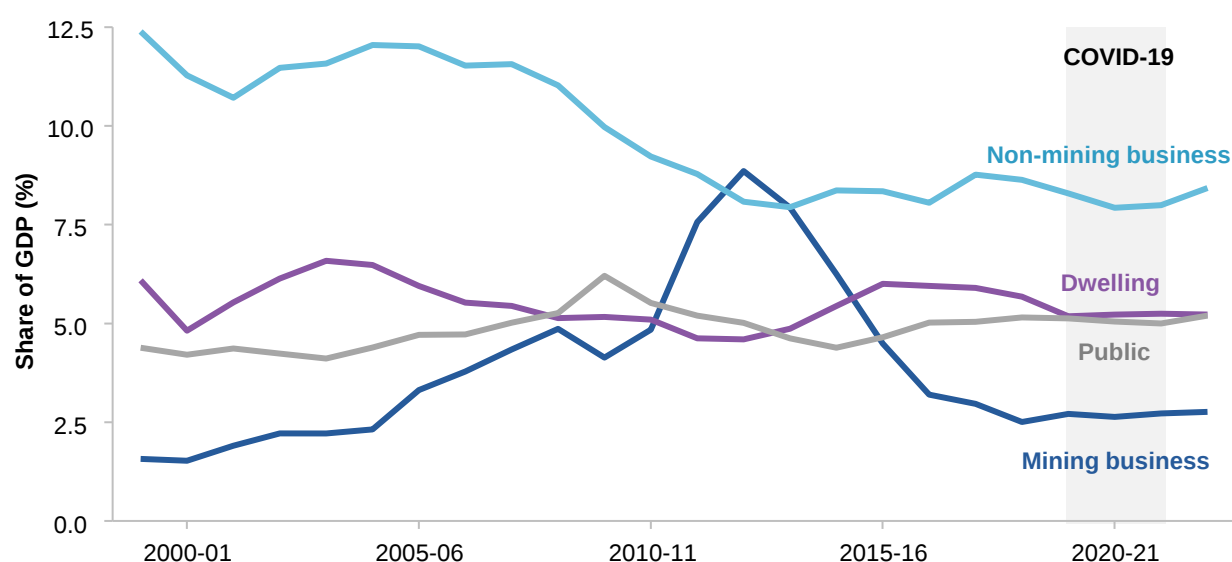
Growth in the capital stock has been minimal due to trends in investment and depreciation

Capital stock fluctuates if there are changes to investment (amount of new capital stock added) or depreciation (a decline in the stock of capital). During the pandemic, there were no significant changes to the rate of depreciation and while investment did fluctuate, these changes were short-lived and minimal relative to the value of total capital stock.⁶ Investment declined by 4.9% in the June quarter of 2020 due to uncertain

⁶ Some authors (such as Mischke et al. (2024)) have identified a lack of investment through the pandemic period as a key factor in Australia's weak productivity performance.

economic conditions and restrictions that affected business operations in many sectors (ABS 2020a, 2022g). That dip in investment was short-lived – investment growth rebounded in 2021, driven mostly by recovering business and dwelling investment, and also in 2023 due to strong public and business investment growth. Non-mining private investment as a share of gross domestic product (GDP) has recovered since its dip at the height of the pandemic and exceeded pre-pandemic levels (figure 2.4) (despite a decline in investment over the last three quarters of data analysed (ABS 2024a); in-part due to high interest rates since 2022). Overall, the pandemic seems to have done little to significantly alter investment levels in Australia. However, while investment has recovered since its initial decline, this recovery has been insufficient to match the increase in labour, leading to the decline in the capital-to-labour ratio.

Figure 2.4 – Investment has recovered since the pandemic but remains low
Annual gross fixed capital formation^a as a share of GDP (current prices)



a. Ownership transfer costs are excluded.

Source: PC estimates using ABS (2023b tables 1, 52, 53 and 54).

Long run investment growth has been low

While investment and capital has reverted back to its pre-pandemic levels, this is not necessarily a positive story for investment. Investment in the years leading up to the COVID-19 pandemic was characterised by low growth or a decline (Evans et al. 2024). If this low rate of investment persists, it may contribute to a longer term productivity slowdown in Australia. There are multiple potential explanations for the long term stagnation in private non-mining investment.

- **Increasing risk premium associated with investment:** There was an increase in market risk premium (additional return that investors need to be compensated for when taking on risk) after the global financial crisis which could partly explain the slowdown in investment (Evans et al. 2024). The rising risk-premium could be a function of growing uncertainty in the face of changing global conditions, or rising risk-aversion among firm decision makers (Evans et al. 2024).
- **Shift towards services sector:** The shift toward the services sector, which on average relies less on physical capital, contributes to lower investment intensity (Adeney 2018; Wölfl 2005). However, this accounts for only a small part of the decline, with more significant reductions happening within individual

sectors (Hambur and Jenner 2019). It is also the case that some service industries are more capital intensive than goods industries (PC 2021), so a shift to services need not lead to a decline in investment.

- **Changes to the composition of capital:** Investment is increasingly centred on longer lived assets such as buildings and infrastructure (Hambur and Jenner 2019; PC 2023b, p. 19) which may reduce the need for future investment. Moreover, increased investment in intangibles such as data would not be measured in the national accounts and could account for the decline in measured investment (PC 2023b).
- **Weak economic growth** in Australia could also contribute to reduced investment as, in response to low demand, firms are reluctant to invest and grow capacity. Rather, firms decide to take up defensive strategies (such as focussing on cost-reduction and building up cash supplies), which reduce investment as firms prioritise other aspects of their business (Jones 2021; The Australian Government and Heads of Treasury 2017).
 - Expectations of weak future economic growth could also contribute to subdued expectations of future demand, further restraining investment (Jones 2021).
- The **growing market power of firms** affects investment decisions, as firms can increase revenue by marking-up prices rather than increasing output. Theoretically, firms with more market power may have less incentive to produce output and build capacity, therefore reducing capital accumulation (Farhi and Gourio 2019).
- **Low marginal factor of productivity growth** may reduce productivity gains from capital stock and therefore reduce investment incentives.

In addition to a low growth in investment, recent changes to the economy (such as increased workplace digitisation), may lead to lasting changes to the *nature* of investment – although the implications of this for labour productivity are unclear (box 2.2).

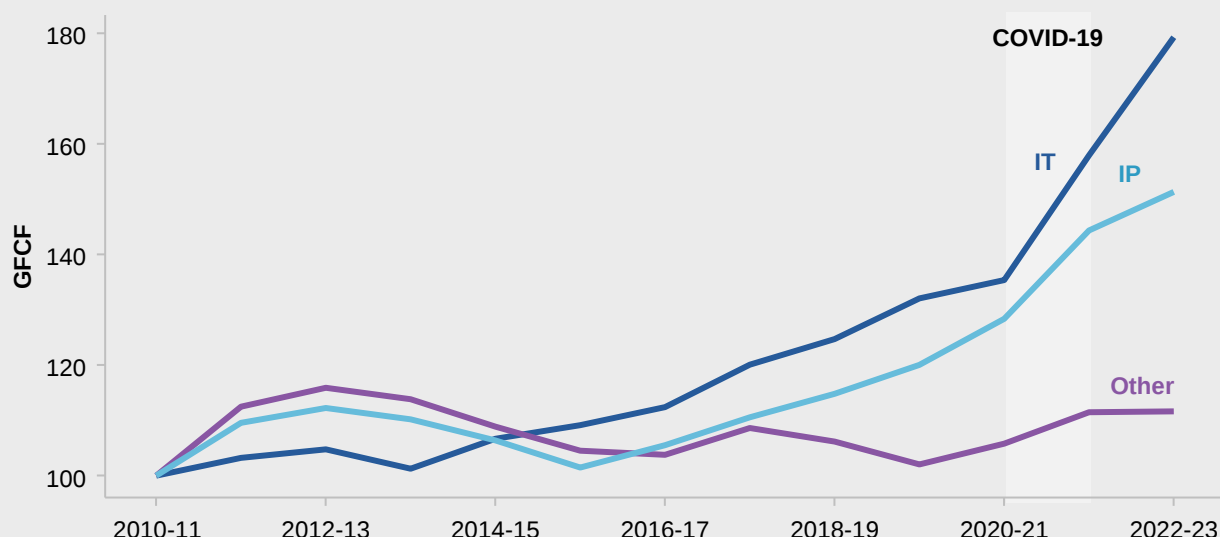
Box 2.2 – Changes to the type of investment during COVID-19

There are several types of capital. Capital can be physical objects like tools and machines or can be intangible (no physical form) like software, data, knowledge or brand-value. Information and communication technology (ICT) capital refers to assets that are used for the creation, storage and transfer of electronic information. ICT capital can be both tangible (computers, electrical and electronic equipment) or intangible (software and intellectual property products). In recent years, structural changes to the economy like digitalisation and the shift towards service sectors have made productivity growth increasingly dependent on intangible and ICT capital (Deutsche Bundesbank 2023; PC 2020, pp. 10–11).

During the coronavirus pandemic, intangible and ICT capital may have increased in importance as they helped firms adapt to COVID-related challenges (for example, working from home arrangements and automation in response to labour force shortages) (Jaumotte et al. 2023; PC 2023a, p. 72; Uddin, Hasan and Abadi 2022). This is evident in the fact that information technology (IT) investments and intellectual property (IP) investments¹ (incomplete measure of intangible investments) have seen higher growth relative to other forms of investments during the pandemic (figure below).

IP and IT^a investments showed greater resilience during the pandemic

Annual gross fixed capital formation (GFCF)^b (chain volume measure, index 2010-11=100)



a. IT capital includes computers and peripherals, electrical and electronic equipment and computer software.

b. GFCF includes investment in dwellings, ownership transfer costs, non-dwelling construction, machinery and equipment, weapons systems, cultivated biological resources and intellectual property products.

Source: PC estimates using ABS (2024f table 70) and ABS (2023b table 64).

If intangible and/or IT capital had greater productivity enhancing effects compared to traditional forms of capital, then a COVID-19 era shift towards these alternate forms of capital may have contributed towards the productivity bubble.

Are intangibles and IT investments better for productivity?

Capital investments can generate labour productivity growth through two ways: by contributing to growth in the capital-labour ratio or by increasing the efficiency of the production process (i.e. MFP growth). ICT capital and intangible capital usage may have greater productivity boosting effects compared to physical capital if these forms of capital have a greater effect on MFP growth.

One reason for a potential link between ICT/intangible capital and MFP growth is that these forms of capital may enable widespread innovation in products and processes (PC 2002). For example, the use of computer technology and better data storage in the finance sector led to the development of new financial products (such as online banking and lending platforms, mobile payment apps), less face-to-face interactions and consequently less dependence on physical offices and workers which has been linked to productivity growth.

Moreover, unlike traditional forms of capital, intangible capital may have greater spillover effects. If one firm invests in intangible capital for some of their workers (such as the skillset of their workers or new knowledge), the productivity benefits may spill over both to other workers within their firm and to other firms through knowledge transfers and labour movement, leading to more widespread productivity growth. International evidence supports the presence of productivity spillovers from ICT (including intangible ICT) capital (Corrado, Haskel and Jona-Lasinio 2017).

Box 2.2 – Changes to the type of investment during COVID-19

However, evidence on the relationship between ICT and intangible capital and MFP growth is mixed. Natakani (2024) uses data from 12 countries between 1996–2015 and finds that the relationship between intangible capital and MFP growth varies by country, industry and over time, with only six countries exhibiting a statistically significant positive relationship. Moreover, the contribution of ICT capital usage to MFP and labour productivity growth depends on the existence of complementary intangible capital like organisational culture, management practices, and workforce skills, without which ICT usage can lead to negative productivity effects (Brynjolfsson, Rock and Syverson 2017; Liao et al. 2016).

Even if ICT and intangible investments have historically promoted labour productivity, investments made during the pandemic are not fully comparable to historic investments. This is because a significant portion of COVID-19 era investments were likely made to enable temporary adaptations to the pandemic (like additional personal computers to enable remote work) and while this may have supported short-term productivity it was not necessarily targeted towards long term productivity growth. As such, while the investment mix has changed due to the pandemic, it is too early to assess the extent to which this change in investment has had, or will have, a meaningful impact on labour productivity.

¹ As per Corrado, Hulten and Sichel's (2005) methodology for measuring intangible investments, the Australian national accounts only provides a partial measure of intangible investments. While IP investments like investments in research and development, mineral and petroleum exploration, computer software and entertainment are included, other forms of intangible investment like investment in development of financial products, market research and branding, supply chains and employer-provided training are excluded (ABS 2021c; Barnes 2010). More comprehensive measures of intangible investment in other countries indicate that globally, intangible investments continued to grow during the pandemic while tangible investment stagnated (WIPO-LBS 2024, p. 2).

2.3 Conclusion and potential for future work

Labour productivity fluctuated during COVID-19 due to changes in the capital-to-labour ratio. These changes were not driven by investment trends but were instead caused by significant changes in the labour market during the pandemic. While investment recovered over 2022-23, it declined slightly between December quarter of 2023 and June quarter of 2024 (ABS 2024b), and growth in capital is still insufficient to match increases in hours worked – a function of long term investment weakness in Australia rather than a COVID-19-specific phenomenon. It remains uncertain whether there will be a full rebound in the capital stock to match the rise in hours worked and restore the pre-pandemic level of capital per worker. Further work is needed to explore the effects of this weak investment on capital deepening over the longer term, as well as to understand the drivers behind these investment trends.

3. The quality of the labour force

Key points

- * Labour productivity tends to improve as workers gain more skills, knowledge and experience that enables them to become more efficient at their job.
- * At the onset of the pandemic, as lockdowns were enacted and firms cut back on production, younger, less experienced workers (who are on average less productive) were more likely to lose their jobs.
 - This led to a rise in the aggregate quality of the labour force and contributed an estimated 37% of the measured rise in labour productivity.
- * As the pandemic subsided and pent-up demand led to a high demand for workers, younger, less experienced workers were more likely to join the workforce.
 - This led to a decline in the quality of labour force, contributing to an estimated 14% of the measured decline in labour productivity.
- * Over time, as younger workers gain experience and skills from learning on the job, the decline in workforce quality is likely to reverse and lead to improvements in labour productivity.

3.1 Why does labour quality matter to productivity?

Labour productivity growth can occur through changes in the quality of labour – workers gaining more skills, knowledge and experience, enabling them to become more efficient at their jobs. For example, a construction worker with experience and training will be able to produce more output within an hour of work compared to a person with no experience or technical training in construction. At an economy-wide level, inflows of workers who have fewer skills, less experience and greater spells of unemployment may put downward pressure on productivity in the short term as these workers tend to take time to learn on the job to match the productivity of their incumbent colleagues.

The COVID-19 pandemic – and the subsequent economic rebound – had implications for the quality of Australia's labour force, which may have shaped the productivity bubble. Initially, lockdowns impacted industries differently and the economic downturn led to increases in job separations. When the economy rebounded, hours worked reached record highs, bringing more people into the workforce who were previously only marginally attached. The PC has hypothesised these macroeconomic changes altered the skills and knowledge of the workforce and therefore influenced the observed patterns in productivity – the initial lockdowns boosted labour quality and

contributed to the rise in productivity; while aggregate labour quality declined during the economic rebound, acting as a drag on labour productivity. These hypotheses are tested below.

Box 3.3 – How labour quality is currently accounted for in productivity statistics

While there are differences across the workforce in labour quality and skills, the ABS headline labour productivity measurements treat all hours worked as equal inputs. These differences in the quality of the labour force are not identified in *standard* multifactor and labour productivity measurements – changes to labour quality over time are captured by the changes in multifactor productivity, which is a residual after taking into account the direct output effects of changes in capital and labour inputs. However, the ABS estimate a quality adjusted labour input measure, which uses the education and age of workers as a proxy for worker quality. Unfortunately, data limitations restrict its application in analysing short term productivity trends (this is discussed further in the final section of this chapter).

