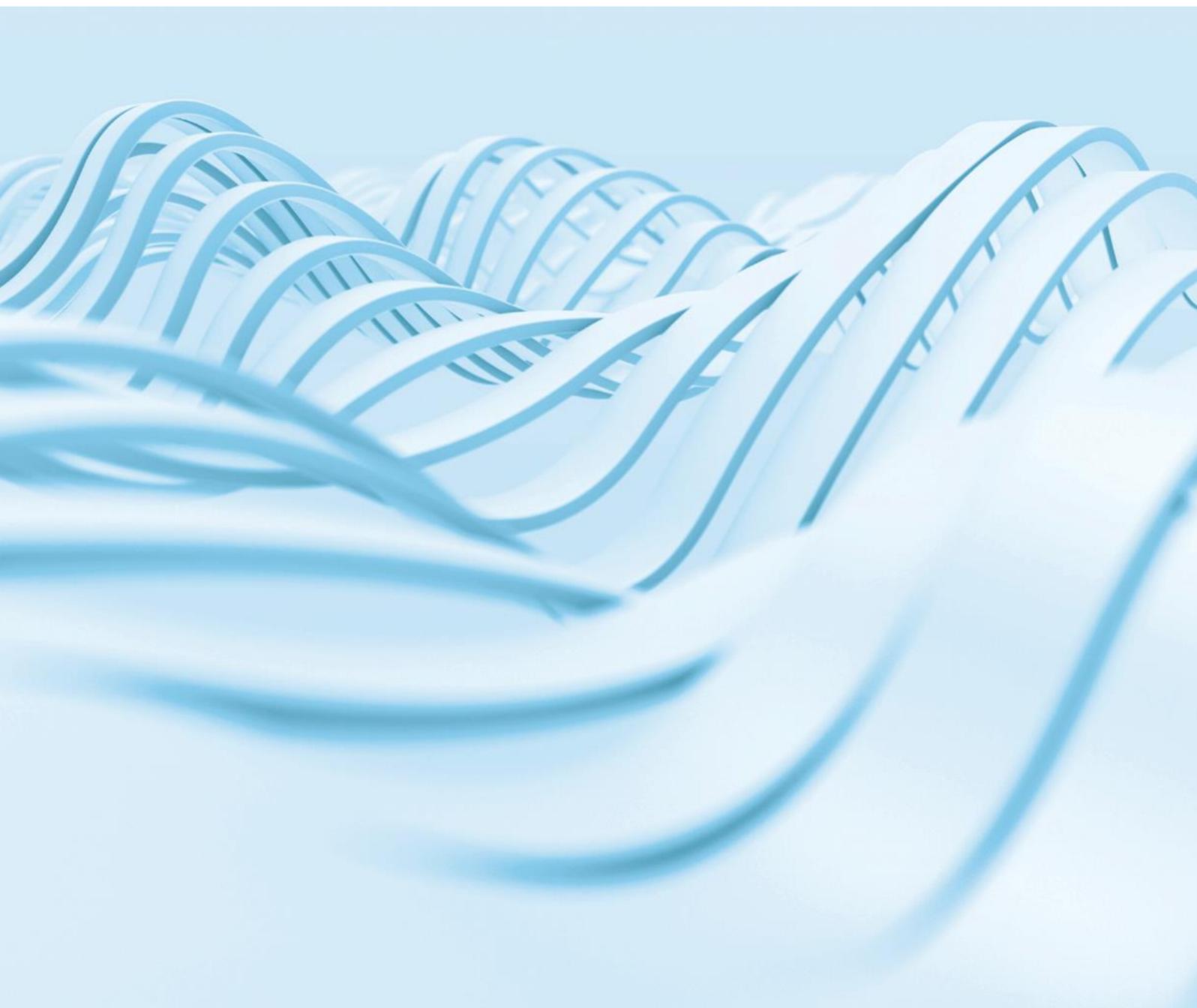




5-year Productivity Inquiry: Keys to growth

Inquiry report – *volume 2*



The Productivity Commission acknowledges the Traditional Owners of Country throughout Australia and their continuing connection to land, waters and community. We pay our respects to their Cultures, Country and Elders past and present.

The Productivity Commission

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

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

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

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The Commission's report is divided into 9 volumes: an overview document (volume 1) that presents our policy agenda, and inquiry content volumes (volumes 2–9) that explain in greater detail the reforms that make up the policy agenda, including a modelling appendix. The full report is available from www.pc.gov.au.

Preface

Productivity is the key to prosperity.

It is the process by which we learn how to get more from less: more and better products — new solutions to meet human needs, produced with less hours of work, fewer resources and a lighter environmental impact.

In essence, productivity growth is about working smarter. The extraordinary rise in average living standards over the past 200 years has come about through the ongoing discovery and spread of new, useful ideas. Some took the form of new technology — like electricity or antibiotics. Others were new business models like mass production or ride sharing. Still others were institutional innovations like accounting standards, capital markets or free trade. Australia has not had to generate all these new ideas, but has benefited from its own ingenuity in raising productivity across the economy, and from diffusing, using and building on others' inventiveness.

What will come next? What should we do to speed the pace of growth, or at least clear a path?

The current 5 year Productivity Inquiry tackles these questions. It builds on the work of the last review, *Shifting the Dial*, released in 2017. It starts with this document, which lays out the context of our productivity challenge: what we have learned from history, what we think is most salient about the present and where we might therefore focus our policy effort.

A key message is that the path and pace of growth is necessarily uneven. Countless innovations have burst onto the scene, radically transformed an industry or aspect of life, and then plateaued towards a new normal. They have varied in their effect: some innovations made a product dramatically cheaper. Others improved the quality of a good or service. Others came up with a good or service that was entirely new. And some did a combination of all three. This unevenness extends to parts of the economy. Agriculture was completely transformed in the twentieth century. Some service industries, by contrast, have seen less change. No transformative change of the past was foreseeable ahead of time.

Productivity policy is about *positioning* rather than prediction. It involves a set of institutions and policy settings that can foster innovation and can efficiently test, select and spread the best new ideas across the economy. By this, the benefits of (uneven) progress can be widely shared.

Our current state

The unevenness of productivity growth — both in its causes and effects (cost, quality and novelty) — makes it hard to measure. But the evidence suggests that like its global peers, Australia's productivity growth has slowed in the past two decades.

Recapturing the productivity growth rates of the past could yield large benefits in extra income alongside a reduced working week.

But productivity faces some headwinds. One is the gradual but dramatic rise of a predominantly services-based economy. Ironically, productivity growth in the production of goods has seen a shift of labour and other resources into services, which have risen to make up 80% of the economy. Many services are delivered in person. Many are government funded and/or delivered. Often it has proven hard to automate aspects of the service, or otherwise economise on the labour input. Hence productivity growth in most services has been slower than traditional sectors like agriculture, manufacturing and mining, where capital

has replaced much labour and new technology has driven large gains in overall productivity. Moreover, globally, Australia ranks lower in service sector productivity than we do in the goods sector.

Slower productivity growth in services is a historical pattern. It need not be our future. New approaches, such as digital technologies and the better use of data (through artificial intelligence, for example) hold great promise for broadly based productivity gains, including in services.

This does not mean that we will ignore productivity enablers in traditional industries. Rather, the point is to broaden the policy conversation about productivity to encompass the services sectors that now employ the bulk of the workforce.

The COVID-19 pandemic has forced the take up of technology, including online retail, telehealth and remote work. It forced new realities on the producers and consumers of services — the sector hardest hit by pandemic restrictions. The adaptations forced by the pandemic (including of government regulators) are now opening new possibilities for future productivity growth, if we can grasp them.

But the pattern of productivity growth could look different in services. Perhaps quality improvements will be more salient than cost reductions, making it even harder to accurately measure the gains. Service innovation could be focused less on the invention of new technology and more on its use, particularly for a small open economy like Australia. Getting value from university expertise could be as much about person-to-person connections as commercialising academic intellectual property. A focus on service sector productivity forces a rethink and subtle adjustment of many traditional policy tools.

Global forces are creating their own productivity headwinds. The need to decarbonise the economy is one. Decarbonising represents an effort to reduce costs — specifically the cost of carbon emissions not hitherto counted in firm profits or GDP. It will require global and local innovation, strong partnerships between the public and private sector and significant new investment — partly to replace rather than add to the existing capital stock. Australia's success in meeting this challenge efficiently will be a key determinant of our overall productivity performance in coming decades.

Heightened geopolitical tensions and supply chain disruptions also pose a challenge. Global trade and investment have been a great benefit to Australia as a small open economy. Building supply chain resilience (and redundancy) might be attractive to some firms, but will almost certainly increase costs, and prices faced by consumers. Any fragmentation of the multilateral rules-based order could crimp the benefits to Australia from trade and investment flows.

1. Productivity growth and prosperity

Key points

- * **Productivity growth — producing more outputs, with the same or fewer inputs — is the only sustainable driver of increasing living standards over the long term. While economic growth based solely on physical inputs cannot go on forever, human ingenuity is inexhaustible.**
- * **Sustained productivity growth is a relatively recent historical phenomenon. It has ensured that modern life is richer in potentially every sense compared with any time in the past.**
 - Over the past 200 years, productivity growth has lifted hundreds of millions of people out of poverty and has led to a dramatic increase in living standards for the vast majority of the world's population.
 - Technological developments and inventions — including vaccines, antibiotics and statins — have driven huge increases in the quality and length of life over the past century.
- * **The benefits of productivity growth come in the form of:**
 - goods and services that cost less, in terms of number of hours employees need to work to afford them
 - goods and services whose quality improves over time
 - completely new goods and services invented to improve everyday lives.

In practice, novel products, improved quality and reduced cost often blend together.
- * **As goods and services become more affordable, people can work fewer hours and consume more; over the past 120 years, the economic output of the average Australian is up 7-fold, while hours worked have consistently fallen.**
- * **While productivity growth is an imperfect measure of rising wellbeing, lifting the rate of productivity growth is an essential element of any policy strategy aimed at increasing the collective welfare of the Australian community. Productivity growth relaxes the constraints of scarcity and opens up opportunities — for individuals, businesses and the general community.**

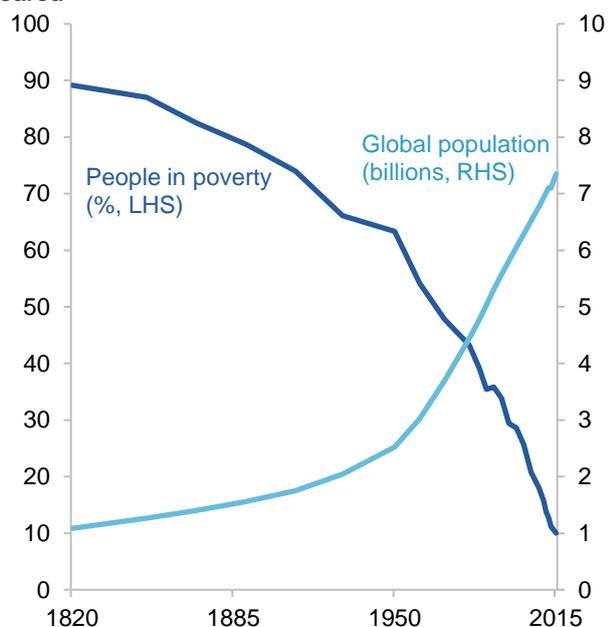
1.1 Productivity and prosperity go hand in hand

One of the most startling facts in human history is the dramatic rise in living standards over the past two centuries. This is despite the global population increasing almost 7-fold over that period. Just 200 years ago, 90% of the world's population lived in a state of extreme poverty, compared with less than 10% today (figure 1.1 panel a). In Australia, economic output per person — a general measure of prosperity — is about 7 times

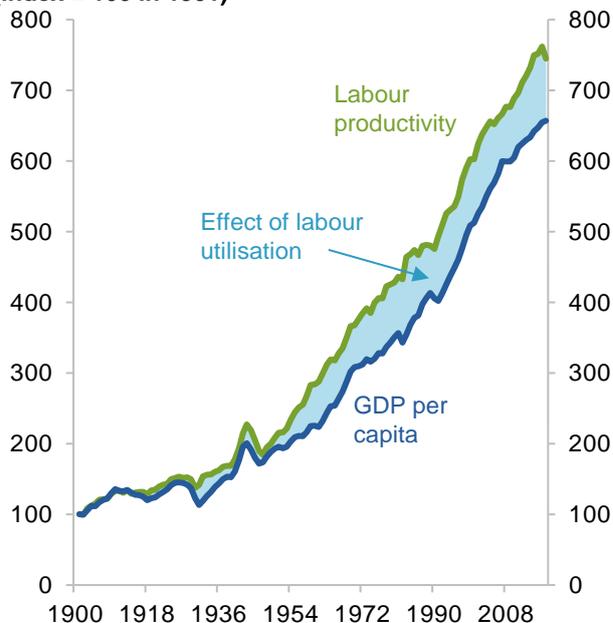
higher than at Federation (122 years ago).¹ This transformation is ultimately a function of human ingenuity: of being more productive — working smarter not harder (figure 1.1 panel b).