Analysing and accounting for changes in the quality of the labour force can provide insights into the long term drivers of labour productivity. ABS estimates suggest that approximately one third of labour productivity growth and 40% of multifactor productivity growth in the market sector from 1994-95 to 2022-23 were driven by improvements in the workforce's human capital (ABS 2023d).⁷

3.2 The quality of the labour force through the pandemic

The skills, knowledge and experience of the labour force can serve as indicators for the quality of the labour force.

Skills and knowledge tend to be acquired through formal education and training, or on-the-job experience. Formal education and training are relatively straightforward to measure, with an increasing proportion of workers holding higher education qualifications assumed to represent an increasing quality of the workforce. Skills from on-the-job experience are harder to measure – job tenure and age are used as estimates of on-the-job experience, with older and more experienced workers assumed to be of higher quality.

These indicators – qualifications, job tenure, and age – provide a basis to consider how the quality of the workforce changed throughout the pandemic and are explored throughout this section. These indicators should be interpreted with caution, however, as an individual's estimated labour quality may not be accurately reflected through the proxies, and the usefulness of certain skills and knowledge is dependent on an appropriate job match. For example, a university degree in medicine may not raise productivity for an individual that is working in hospitality.

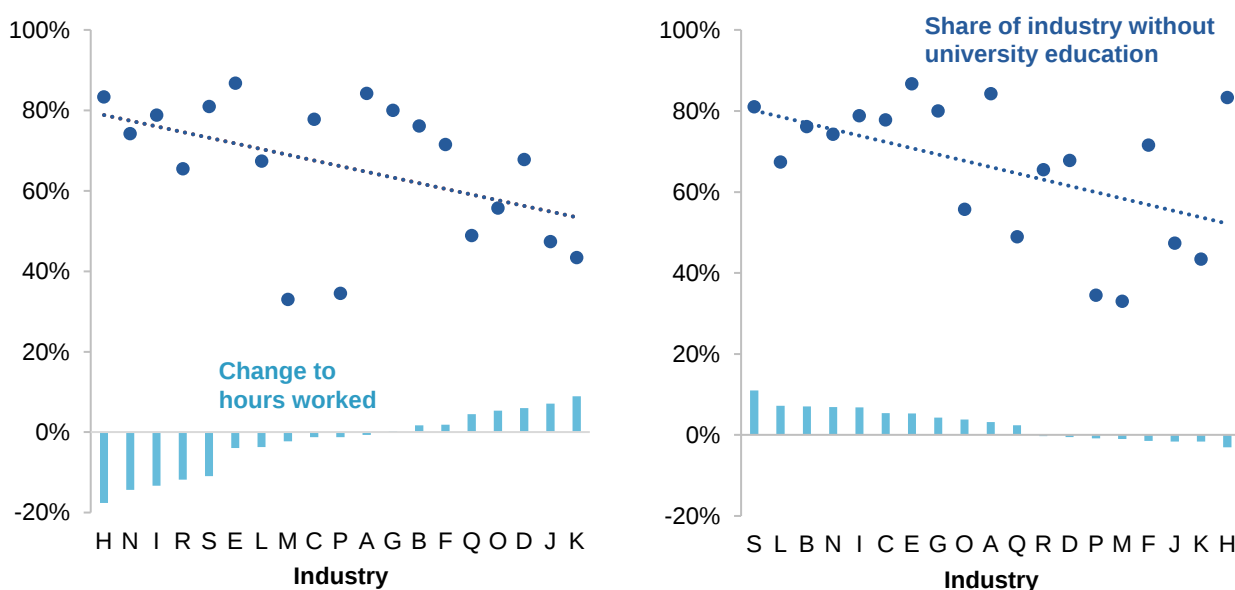
⁷ Looking over the long term, using ABS quality adjusted labour inputs suggests that approximately one third of labour productivity growth and 40% of multifactor productivity growth in the market sector from 1994-95 to 2022-23 was driven by improvements in the workforce's human capital (ABS 2023d).

Economic restrictions disproportionately affected industries where workers had lower educational attainment

Lockdowns and economic disruptions at the beginning of the pandemic disproportionately affected industries that had, on average, a lower proportion of workers with a university degree (figure 3.1). As the number of jobs and hours worked fell in these industries, a greater proportion of the overall remaining workforce had university qualifications, and this improved the average ‘quality’ of human capital of the workforce – likely contributing to the strong measured productivity performance at the start of the pandemic.

This trend reversed once the lockdowns ended and industries with a higher proportion of non-tertiary educated workers (such as accommodation and food services) opened back up and non-tertiary educated workers returned to their jobs. This is likely to have reduced the average human capital in the labour force, which could in part explain the downturn observed in productivity after March 2022.

Figure 3.1 – The largest change to hours worked immediately after the pandemic was observed in industries with a higher proportion of workers without university education
Change to industry hours actually worked and proportion of industry without university education^{a,b}, Dec 2019 – Dec 2020 (LHS) and Dec 2020 – Mar 2022^c (RHS)



a. The industries are ranked in ascending (LHS) and descending order (RHS) order by percentage change in hours worked from December 2019 to June 2020 (LHS) and June 2020 to December 2021 (RHS). Industries are represented by their Australian and New Zealand Standard Industrial Classification (ANZSIC) letter code. A=Agriculture, forestry and fishing, B= Mining, C= Manufacturing, D=Electricity, gas, water and waste services, E=Construction, F= Wholesale trade, G=Retail trade, H=Accommodation and food services, I=Transport, postal and warehousing, J=Information, media and telecommunications, K=Financial and insurance services, L= Rental, hiring and real estate services, M=Professional, scientific and technical services, N=Administrative and support services, O=Public administration and safety, P=Education and training, Q=Health care and social assistance, R=Arts and recreation services, S=Other services. **b.** Industry education levels are sourced from the 2021 Census. **c.** Time period chosen align with ‘reallocation phase’ and ‘productivity gain’ of the productivity bubble, as lockdowns were most severe and then unwound.

Sources: PC estimates using ABS (2024d table 1) and ABS (2021e).

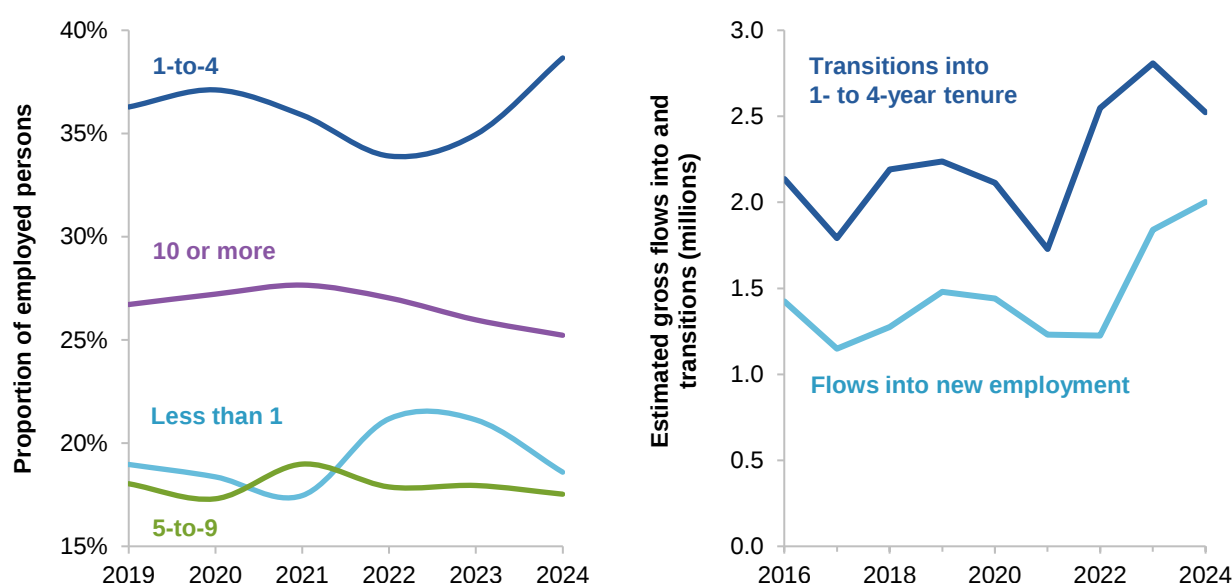
Job tenure rose at the onset of the pandemic, and has declined as people found new jobs after lockdowns

Disruptions caused by the COVID-19 pandemic led to an increase in job retrenchments (ABS 2024i), affecting job tenure (figure 3.2). Job tenure can be used to estimate the quality of the workforce: as workers become more accustomed to the processes of the workplace, they, on average, can become more productive at their job (Buchinsky et al. 2010).⁸ The large number of outflows from employment during the lockdowns led to a decrease in the proportion of remaining workers with less than four years of job tenure,⁹ as workers with less tenure at a workplace were more likely to be laid off. This suggests that employers had a preference to keep workers with higher experience, which is likely to have contributed to rising productivity over the start of the pandemic.

As the economy rebounded, people found new jobs leading to an increase in the share of employees with less than one year tenure at their main job. As the workforce had, on average, less job-specific experience at the beginning of the economic upturn, this is likely to have acted as a drag on productivity. Many of these new job matches have transitioned into the 1-to-4-year tenure category in the past two years (figure 3.2).

Figure 3.2 – The average experience of the workforce rose as the economy shutdown, then declined as the economy recovered and people started new jobs

Proportion of the workforce by tenure of main job (years)^{a,b}, 2019 – 2024 (LHS); gross flow into employment and transitions into 1-to-4 year tenure^c, 2019 – 2024 (RHS)



a. Data is collected in February of each year. **b.** Each series is using a smoothed line between annual estimates. **c.** Estimates assume individuals that change main job are classified under 'left or lost job last year', this assumption is used to deduce transitions between tenure groups.

Source: PC estimates using ABS (2024i tables 1 and 2).

⁸ Increases in job tenure have been associated with increases to wages (Buchinsky et al. 2010).

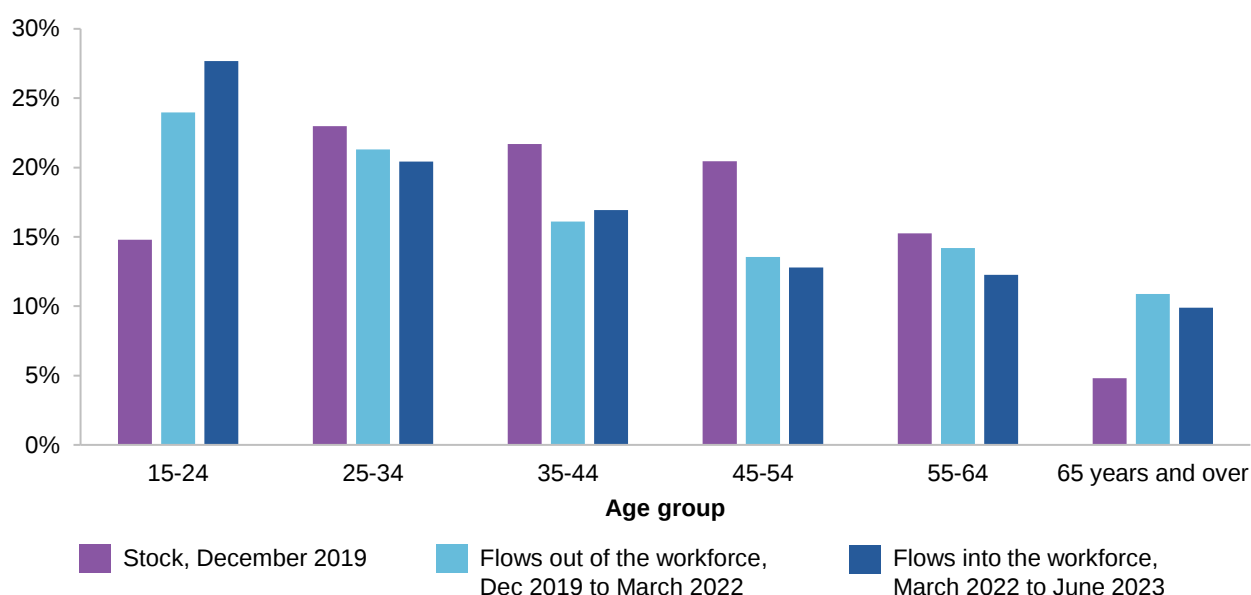
⁹ Noting that the fall in job mobility at the beginning of the pandemic (Black and Chow 2022) signals that this was not driven by people changing jobs at an increasing rate.

The workforce became more experienced during the COVID-19 pandemic as younger workers were more likely to lose their job

Outflows of employment at the beginning of the pandemic disproportionately affected individuals under 25 and over 65 years old. For example, 15- to 24-year-olds made up 15% of the workforce in December 2019 but 24% of flows out of employment from December 2019 to March 2022 (figure 3.3). To the extent that age is a reasonable proxy for work experience, this trend could explain part of the rise in productivity at the beginning of the pandemic – the layoffs resulted in the workforce becoming, on average, more experienced and therefore more productive.

Figure 3.3 – Flows in and out of employment disproportionately affected the youngest and oldest workers

Share of employed persons, January 2020; Flows out of employment^a, Dec 2020 – March 2022; Flows into employment^b, March 2022 – June 2023^c



a. Flows out of employment include individuals employed in the previous month to the reference period that become unemployed or exit the labour force. Calculations use current month's weights. **b.** Flows into employment include individuals that were unemployed or out of the labour force in the month previous to the reference period and then become employed. Calculations use current month's weights. **c.** Time period chosen reflects the flows out of employment through the initial productivity uplift, and flows into employment as productivity fell and the labour market surged.

Source: PC estimates using ABS (2024I GM 1).

Flows into employment during the economic upswing saw the youngest and oldest workers return back into employment in relatively larger numbers, offsetting some of the changes that occurred at the beginning of the pandemic. For example, individuals aged 15 to 24 years old accounted for 28% of flows into to employment from March 2022 to June 2023 (figure 3.3). A similar pattern was evident for individuals aged 65 and over. The return of younger workers to the workforce as aggregate demand rebounded meant that the workforce, in aggregate, was less experienced and could also, at least in-part, explain the decline in productivity observed since the March 2022 quarter.

3.3 Conclusion and potential for future work

This analysis can be tied together through quality adjusted labour inputs (QALI). QALI combine worker's education levels, age and other factors to form a proxy for labour quality. The ABS publishes their estimate of the quality of the labour force in the market sector by estimating productivity differences between people of different ages and education levels.

However, there are limitations to the ABS measure – in particular, it relies on Census data to be updated, and so misses changes to the workforce that occur between the five-yearly Census dates. Therefore, the ABS labour force measure fails to pick up many of the workforce changes highlighted above. A more timely estimator developed by the RBA is used in this paper. The RBA QALI measure uses similar inputs as the ABS measure, but allows for more frequent updates to the data inputs (Bruno, Hambur and Wang 2024).

The RBA QALI estimates suggest that, as labour productivity was rising between June 2019 and June 2022, the quality of the workforce (as proxied by the education attainment and experience (age) of the workforce) was rising too. After taking into account the rising quality of the workforce, about 37% of the rise in productivity is attributable to improvements in the quality of the labour force.¹⁰

Further, the RBA QALI measure suggest that the quality of the workforce declines over the 2022-23 financial year – consistent with the fall in experience, tenure and potentially education profile of the workforce highlighted above.¹¹ This fall in the quality of the workforce contributed to an estimated 14% of the decline in labour productivity over 2022-23.

Estimates suggest that changes to the quality of the labour force (as younger, less experienced, and less skilled workers were first removed from the workforce then reintegrated) were an important factor in explaining part of the increase of the productivity bubble and were a small contributor to the decrease. It does not fully explain the bubble, meaning there are still other factors at play which contributed to the recent rise, then decline, in labour productivity.

Further research could evaluate the accuracy of the estimators for marginal productivity through evaluating the effect of job tenure, education and age, respectively, on wage-productivity differences amongst certain cohorts of workers in Australia. This work would provide insight into the accuracy of QALI and the applicability of different wage theories, including wage/tenure contracts.

¹⁰ For reference, the ABS QALI measure suggests that 18% of the rise in productivity is attributable to improvements in the quality of the labour force. This is likely to be understated, as the ABS measure fails to capture the rapid changes to the workforce that were occurring during the COVID-19 pandemic.

¹¹ This differs from the ABS measure, which suggests workforce quality continued to improve.

4. Growth in the care economy

Key points

- ✱ **Measured labour productivity in the care economy has been persistently low, partly because of limited opportunities to augment productivity with capital, and partly due to measurement challenges.**
 - That is not to say that there are not opportunities to use new technology and capital to improve labour productivity in the care economy; only that they are more limited.
- ✱ **A decline in labour productivity in the care economy, combined with a significant growth in hours worked, has contributed 1.1 percentage points (out of 6.1%) in the fall in Australia's labour productivity between March 2022 and June 2023 – 18% of the total productivity drop over the period.**
 - Hours worked in the care economy have increased significantly since mid-2022.
 - A significant proportion of the growth is likely to be due to the introduction of government policies such as expansions in the National Disability Insurance Scheme, increases in minimum delivery standards as a result of recommendations made by The *Royal Commission into Aged Care Quality and Safety* final report, and the Early Childhood Education Workforce package and changes to early childhood education and care subsidies.

4.1 Why does the care economy matter for productivity?

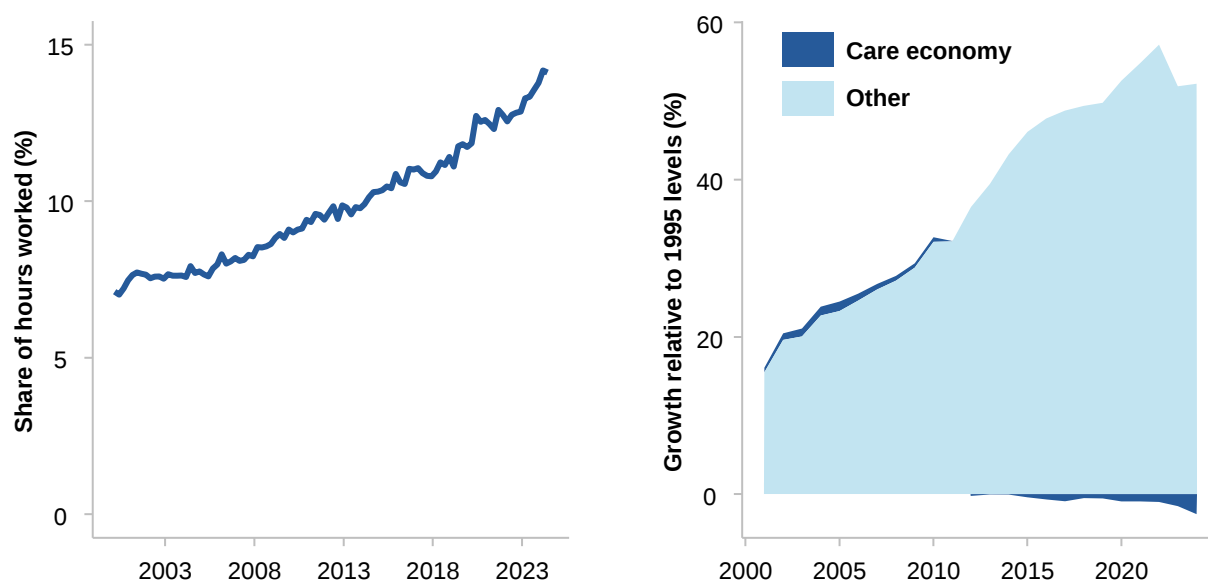
The care economy provides critical support for the wellbeing of care-dependent Australians including older people, those who are unwell, people with a disability, and children. While there are different definitions for the 'care economy', in this report the term refers to the 'healthcare and social assistance sector' ANZSIC classification and includes four sub-industries – hospitals, social assistance services, medical and other health care services, and residential care services (ABS 2013). Social assistance services include childcare, disability assistance services, aged care services, youth welfare services and others (ABS 2013).

The care economy employs a significant share of labour in the economy. Therefore, productivity trends in the care sector have a significant effect on economy-wide productivity. While the care economy's share of labour hours used has increased over time (figure 4.1, panel a), its labour productivity growth has been persistently low, reducing overall measured productivity (figure 4.1, panel b). It is important to note that the drag on productivity caused by the care economy could be overstated, as the *quality* of care could be improving but this is not picked up in the productivity statistics (box 4.1). Further, the care economy indirectly promotes labour productivity by supporting the health and wellbeing of the workforce, but these indirect effects are not attributed to the care sector in productivity statistics.

Overall, the care economy has reduced total measured productivity growth since 1995 by approximately 2.6%¹². As the demand for care services is projected to grow in the future due to Australia's aging population and increasing labour force participation of women (who have traditionally taken on the bulk of unpaid care) (Commonwealth of Australia 2023, p. 15), the implications of low measured productivity growth in the care economy will become more significant.

Figure 4.1 – As the care economy grows, it drags down measured labour productivity

a) Hours worked in the care economy as a share of total hours worked **b) Contribution of care economy^a to economic growth in all industries**



a. Contribution of care economy includes both the contribution of productivity growth within the care economy and the effect of labour reallocation between care economy and other sectors.

Sources: PC estimates using ABS (2024k industry summary table) and ABS (2024d table 6).

Box 4.1 – Explanations for low productivity in the care economy

High dependence on labour

While work in manufacturing and agriculture can be made more productive through automation and better use of technology, this is harder to achieve in some areas of the care economy (such as childcare) where human-to-human interactions are an important part of service delivery. There is still scope for improvements through technological advancements, administrative savings and better equipment, but these opportunities may be more limited or more difficult to secure in comparison with many other industries.

¹² The effect of the care economy on productivity growth includes both the direct effect of low productivity growth within the care sector and the effect of labour reallocation between the care economy and other sectors. The decomposition of the productivity effect into a direct effect and labour reallocation effect follows a similar methodology to method outlined in section 1.

Box 4.1 – Explanations for low productivity in the care economy

Mismeasurement of output

Output in the care sector is difficult to measure because the care sector relies heavily on non-market production (production that is fully or heavily subsidised by the government). In market sectors, output measures are calculated using market prices which indicate the value of the good or service being produced. Price information also allows the value of different goods and services to be compiled. In non-market sectors, since most goods and services are at least partly subsidised by the government, prices do not reflect the value of production.

Instead, data on production costs are used as a proxy for prices (or in cases where quantity data does not exist, the value of inputs is assumed to equal to the value of outputs), but this method tends to understate improvements to quality of outputs over time. This is particularly distortive for the healthcare sector, which has seen significant quality improvements through technological innovation. When adjustments are made for quality changes, multifactor productivity¹³ for a subset of health conditions (that accounted for about one third of healthcare spending) is estimated to have grown by an annual rate of 3% between 2011-12 and 2017-18 (PC 2024a, p. 2). These adjusted estimates are not reflected in aggregate productivity estimates.

4.2 Changes to the care sector through the pandemic

Services delivered by the care sector initially declined, but rebounded quickly

Like most sectors in the economy, the care economy saw a decline in output (gross value added) during the June quarter of 2020 (figure 4.2). This was partly due to the coronavirus pandemic (COVID-19) and related public health restrictions (e.g. lockdowns and requirements for social distancing) on the health and social care service provision. Specifically:

- many elective surgeries and visits to healthcare professionals were delayed or cancelled to prevent the spread of the virus (ABS 2022h); some types of cancer screening were also suspended (AIHW 2024).
- childcare attendance decreased due to health concerns and an increase in working from home (Baxter 2021).
- some aged-care facilities became hotspots for COVID-19 outbreaks and were affected by significant labour shortages and infection control measures (Battams and Martini 2024; Thomas et al. 2024).

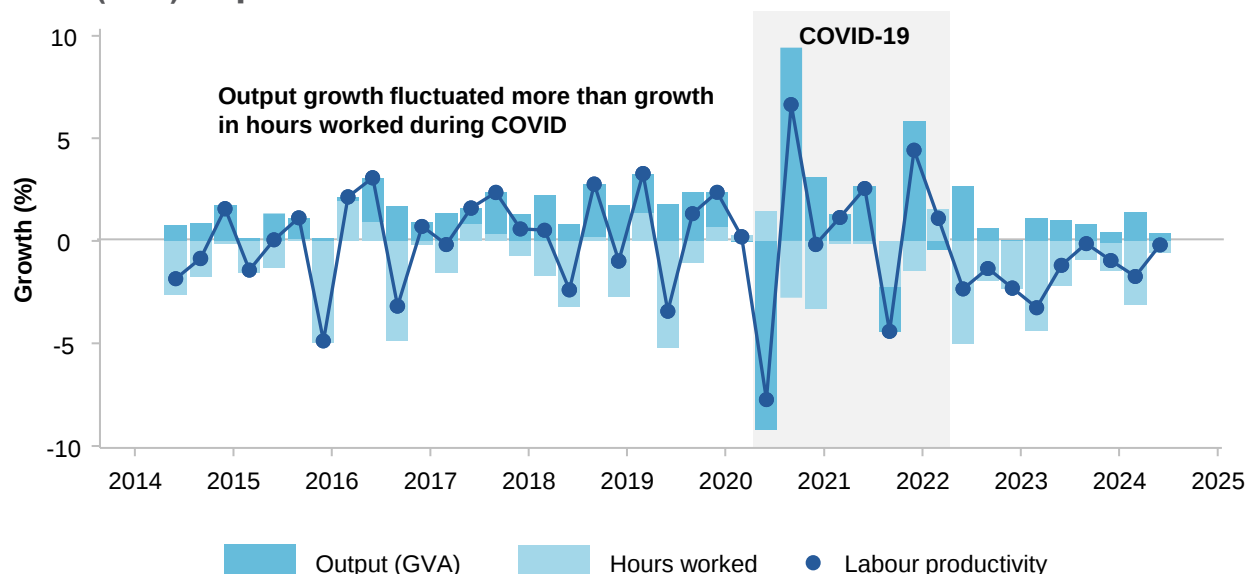
The immediate disruption to output in the care economy was short-lived – service delivery rebounded with output growing by 9.4% in the September quarter of 2020 but fluctuated through the remainder of the pandemic. Output growth generally remained positive except in the September quarter of 2021 and the March quarter of 2022 which saw small declines in output. The fluctuations in output could reflect a range of possible factors, including the expansion of the National Disability Insurance Scheme (NDIS) (which is likely to have contributed to a rise in service provision), later waves of COVID-19 that were more severe,

¹³ While labour productivity looks at the efficiency of labour in producing output, multifactor productivity looks at the efficiency of labour, capital and intermediate inputs in producing outputs.

improvements in healthcare provision (e.g. telehealth which could have helped bolster service provision during lockdowns), and the roll out and roll back of public health restrictions.

Figure 4.2 – Labour productivity growth in the care economy during COVID-19 was driven by fluctuations in service delivery levels^{a,b}

Quarterly growth in labour productivity broken down by contribution of gross value added (GVA) output and hours worked



a. Changes in natural logarithm values are used as an approximation for percentage changes. **b.** Labour productivity growth is expressed as growth in gross value added (GVA) output minus growth in hours worked. While the contribution of GVA to labour productivity growth represents positive growth in GVA, the contribution of hours worked to labour productivity growth represents negative growth in hours worked.

Sources: PC estimates using ABS (2024d table 6) and ABS (2024k industry summary table).

Growth in hours worked in the care economy is driving record employment growth nationally

Due to the essential nature of many care services and requirements for in-person service delivery, many workers in the care economy were exempt from lockdown restrictions. As such, hours worked in the care economy typically rose throughout the COVID-19 period, in contrast to the decline and recovery in hours worked in other industries throughout the pandemic (figure 4.3).

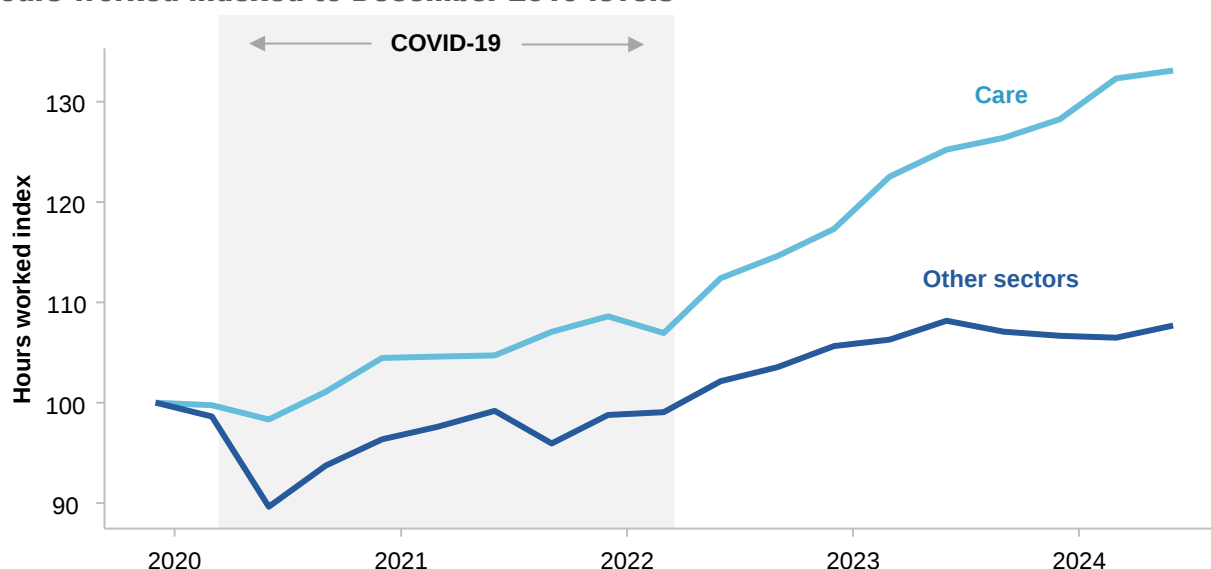
From the middle of 2022, hours worked in the care economy have increased significantly. In 2022-23, employment growth was driven by the childcare services and 'other social assistance services' which includes disability assistance services, aged care services, youth welfare services and others (PC 2024c, p. 4)¹⁴ and, in 2023-2024, the sector's employment growth was roughly equal between the four sub-industries (hospitals; social assistance services; medical and other health care services; and residential care services). The increase reflects a combination of continued growth in demand, as well as the implementation of new policies. For example, the NDIS was rolled out between 2016 and 2020 and became

¹⁴ It is difficult to disaggregate the increase in hours worked in the social assistance services sub-industry into more granular sectors (e.g. childcare, disability services and other sectors). The best available data suggests that about one third of the increase in employed persons in the social assistance services industry between May 2022 and May 2023 was from the childcare services sector (PC 2024, p. 4).

available to all eligible Australians by 2020, leading to an increase in NDIS uptake and service provision (NDIA 2023). Increases in minimum delivery standards for residential care employment stemming from the *Royal Commission into Aged Care Quality and Safety* final report (2021) likely led to employment in that sector, and the introduction of the Early Childhood Education Workforce package in 2023 provided \$72.4 million towards grants and supports for the retention and training of childcare educators which could have played a role in promoting employment in the sector (Commonwealth of Australia 2024), while increases to childcare subsidies could also have boosted demand for childcare services.

Figure 4.3 – Labour hours rose in the care economy during COVID-19

Hours worked indexed to December 2019 levels



Source: PC estimates using ABS (2024k industry summary table).