Figure 1.1 – Productivity makes people better off

a. Extreme poverty has plummeted while populations soared^a



b. Australians are better off due to rising productivity^b
(index = 100 in 1901)



a. Extreme poverty is defined as an income lower than 2.15 USD per day (2017 prices, the equivalent of 1 USD in 1985 prices) (World Bank 2022a). **b.** The effect of labour utilisation is the difference in growth between GDP per capita and labour productivity. Here this effect has been negative (decreased growth in GDP per capita) because the ratio of total hours worked in the economy to total population has fallen due to falling average hours worked.

Source: Productivity Commission estimates using Bergeaud, Cette and Lecat (2016); Roser, Ortiz-Ospina and Giattino (2019).

But what has this meant in practice? It means that people alive today have the opportunity to access an array of goods and services that were unimaginable in the past. And access to these goods and services can transform people's quality of life.

At the turn of the twentieth century, life was materially worse for the average Australian than it is today on many dimensions.

- For every 10 000 newborn babies, more than 1000 died before they reached their first birthday, compared with just 3 in 10 000 today (ABS 2002; AIHW 2022).
- For those that survived childbirth, life expectancy was about 60 years, compared with more than 80 years today. The invention of antibiotics, which largely eradicated infectious diseases such as cholera, diphtheria, pneumonia, typhoid fever, plague, tuberculosis, typhus and syphilis, was decades away, and only became a mainstream medicine from the 1950s (Adedeji 2016).
- During their 60 years of life, the average Australian worked much longer hours than today (the 48-hour week was legislated in 1916); with little access to paid leave (paid annual leave was first introduced into

¹ The picture is similar in other countries. In the United States, 95% of the increase in living standards over the past 70 years is attributable to growth in productivity. In China, 92% of the increase in living standards over the past 30 years was attributable to productivity growth (Feenstra, Inklaar and Timmer 2015).

industry awards in 1935 (Fair Work Ombudsman 2022)); and they worked in a more dangerous workplace (Jansz and Gilbert 2017).

- The average Australian would also die before accessing the age pension, which was introduced in 1909 for men aged 65 years and over (ABS 1988). The average person could afford far fewer goods and services for the wages earned (a steak would have cost the equivalent of 5% of a week's wages (table 1 sources)).
- Home life was more crowded (about 5 people per household in 1910 to less than 3 today in much larger housing (AIFS 2017)) and much dirtier: automatic dishwashers and washing machines did not become commonplace in Australian households until at least the 1970s, and toilets were often located outside the house until as recently as the 1950s.

In many cases productivity growth by itself did not directly cause shorter working weeks, more holidays, and longer, healthier lives — some of the beneficial changes that make life generally better today than in the past. But productivity growth did enable those changes, by consistently freeing up small amounts of time and resources year after year, which could subsequently be reallocated to more valuable pursuits. Small changes add up: steady productivity growth has underpinned massive increases in living standards over the longer run (box 1.1). Although in the short term, people can increase their incomes by working more hours (to increase production now) or consuming less and saving more (to produce more tomorrow), neither option can increase living standards indefinitely.² There are only so many hours in the day to work, and only so much that can be saved from a given income.

Despite its pivotal role in driving prosperity, the precise causes of productivity growth are not universally agreed or well understood (appendix A.2). Some combination of flexible and dynamic markets (where prices determine the allocation of resources), institutional settings (including relatively stable government), transparent property rights, access to resources (including finance), and the application of science and ingenuity to production processes are likely key ingredients. What we are sure about is that productivity growth is about learning to do more with the resources we already have — working smarter, not longer — investing in the latest technology and the best ideas (from domestic and international sources), which become embodied in the things that we build and the ways that we organise and approach tasks.

Productivity growth is generally described in terms of a single, economy-wide aggregate — the percentage change in GDP per hour worked. This measure is invaluable for understanding the rate at which productivity changes, and for making comparisons over time and across different countries. But it can also obscure the reality that underpins the aggregate: the disparate, uneven and unpredictable short-term movements — both up and down over time and at different rates across the economy, reflecting actions taken by individual firms across different industries — that ultimately lead to improvements in the production of individual goods and services.

A more 'micro' lens is a useful starting point for understanding Australia's current productivity challenges and identifying policy responses.

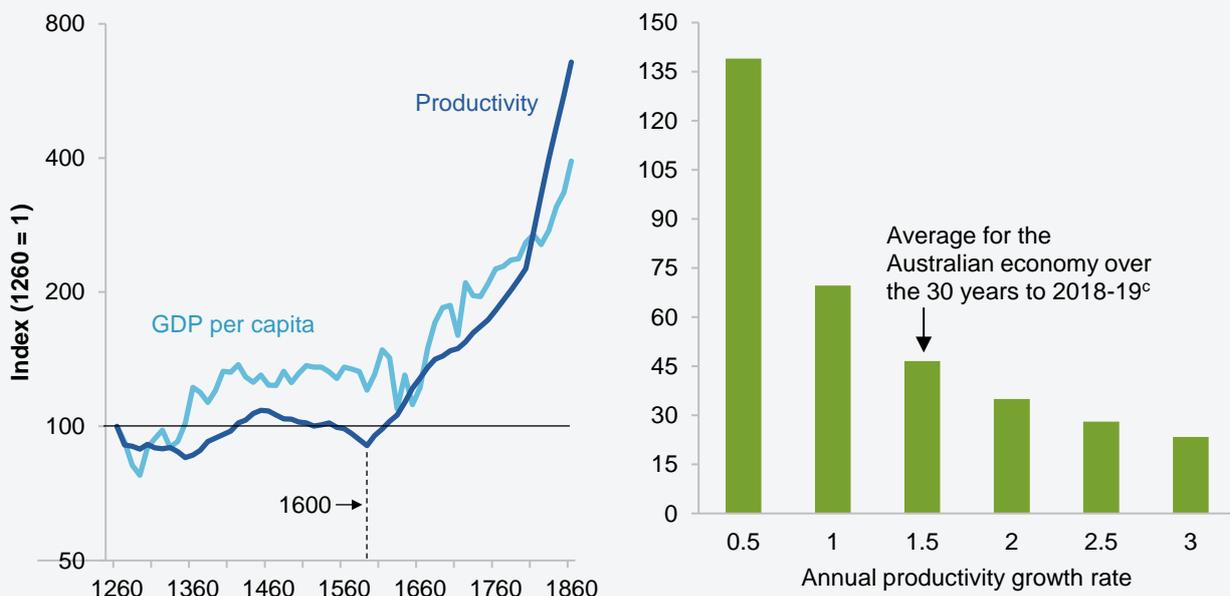
² Technically, both options are, absent productivity growth, subject to diminishing marginal returns on additional capital and labour inputs.

Box 1.1 – Consistent productivity growth is vital for prosperity

The dramatic rise in living standards over the past 200 years is not the historical norm. For most of human history, the average person experienced virtually no growth in material prosperity. This is illustrated for the United Kingdom — one of the only countries where long-term economic data is available — in the figure below (panel a), which illustrates the relationship between GDP per capita and productivity. For many hundreds of years growth in per capita GDP was stagnant, consistent with non-existent productivity growth.¹ Starting in the early 1600s, productivity growth began and rapidly accelerated, as the industrial revolution gathered pace and scope (Bouscasse, Nakamura and Steinsson 2021). Growth in per capita GDP, and increasing economic prosperity, followed.

Compounding of this growth is important: seemingly small productivity growth leads to large changes in economic output over longer periods of time (panel b) — so policy changes that secure even small increases in productivity growth matter. For example, in any economy, if productivity growth averages 2% per year, other things equal, economic output per person will double in 35 years, triple in 55 years and increase by more than 5-fold over 85 years — the life expectancy of an Australian born today. Conversely, if productivity grows at a slower rate of 1% per year, economic output will take 70 years to double.

a. Productivity and GDP per capita in the United Kingdom **b. Years to double per capita economic output^b**



a. Based on estimates of total factor productivity from Bouscasse et al. (2021). **b.** This chart shows for a hypothetical country how long it would take for per capita economic output to double for various rates of productivity growth. It assumes no change in labour utilisation rates (i.e. holding participation and hours worked constant), hence the rate of productivity growth is the sole determinant of the rate of economic growth. **c.** As reported in the 2021 Intergenerational Report (2021a).

Source: Broadberry et al (2012).

¹ Prior to the 1600s, productivity increases tended to lead to increases in the population and hence there was no change in real living standards. This is known as the Malthusian trap.

**Finding 2.1****Productivity is a recent phenomenon**

Productivity growth is a recent historical phenomenon and over the past 200 years has led to massive growth in living standards around the world.

1.2 A micro lens on productivity growth



At the most elementary level, productivity describes the quantity of products that can be generated (output) from the resources (inputs) used in the production processes.³

In reality, the change in productivity — productivity growth — reflects not only the *quantity* of goods and services produced but also changes in their *quality* over time. It also reflects the invention and introduction of entirely new products.

Hence, the growth in living standards experienced over the past 200 years can be seen as manifesting in three main ways.

1. Goods and services that became **cheaper** — through a fall in the *number of hours* ('labour cost') of workers' time needed to produce existing goods and services
2. Goods and services that got **better** — through improvements in *quality* on multiple dimensions (by an amount worth more than any additional resources required to improve them)
3. **Entirely new** goods and services — as new ways were found to satisfy human wants (or new wants were discovered and developed) either through wholly novel products or new varieties of existing ones.

Different goods and services, and different parts of the economy, have experienced different combinations of these three effects. Some everyday items have become materially cheaper; others have become much better; and many have done both. All the while, the introduction of new goods and services has fundamentally re-shaped the economy.

... growth as we have known it has centrally involved the birth of new products and industries and the decline and death of others, a perspective incompatible with thinking about and measuring growth simply as an aggregate phenomenon. (Nelson et al. 2018, p. 153)

In each of these three ways, productivity growth has increased the typical worker's purchasing power — a smaller number of hours of work is required to achieve any particular level of material living standards (which encompasses the quality, quantity and variety of goods and services).

³ More formally, productivity is defined as the ratio of some measure of output (goods and services after accounting for goods supplied by others) to some measure of inputs (typically labour, machines, equipment, or the combination of these) for some unit of analysis (be it a single company, an industry within an economy, or an entire country).

**Finding 2.2**
The benefits of productivity

Productivity growth benefits the average Australian by increasing their purchasing power. The average worker can consume more, better quality, and novel goods and services, while working fewer hours.

Things that get cheaper: lowering the labour cost of goods and services

Productivity growth often involves finding ways to produce goods and services with fewer inputs. This in turn means that the goods and services become cheaper over time to purchase. One way to measure this is by the number of hours the typical employee (receiving the average wage) needs to work in order to buy particular goods and services. In fact, on this measure, the ‘labour cost’ of many everyday items has indeed fallen consistently over time as productivity has improved (table 1.1).

For example, a double bed with a mattress, a blanket and pillows in Australia in 1901 cost the equivalent of 3 weeks of work at the average weekly wage, compared with 1 week in 1980, and just 2 days in 2021. Even housing rental costs, which have risen in inflation-adjusted terms over the past 40 years, have fallen (on average, across the country) in terms of their labour time cost — the average person needed to work about 20 hours to rent a three-bedroom house in 1901, while in 2021 the same person would only need to work for about 9 hours. A more dramatic example is the bicycle, which in 1901 would require several months of work to afford but now requires less than a day of work.