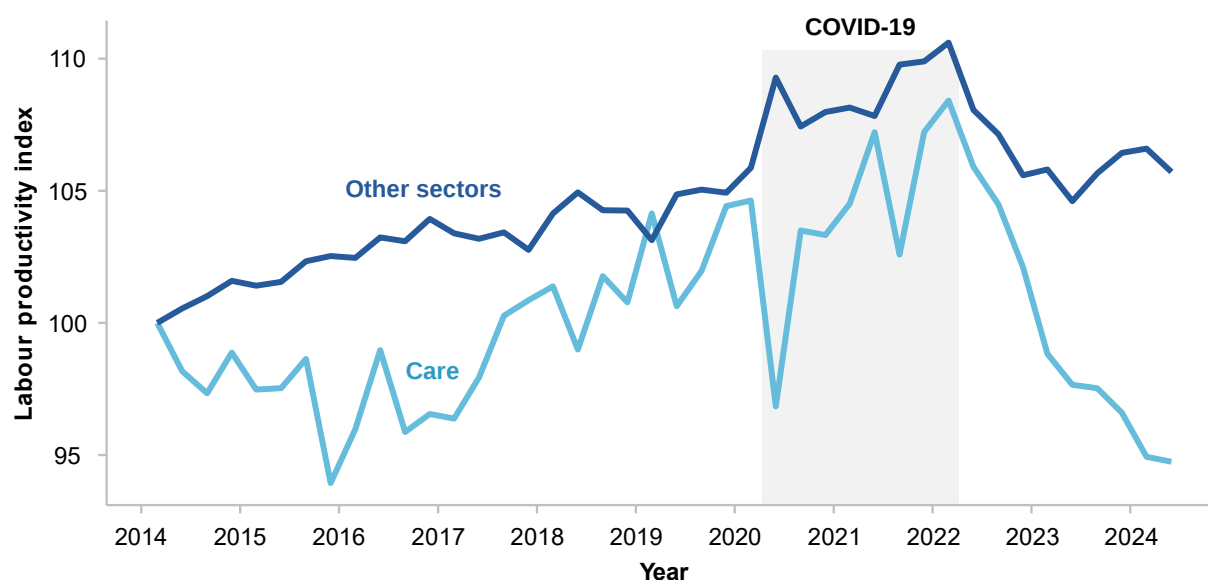
The labour productivity gap between the care economy and other sectors has widened after the pandemic

A consequence of this rapid increase in hours worked in the care economy, without a commensurate increase in output, has been a significant decline in measured labour productivity in the care economy¹⁵ (figure 4.4). As a result, productivity trends in the care economy and other sectors have diverged. This divergence was apparent in the first few months of the pandemic, when the stability of labour in the care sector meant that it experienced a decline in productivity, while other sectors experienced an initial rise in productivity.

¹⁵ The large decline in labour productivity in the care economy could be a result of mismeasurement (box 4.1). As this paper is focussed on the contribution of the care sector to productivity trends as measured in official statistics (i.e. the productivity bubble), it takes labour productivity in the care economy as given. However, if the tail end of the productivity bubble reflects mismeasurement of quality improvements in care provision rather than a true decline in productivity, this could mean the post-pandemic decline in measured productivity is exaggerated.

Figure 4.4 – Measured labour productivity in the care economy declined by a greater extent post pandemic^a

Labour productivity ^a index (March 2014=100)



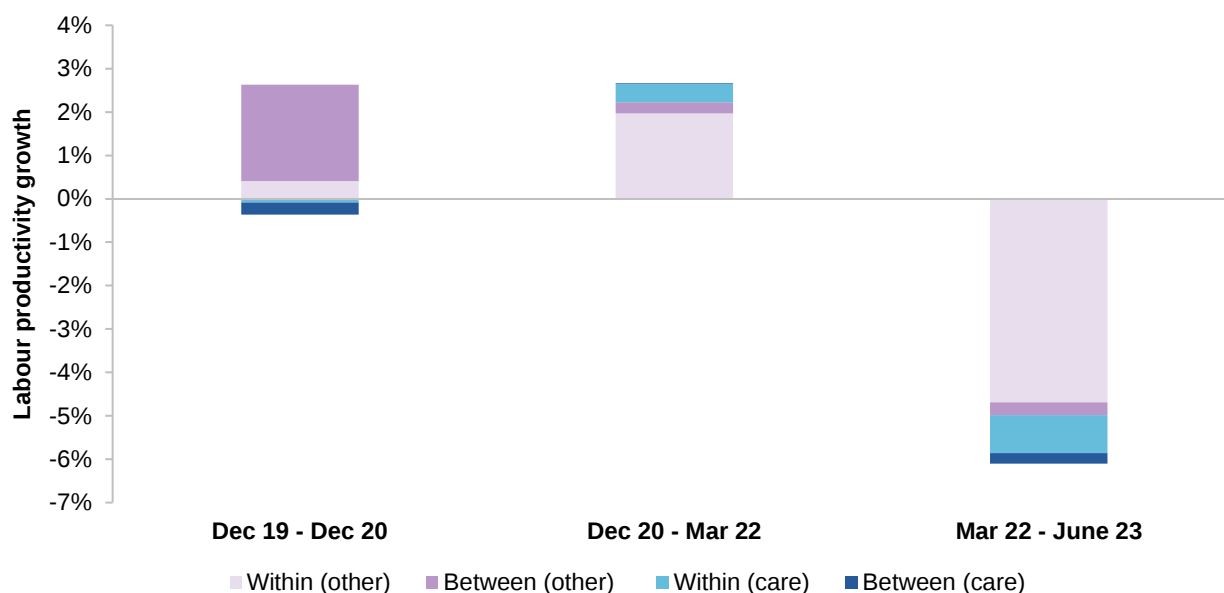
a. Labour productivity estimates are calculated using seasonally adjusted chain volume measures of GVA.

Sources: PC estimates using ABS (2024d tables 1 and 6) and ABS (2024k industry summary table).

Given these trends in labour productivity in the care economy, it follows that the contribution of the care economy to the rise in productivity during the beginning of the productivity bubble was minimal; but it has played a greater role in the subsequent fall in measured productivity after 2022. During the first twelve months of the pandemic (December 2019 – December 2020), the care sector dragged down the high productivity growth observed in rest of the economy, largely as workers moved from higher productivity industries to the less productive care sector (defined as the ‘between’ effect in section 1) (figure 4.5). While care sector productivity improved in the following 15 months, it experienced a strong decline from March 2022. Overall, measured labour productivity in Australia fell by 6.1% between March 2022 and June 2023 and roughly 1.1 percentage points of this decline was due to declining productivity within the care sector.

Figure 4.5 – The contribution of the care economy to the productivity bubble increased over the pandemic^a

Contribution of care economy and other sectors to labour productivity growth



a. The 'within' effect refers to the effect of labour productivity growth in a specific sector on aggregate labour productivity growth. The 'between' effect refers to the effect of labour reallocation between different sectors on aggregate labour productivity growth.

Sources: PC analysis of ABS (2024d table 6) and ABS (2024k industry summary table).

4.3 Conclusion and potential for future work

While the contribution of the care economy to the initial jump in measured productivity during the onset of COVID-19 was minimal, it played a more substantive role in the subsequent fall in measured productivity after 2022. The widening gap in productivity between the care economy and other sectors is largely due to an increase in labour hours in the care sector, which has not been matched by an equivalent increase in measured output. As part of the ongoing inquiry into delivering quality care more efficiently, the PC will identify potential policies to improve care sector productivity and overcome these recent trends.

5. Creative destruction, and firm entry and exit

Key points

- ✳ **Creative destruction is the process by which low productivity firms exit the market, paving the way for new, or higher productivity firms to take their market share. This process generates both a ‘reallocation’ and ‘scarring’ effect for labour productivity.**
 - The reallocation effect suggests that firm entry and exit can improve productivity as lower productivity firms are more likely to exit the market, reallocating labour and capital towards higher productivity firms.
 - The scarring effect suggests that firm entry and exit weakens productivity as productive but financially constrained businesses exit, fewer high quality job matches are created and job-specific and organisational capital is lost.
- ✳ **During the pandemic, it is unlikely there were significant implications of firm entry and exit for the labour productivity bubble, as:**
 - there was only a weak correlation between businesses turnover and productivity growth
 - changes to firm entry and exit rates throughout and after the pandemic were small.
- ✳ **Australia’s policy interventions during the pandemic, such as JobKeeper, prioritised supporting workers and businesses.**
 - These policies are likely to have prevented significant labour productivity declines associated with the scarring effects of firm turnover (by minimising firm exits and any associated falls in labour productivity).
 - However, they may have also inhibited the benefits associated with the reallocation effect (minimising any potential increase in labour productivity) by supporting relatively unproductive firms that would have otherwise exited the market.
 - That said, the policy interventions have underpinned record growth in Australia’s labour market.

5.1 Why does firm entry and exit matter to productivity?

Creative destruction is the process by which low productivity firms exit the market, paving the way for new, or higher productivity firms, to take their market share. This process generates both a ‘reallocation’ and ‘scarring’ effect for labour productivity.

The **reallocation effect** suggests that firm entry and exit can improve productivity as lower productivity firms are more likely to exit the market, reallocating labour and capital towards higher productivity firms. This was true in Australia, at the beginning of the COVID-19 pandemic – the exit probability for low productivity firms

was around five percentage points higher than for high productivity firms (Andrews, Bahar and Hambur 2023).¹⁶ In addition, new entrants increase the amount of competition that incumbents face, incentivising innovation, and consequently productivity growth. In Australia, there is evidence that firms in industries with higher firm entry and exit converge more quickly to the global productivity frontier (Andrews et al. 2022, p. 10).

Increases in firm entry and exit rates can also have detrimental effects on productivity – known as the **scarring effect**. This occurs if productive but financially constrained businesses face bankruptcy and insolvency, if fewer high quality job matches are created (Barlevy 2002, 2003) and through the loss of job-specific and organisational capital.

Firm entry and exit rates were affected by COVID-19, first as the lockdowns reduced aggregate demand and restricted business activity, and then as policies were introduced to support businesses that may have been facing short term financial challenges due to the pandemic. These changes likely had both a reallocation and scarring effect on long term productivity; however, there are no clear signals that either effect significantly contributed to the productivity bubble.

5.2 Firm entry and exit through the pandemic

The government responded to COVID-19 with policies to support businesses and workers

The government responded to the economic effects of the COVID-19 pandemic – and subsequent lockdowns – by supporting firm survival through the JobKeeper program, changes to bankruptcy laws and other assistance programs, including Boosting Cash Flow for Employers, industry-specific assistance and encouraging delayed loan repayments. All of these are likely to have implications for firm entry and exit rates.

The government initiated changes to provide temporary relief for financially distressed businesses in March 2020, most notably by increasing the bankruptcy threshold from \$5000 to \$20 000.¹⁷ The bankruptcy threshold then decreased to \$10 000 at the beginning of 2021 (Australian Financial Security Authority 2020, p. 60, 2021, p. 52).

JobKeeper – a wage subsidy scheme – was also provided by the government to help employers continue to pay their workers despite the economic slowdown.¹⁸ The scheme was rolled out in three phases: the first one from March to September 2020 and then two extension phases that covered the period from September 2020 until the end of March 2021 (ATO 2023). The first phase of the JobKeeper scheme was relatively more likely to be taken up by productive (but financially constrained) firms, while the latter two phases were relatively more likely to subsidise lower productivity firms (Andrews, Bahar and Hambur 2023). This is because firms with higher productivity were less likely to face a prolonged drop in revenue over time, and therefore less likely to be eligible to receive funding under the JobKeeper scheme.

Australia's situation contrasts with the US, which observed a spike and fall in exit rates during 2020, a marked increase in firm entry over 2020 and 2021 (Decker and Haltiwanger 2022), and strong labour

¹⁶ This analysis looked at whether a firm that existed in March 2020 had exited in May 2021.

¹⁷ This included changes to the bankruptcy threshold debt level at which creditors could issue statutory demand on a company and initiate bankruptcy proceedings and providing companies flexibility for unforeseen events that arose as a result of COVID-19.

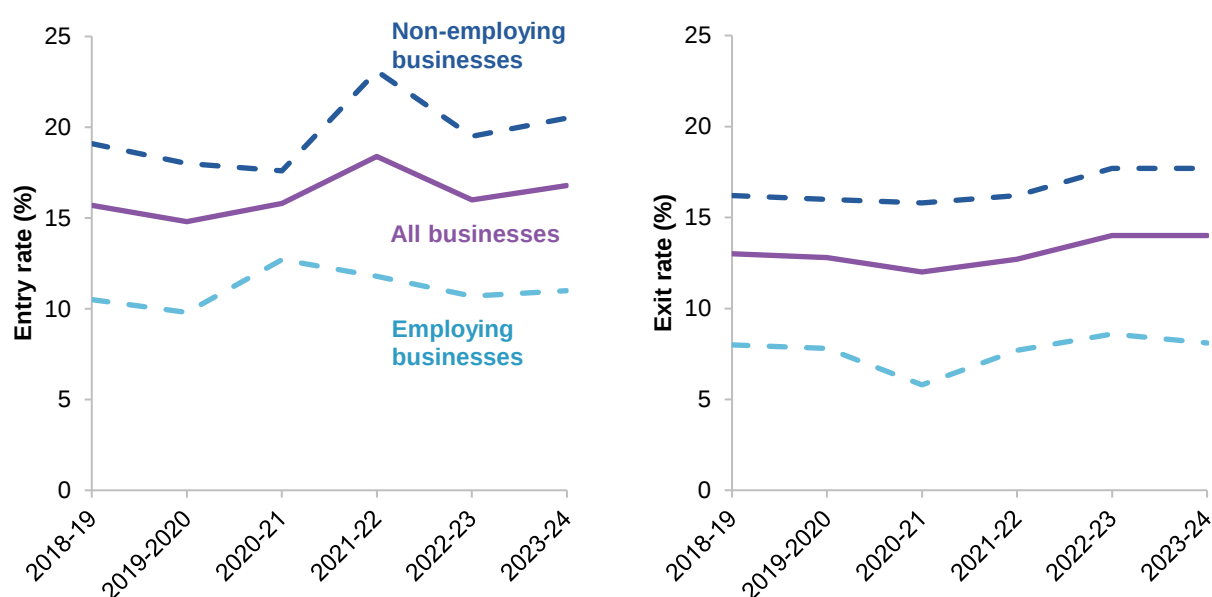
¹⁸ Firms received JobKeeper if their annual turnover or expected turnover decreased below a certain threshold.

productivity growth since the beginning of 2023. Emerging analysis finds that it is likely at least part of this strong growth in US labour productivity was due to ‘creative destruction’ (Dao and Platzer 2024) – a phenomenon largely avoided in Australia due to Australia’s policy focus of supporting existing businesses and workers’ attachment to their employer (PC 2024b).

Government policy responses affected firm entry and exit rates

The firm entry rate rose from the beginning of COVID-19 (likely driven, in part, by an increase in entrepreneurial online sales based businesses¹⁹) and then declined; while firm exit rates dipped slightly in 2020-21 and then increased in the following years (figure 5.1). While these trends are consistent with what would be expected with the changes in government policy (as these changes were intended to support firms at risk of exiting the market; which in turn creates less opportunities for new firms to enter) the magnitude of the increases to entry and exit rates were relatively modest.

Figure 5.1 – Firm entry and exit rates increased at the onset of the pandemic
Firm entry rate (LHS); firm exit rate (RHS), 2018-19 to 2023-24



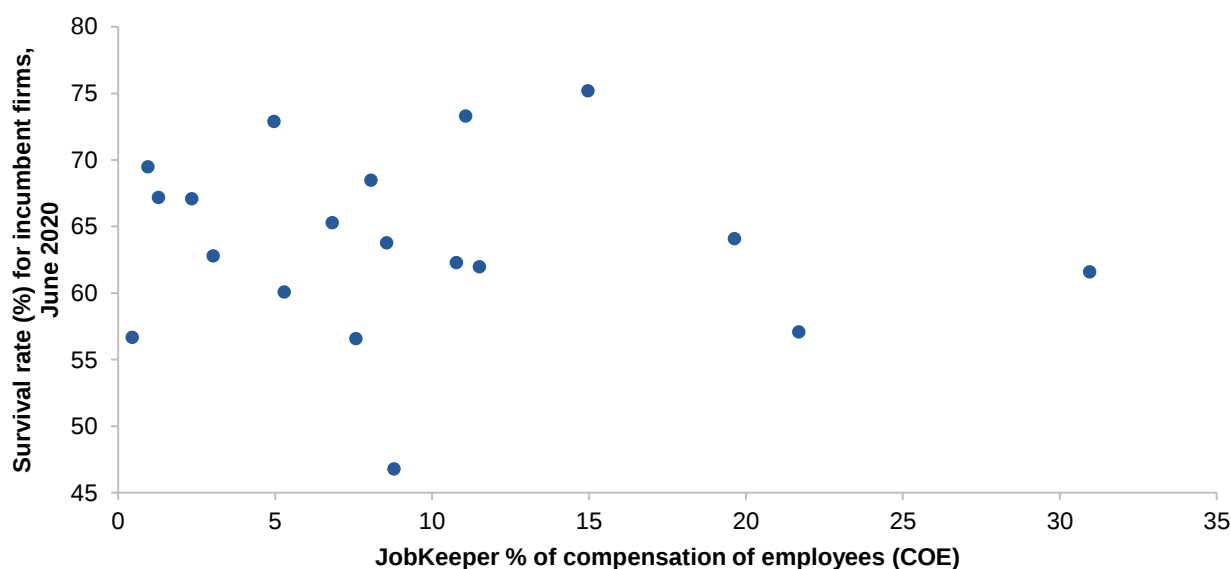
Sources: ABS (2022f, 2023c, 2024g table 13a).

The minimal disruption to firm entry and exit is an indication that government policies minimised the potentially significant impacts of the COVID-19 pandemic. Supporting this hypothesis, preliminary analysis suggests that JobKeeper is likely to have supported firm survival (and minimised firm exit rates).

It would be reasonable to expect that (in the absence of JobKeeper) firms that were more adversely impacted by the downturn would have lower survival rates. However, firm survival rates did not fall with increasing JobKeeper receipts – an indication JobKeeper payments appear to have been successful in supporting firm survival (figure 5.2).

¹⁹ Research using UK data found that their surge in firm entry over COVID-19 was driven by individual entrepreneurs, especially in online retail (Bahaj, Piton and Savagar 2024)

Figure 5.2 – JobKeeper coverage was not related to incumbent firm survival rates
Industry four-year survival rate (%) for incumbent firms, June 2020 and industry
JobKeeper net payments as a % of compensation of employees (COE)^{a,b}



a. COE is from the March 2020 quarter to the March 2021 quarter. JobKeeper began on the 30 March 2020 and ended the 28 March 2021. **b.** Net payments include all phases of JobKeeper.

Sources: PC analysis of ABS (2024g table 3); ABS (2024 table 44); ATO (2023 JK2).

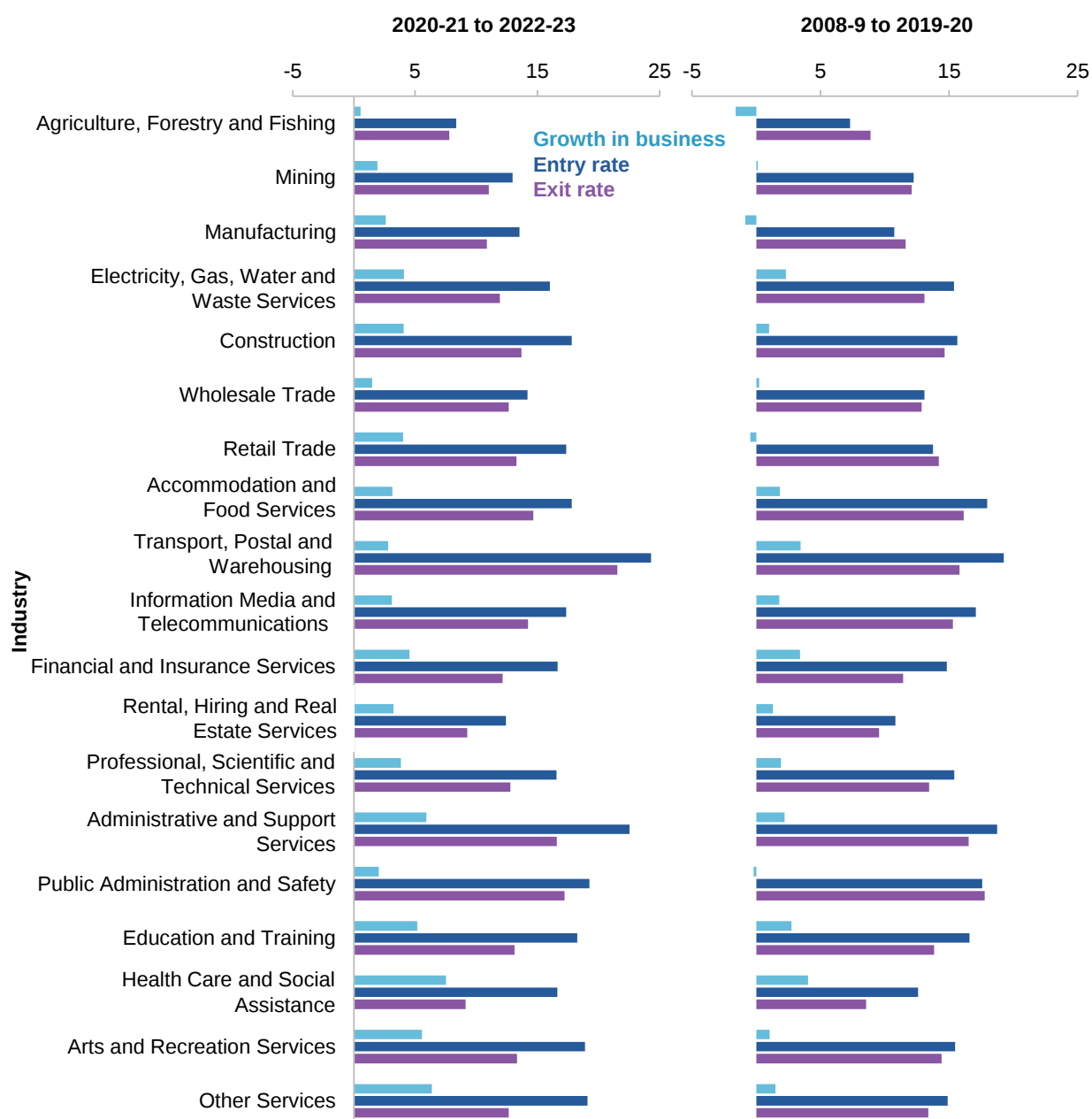
Increases to firm entry offset decreases to firm survival

The stock of businesses has grown since the onset of the pandemic (figure 5.3). The number of businesses grew by an annual rate of 3.8% over the COVID-19 period, which was higher than the average annual change to businesses between June 2008 and June 2020 (1.3%). The uptick in firm entry in Australia was likely due to the restructuring nature of the economic slowdown due to the pandemic (Bahaj et al. 2024). The increase in business growth was broad-based across all industries; suggesting economywide factors – rather than industry specific factors – underpinned this growth.

Andrews et al. (2023) show that there were not significant changes to the types of businesses that were exiting (that is, the low productivity firms were still more likely to exit the market), although little work has been done on the types of businesses *entering* during the pandemic. This would have implications for labour productivity, although such an analysis is beyond the scope of this paper. Future research could investigate the types of firms (in terms of productivity levels and innovation) that entered the market during the COVID-19 pandemic.

Figure 5.3 – Increases to the entry rate over COVID-19 brought about positive business growth to all industries

Growth in businesses, entry rate and exit rate (%) from 2020-21 to 2022-23 (LHS) and 2008-9 to 2019-20 (RHS)^a



a. Averages are the arithmetic mean.

Source: ABS (2009-2023), *Counts of Businesses, including Entries and Exits*, table 1.

5.3 Conclusion and potential for future work

The muted creative destruction process has led to a minimal effect on labour productivity

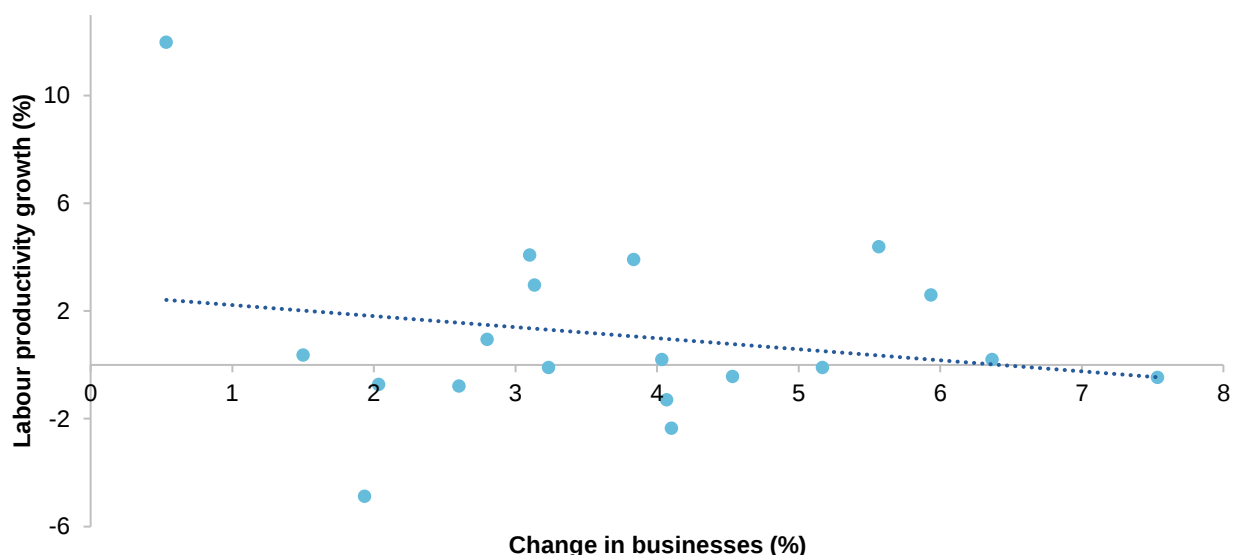
In general, creative destruction tends to affect labour productivity. However, none of the observed trends in business entry or exit rates appear to explain the initial rise, and subsequent fall, in labour productivity between December 2019 and June 2023. There are two reasons the creative destruction process appears to have had a minimal effect on labour productivity.

First, changes to firm entry and exit rates were small, so any effects on the labour productivity bubble attributable to changes in firm entry and exit rates are minor.²⁰

Second, there is only a slight negative correlation between growth in the number of businesses and labour productivity growth at the industry level (figure 5.4). This implies that labour productivity may be slightly weighed down as firm entry and exit rates have been rising post-COVID-19, making a minor contribution to the bubble downswing. However, given the weak correlation, it is unlikely there are significant implications for the labour productivity bubble.

Figure 5.4 – There was a weak negative correlation between business and productivity growth

Industry average annual labour productivity growth (%) and change in businesses^a (%), 2020-21 to 2022-23



a. Average is the arithmetic mean.

Sources: PC analysis of ABS (2024g table 1) and ABS (2024f table 15).

²⁰ This is not to say that the measures did not have positive implications for productivity. Research suggests the first phase of JobKeeper accounted for a 2.6% aggregate gain to labour productivity growth, compared to a counterfactual where the productivity-exit link was severed (Andrews, Bahar and Hambur 2023, p. 4).

Australia's policy intervention – supporting workers and businesses – is likely to have prevented significant labour productivity declines associated with the scarring effects of firm turnover (by minimising firm exits and any associated falls in labour productivity), but it may have also inhibited the reallocation effect (minimising any potential increase in labour productivity) by supporting relatively unproductive firms that would have otherwise exited the market. That said, the policy interventions have underpinned record growth in Australia's labour market.

Further work could be done to understand the apparent trade-off between supporting employment and restricting the creative destruction process, and whether that trade-off is stable over time. There will likely be long term productivity implications from recent trends in firm entry and exit that should be considered and evaluated.

6. Labour mobility

Key points

- ✳ **Labour mobility describes the movement of workers between jobs and is an important feature of an efficient labour market. Labour mobility can result in:**
 - productivity gains if workers find a job that better aligns with their skills or move to a higher productivity firm, or
 - productivity losses, due to the loss of job-specific institutional knowledge and training and recruitment costs for new hires.
- ✳ **It is hard to determine the precise impact of labour mobility on the ‘productivity bubble’.**
 - In the initial phase of the COVID-19 pandemic, economic activity declined, and the job mobility rate declined to its lowest level since 2015. It is likely that this initial drop maintained sub-optimal job-skill matches and inhibited productivity growth in the long run – although keeping people in existing jobs may have benefited labour productivity in the short run.
 - As the economy rebounded from late 2020, opportunities for workers opened up and job mobility rose, reaching its highest level over the previous decade. This will likely support productivity growth in the long run, although the short term effects are unclear.
 - Overall, further research is required to identify the direct impact of job mobility on specific time periods.

6.1 Why does labour mobility matter for productivity?

Labour mobility describes the movement of workers between jobs and is an important feature of an efficient labour market. Being able to move between jobs means workers may find a job that better suits their skillset or preferences, or offers higher wages. There can be productivity gains if workers find a job that better aligns with their skills or move to a higher productivity firm. Higher labour mobility also makes it more likely that labour is flowing from low-productivity to high-productivity firms.

On the other hand, there can also be costs associated with labour mobility, including the loss of job-specific institutional knowledge and training and recruitment costs for new hires. Determining the direct impact from changes to job mobility on productivity in the short term can be challenging due to these offsetting effects. For example, a better matched job for a worker’s skillset may not immediately raise productivity as the employee may take time to learn job-specific skills. However, over the longer term, research shows that falls in labour mobility have coincided with the slower labour reallocation to more productive firms (Andrews and Hansell 2021).

6.2 Labour mobility through the pandemic

Labour mobility initially fell and then rebounded over COVID-19

In the initial phase of the COVID-19 pandemic, economic activity declined, movement was restricted, and job vacancies fell. This led to a drop in the labour mobility rate,²¹ with the rate reaching its lowest level since the 1970s in mid-2020 (Black and Chow 2022, fig. 1). The JobKeeper²² program supported the attachment of employees to their employers, putting downward pressure on both labour mobility and job turnover through supporting employment (Bradshaw, Deutscher and Vass 2023).

From late 2020 as the economy rebounded, labour mobility rose to its highest level since 2015 (figure 6.1), as did the number of people who stated their reason for leaving their job was ‘to find a better job’ or they ‘wanted a change’. This was likely a result of the opportunities from the economic rebound and withdrawal of JobKeeper over this period, as the backlog of workers that were previously restricted in movement or job opportunities began to move again.

Figure 6.1 – COVID-19 and policy responses lead to a drop in job mobility

Labour mobility, 2015–2024 (LHS), reasons for leaving or losing a job, 2019–2024 (RHS)



a. Survey is conducted in February of each year and reflects changes that occurred over the past year.

Sources: PC analysis of ABS (2024m table 2).

The job mobility rebound is likely to have positive long term effects on labour productivity

Measuring the direct impact of labour mobility on productivity can be challenging due to difficulties identifying the ‘cause’ and the ‘effect’. Markets with greater job mobility may increase productivity, but more productive

²¹ Labour mobility is defined as individuals that were employed in their current job within the previous twelve months and were also employed in a different job at in the previous year.

²² Firms received JobKeeper if their annual turnover or expected turnover decreased below a certain threshold.

markets may also spur greater job mobility (as people are more likely to be able to identify better opportunities and move jobs, and more productive markets are more likely to attract more workers).

However, during the initial rise in labour productivity (from December 2019 to December 2020) labour mobility was declining. Workers were more likely to remain attached to their firm due to JobKeeper and limited opportunities for alternative work, evident in the low amount of job vacancies (ABS 2024j). This meant there may have been a rising number of sub-optimal matches between people's skills and their jobs that inhibited productivity growth. On the other hand, the reduced labour movement meant less firm-specific knowledge and experience was lost and there were lower job searching and training costs, which may have supported labour productivity in the short term. Further research – beyond the scope of this paper – is needed to examine this in more detail.