Table 1.1 – Australians need to work fewer hours to afford most goods and services^{a,b}**Hours of work to pay for goods and services**

Good or service	1901	1990	2000	2010	2019
	Hours	Hours	Hours	Hours	Hours
Double bed, mattress, blanket and pillows	185	41	37	24	18
Bicycle	473	-	14	8	6
Rent	20	12	11	10	9
Theatre (minutes)	321	81	84	69	62
Loaf of bread (minutes)	18	5	6	6	4
Smartphone	-	-	-	60	16
Cars (new, months)	-	17	13	7	5

a. Number of hours required to purchase good calculated by dividing the nominal price of each good/service by the average nominal wage (inclusive of tax, bonuses and superannuation benefits). Nominal prices for all products (except smartphones and cars) is known for 1901 and 2000 and for other years the price was extrapolated using the consumer price index series corresponding most closely with that product. Wages were calculated as labour compensation from the national accounts divided by aggregate hours worked in the economy. For pre-1960 wages, the wage estimates for 1960 were backcasted using a variety of data sources including the Long-term productivity database and Butlin. Nominal prices for smartphones and cars come from 2021 and were extrapolated backwards using the consumer price index. **b.** For figures quoted in months, one month is taken to be 20 work days of 8 hours each.

Source: Productivity Commission estimates using ABS (*Australian System of National Accounts*, 2020-21 financial year, Cat. no. 5204.0, table 1; *Consumer Price Index, Australia*, March 2022, Cat. no. 6401.0, table 7); Bradstock (2021); Birot (2021); Butlin, Dixon and Lloyd (2015); Feenstra, Inklaar and Timmer (2015).

Even from this small sample, it is notable that different goods and services have fallen in cost by varying amounts. The path of real cost reduction is neither smooth nor consistent, as might be implied by looking only at aggregate percentage changes in labour productivity across the economy.

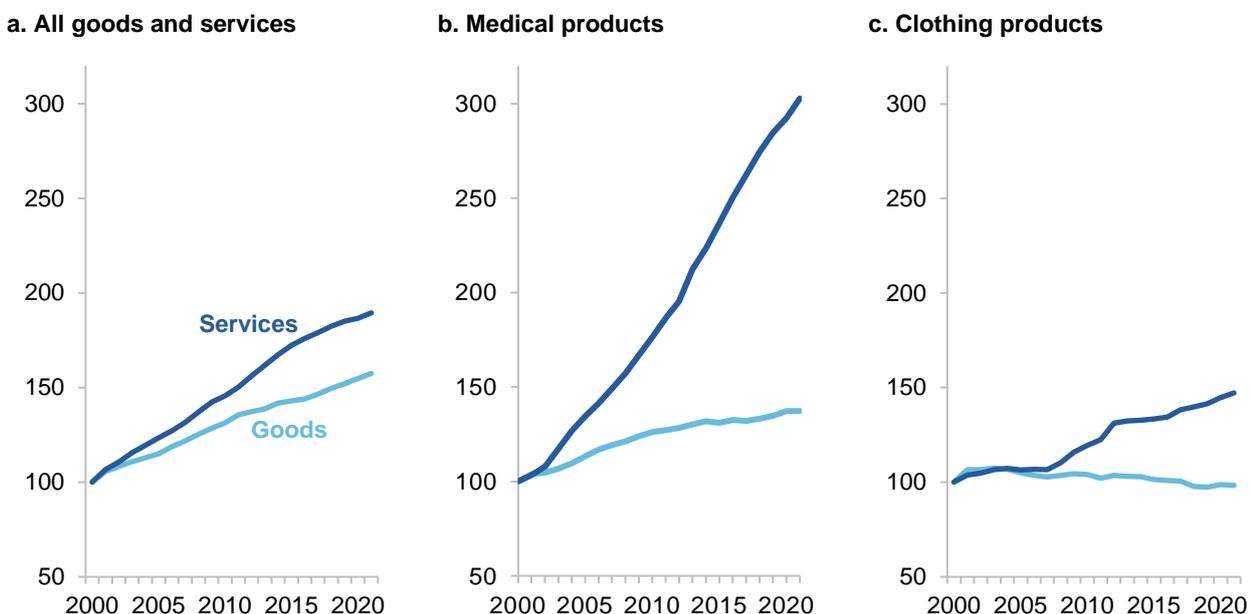
The loaf of bread became cheaper in part because of the complementary effects of innovation and capital investments in agriculture. Innovations — such as the development of synthetic fertilisers, pesticides and new strains of wheat — improved crop yields. These went hand-in-hand with complementary investments in more and better capital that allowed machinery (such as tractors and harvesters) to replace manual and animal labour.⁴

The bicycle became cheaper through improved manufacturing efficiency — cheaper energy, better materials and mass production. The rise of global trade also made the bicycle cheaper to Australian consumers by allowing access to products that are more efficiently produced overseas. In contrast, the cost of housing — measured by rent — has seen a much less spectacular fall, because it has proven more difficult to adopt technological innovations (as well as institutional and governance innovations) which would reduce the real cost of housing, including by getting the most out of available land.

Whether a product is a good or a service can influence how much cost reduction occurs. This can be illustrated by considering pairs of products — one a good and the other a service — that are used in similar contexts (figure 1.2). Almost without exception, the prices of the good, from medical equipment to clothing have risen more slowly (or declined) relative to the price of the similar service (this phenomenon is related to ‘cost disease’ which will be discussed further in chapter 2).

Figure 1.2 – Price growth in services has outstripped goods

CPI index for various pairs of related services and goods (2000 = 100)



Source: ABS (*Consumer Price Index, Australia*, December 2021; Cat. No. 6401.0.; tables 7-8).

⁴ Mechanically interpreting contributions to productivity growth in terms of innovation (or multifactor productivity, MFP) on the one hand — versus capital investment on the other — can potentially be misleading. This is because improvements in MFP raise the productivity (and profitability) of capital, which in turn encourages further investment in capital such that the capital to labour ratio increases. In addition, investment in new capital typically embodies the latest innovation. See appendix A.1 for a more detailed discussion.

Countries with higher productivity typically have a lower cost of living

A similar pattern can be observed across countries. Compared with people in countries that have lower aggregate productivity, the average Australian works fewer hours to purchase the same goods, and vice versa (table 1.2). For example, in Mexico, where labour productivity is 66% lower than in Australia, the average worker would need to work about 4 times as long (420% longer) to afford food, compared with an Australian earning the average wage. Indeed, among the items listed in table 1.2, not a single one is more affordable for the average Mexican (in terms of hours worked) compared with the average Australian.

There are exceptions to this general finding. Compared with the United States, where labour productivity is about 20% higher than in Australia, some goods and services, such as pharmaceuticals and medical services are *more expensive* (90% and 19% respectively) in terms of average hours worked. These outcomes can often be a function of specific government policy designed to alter the consumer prices of certain goods and services. For example, Australia's Pharmaceuticals Benefit Scheme subsidises the cost of selected drugs making them cheaper for consumers.

Table 1.2 – Relative labour cost of goods and services in different countries^a

Labour costs relative to Australia (percentage difference) by country in 2017

Good/service	Mexico	New Zealand	United States
Food (all)	419	42	-17
Bread	425	6	-30
Clothing and footwear	511	29	6
Actual rents for housing	173	21	-29
Electricity, gas and other fuels	224	29	-38
Pharmaceutical products	1331	90	90
Medical Services	178	-11	19
Motor cars	662	62	15
Education	1	-21	37
Catering services	319	17	-16

a. Labour cost is the price of a good/service divided by the average wage (average annual employee earnings divided by average annual hours worked per employee). That is, the number of hours required to buy that particular good or service.

Source: Productivity Commission estimates using OECD (2022b) and unpublished data from the World Bank International Comparisons program (2017 release).

Things that get better: improving the quality of goods and services

Many of the benefits accruing from productivity growth come in the form of improved quality of existing products (figure 1.3). Postal services are faster today, as are almost all communication mediums, including mobile phone networks and the internet, and the quality of the services (e.g. in terms of network reliability) is much higher. Entertainment, such as music and television, is available on a wide variety of mediums, making it more accessible to more people. And health services are available to treat a wider variety of ailments and illnesses with much higher diagnostic precision (more on this below). Goods, such as cars (safer, more powerful, more fuel efficient, more automated); computers (faster and smaller); and homes are all now built with better quality materials with greater functionality and more features than they had in the past.

Each of the quality factors discussed above are ultimately reflected in the prices of each product. But because the price of a product is not typically broken down to reveal the contribution of quality and other changes in attributes, this makes it difficult to directly assess the benefits of productivity growth. The benefits of productivity growth for improved quality can, however, be determined by comparing the quality-adjusted and non-adjusted change in the price of a product over time.

Figure 1.3 – Then and now

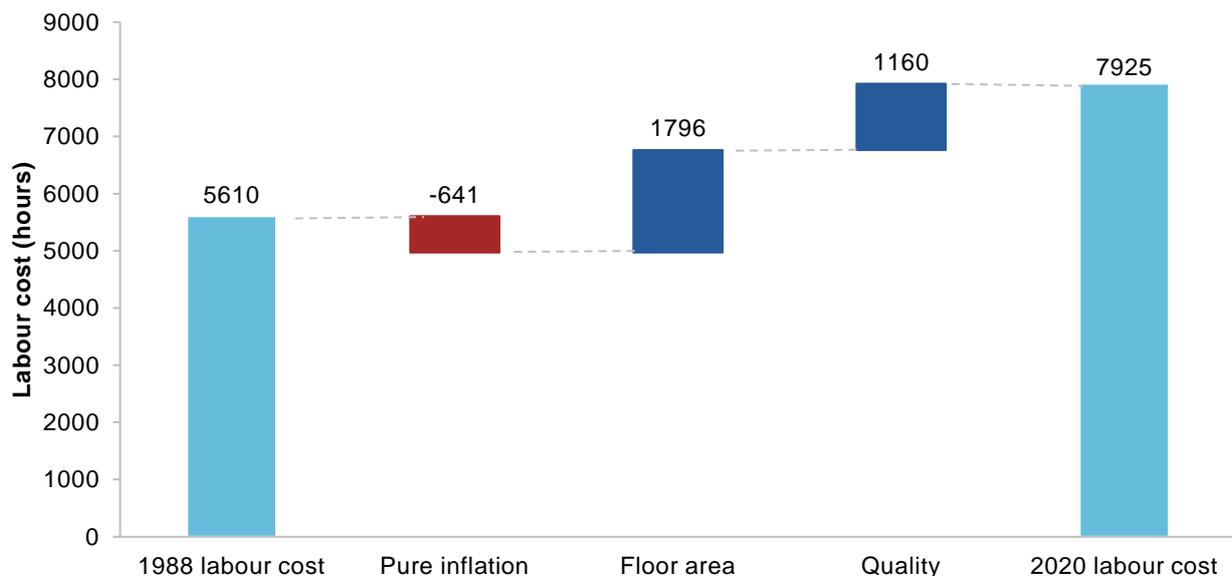
Ford Model T (1908)	VS	Tesla Model 3 (2022)
 <p>20hp crank started Internal combustion</p> <p>~70km/h</p> <p>34-64 km</p> <p>no seat belts</p> <p>Paper maps</p> <p>Sprung Leather seats stuffed with horsehair and cotton</p>	<p>Engine</p> <p>Top speed</p> <p>Range</p> <p>Safety</p> <p>Navigation</p> <p>Comfort</p>	 <p>283hp electric</p> <p>>250km/h</p> <p>600km</p> <p>seat belts, air bags, automatic braking and computer aided collision avoidance systems</p> <p>GPS navigation on an internal touch screen</p> <p>Heated seats and steering wheel and 13 speaker audio system</p>
Apple PowerBook 100 (1991)	VS	Apple MacBook Air (2022)
 <p>9 inch monochrome (1 colour) 640 x 400 pixels</p> <p>Lead acid battery with <4 hours</p> <p>2.3kg</p> <p>up to 40 megabytes</p> <p>Plastic</p> <p>serial modem</p> <p>Single speaker</p>	<p>Screen</p> <p>Battery</p> <p>Weight</p> <p>Storage</p> <p>Material</p> <p>Communication</p> <p>Sound</p>	 <p>13.3 inch touch screen, millions of colours, 2560 x 1600 pixels</p> <p>Lithium polymer up to 18 hours</p> <p>1.3kg</p> <p>1TB (25,000 times larger)</p> <p>Aluminium</p> <p>WiFi, Bluetooth and built in high definition camera</p> <p>Stereo speakers & headphone jack</p>

Source: Information on Apple Powerbook 100 and Macbook Air: Apple (2022) and Wikipedia (2022); Information on Ford Model T and Tesla: anon (2017), Alvarez (2007) and Tesla (2022).

The cost of constructing a house (excluding the land) is illustrative (figure 1.4). Between 1988 and 2020, the labour cost of constructing a new house increased from 5610 hours of work for the average worker to 7925 hours. That is, housing became more expensive. But this was entirely driven by the increasing size (floor area, 1796 hours) and quality (1160 hours) of the average detached house. In fact, the labour cost of building a house in 2020 of identical size and quality to a 1988 house actually fell by 641 hours — or about

11%. Put differently, the typical worker in 2020 wanting to construct a house of the same size and quality typical in 1988 would find it more affordable (641 fewer hours of work time). And most houses now cost more than they did in 1988 because modern detached houses are typically larger and of higher quality.

Figure 1.4 – Houses are costlier to build today because they are bigger and better^a
Price, size and quality contributions to the labour cost of constructing a new house in 1988 compared with 2020



a. The quality effect is the difference in the growth of the average cost of constructing a new house and the implicit price deflator used by the ABS to derive chain volume estimates of construction activity.

Source: Productivity Commission estimates using ABS (*Building Activity, Australia*, various releases, Cat. no. 8752.0.); Feenstra, Inklaar and Timmer (2015).

Entirely new things: increasing the variety of goods and services

Productivity improvements also come in the form of novel products, which contribute to an increase in product variety. A notable example is the introduction of electric sources of light. When this service was first introduced, the market price of electric lighting was similar to gas. But the light produced was brighter, creating substantial additional benefits (e.g. fewer accidents in factories) without requiring additional resources.

A more recent example is the rapid improvement in communication technology: between 1983, when mobile phones were first introduced, to 2007, when the first ‘smartphone’ (the iPhone) was introduced, mobile phones evolved from being brick-like devices that could be used for making wireless phone calls (itself a significant breakthrough), to small hand held computers with complete access to the internet, bundling a broad range of functions including telephony and photography.

Smartphones are now ubiquitous around the world — there are more people with a smartphone than with a flushing toilet.⁵ This ubiquity tends to understate the immense economic value of the novelty (including its mobility and versatility) of the smartphone. It has been estimated that to create the equivalent computing

⁵ In 2018, about 67% of the global population (5.095 billion out of 7.602 billion) own a smartphone while in 2018 about 60% of global population did not have a toilet to safely manage human waste at home (Statistica 2022; UNICEF 2018; World Bank 2022b).

power contained in an iPhone X in 1957 (using vacuum tubes) would have cost roughly one and a half times 2017's global GDP (or 14 times the global GDP in 1957), required 100 billion square metres of floor space (a factory 50% larger than Tasmania) and consumed about 30 times the global electricity generation capacity at the time (DeLong 2017).

The smartphone showcases how novel products, improved quality and reduced cost often occur simultaneously. In addition to the novelty of the smartphone, it also indirectly reduces cost by replacing a range of other items for many people: cameras, torches, stereos, telephone books and calculators.

Overall, the volume of new and improved goods (and increases in their variety) introduced into the market each year is enormous. For example, more than 50% of online transactions between 2014 and 2017 were purchases of products that did not exist in the previous year (Goolsbee and Klenow 2018).

The benefits of new and better products are larger than we might think

The size and nature of the benefits of novel and improved quality products are difficult to measure and are typically underestimated (box 1.2 and appendix A.3 and A.4). Whilst these measurement problems have always been present, it is unclear whether they have worsened or improved in recent decades and hence it is also unclear whether the consumer welfare gain associated with recent innovations (often involving ICT products and the internet) has been larger or smaller than other past breakthroughs (such as electricity or refrigerators) (Gordon 2018; Mokyr 2018).

Box 1.2 – Examples of mismeasuring the benefits of new products: statins and free digital goods

To measure the benefit of new products accurately, we would need to know how much people would have hypothetically paid for the new product before it existed. Similarly, for products whose quality (or variety) has improved, we would need to know how much a consumer would have been willing to pay for the quality improvement, or for greater variety of choice.

These measurement issues can be illustrated with reference to the productivity benefits associated with the ICT revolution such as smartphones, discussed above, and 'free online goods and services' such as social media and map apps. The benefits of free goods and services are likely undermeasured because while they create significant value for consumers, there is no price with which to weight them and the advertising revenue they generate likely also understates their value. Brynjolfsson et al. (2019) recently developed a method to estimate the value created by these services and found that the existence of Facebook alone would, if properly incorporated into GDP measurement, add about 0.05-0.11 percentage points to annual GDP growth. Including the gains to consumer welfare from cameras on smartphones adds another 0.62 percentage points to annual growth in GDP (between 2008 and 2017). Even if these estimates are optimistic, they do point to the real consumer benefits that have accrued from the ICT revolution that are often undermeasured in productivity statistics.

Medical improvements over the past century provide some notable examples of novel products that have provided large benefits to society (Feldstein 2017). One contemporary instance is statins (others are vaccines and antibiotics), which were trialled in 1994 as a cholesterol reducing medication, and are today the most prescribed medication among Australians aged 65 and over to treat cardiovascular disease (in 2016 44% of this age group were prescribed statins (Ofori-Asenso et al. 2018)). The benefits of statin use to

individuals and society are large. They accrue in the form of, for example, additional years of life and earnings by lowering morbidity rates, heart attacks, strokes and related hospitalisations.

More generally, mismeasurement of the benefits of novel and improved quality products may mean that real wages growth has actually been higher than its measured rate.

Advantages of the micro lens

Seeing productivity growth through a micro lens — as existing goods and services that get cheaper and better through time and new products that come into being — has several advantages.

First, a micro lens demonstrates that productivity growth *manifests* differently in different parts of the economy. Some goods and services (including many manufactured products) have become dramatically cheaper over time (such as through productivity improvements in their source country). Others (such as health care) have primarily improved in quality rather than cost. Other goods and services have not improved as much along either dimension.

Second (and relatedly), a micro lens reminds us that the *proximate causes* of productivity growth, such as specific innovations and technological discoveries, operate in uneven and unpredictable ways — both across the economy and through time. There are observed waves of technological progress in enabling areas such as energy, transport or communications, with rapid take-up often followed by a levelling off at high rates of adoption. Some innovations have broad application (so-called ‘general purpose technologies’), such as the take up of electricity, computers or the internet; others have more specific application to an individual industry. The implications for rates of productivity growth across and within different sectors of the economy vary considerably.

Third, a micro lens demonstrates that the benefit of productivity growth is not merely about having more ‘stuff’ — that is, cheaper and more plentiful supplies of the existing suite of goods and services. Much of the dividend from productivity growth comes in the form of better or entirely new goods and services, often satisfying new or previously unaddressed human needs.

Fourth, a micro lens illustrates that the analysis of productivity growth need not be confined to that which is measurable or included in an aggregate such as GDP. Productivity growth can improve lives on multiple dimensions wherever innovation can reduce the inputs required to achieve a desired outcome. The right policies and institutions can encourage productivity growth in non-market sectors (where it may not be reflected in GDP statistics), for example.

Nonetheless, there are important insights to be gained from taking all these disparate instances of productivity growth and combining them into a statistical aggregate, such as GDP per hour worked. For all their imperfections, these aggregate measures do tell us something about relative progress through time and across countries.

1.3 The aggregate picture

Despite the uneven *sources* of productivity growth, the benefits tend to be widely distributed across the economy in the long term, flowing to business owners, workers and ultimately, consumers.

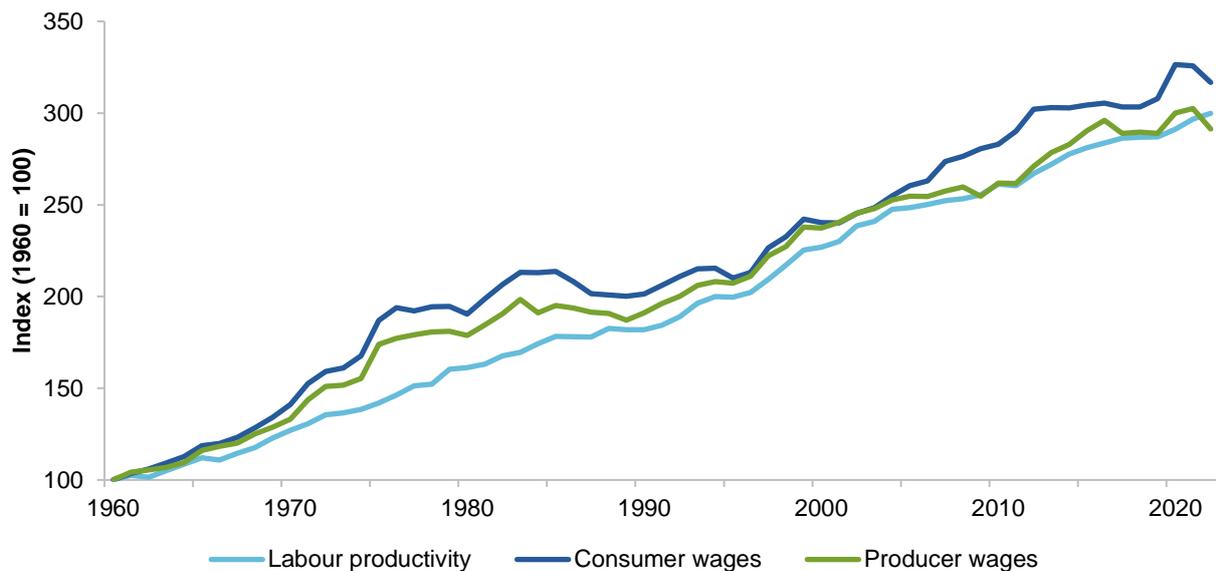
Being more productive enables increases in real wages

In terms of wages, growth in labour productivity — the broadest measure of productivity, which measures the number of hours required to produce a unit of economic output (GDP) — is very strongly correlated with the long-term growth in real wages received by the average worker (figure 1.5). In the short to medium term, factors such as relative bargaining power and economic shocks, such as large movements in the terms of trade, can lead to deviations in the relationship between real wages and productivity — for example, in the

1970s when growth in wages outstripped labour productivity (leading to an expansion in the labour income share) and conversely over the past decade when the opposite occurred (box 1.3). But in the long run, almost all increases in real wages are due to labour productivity improvements.

Figure 1.5 – In the long run, wage increases are driven almost entirely by productivity growth^{a,b,c}

Australian average hourly real wages and labour productivity, 1959-60 to 2021-22 (indices, 1960 = 100)



a. Due to data limitations, the wage data are constructed using total labour compensation per hour only, without labour income from owner operators, which was not available back to 1960. Hours data (used to calculate both labour productivity and wages) prior to 1975 have been sourced from the Penn World Tables. **b.** Consumer wages are calculated by deflating nominal average hourly wages by the consumer price index, producer wages are calculated by deflating nominal average hourly wages by the GDP deflator, while labour productivity is calculated by deflating nominal GDP per hour by the GDP deflator. **c.** Total hours (which includes employees *and* owner operators) are used to calculate average wages, not just employee hours. Even if estimates for employee hours were available back to 1960, it is necessary to use total hours in both the wage and labour productivity calculations for the purposes of, for example, analysing changes in income shares (these issues will be explored in a forthcoming PC research paper). It should be noted, however, that constructing real wage measures that include labour income from owner operators using the more detailed data available for the period after 1995 shows almost identical movements to the data series shown in this chart.

Source: Productivity Commission estimates using ABS (*Australian System of National Accounts*, 2020-21 financial year, Cat. No. 5204.0, tables 1,16, 46; *Consumer Price Index, Australia*, December 2021, table 1, Cat. No. 6401.0); Feenstra, Inklaar and Timmer (2015).

Box 1.3 – Why might the rate of real wages growth diverge from productivity growth?

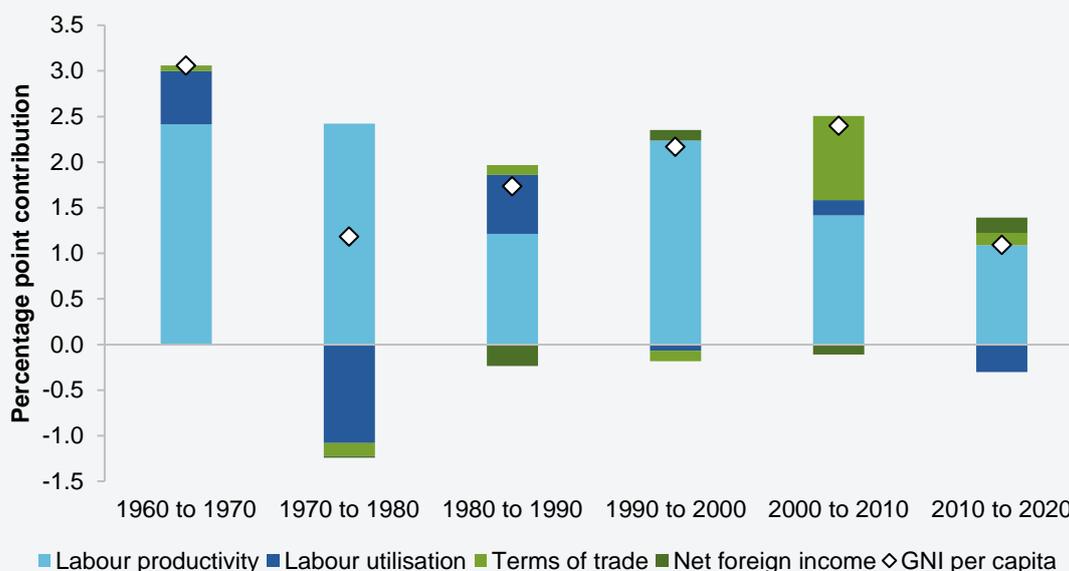
Over the *long run*, real wages are almost entirely driven by productivity. However, over the short and medium term, changes in, for example, the terms of trade and utilisation rates in the labour force, can temporarily cause a divergence between wages and productivity growth (figure).