Research by Andrews et al. (2023) showed that JobKeeper became increasingly distortionary after September 2020. This is because, JobKeeper initially supported firms that were productive, but financially constrained. However, over the latter two phases²³, JobKeeper supported less productive firms, which slowed the movement of labour away from less productive firms and towards more productive firms (a key mechanism through which labour mobility can lead to increases in labour productivity) (Andrews, Bahar and Hambur 2023).

Put simply, workers were relatively less likely to move during 2020 and, when they did start moving between jobs at the end of 2020, JobKeeper meant workers were not necessarily moving away from unproductive firms towards productive firms. Therefore, the initial rise in labour mobility post the COVID-19 shutdowns was unlikely to have had significant positive effects on labour productivity.

The withdrawal of JobKeeper and increases in the vacancy rate over 2021 likely contributed to the rise in labour mobility and number of workers 'leaving to get a better job' or 'wanting a change' observed over 2022 and 2023 (figure 6.1).²⁴ This movement of workers will likely lead to positive productivity effects in the long run, as workers that were previously incentivised to remain attached to their existing job were presented with more opportunities to find a better job-skill match. However, in the short run, the increase in job mobility is likely to have had competing effects on productivity – and the effect on the downswing of the productivity bubble is therefore unclear.

Other research over this period has found ambiguous effects on productivity. Research using data on self-reported job-skill matches found little evidence that the increase in labour mobility over 2021 and 2022 affected how well workers were matched with their job (Wiley and Wang 2024). The research also predicts that as these matches increase in maturity in the future, they will not improve in their job-skill match. Alternatively, research using labour market matching efficiency as an indicator shows that job finding rates rose with rising labour market tightness during the economic rebound. Unemployed individuals were more likely to find work in 2022 than at any point in time since 2004. Better matching efficiency can reflect better connection between the job-skill match of jobs and employees (Mackey 2024) – and while this may have positive effects for labour productivity in the long run, there is little evidence of how this has affected labour productivity through, during and immediately after the COVID-19 pandemic.

²³ The research breaks down JobKeeper into three phases. The first phase of JobKeeper is from 30 March 2020 to 27 September 2020 and the latter two phases encompass the period from 28 September 2020 to 28 March 2021.

²⁴ 2022 in figure 6.1 refers to the time period from February 2021 to February 2022.

Box 6.1 – High labour market churn in the US has been associated with productivity growth

The United States government response to COVID-19 supported unemployment benefits over maintaining the attachment of an employee to their employer (Harris and Sinclair 2024). This may have supported the greater productivity growth that has been observed in the US. The job-to-job quit rate in the US has been at record highs since mid-2021 and they have experienced high rates of churn in the labour market over COVID-19. Research by Dao and Platzer (2024) estimated that labour market churn was a large contributor to recent productivity growth in the US. However, as labour market churn normalises, gains to productivity are expected to slow.

6.3 Conclusion and potential for future work

Overall, it is hard to determine the direct impact of job mobility on the productivity bubble

It is likely that initial drop in labour mobility as the pandemic commenced in 2020 maintained a larger proportion of workers in sub-optimal job-skill matches and inhibited long run productivity improvements. However, this may have boosted labour productivity in the short run, as people stayed in their existing jobs and did not have to search for a new job or learn new skills. As labour mobility rebounded, the positive effects on labour productivity are likely to have been muted, as JobKeeper limited the productivity enhancing movement of workers from low-productivity to high-productivity firms. Overall, it is unclear to what extent – if any – this contributed to the initial rise in labour productivity between December 2019 and December 2020.

With the withdrawal of JobKeeper in March 2021, the continued high level of job mobility will likely support productivity growth in the long run, although the short run effects are unclear. Overall, further research is required to identify the direct impact of job mobility on specific time periods. It is therefore hard to determine its precise impact on the productivity bubble.

7. Supply chain disruptions

Key points

- * The COVID-19 pandemic led to widespread disruption to many different supply chains. The war in Ukraine increased oil and gas prices, which increased input prices for industries that use oil and gas. It also increased input prices for industries that use intermediate inputs that depend on oil or gas, such as electricity generation.
- * Our cursory analysis of the effects of these supply chain disruptions on labour productivity is inconclusive.
 - Our primary analysis suggests that supply chain disruptions may have reduced labour productivity, but the strength of this evidence is weak.
 - Our secondary analysis, based on an alternative and less preferred measure of supply chain disruptions, does not suggest that supply chain disruptions affected reduced labour productivity.

7.1 Why do supply chains matter for productivity?

This chapter discusses the effects of disruptions to industries that produce intermediate products (upstream industries) on the labour productivity of industries that use those intermediate products (downstream industries).²⁵

Establishing a link between these disruptions and labour productivity is not straightforward. Disruptions are likely to increase the prices of intermediate inputs for downstream industries or lead to input shortages, but this does not necessarily reduce those industries' labour productivity. Indeed, there are cases where the disruption is likely to have negligible effects. For example, if an industry produced essential products and it was not possible to substitute the intermediate input for another, the most likely response would be for the industry to pay the higher price for the input, continue production as normal, and pass the higher costs through to its consumers. The industry's labour productivity, if measured correctly, would be unlikely to be changed.

Until quite recently, there was a consensus among economists that supply chain disruptions had negligible impacts on the *multifactor* productivity of downstream industries. Economic theory from the 1970s and 1980s suggests that a shock to the multifactor productivity of an industry should not affect the multifactor

²⁵ In 2022-23, intermediate production accounted for 43% of total gross output (roughly equivalent to producers' sales). The remainder was final consumption (33%), exports (12%), gross fixed capital formation (10%) and changes in inventories and re-exports (1%) (PC estimates based on ABS 2024e).

productivity of other industries, regardless of the flow of products between industries.²⁶ However, this theory relies on simple approximations of complex models. More recently, Barqaee and Farhi (2019) showed that when better approximations are used, supply chain disruptions can have large effects on the multifactor productivity of downstream industries.²⁷ For example, they estimate that the oil shocks of the 1970s reduced world GDP by about three times the direct effect of the reduction in global oil production, because of the flow-on effects of the oil shocks to oil-using industries.

Economic theory has focussed less on the link between supply chain disruptions and *labour* productivity (as opposed to *multifactor* productivity). Whether these effects are stronger or weaker than the effects of supply chain disruptions on multifactor productivity may depend on the disruption in question. Burnett (1991) noted that the 1970s oil shocks reduced labour productivity because high oil prices induced a substitution away from energy-intensive (capital-intensive) production toward labour-intensive production. The key point is that oil is a complement in production to capital more so than it is to labour, but the opposite is true for some other intermediate inputs, such as face masks and other personal protective equipment.

7.2 Supply chain disruptions through the pandemic and the war in Ukraine

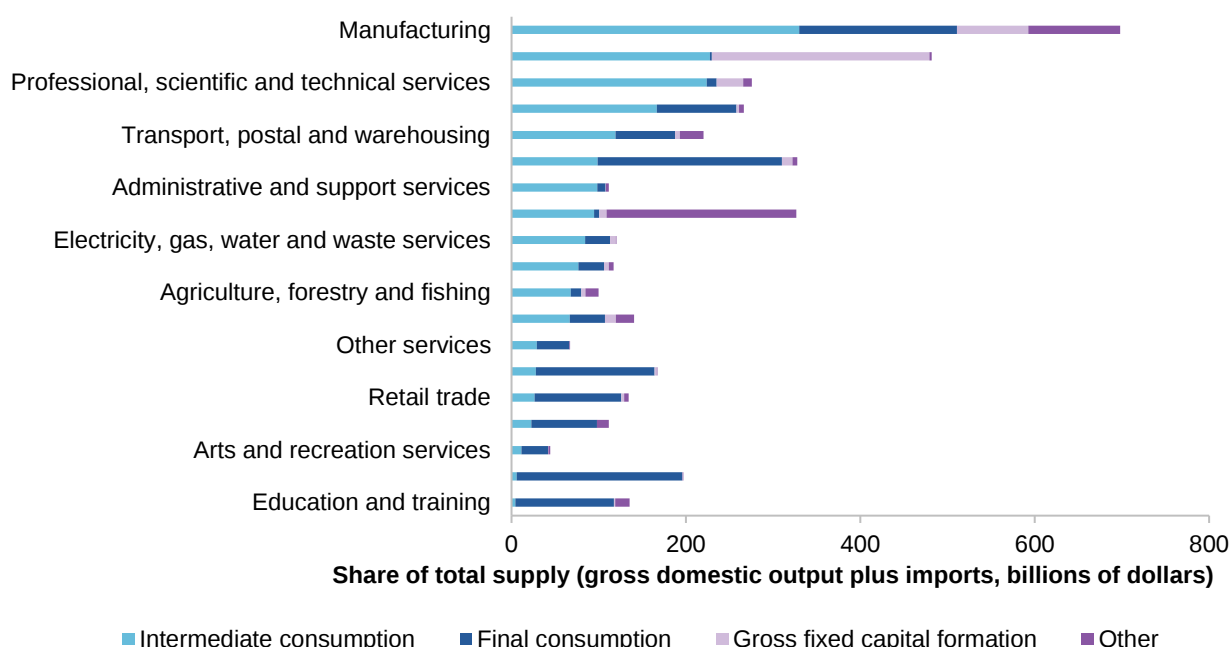
The last few years have witnessed many supply chain disruptions, mostly notably those brought about by the COVID-19 pandemic and the war in Ukraine.

The pandemic disrupted many industries in Australia and abroad. Industries that could not shift to remote work or adapt their operations in response to lockdowns and social distancing requirements were temporarily curtailed. Where these industries produced substantial quantities of intermediate inputs (such as the domestic and foreign manufacturing and construction industries), this is likely to have affected industries downstream by increasing intermediate input prices or creating shortages of intermediate inputs (figure 7.1). Transport links, such as ports, also faced restrictions, which particularly affected international supply chains.

²⁶ Syrquin (1987) showed that, to a first-order approximation, the effect of a shock to an industry's gross-value added multifactor productivity on economywide multifactor productivity is equal to the product of the productivity shock and the industry's gross value added as a share of gross domestic product (GDP). As GDP is equal to the sum of each industry's gross value added, this implies that the shock to an industry's gross-value added multifactor productivity does not have broader effects on multifactor productivity (to a first-order approximation). This is a reframing of an earlier theorem of Hulten (1978), which was stated in less intuitive gross output terms.

²⁷ Barqaee and Farhi (2019) investigated second-order approximations to Hulten's 1978 theorem.

Figure 7.1 – Total supply by industry, and how that supply was used^a
Australia, 2018-19



a. 'Other' comprises exports and changes in inventories.

Source: PC estimates using ABS (2021a, table 8).

Measuring the magnitude, timing and distribution of these supply chain disruptions is challenging because the pandemic had many different and simultaneous impacts on Australia's economy. Our approach to investigating whether the disruptions impacted productivity – discussed in the next section – draws on one of the approaches to measuring the disruptions used by other studies (box 7.1).

Box 7.1 – Measuring pandemic-induced supply chain disruptions and broader supply shocks

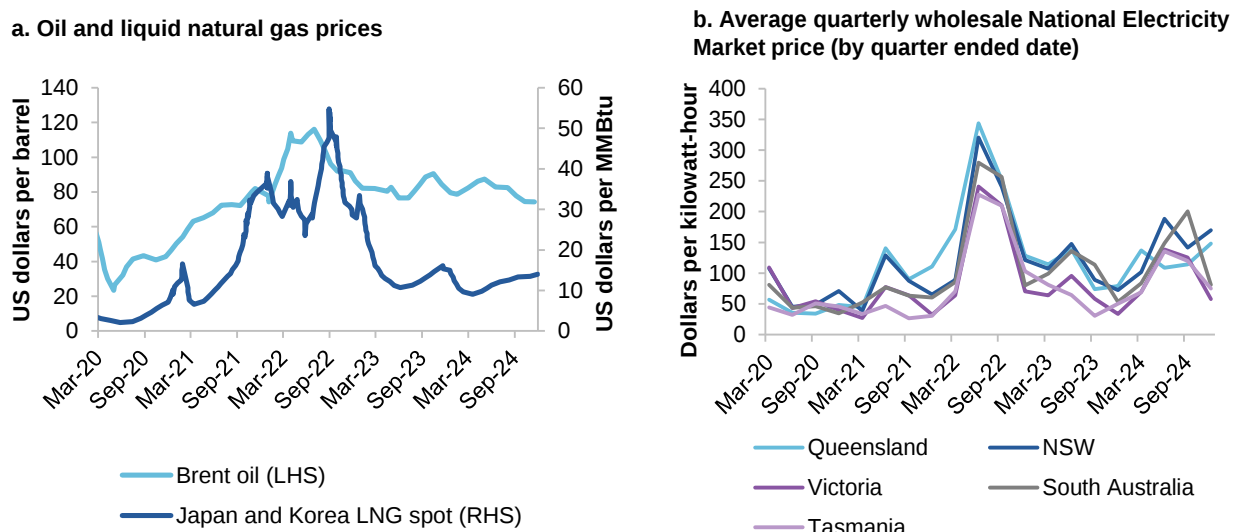
Measuring the pandemic-induced supply chain disruptions is challenging, for three reasons. First, as many supply chains span more than two industries, a disruption to one industry can cascade to industries that do not purchase intermediate inputs from the disrupted industry. Second, the pandemic created unusually complex supply chain disruptions because many industries around the world were curtailed, to varying degrees and at varying times. Third, the pandemic had substantial and uneven impacts on industry-level demand as well as industry-level supply (Baqaei and Farhi 2022). Consumption shifted from services to goods during the period of lockdowns and social distancing, and aggregate demand grew strongly in 2021 and 2022 due to the development of vaccines and the substantial monetary and fiscal support the economy received during the pandemic (Beckers, Hambur and Williams 2023).

Recognising these issues, studies of the effects of pandemic-induced supply chain disruptions and supply shocks more generally have used several different approaches to examine their effects.

Box 7.1 – Measuring pandemic-induced supply chain disruptions and broader supply shocks

- The first type of studies restrict attention to the effects of supply chain disruptions to importing countries created by the lockdowns in China in early 2020. At this point, the pandemic was unlikely to have substantially influenced demand in countries other than China, and so any effects are likely to be the result only of supply chain disruptions. Lafrogne-Joussier et al. (2022) found that French firms exposed to this supply chain disruption experienced a 5.5% drop in domestic sales and a 5% drop in exports. Meier and Pinto (2020) found that exposure to Chinese intermediate inputs explained approximately 11%-14% of the variance in industrial production growth between United States industries during March and April of 2020.
- The second type of studies make use of the insight that shocks to demand tend to move prices and quantities in the same direction, while shocks to supply tend to move prices and quantities in opposite directions. For example, while an increase in demand and a decrease in supply both increase prices, the increase in demand increases quantity while the decrease in supply decreases quantity. If a price increase is observed, the movement in quantity can indicate whether the driver was a negative supply shock or a positive demand shock. This microeconomic approach suggests that some *relative* prices will rise, whilst others could fall, but it does not necessarily have implications for movements in the average level of *all* prices over time. Notwithstanding this, the approach has mostly been used at the economywide level to disentangle the effects of shocks to aggregate demand and aggregate supply; for example, by Beckers et al. (2023) for Australia and Bekaert et al. (2020) for the United States. That said, it has also been used in concert with other modelling approaches to study the effects of supply chain disruptions arising from curtailments to the global manufacturing industry, finding that these shocks in 2021 reduced Australia's GDP growth by about 0.5 percentage points and increased inflation by nearly 1.5 percentage points (Kemp et al. 2023).
- The third type of studies use structural modelling approaches that map out the functioning of the economy in more detail. For example, Baqaee and Farhi (2022) built a sophisticated model that includes interactions between industries of the United States economy and found that supply and demand shocks each accounted for about half of the reduction in real GDP between February and May 2020.

The supply chain disruptions caused by the war in Ukraine are somewhat easier to identify in the data because the disruption was more isolated. Russia's invasion of Ukraine in February 2022 and the consequent economic sanctions imposed on Russia, a major oil and gas exporter, led to a large upswing in oil and (especially) gas prices that persisted for much of 2022 (figure 7.2, panel a). This supply chain disruption impacted Australian industries that use oil and gas as well as industries that use intermediate inputs that are themselves produced using oil or gas; for example, wholesale electricity prices in the National Electricity Market also spiked in 2022 (figure 7.2, panel b).