With respect to the terms of trade, when global demand is particularly strong for Australian commodities, our export prices — and our terms of trade — tend to rise. A rising terms of trade generally causes measures of real income to rise with them. Indeed, in the most recent mining investment boom (roughly 2001-02 to 2011-12), real wages in Australia increased at about twice the rate of growth of labour productivity and gross national income (GNI) per capita increased almost three times as much as labour productivity.

Changes in labour utilisation (which measures the effect of labour force participation, unemployment and average working hours) have also contributed to increases in real incomes during certain periods. Structural changes in the Australian economy beginning in the 1960s led to rising labour force utilisation as the share of women (and later, also the average number of hours they worked) in the labour force increased. On average, this contributed about 0.5 percentage points to annual growth in GNI per capita over the decade. However, across the past 60 years, increasing labour utilisation has contributed less than 0.1 percentage points to annual growth in the same measure (figure).

However, in the long run, the magnitude of the income effects pales in comparison to the much larger effect of sustained productivity growth. For example, even if the gains to national income from the terms of trade since 2000 (which added about 23% to gross national incomes) are sustained permanently, this contribution would still be outweighed by the 33% increase to incomes accruing from labour productivity growth over the same period.

Terms of trade booms and increasing participation drive only temporary changes to real growth in average national incomes^{a,b}



a. Real wages are defined as labour compensation per hour (using Penn World Tables for hours pre-1980) but excludes the income of the self-employed. **b.** Real wages have been deflated by CPI while GNI per capita and labour productivity were deflated by the implicit GDP deflator.

What determines who — business owners, workers or consumers — receives the benefits from productivity growth over time is complex, particularly in a modern economy where the distinction between these groups can be somewhat artificial (e.g. a worker can be an employer and a shareholder in a business, as well as a consumer). With respect to wages, at least in the near term, factors such as the relative bargaining power between business owners and employees, and the institutional and regulatory settings that govern these interactions, are important.

The extent to which the gains from productivity growth are passed on to consumers (through lower prices) is a function of market structures, both in input and output markets. This includes the extent of barriers to market entry and the degree of competition, which determines the markup that businesses can charge for their products. Again, the distribution of gains can also be affected by institutional settings — such as legislation affecting how businesses compete (competition policy) and how much of the profits from innovation they can capture (this includes intellectual property rights legislation, and subsidies or taxes designed to alter relative prices, and therefore consumption).



Finding 2.3
Productivity necessary for long run wage increases

Almost all sustained increases in real wages are underpinned by improvements in labour productivity growth.

Being more productive enables greater consumption

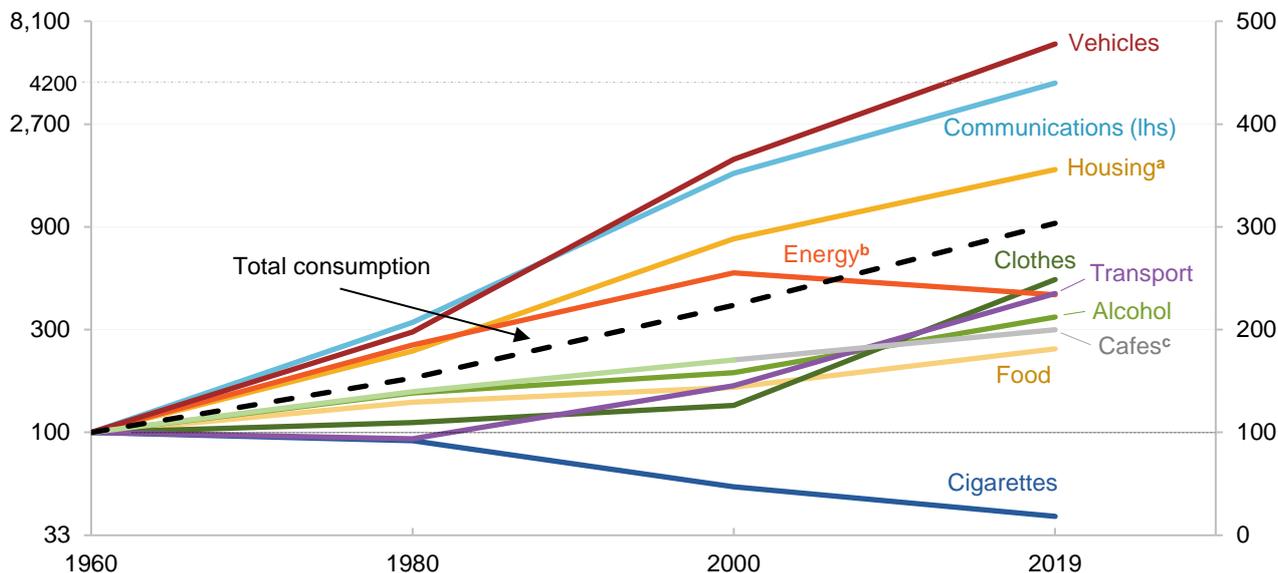
A consequence of productivity growth lowering the labour cost of most goods and services is the potential for higher consumption of almost everything. The average Australian now consumes about 3 times more than they did in 1960, across almost every category of goods and services (figure 1.6).

Much of these increases in consumption have come through *quality* improvements rather than *quantity*.⁶ As illustrated above for cars and laptop computers, typically consumer products have significantly improved in quality and variety. These quality improvements — because they provide substantial benefits to consumers — are measured as higher levels of consumption, even where the physical number of products consumed is the same.

But again, there are exceptions to this finding, which can be the outcome from government policy. For example, the falls per person in consumption of cigarettes likely reflect attempts at both moral suasion (e.g. negative advertising campaigns) and the use of ‘sin taxes’ (which, by pushing up consumer prices of cigarettes, puts downward pressure on their consumption) by governments seeking to reduce the incidence of smoking.

⁶ The net change in consumption is the result of changes in three factors: the quantity of a product consumed, changes in the mix of products consumed (buying more high value products) and changes in the quality of products consumed.

Figure 1.6 – Australian household consumption has increased for almost everything
Real household consumption per person (1960 = 100, right hand axis unless noted)



a. Housing consists of actual rents and imputed rents for owner occupiers and maintenance of dwellings. b. Includes electricity, gas and other fuel. c. Includes hotels and restaurants.

Source: Productivity Commission estimates using ABS (2021, *Australian System of National Accounts*, 2020-21 financial year, Cat. no. 5204.0, tables 1 and 42).



Finding 2.4
Productivity is also about quality and novelty

Being more productive means that the average Australian can consume more higher quality and completely new goods and services.

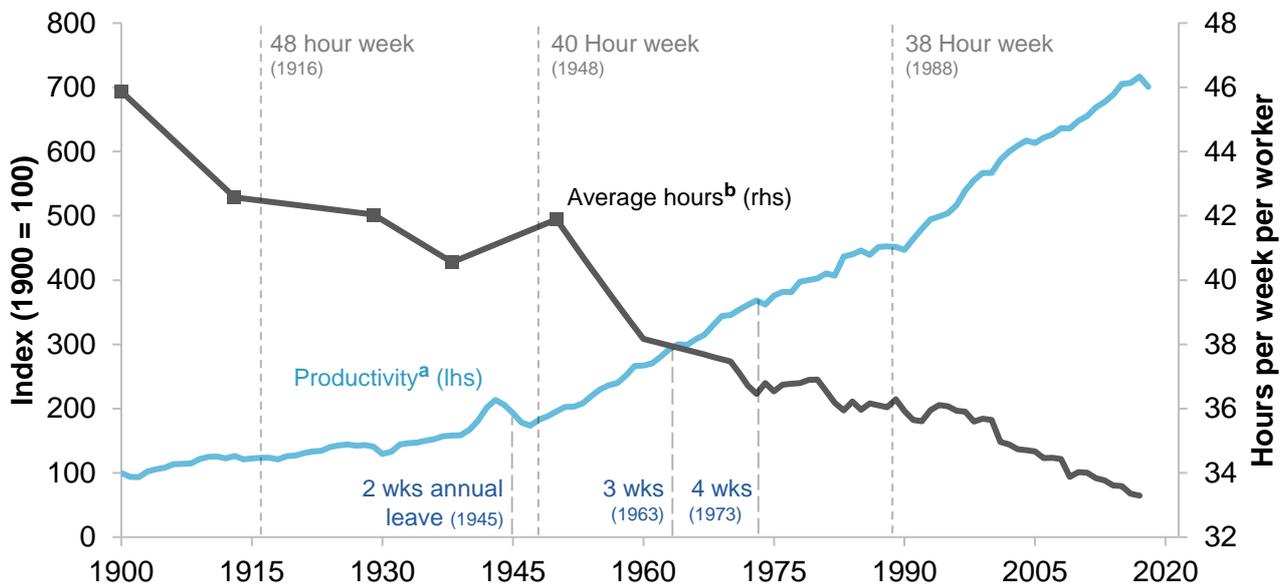
Being more productive enables more leisure

Productivity growth can also enable Australians to reduce their hours spent working (at least in a paid capacity). And most importantly — because of increased purchasing power (the amount of goods and services that can be purchased from income earned) — Australians can actually work fewer hours and still be at least as well off in terms of how much they can consume. While not all reductions in hours are due to productivity growth (the tax system also affects hours worked, for example), it enables people to work less and consume more (box 1.4). This has been the lived experience of the average Australian (and much of the world) over the past 120 years (figure 1.7).

Since 1900, aggregate labour productivity has increased by more than 700%, underpinning a similarly large increase in economic output per person (650% between 1901 and 2018, figure 1.1 panel b) and facilitating a

significant reduction in average hours in paid work, which fell by about 30% or 13 hours in line with legislated reductions in the length of the working week and annual leave provisions (figure 1.7).⁷

Figure 1.7 – Productivity growth supports higher economic output with less work



a. GDP per capita is expressed in \$US2011. **b.** Prior to 1950 the data is reported on an intermittent basis and shows full time hours for production workers only. From 1950 the data is reported annually, for all workers.

Source: Bergeaud, Cette and Lecat (2017); Denniss (2003); Irvine (2021); National Museum of Australia (2022); Roser, Ortiz-Ospina and Giattino (2020).



Finding 2.5 Productivity enables leisure

Being more productive means that the average Australian can spend fewer hours at work to achieve a given level of consumption if they choose to.

Box 1.4 – Productivity growth makes it possible to consume more and work less

The decreased hours of work and increased income that result from productivity growth can be thought of as a ‘productivity dividend’. One way to illustrate these benefits of productivity growth is to think about the trade-off that it implies for the average worker between hours spent working on the one hand, and consumption possibilities, on the other. As discussed, productivity growth leads to higher real wages and lower real prices, which means that the average worker can choose to:

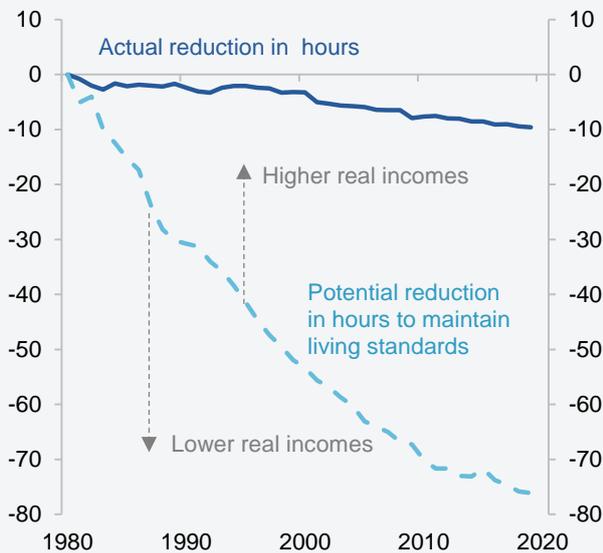
⁷ More recently average working hours have fallen due to a combination of increases in part-time work — primarily women entering paid work on part time hours — and a decrease in full-time work — principally men who were working full-time leaving the labour force (Lattimore 2007, ABS 2022c). However, overall, the average working hours per employee of both genders has fallen over the period 1978 to 2022, although the fall is more pronounced for male workers (ABS 2022c).

Box 1.4 – Productivity growth makes it possible to consume more and work less

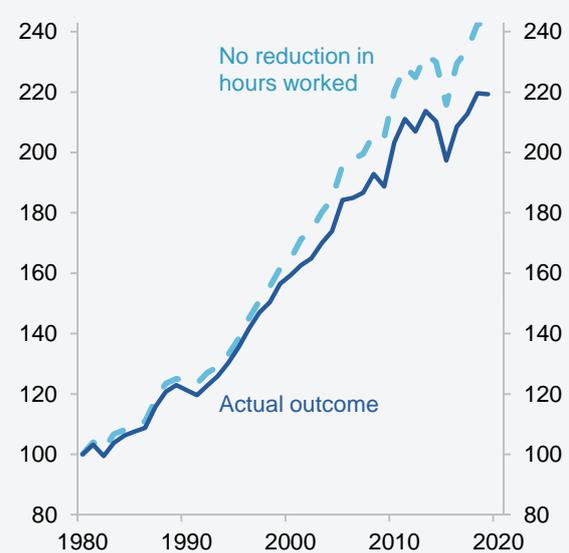
1. work the same and consume more (the whole dividend is used to increase consumption)
2. work less and consume the same (the whole dividend is used to reduce work)
3. some combination of the above including working *less* and consuming *more* (the dividend is divided between less work and more consumption).

In practice, Australians have (looking collectively) implicitly ‘chosen’ the third option. The outcome of this choice, in terms of work and income, is illustrated in the figures below. The solid line in panel a shows that since 1980, Australians have used their productivity dividend to reduce their average hours worked by about 10%. Over the same period, real incomes (as proxied by growth in real GDP per capita) more than doubled (solid line in panel b). The dashed line in panel a illustrates option 2. If Australians had been content with a 1980s standard of living they could have reduced their average hours by 76% (28 hours per week) and real incomes would have stayed the same. In other words, Australians used about 13% of the productivity dividend to ‘purchase’ leisure. The dashed line in panel b illustrates option 1 and shows that if there had been no reduction in hours worked (assuming that actual labour productivity outcomes prevailed) incomes would have increased by an additional 22 percentage points since 1980.

a. Actual vs potential change in hours worked per week to maintain GDP per capita at 1980^a



b. Actual vs potential income (GDP per capita) growth since 1980^a (index 1980=100)



a. GDP measured at chained PPPs in million 2017US\$ using data from 2019.

Source: Productivity Commission estimates using the Penn World Tables (eleventh edition).

1.4 Productivity: what lies beyond the aggregates?

Aggregate measures of productivity growth provide a useful approximation of the rate of economic progress, including the trade-off between consumption and work. But the micro lens illustrates the richness and variety in the way economic progress unfolds in the real world. And there are other aspects of community wellbeing that the macro aggregates can miss (although in many cases these tend to be positively correlated with productivity growth).

In practice, community wellbeing can be imperfectly represented by aggregate measures such as income per capita or GDP per hour worked. Three commonly cited areas in which these economic aggregates fall short are:

- **equity:** are the fruits of rising productivity being evenly shared across all groups and individuals?
- **the natural environment:** are we adequately counting the impact of environmental degradation, carbon emissions or the depletion of natural resources?
- **life satisfaction:** do higher incomes necessarily make us happier?

How well does Australia spread the gains of productivity growth?

Historically, consumers have received outsized benefits from productivity growth. For example, analysis of the US market (Nordhaus 2004) showed that about 98% of the value generated by the production of novel goods and services between 1948 and 2001 accrued to consumers, as opposed to entrepreneurs and business owners.⁸

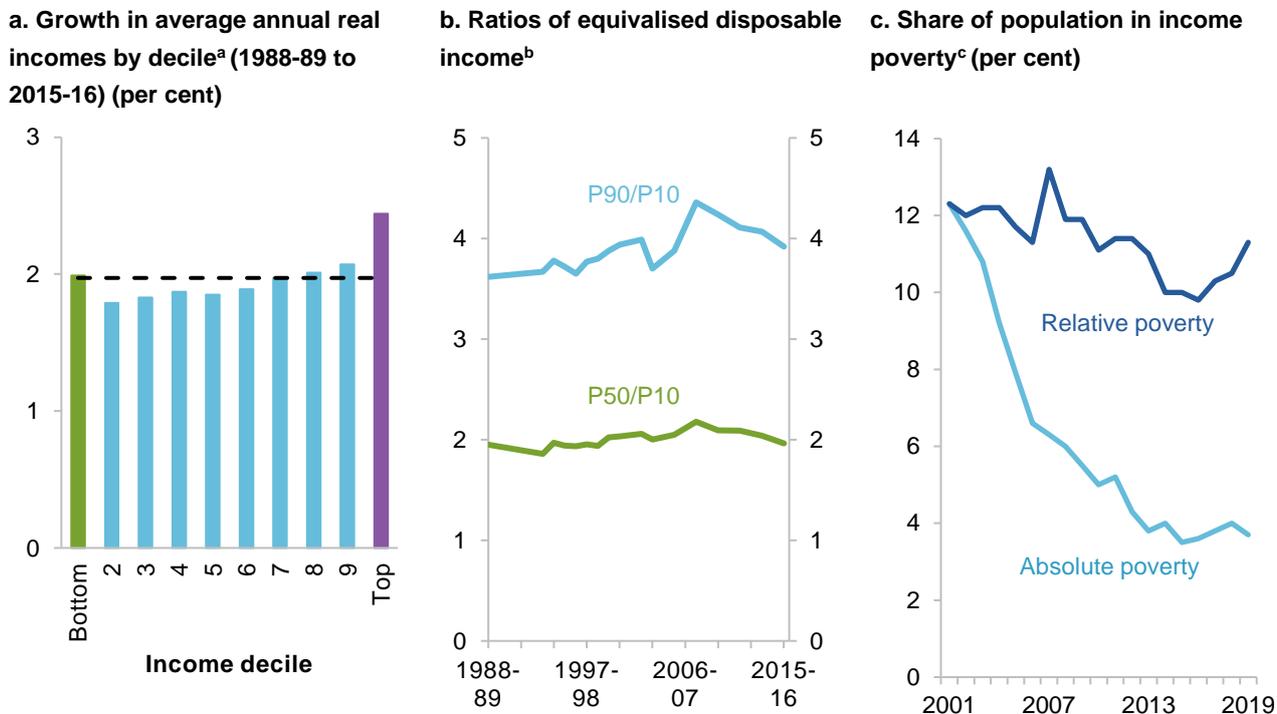
In many other respects, the fruits of productivity growth (such as quality improvements and lower prices) inherently benefit everyone regardless of income (as discussed, technological advances tend to become embedded in new and existing goods and services, improvements in medical services — which benefit all Australians in the form of subsidised access to medical care — is one such example).⁹ That said, a focus on average outcomes can mask the actual lived experience of some Australians. In this case, redistributive policies, including provision of a robust safety net, play a role in ensuring that the benefits of productivity growth are widely distributed. And productivity growth, by growing the pie, allows governments, via the tax and transfer system, to reinforce that safety net (box 1.5). Indeed, over the longer term, providing a more generous social safety net and delivering the government services that many Australians rely upon would not be possible without robust productivity growth.

Over the past three decades, real income growth of the lowest income groups has been only slightly below the average (figure 1.8 panel a). Inequality in income (and consumption) has increased only modestly in Australia since the late-1980s and measures of income poverty have tended to fall, significantly so in the case of absolute poverty over the past two decades (figure 1.8 panel b and c).

⁸ Nordhaus (2004) estimated the social value of technological advances and the amount that was captured by producers and consumers. The typical rate of return on capital in the United States between 1948 and 2001 was about 5.9%, which is very close to the cost of capital (Nordhaus 2004, p. 35), indicating that most firms typically do not capture profits above the cost of capital.

⁹ In absolute terms, even if the *nominal* income of Australians does not change, real incomes will likely rise due to lower prices, higher quality and the invention of new products — in this way the benefits are broadly distributed. In a relative sense, low income Australians may have benefited by proportionately more than the average to the extent that they spend a higher share of their incomes on non-discretionary items, such as food, whose price has fallen dramatically in line with agricultural productivity improvements, amongst other things.

Figure 1.8 – Productivity growth has not exacerbated inequality and, it has been associated with rapidly declining absolute poverty rates



a. Income is deflated by CPI. b. Equivalised measures of income adjust for household size and composition. c. Relative poverty is defined as household equivalised income that is less than 50% of the median household equivalised income. Absolute poverty is based on an income poverty threshold whose real value is held constant over time. In this case, equivalent to the relative poverty threshold in 2001.

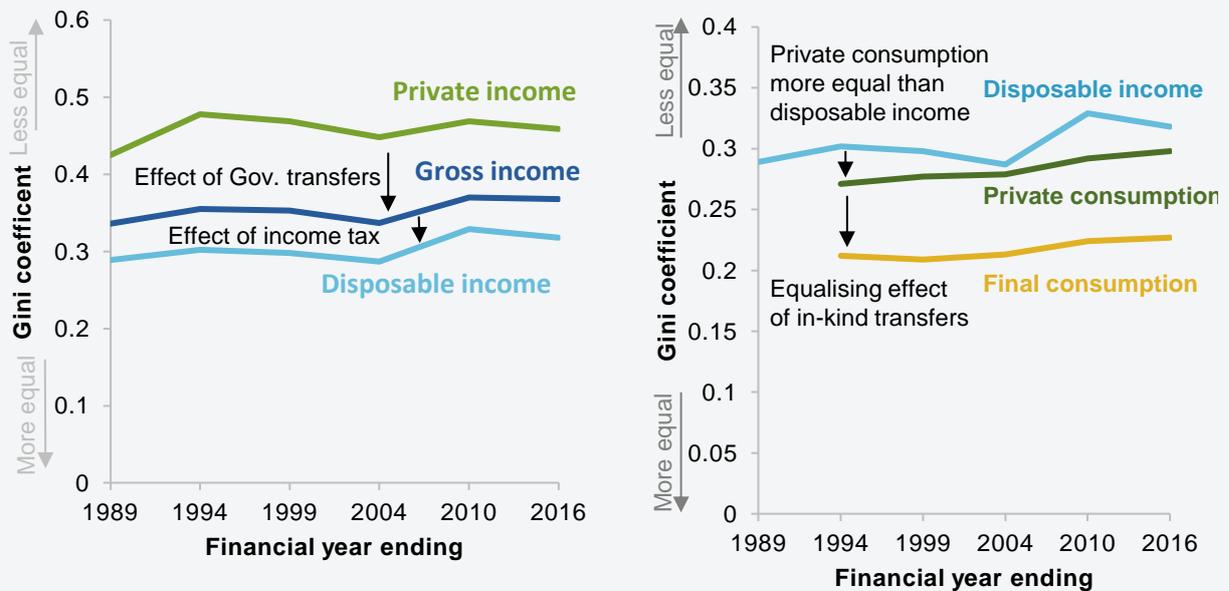
Source: Panel a & b: Productivity Commission estimates using ABS (Microdata: *Household Expenditure, Income and Housing, 2015-16*, Cat. no. 6540.0, released 25/10/17) and ABS (*Household Expenditure Survey Basic confidentialised unit record file for 1988-89* as available at 25/10/17). Panel c: Wilkins et al. (2020).

Box 1.5 – Well targeted redistribution by governments significantly reduces inequality in Australia

While income inequality has remained steady over the past few decades, Australia’s progressive tax and highly targeted transfer systems substantially reduce the level of inequality at a given point in time. For example, an often-used measure of income inequality, known as the Gini index (which rises as income inequality increases) reduces consistently as government transfers (such as unemployment benefits and rent assistance) and income taxes are applied to private incomes. Similarly, the Gini index for final consumption, which includes in-kind government transfers such as health, education and social housing, is lower than both final consumption, which in turn is lower than for disposable income (which likely reflects access to finance and savings behaviour). In effect, government policy has meant that while an individual’s (or a household’s) income from work and investments can be volatile over time, their actual spending on goods and services is usually much more stable. This indicates that redistribution, while imperfect, does act as a form of insurance against income shocks.