Figure 7.2 – Oil, gas and electricity price shocks following the onset of the war in Ukraine^{a,b}

a. 'MMBtu' stands for 'metric million British thermal unit'. **b.** Brent oil and Japan and Korea liquefied natural gas (LNG) spot prices data are approximate only as they are extracted from charted data as the underlying data are unpublished.

Sources: AER (2024) and RBA (2024).

An industry-level analysis can provide some insights into the effects of supply chain disruptions on labour productivity in downstream industries. If the supply chain disruptions materially affected labour productivity, it is likely that industry-level movements in labour productivity would be negatively correlated with the timing and magnitude of industry-level supply chain disruptions. In other words, industries that faced larger upstream supply chain disruptions would experience less productivity growth (or larger productivity declines) than other industries.

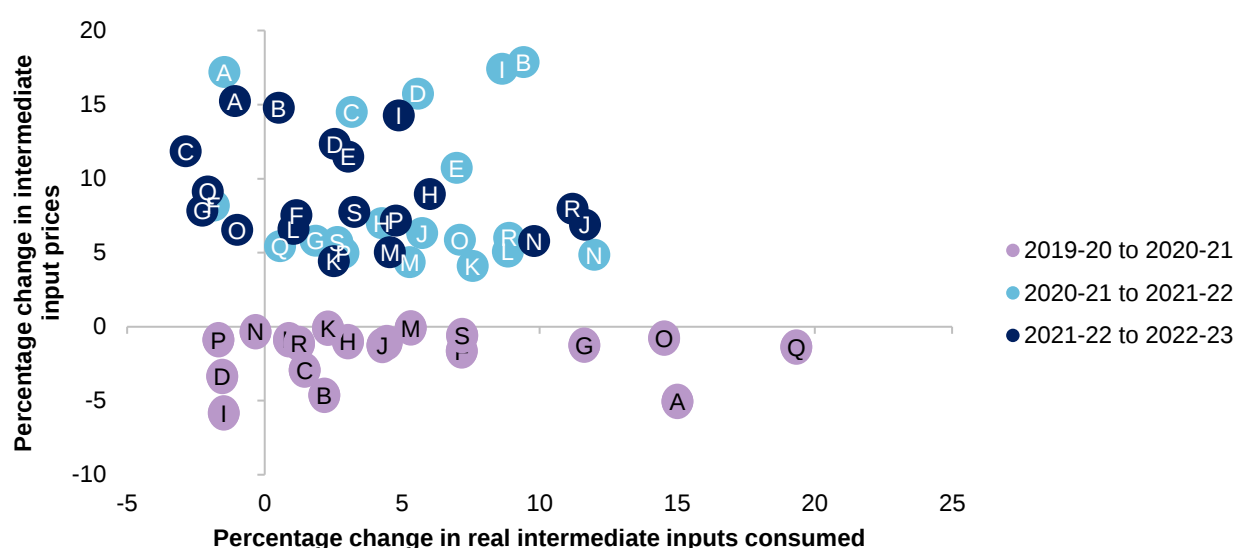
One measure suggests the supply chain disruptions reduced labour productivity ...

Our primary approach measures the relative magnitude of the supply chain disruptions affecting each industry by examining changes in the intermediate input prices that each industry faces and the quantity of intermediate inputs each industry consumes (figure 7.3). Examining changes in intermediate input prices in isolation can give a misleading picture of supply chain disruptions because shocks to demand also influence input prices. But examining these price changes alongside changes in quantities of intermediate inputs can provide some indication of whether the increases in input prices are, on net, the result of decreases in the supply of inputs (consistent with a supply chain disruption) or the result of increases in the demand for inputs (consistent with an increase in demand for the output of the industry). This is because decreases in the supply of inputs will tend to increase prices but reduce quantities, while increases in the demand for inputs will tend to increase prices and increase quantities (Hendrickson 2024).

According to this measure, the industries most impacted by supply chain disruptions *in a financial year and relative to the previous financial year* are those that appear to the upper and left of other industries in figure 7.3. For example, the measure suggests that industry A (agriculture, forestry and fishing) suffered from a supply chain disruption in 2021-22 (relative to 2020-21) and further disruptions in 2022-23 (relative to 2021-22). Because 2020-21 contained many deviations from the pre-COVID-19 norm (partly captured by 2019-20), some of the 2020-21 to 2021-22 results reflect returns to normalcy rather than the emergence of new shocks. For example, the supply shock to agriculture, forestry and fishing (A) in 2021-22 may have been

a return to normalcy after the industry experienced an increase in the supply of inputs in 2020-21. And for many industries the results are consistent with positive demand shocks in 2021-22 and 2022-23, which may in some cases be due to a return to normalcy after weak demand in the initial COVID-19 period. While somewhat counterintuitive, this is an appropriate way to characterise supply chain disruptions for the purposes of comparison with labour productivity data. This is because the supply chain disruptions hypothesis is ‘symmetrical’ – just as we hypothesise that a decrease in the supply of an intermediate input (a supply chain disruption) decreases labour productivity, we hypothesise that an increase in the supply of an intermediate input increases labour productivity.

Figure 7.3 – Change in intermediate input prices and intermediate inputs consumed, by industry^a



a. Industries are represented by their Australian and New Zealand Standard Industrial Classification (ANZSIC) letter code. A = Agriculture, forestry and fishing, B = Mining, C = Manufacturing, D = Electricity, gas, water and waste services, E = Construction, F = Wholesale trade, G = Retail trade, H = Accommodation and food services, I = Transport, postal and warehousing, J = Information, media and telecommunications, K = Financial and insurance services, L = Rental, hiring and real estate services, M = Professional, scientific and technical services, N = Administrative and support services, O = Public administration and safety, P = Education and training, Q = Health care and social assistance, R = Arts and recreation services and S = Other services. **b.** See box 1.2 for a description of the methodology.

Source: see appendix A.

We undertook a regression analysis to assess the relationship between the supply chain disruptions implied by figure 7.3 and movements in labour productivity. This regression analysis examined the correlation between supply chain disruptions and labour productivity while controlling for the level of productivity in each industry and economywide changes in labour productivity.

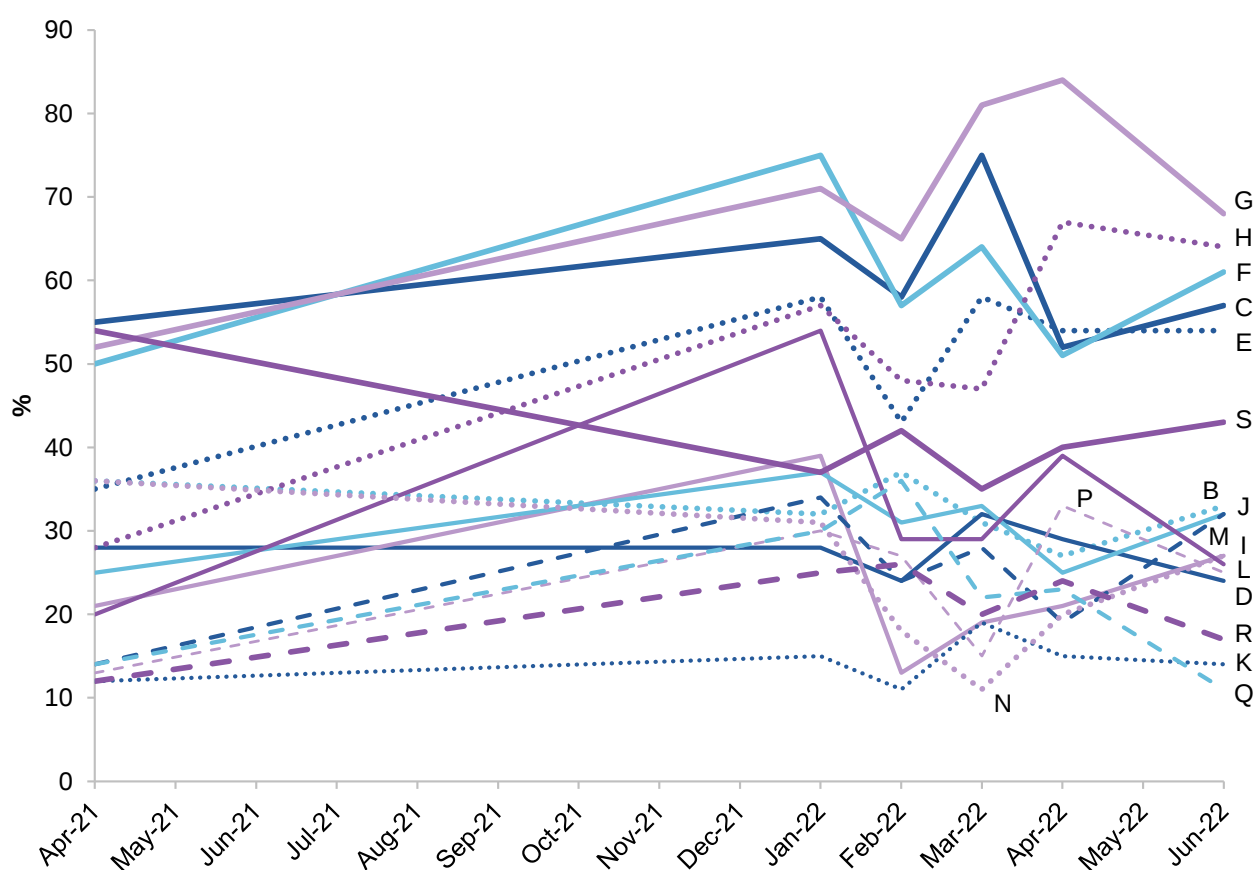
The regression analysis suggests that the supply chain disruptions negatively impacted labour productivity, but the quality of this evidence is weak. The relevant coefficient is not statistically significant (the p-value is 0.12), which partly reflects the small number of observations (57 observations; 19 industries over three time periods). Appendix A outlines this analysis in more detail.

While these results are somewhat informative, this measure of supply chain disruptions has flaws. Due to data limitations, only 59% of intermediate inputs are accounted for, ranging from 28% to 84% industry-by-industry. This is discussed in more detail in appendix A.

... but another measure does not suggest that the supply chain disruptions reduced labour productivity

Our secondary approach captures industry-level supply chain disruptions by drawing on surveys of firms conducted by the Australian Bureau of Statistics (ABS) in response to the pandemic – the Business Conditions and Sentiments surveys. Six of these surveys asked firms whether they were currently experiencing supply chain disruptions; surveys conducted in April 2021, January 2022, February 2022, March 2022, April 2022 and June 2022. The ABS reports the share of firms in each industry who responded that they were currently experiencing supply chain disruptions for all industries except ‘agriculture, forestry and fishing’ and ‘public administration and safety’ (figure 7.4).

Figure 7.4 – Share of firms reporting supply chain disruptions, by industry^a



a. The trends between April 2021 and January 2022 and April 2022 and June 2023 are interpolated. **b.** Industries are represented by their ANZSIC letter code. B = Mining, C = Manufacturing, D = Electricity, gas, water and waste services, E = Construction, F = Wholesale trade, G = Retail trade, H = Accommodation and food services, I = Transport, postal and warehousing, J = Information, media and telecommunications, K = Financial and insurance services, L = Rental, hiring and real estate services, M = Professional, scientific and technical services, N = Administrative and support services, P = Education and training, Q = Health care and social assistance, R = Arts and recreation services and S = Other services.

Sources: ABS (2021b, table 14); ABS (2022c, table 14); ABS (2022b, table 15); ABS (2022e, table 12); ABS (2022a, table 14) and ABS (2022d, table 16).

The advantage of this measure is that, unlike our primary measure, it incorporates all intermediate inputs. The disadvantage is that it may do a poor job at isolating the effects of supply chain disruptions. To the extent that firms consider a supply chain disruption to be an inability to source intermediate inputs at the

price they are used to paying, a positive demand shock and a negative supply shock may appear very similar, just as consumers may have perceived the difficulties in obtaining hand sanitiser and toilet paper in the early days of the pandemic as to be due to a supply chain disruption rather than due to a sizeable increase in demand. For this reason, we prefer the price-quantity measure of supply chain disruptions.

We undertook a regression analysis to assess the relationship between the supply chain disruptions implied by this measure and movements in labour productivity. The approach is analogous to that used for the price/quantity measure of supply chain disruptions.

The results did not suggest that the supply chain disruptions reduced labour productivity, but again these results should be treated with caution due to the very small sample size (34 observations; 17 industries over two time periods). This is discussed in more detail in appendix A.

7.3 Conclusion and potential for future work

Our initial analysis of the effects of the supply chain disruptions due to the pandemic and war in Ukraine on labour productivity is inconclusive. Our preferred measure of supply chain disruptions weakly suggests that the disruptions reduced labour productivity, while our less preferred measure does not suggest that the disruptions reduced labour productivity. Moreover, economic theory does not clearly suggest that supply chain disruptions reduce labour productivity (other than in the industry that experiences the disruption, which is not being considered here). The effect of the supply chain disruptions on labour productivity in general, and the labour productivity bubble more specifically, thus remains highly uncertain.

As these supply chain disruptions do not present longer term issues for the Australian economy, the PC is not proposing further research into their effects on labour productivity.

8. Changes to how people work

Key points

- * There is limited research on working from home in an Australian context, making the effects of working from home on labour productivity, and specifically on the productivity bubble, uncertain.
- * Restrictions placed on businesses during COVID-19 are likely to have slowed down business processes and reduced labour productivity, but this effect is difficult to measure.

This section considers the implications on workers and businesses from regulations introduced during the COVID-19 pandemic. The pandemic led to changes in the way people work and businesses operate which had implications for labour productivity.

First, the introduction of lockdowns meant that many workplaces were forced to shut down and workers had to continue their jobs through remote and/or hybrid work-from-home arrangements.

Second, social distancing requirements and more stringent demands for cleanliness meant that some workers required more time to perform tasks compared to before COVID-19.

As these were found to be of minor significance or they are difficult to study due to data limitations, these have been discussed only briefly in this section below.

8.1 Remote work and hybrid work arrangements

Why does working from home matter for productivity?

The spread of the coronavirus pandemic led to governments recommending and often mandating that people work from home where possible. As working from home is a fundamental change to how people do their jobs, it is likely to have implications for labour productivity.

Working from home through the pandemic

The pandemic caused more people to work from home, and this persisted after the pandemic had ended

Prior to the pandemic, 11% of working age Australian adults reported that they had worked from home at once a week in the last four weeks and 12% reported that they worked from home on all or most days of the week. In September 2020, when several major cities were under lockdown due to the pandemic, the proportion of working adults that had worked from home at least once a week in the last four weeks decreased to 9%, and the proportion who worked from home on all or most days a week in the last four

weeks increased to 31%. By April 2022 after most lockdowns had been removed, both of these rates changed to 18% and 27% respectively, indicating increased popularity of more hybrid work arrangement (ABS 2021d, 2022i). In August 2024, 36% of employed people reported that they usually worked from home, indicating a sustained shift in work practices (ABS 2024o).

Hybrid work can be beneficial to labour productivity

The frequency with which a worker works from home can influence their productivity levels. Academic studies have examined this relationship, particularly in the post COVID-19 period. While the literature is still evolving, some themes have emerged.

In-person interactions are important for ideas and task generation ...

Studies suggest that fully remote work during the pandemic was likely to be detrimental to productivity (Atkin, Schoar and Shinde 2023; Emanuel and Harrington 2024; Gibbs, Mengel and Siemroth 2023).

A key reason for this is that in-person interactions may be better for collaborative tasks and idea generation. Gibbs et al. (2023) found that a shift to remote work during the pandemic at an IT firm led to more time being spent on meetings and coordination activities which reduced the time available for work tasks; meaning hours worked increased while output declined. Similarly, Yang et al. (2022) found that a shift to remote work during the pandemic led to communications between employees becoming more siloed and stagnant.