Box 1.5 – Well targeted redistribution by governments significantly reduces inequality in Australia

The impact of redistribution on measures of inequality^{a,b}



a. The Gini index is a measure of inequality ranging from 0 (completely unequal) to 1 (perfectly equal) that is calculated by comparing the actual cumulative proportional distribution of income to the counterfactual cumulative distribution if the society was completely equal. b. Private income refers to income before tax and transfers, disposable income is income after taxes and transfers and final consumption is private consumption plus in-kind service received for health and education.

Source: PC (2018, pp. 54, 65).



Finding 2.6 Productivity and the safety net

Consumers have received large benefits from productivity growth, including the capacity to benefit from a broad government social safety net.

Accounting for environmental impacts

As with any manifestation of progress in the economy, productivity growth can give rise to either negative or positive environmental outcomes associated with the destruction, or preservation (respectively), of natural land and water resources.

Creating more and higher quality goods and services from the use of fewer inputs can lessen the use of scarce natural resources and reduce adverse environmental impacts, as well as returning more leisure time to people to enjoy environmental assets.

If there are no markets to provide an indication of how different environmental outcomes are valued, or regulations to influence behaviour to achieve environmental outcomes valued by the community, then this can mean there are environmental consequences of productivity growth that detract from people's wellbeing.

Input and output prices are the fundamental market signals that help businesses allocate resources to the production of goods and services, and (in the case of output prices) provide information to consumers to make consumption choices.

When prices are incomplete (because the prices for certain inputs and outputs are themselves missing, typically because of an absence of property rights, markets, regulation or information), market participants will tend to over or under produce certain outputs, relative to levels which maximise the community's well-being.¹⁰ Missing prices tend to plague the use of 'common-property' natural resources, such as the Earth's atmosphere.

- In the 1980s the production of chlorofluorocarbons (CFCs) — a chemical used in fridges, air conditioners and aerosols — was found to be destroying a part of the Earth's stratosphere known as the ozone layer. A depleted ozone layer leads to an increase in ultraviolet light reaching the earth from the sun, which tends to increase the rate of skin cancers and cataracts in humans, as well as being deleterious to marine and terrestrial ecosystems. This damage was not reflected in the price of products (nor initially in non-price regulations) that contained CFCs.
- A scientific consensus was reached in the 1990s that greenhouse gas emissions associated with the production of fossil fuel-based energy (burning coal or gas in power plants and petrol in cars) were influencing the climate, leading to, amongst other things, more frequent and more destructive weather events. This damage was also not reflected in the price of products that directly or indirectly used fossil fuels.

In both of these cases, damage is caused, which detracts from income growth, but the lack of an explicit market price (associated with CFC and carbon emissions) means that economic harm is poorly measured, or not measured at all (box 1.6).

Box 1.6 – Accounting for the environmental impact of carbon emissions: a stylised example

Some economists have experimented with applying a hypothetical market price to certain environmental outcomes to investigate the potential impact on economic outcomes. An example of this for Australia is putting a hypothetical price on carbon dioxide emissions (a price or cost per tonne of emissions) with an eye to estimating an 'emissions cost', which could then be deducted from real GDP per capita (figure).

Imputing a price to carbon emissions has the effect of reducing the estimate of past GDP but increasing the estimate of recent GDP growth. In other words, the failure to count carbon emissions as a cost has led in the past to an over-estimate of GDP levels and an underestimate of GDP growth, as carbon emissions fell between 2000 and 2020. For modest carbon price assumptions, these differences are relatively small.

This hypothetical example is an accounting exercise and does not purport to measure the economic impacts of an actual carbon price. It does not necessarily imply that if an actual carbon price had been imposed on the Australian economy in 2000 that incomes — and wellbeing — would have been lower.

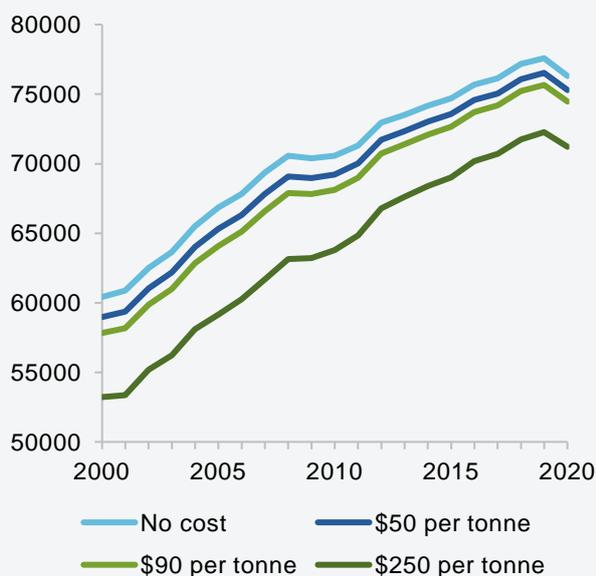
¹⁰ This can be problematic when outputs, either directly (cigarettes and alcohol) or indirectly (pollution), detract from income and harm wellbeing. Similarly, regulations that, for example, lock up natural environments in the absence of a market price carries an opportunity cost that may, to the extent that it bans productive uses, also detract from well-being.

Box 1.6 – Accounting for the environmental impact of carbon emissions: a stylised example

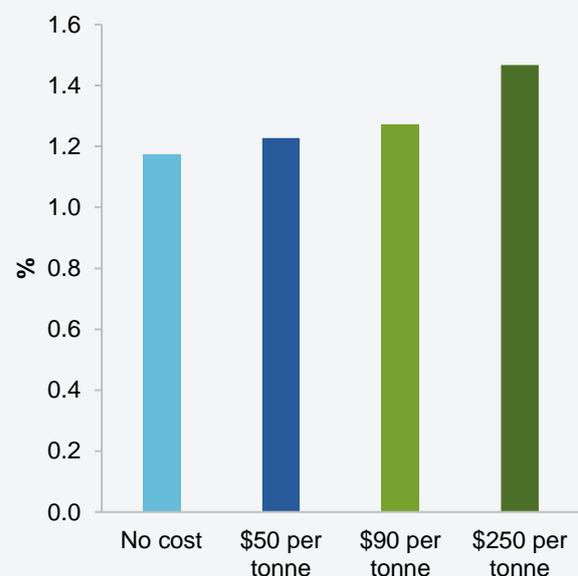
Rather the examples serve to demonstrate the benefits of having a more complete view of the environmental impact of growth, either incorporated in or as a supplement to, measures of average income. The example also assumes that Australia can wholly capture the benefits (and costs) of any emissions reductions undertaken here. But ‘carbon leakage’ and offsetting actions by other countries means this is unlikely the case. Moreover, because we do not know the cost of reducing emissions in the past, we do not know whether we could have been better off by not cutting emissions as much as we have. In other words, we do not know the net benefits of cutting emissions.

Accounting for carbon emissions decreases the measured level of incomes but increases measured growth rates^a

a. GDP per capita levels



b. GDP per capita annual growth (1999-00 to 2019-20)



a. The value of a tonne of carbon dioxide emissions is assumed to be constant over time.

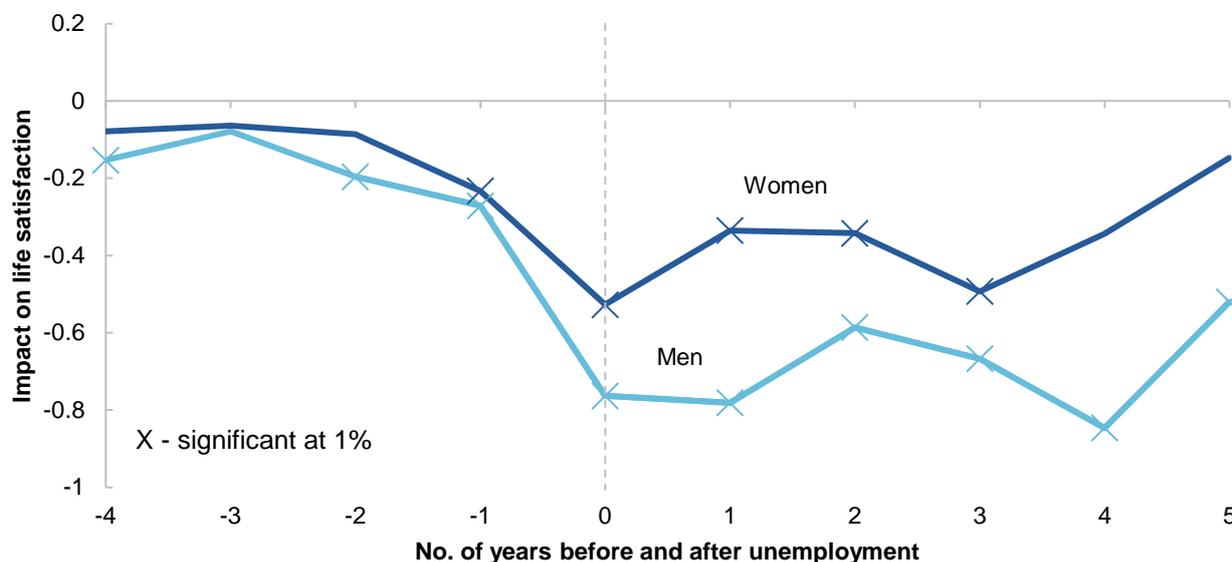
Source: Productivity Commission estimates using ABS (*Australian System of National Accounts*, 2019-20 financial year, Cat. no. 5204.0, table 1); DISER (2021).

Productivity can be an imperfect reflection of wellbeing

Productivity statistics are not designed to explicitly measure wellbeing. While productivity growth equates to higher real wages and higher consumption on average, most people consider their well-being with reference to more than just the volume of goods and services that they can purchase.

Quality of personal relationships, a sense of fulfilment in life, mental health status, all play a role in how individuals rate their subjective well-being. The well-being of individuals is a function of their *own* economic outcomes (figure 1.9) but can also be related to their perception of the economic outcomes experienced by other people — for example, whether or not they perceive equality or fairness in the distribution of economic resources throughout society.

Figure 1.9 – The effect of unemployment on life satisfaction^a



a. Reproduced from analysis of data from the German Socio-Economic Panel Study between 1984 and 2003. Life satisfaction is measured on a 10-point scale.

Source: Clark et al (2008).

While productivity is not a direct measure of well-being, in practice it is a key input and often a correlate. The level of productivity across countries correlates with numerous measures of well-being and environmental outcomes (figure 1.10). Countries with higher productivity tend to have longer life expectancies, rate their life satisfaction higher and have lower levels of income and wealth inequality.¹¹

The positive cross-country correlation between productivity and various measures of well-being likely reflects that many measures are in fact highly correlated with material wealth and relative abundance. That is, productivity improvements explicitly (for example, health related innovations that prolong life) and implicitly improve well-being by creating additional income for given amounts of effort.

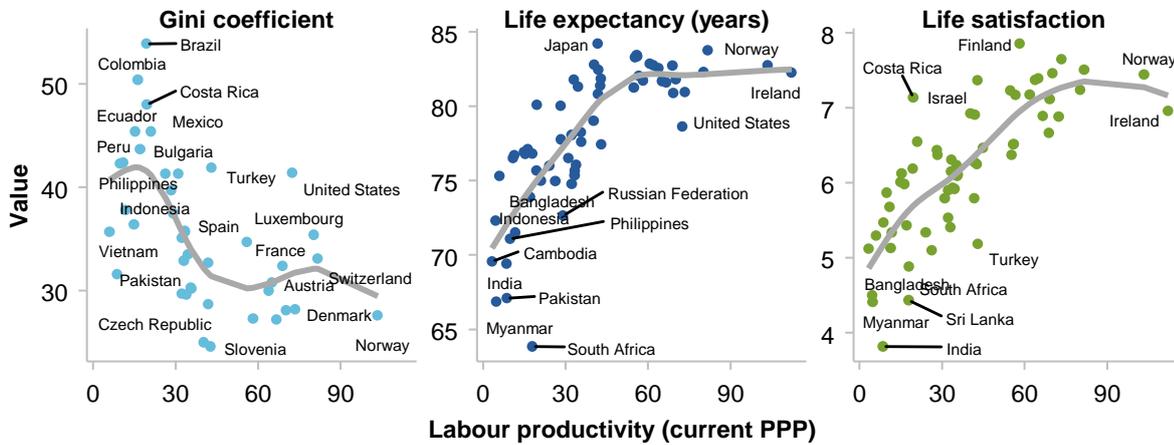
This means the productivity dividend has potential to ‘lift all boats’. It can be redirected by individuals into consumption of goods and services that directly improve their own subjective well-being, and by businesses and entrepreneurs into innovation and further investment. But governments can also redirect the dividend on behalf of the community into areas that improve well-being for those who for whatever reason, may not directly benefit from productivity growth (unemployment benefits, publicly funded education and health care). In this way, productivity growth is a positive policy objective.