Experimental evidence from engineering firms indicates that idea generation benefits from in-person interactions but in-person and virtual teams were equally effective in evaluating and selecting ideas that have already been developed (Brucks and Levav 2022). They suggest that this is because team members in virtual meetings are forced to focus on a screen which narrows their cognitive focus. Further supporting this idea, scientists and inventors who collaborated virtually were less likely to make breakthrough discoveries relative to teams that met in-person (Lin, Frey and Wu 2023).

However, these results are hard to generalise into economy-wide findings as the effects of working from home on communication may differ between individuals and organisations due to differences in managerial efforts to facilitate communication, organisational culture and use of virtual collaborative tools.

... but workers don't need to be in the office full-time to experience these benefits

Workers do not need to be in the office full-time to experience the benefits of in-person interactions. As a result, hybrid work (working some days remotely and some days in the office) tends to be beneficial to productivity, or at least, is not detrimental to productivity (Bloom et al. 2015; Choudhury et al. 2022).

Allowing workers to work from home some days can improve worker satisfaction (Choudhury et al. 2022), and allows people to benefit by avoiding the commute to work, meaning they have additional time for other purposes. It is estimated that workers would be willing to give up around 7-8% of their wages to work from home (Barrero, Bloom and Davis 2021; Mas and Pallais 2017). Remote work also reduce breaks and sick-days (Bloom et al. 2015), and result in less distractions (Fenizia and Kirchmaier 2025), all of which are typically found to be beneficial for productivity.

Further, among hybrid workers, there are differences in productivity levels depending on the extent someone works remotely. Bloom et al. (2024) shows that working from home for two days a week did not affect employee performance, but did improve employee retention. Choudhury et al. (2022) find that hybrid work is

associated with higher quantity and novelty of output compared to workers who are full time in the office or full time working remotely.²⁸

Remote work could have greater negative productivity effects on less experienced workers

For less experienced workers, in-person interactions may be an important avenue for skill development as there may be a greater knowledge transfer from senior workers and junior workers through informal in-person interactions. Emmanuel et al. (2023) found that remote work during the pandemic led to a decrease in peer feedback that software engineers received on their code, and this decline was greatest amongst less experienced engineers. Emmanuel and Harrington (2024) also found that remote work at a call centre negatively affects call quality, especially for less experienced employees.

Remote work has the potential to boost workforce participation

There are also indirect effects on labour productivity. Allowing for remote work reduces geographical barriers to employment and expands the geographical pool of potential employees and employers, which could improve job fit and thus productivity.

Remote, or hybrid, work may also provide opportunities for workers to participate in the workforce when they would otherwise be unable to do so if they were required to be in the workplace. Evidence shows working from home improves labour force participation for mothers, workers with a disability, and other workers who might find it harder to come into the office 5 days a week (Bloom, Dahl and Rooth 2024; CEDA 2024).

And while the implications of these shifts in workforce participation on labour productivity are uncertain, there are other benefits such as increasing gross domestic product (GDP) and reducing economic disadvantage and inequality.

Conclusion and potential for further work

Identifying the aggregate effects of increased working from home on economy-wide labour productivity is difficult because these effects are hard to isolate from other changes that may have affected the economy at the same time. While some small experimental studies have been able to identify the effect of working from home policies in specific firms and workers, these findings are dependent on factors like the type of worker and tasks and cannot be easily applied to the whole economy. Moreover, they do not always capture indirect effects of working from home or longer-term implications.

The evidence on working from home is still evolving. However, given most studies find hybrid work to be either neutral or positive for labour productivity, there is no evidence to suggest that the trend towards hybrid working has contributed to the productivity loss phase of the productivity bubble.

²⁸ Specifically, Choudhury et al. (2022) studied a sample of administrative workers at a human resources department and found that an intermediate rate of working from home (23-40% of the week in the office) is associated with higher quantity and novelty of output (emails) compared to low (40-100% of the week in the office) and high (0-23% of the week in the office) rates of working from home.

8.2 COVID-19 restrictions at workplaces

Why do restrictions matter for productivity?

In response to the coronavirus pandemic, the Australian government initially adopted a zero-COVID-19 suppressions strategy which aimed to stop the spread of the virus through lockdowns and strict restrictions on public movement and gatherings. As a result, some businesses like restaurants and entertainment venues closed down in the initial months of the pandemic and others adapted to the new restrictions. These restrictions (such as limited number of people in indoor spaces) likely suppressed labour productivity (as firms would not be able to work in their preferred methods). For example, in the manufacturing industry a production line would have had less than the optimal number of people manning each station, causing labour productivity to decline. COVID-19 restrictions likely weighed down on labour productivity in the initial part of the pandemic in 2020, but then helped labour productivity rebound as the restrictions unwound over 2021.

COVID-19 restrictions through the pandemic

COVID-19 restrictions likely slowed down business processes ...

In March 2020, 48% of businesses reported that COVID-19 government restrictions impacted their operations and 7% reported that they were not trading due to COVID-19 (ABS 2020b).

Even as many cities exited lockdowns in the latter part of 2020 and 2021, restrictions on the size of public gatherings, and requirements for social distancing and high cleanliness standards remained. In April 2020, 32% of businesses impacted by the pandemic were operating with changed business practices and this increased to 70% in July 2020, as businesses began to reopen and adapt to the changing environment (National Skills Commission 2021). These effects remained in 2021 – in April 2021, nearly two thirds of businesses reported that they were negatively affected by COVID-19 safe controls and of these 46% were negatively affected by additional cleaning and disinfecting requirements, 35% by providing personal protective equipment to staff, 34% by physical distancing of customers/clients and/or venue capacity limits and 19% by physical distancing of employees (ABS 2021b). Workers in some sectors were required to sanitise tools and the surrounding environment more frequently than before COVID-19. Workers also had to maintain social distancing in meetings, production lines and workstations which may have slowed down production processes. Moreover, restaurants and other public venues were required to space out seating which reduced the number of customers they were able to serve.

Conclusions and potential for further work

These changes are likely to have negatively affected labour productivity, but measuring the aggregate effect is difficult. This is because the introduction of COVID-19 restrictions in workplaces occurred simultaneously with other changes to the economy (e.g. supply chain shocks, reduced demand and increased rates of working from home). Studies to date have not measured the impact of the COVID-19 restrictions on labour productivity, and further work would be required to determine the extent to which the COVID-19 restrictions affected labour productivity at the aggregate level across Australia. Regardless, if the introduction of COVID-19 restrictions reduced labour productivity, it would have suppressed the rise in productivity at the onset of the pandemic, rather than contributed to it.

Conclusion and next steps

The pandemic created an unusual situation for labour productivity in Australia – only Canada appears to have had a similar, but shorter lived, bubble. This research identified that the drivers of that bubble pattern were distinct in different periods.

The early rise was caused by a re-allocation of labour caused in large part by the lockdowns and changes to the labour market. The follow-on rise were broad based across 15 industries in the economy. The eventual return to the long term trend, as opposed to productivity remaining higher, appears to have been driven by the flow of workers back into lower-productive industries, a slowing capital-to-labour ratio and a decline in the average skills and experience of the workforce as new workers joined the labour force. Some of these are likely to (or already have) improved as the shocks caused by the pandemic fade.

Other challenges caused by the pandemic – such as supply chain disruptions – while having impacts on prices and trade, is unlikely to have had an effect on labour productivity.

And finally, some areas – such as labour mobility, firm entry and exit and working from home – require further research to fully understand their impact on labour productivity through the pandemic, and how they may affect labour productivity going forward. The long term picture remains one of needing to lift labour productivity, and the lessons from the pandemic on some of these short term drivers should help us understand and focus on the long term issues.

A. Measuring the effects of supply chain disruptions on labour productivity

This appendix provides more detail about the two measures of supply chain disruptions drawn on in chapter 7 and how we estimated the relationship between industry-level supply chain disruptions and industry-level productivity.

A.1 Price and quantity measure of supply chain disruptions

Constructing the measure of supply chain disruptions

The measure is centred on the ABS's estimates of the annual nominal supply of products (imported and domestically produced) to industries as intermediate inputs, contained in the supply-use tables (ABS 2023a, 2024e). These products are delineated by product type rather than supplying industry, although the product type classification (supply-use product groups; SUPGs) is designed to map to an industry classification (input-output industry groups; IOIGs) that specifies the industry that typically supplies the product. We assumed that all domestically produced SUPG products were supplied by their corresponding IOIG industry. To split the intermediate inputs into domestically produced inputs versus imported inputs, we used the corresponding split of imports versus domestic production from the ABS's 2021-22 input-output tables (ABS 2024c). These specify intermediate inputs by IOIG (consistent with the supply-use tables once converted from SUPG to IOIG) but classify receiving industries differently; this involved converting the supply-use classification (supply-use industry classification) to the IOIG classification used for the input-output tables. To summarise, this gave, for each year, the nominal value of the flow of domestically produced and imported intermediate inputs (classified by IOIG) to receiving industries (also classified by IOIG).

Next, we mapped price indexes to as many of these flows as possible.

- For domestically produced intermediate inputs, we used the producer price index that corresponded with the output of the industry assumed to be producing the inputs (ABS 2024n). For the 'manufacturing', 'construction' and 'rental, hiring and real estate services' industries, these price indexes are available for all outputs at the ANZSIC subdivision level, which could be mapped directly to the IOIG classification. For the other industries for which producer price indexes are available (mostly service industries), we manually mapped the ANZSIC sub-subdivision-level-denominated price index to the IOIG classification. In doing so we assumed that if any price index was available for an IOIG industry, it was representative of all the outputs of that industry. Where multiple price indexes were available for an IOIG industry, we took a weighted average based on ABS-supplied weights (ABS 2015).
- For imported intermediate inputs, we used the ANZSIC subdivision level import price index that corresponded with the IOIG industry (ABS 2024h).

In all, we mapped 59% of intermediate inputs, but the share varied greatly by receiving industry (table A.1).

Finally, we used these price indexes to decompose the change in the nominal flow of intermediate inputs (where a price index was available) into a price change component and a quantity (real) change component, and then aggregated the receiving industries to the ANZSIC division level.

**Table A.1 – Coverage of intermediate inputs, by receiving industry
2019-20 to 2022-23**

Industry	Share of intermediate inputs accounted for (%)
Agriculture, forestry and fishing	46
Mining	56
Manufacturing	59
Electricity, gas, water and waste services	28
Construction	49
Wholesale trade	77
Retail trade	70
Accommodation and food services	73
Transport, postal and warehousing	75
Information media and telecommunications	55
Financial and insurance services	59
Rental, hiring and real estate services	39
Professional, scientific and technical services	76
Administrative and support services	71
Public administration and safety	56
Education and training	67
Health care and social assistance	72
Arts and recreation services	68
Other services	84

Source: PC estimates.

Estimating the relationship between supply chain disruptions and labour productivity

To assess whether the supply chain disruptions implied by movements in the price and quantity of intermediate inputs that each industry consumes correlate with movements in labour productivity, we estimated the following model using ordinary least squares:

$$\Delta \ln \text{Labour productivity}_{i,t} = \beta (\Delta \ln \text{Intermediate input prices}_{i,t} - \Delta \ln \text{Real intermediate inputs}_{i,t}) + \mathbf{X}'_t \boldsymbol{\gamma} + \varepsilon_{i,t}$$

$\text{Labour productivity}_{i,t}$ is the labour productivity of industry i in year t , $\text{Intermediate input prices}_{i,t}$ is average intermediate input prices faced by industry i in year t , $\text{Real intermediate inputs}_{i,t}$ is the quantity

of intermediate inputs consumed by industry i in year t , and X_t is a vector of time dummies.²⁹ Note that the term $\Delta \ln \text{Intermediate input prices}_{i,t} - \Delta \ln \text{Real intermediate inputs}_{i,t}$ is increasing in positive changes to intermediate input prices and negative changes intermediate input quantities, which indicate supply chain disruptions. The changes are taken over the period 2019-20 to 2020-21, 2020-21 to 2021-22 and 2021-22 to 2022-23.

The results give some indication that the supply chain disruptions impacted labour productivity. The estimated value is $\hat{\beta} = -0.19$, meaning that the difference between proportional increases in the price of intermediate inputs and proportional decreases in the quantity of intermediate inputs – the factors suggestive of supply chain disruptions – were associated with lower labour productivity growth. However, these results should be treated with extreme caution as the coefficient is close to but not statistically significant (the p-value is 0.12), which partly reflects the very small sample size (57 observations; 19 industries over three time periods).

A.2 Survey measure of supply chain disruptions

The second measure of industry-level supply chain disruptions discussed in chapter 7 is based on surveys of firms conducted by the Australian Bureau of Statistics (ABS) in response to the pandemic – the Business Conditions and Sentiments surveys. Six of these surveys asked firms whether they were currently experiencing supply chain disruptions; surveys conducted in April 2021, January 2022, February 2022, March 2022, April 2022 and June 2022. The ABS reports the share of firms in each industry who responses that they were currently experiencing supply chain disruptions for all industries except ‘agriculture, forestry and fishing’ and ‘public administration and safety’.

To assess whether the supply chain disruptions implied by these surveys correlate with movements in labour productivity, we estimated the following model using ordinary least squares:

$$\Delta \ln \text{Labour productivity}_{i,t} = \gamma \Delta \ln \% \text{ firms reporting supply chain disruptions}_{i,t} + X'_t \boldsymbol{\gamma} + \varepsilon_{i,t}$$

$\text{Labour productivity}_{i,t}$ is the labour productivity of industry i in quarter t ,

$\% \text{ firms reporting supply chain disruptions}_{i,t}$ is the average share of firms in industry i reporting supply chain disruptions during quarter t , and X_t is a vector of time dummies. The changes are taken over the periods Q2 2021 to Q1 2022 and Q1 2022 to Q2 2022.³⁰ This mirrors the approach used with the price-quantity measure of disruptions although with quarterly rather than annual data.

The results do not suggest that the supply chain disruptions impacted labour productivity. The estimated value is $\hat{\gamma} = 0.03$, indicating a larger share of an industry’s firms reporting supply chain disruptions was associated with higher productivity growth in that industry. Again, however, these results should be treated with extreme caution as the coefficient is not remotely statistically significant (the p-value is 0.45), which partly reflects the very small sample size (34 observations; 17 industries over two time periods).

²⁹ This specification is a logged and first-differenced transformation of the following model for labour productivity:

$\text{Labour productivity}_{i,t} = e^{X'_t \boldsymbol{\gamma}^{trans}} \times \left(\frac{\text{Intermediate input prices}_{i,t}}{\text{Real intermediate inputs}_{i,t}} \right)^\beta \times \alpha_i \times e^{\varepsilon_{i,t}}$. The model assumes that the labour productivity of industry i in year t can be decomposed multiplicatively into an economy-wide year-specific fixed effect ($e^{X'_t \boldsymbol{\gamma}^{trans}}$; $\boldsymbol{\gamma}^{trans}$ is a linear transformation of $\boldsymbol{\gamma}$ to account for differencing), an industry-specific fixed effect (α_i), a random error term ($e^{\varepsilon_{i,t}}$) and the ratio of average intermediate input prices to real intermediate inputs, which is increasing in intermediate input prices and decreasing in real intermediate inputs and so captures supply disruptions.

³⁰ To construct $\% \text{ firms reporting supply chain disruptions}_{i,t}$, we took the average of the values recorded within these quarters; i.e. the April 2021 data contributed to Q2 2021, the January, February and March 2022 data contributed to Q1 2022 and the April and June 2022 data contributed to Q2 2022.

Abbreviations

ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
COVID-19	Coronavirus disease of 2019
GDP	Gross Domestic Product
GFCF	Gross fixed capital formation
GVA	Gross value added
ICT	Information and communication technology
IOIG	Input-output industry group
IT	Information technology
MFP	Multifactor productivity
NDIS	National Disability Insurance Scheme
QALI	Quality adjusted labour inputs
RBA	Reserve Bank of Australia
SUPG	Supply-use product group
UK	The United Kingdom
US	The United States of America

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