To a certain degree, welfare improvement may be better assessed not by jettisoning traditional productivity estimates but by considering a broad suite of welfare indicators in addition to productivity and income, such as measures of inequality or disadvantage for particular groups.

¹¹ For some measures of wellbeing, such as subjective happiness, the story is less conclusive, with some arguing that the correlation can be negative across time within the same country (for example Easterlin et al. 2010; Easterlin and O’Connor 2020; Stevenson and Wolfers 2008).

Figure 1.10 – Productivity correlates with many other policy objectives^{a,b}

Cross country comparison of labour productivity (current PPP) against various measures of policy objectives for 2019



a. Gini index ranges from 0 to 100 (higher is more unequal) and life satisfaction ranges from 0 to 10. **b.** Solid line is line of best fit using a natural spline.

Source: Productivity Commission estimates using Feenstra, Inklaar and Timmer (2015).



Finding 2.7

Productivity provides the resources to improve wellbeing

Productivity growth is an imperfect measure of wellbeing, but higher productivity growth means more opportunities for individuals, businesses and government to devote resources to directly improving wellbeing.

2. Forces shaping Australia's productivity challenge

Key points

- ✳️ **Australian productivity growth is at its lowest rate in 60 years. This broad-based slowdown has been observed across advanced economies.**
 - Australia's productivity performance in the goods sector, including mining and agriculture, is consistently strong when compared with global peers. Australia's services — which employs almost 90% of Australian workers and accounts for about 80% of economic activity — are comparatively less productive.
 - Australia has slipped down the productivity rankings recently and has instead maintained its rich country status largely through increasing the share of people in the workforce.
- ✳️ **The Australian economy faces challenges bouncing back from its recent poor productivity performance. These include:**
 - Continuing increase in the size of the services sector, where productivity growth has historically been more difficult to achieve than in the traditional goods sectors (e.g. mining, manufacturing and agriculture).
 - A fast growing, government funded and regulated, non-market services sector (e.g. aged care, schools, childcare and disability services), where a lack of competition and contestability can mask underperformance and the freedom to innovate and the sharing of new approaches can be limited.
 - Impacts of climate change and the task of decarbonising the Australian economy in line with international commitments.
 - Threats to open and flexible international markets for trade, capital and labour — which has benefited Australia enormously in the past — as some countries turn inwards in the face of increasing global tensions.
- ✳️ **COVID-19 prompted an acceleration in the uptake of digital technologies across the Australian economy and showed that when governments, businesses and households worked together they could adapt quickly, including to remove long standing productivity bottlenecks.**
- ✳️ **As the economy evolves in the wake of COVID-19, increased digital capacity could lead to a productivity dividend, particular in the services sector. Taking advantage of the opportunities afforded by digital technology — such as online service delivery, artificial intelligence and data analytics — will require:**
 - governments and businesses continuing to adopt and adapt innovative business models.
 - a suitably skilled workforce (and training infrastructure) adept in non-routine tasks.
 - access to data, much of which is collected through businesses reliant on funding or regulation of governments, is not unduly locked down.

Australia has maintained its position as a relatively high income, high living standard economy for the past 200 years thanks to consistent, long-term growth in productivity. However, over the past decade, in line with most advanced economies, Australia's rate of productivity growth has slowed significantly. Indeed, the Australian government has officially acknowledged the productivity slowdown, reducing the productivity assumption underlying its annual economic forecasts from 1.5% to 1.2% (box 2.1).

Several contemporary forces will likely shape productivity growth in the future — as well as influencing whether, and to what extent, the economy can bounce back from this slowdown.

- A growing services sector: The Australian economy, like most other advanced economies, is now dominated by services, which account for about 80% of production and 90% of employment. Historically at least, achieving productivity growth has been relatively difficult in services, particularly when compared with the rapid gains seen in the more traditional goods industries, such as agriculture, manufacturing and mining. Some of the most significant areas of services delivery are those — such as healthcare, aged care, disability support and education — that are heavily regulated and have a substantial reliance on government funding.
- The recovery from COVID-19: The pandemic has highlighted deficiencies in digital infrastructure and how a lack of effective co-operation between governments, businesses and households in Australia can hobble the economy during a crisis. Changing priorities during the pandemic highlighted the need for consistent institutional structures and an adaptable workforce, while the labour shortages in the wake of the pandemic bring a greater focus on investment in labour-saving technology.
- Decarbonisation: Australia is richly endowed with fossil fuel-based resources, but the economy — and the country more broadly — is highly exposed to downside risks associated with climate change. Decarbonising the economy in line with international commitments over the next thirty years will have a non-trivial bearing on productivity outcomes.

Box 2.1 – The projected impact of slower productivity growth on income and leisure

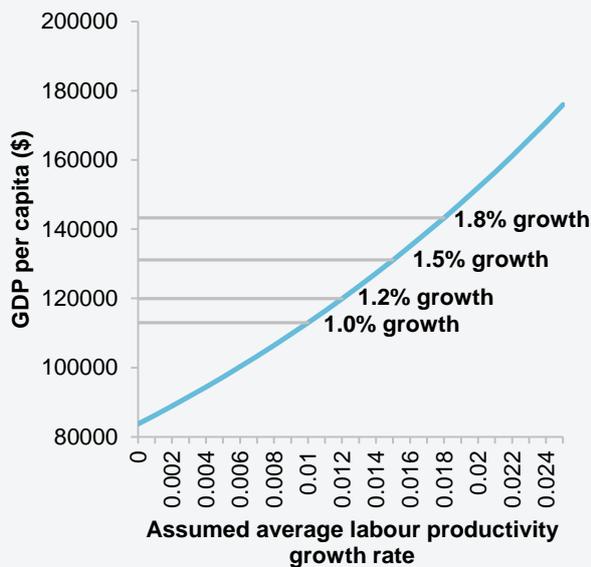
In the 2022-23 Australian Government Budget the productivity assumption was revised down to 1.2% from 1.5% (Commonwealth of Australia 2022).

This seemingly trivial downgrade implies that for average Australians, future incomes over the next 40 years (the timeline considered in the Australian Government's Intergenerational Report) are projected to be almost 20% lower than they would otherwise be.

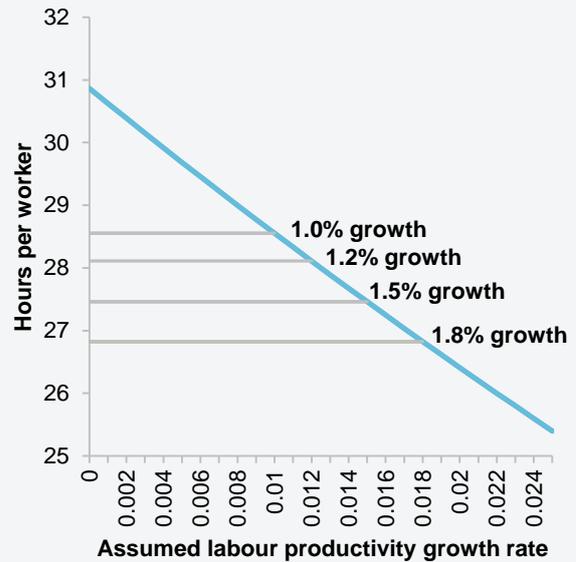
And compared with the average over the past 60 years (1.8%), 1.2% productivity growth implies about 40% less growth in projected future incomes and the working week will be 5% longer (figures).¹

Box 2.1 – The projected impact of slower productivity growth on income and leisure

a. GDP per capita in 2061-62 for different rates of average productivity growth^a



b. Average hours per worker in 2062 for different rates of productivity growth^a



a. Estimates of GDP in 2021-22 taken from national accounts, estimates of hours worked taken from Labour Account while estimates of employment taken from Labour Force Survey.

Source: Commission estimates using ABS (*Australian System of National Accounts*, 2021-22 financial year, Cat. no. 5204.0, table 1; *Labour Account Australia*, June 2022, Cat. no. 6150.0.55.003, Industry summary table; *Labour Force, Australia*, October 2022, Cat. no. 6202.0, table 1).

¹ These projections are based on assumptions for forecasting incomes, productivity and working hours in 2062.

- The roles of capital deepening and multifactor productivity in driving labour productivity growth have not been separately delineated. Relatedly, this model only considers gross measures (such as GDP and labour productivity), and so the role of depreciation in decreasing incomes will not be considered.
- The employment to population ratio is the same as its present value. This is similar to the forecasts in the Intergenerational Report, which have participation rates falling from 66.3% to 63.6% between 2021 and 2061 (Commonwealth of Australia 2021, p. 35)).
- While the number of employees is fixed exogenously, working hours per worker decrease proportionally with labour productivity about the rate at which they have since 1950. Historically, for every 10% increase in labour productivity, average hours per worker fall about 2% (estimated using Feenstra, Inklaar and Timmer (2015)). This assumption was used to forecast average working hours given.
- The role of international borrowing and investing as well as the terms of trade have been ignored.

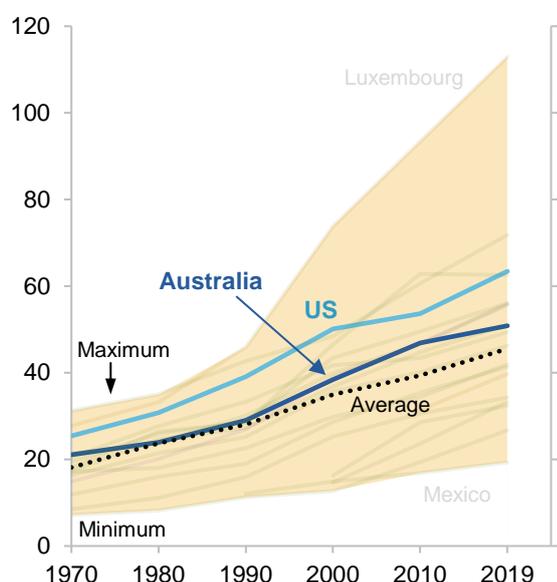
2.1 Australia's recent productivity performance

Consistent, but overall, not world leading ...

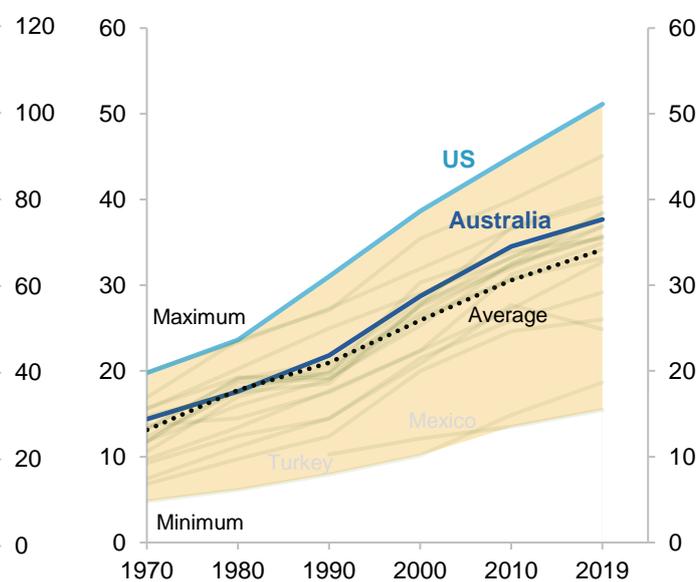
The Australian economy has maintained a relatively high standard of living throughout the past hundred or so years. More recently, over the past five decades Australia has experienced healthy growth in real incomes — up 250% between 1970 and 2019 (figure 2.1) — and today, Australia remains a relatively rich economy with consumption levels well above average.

Figure 2.1 – Income and consumption amongst OECD economies

a. GDP per capita^a (\$'000s)



b. Consumption per capita (\$'000s)^{a,b}



a. OECD membership has changed over time. To reflect this, the group of countries included in the 'OECD' calculations here changes based on the nearest decade at which the country ratified membership. Measured at chained PPPs in million 2017US\$ using data from 2019. OECD average is weighted by country population. **b.** Consumption is real consumption of households and government, at current PPPs (in mil. 2017US\$).

Source: Feenstra, Inklaar and Timmer (2015).

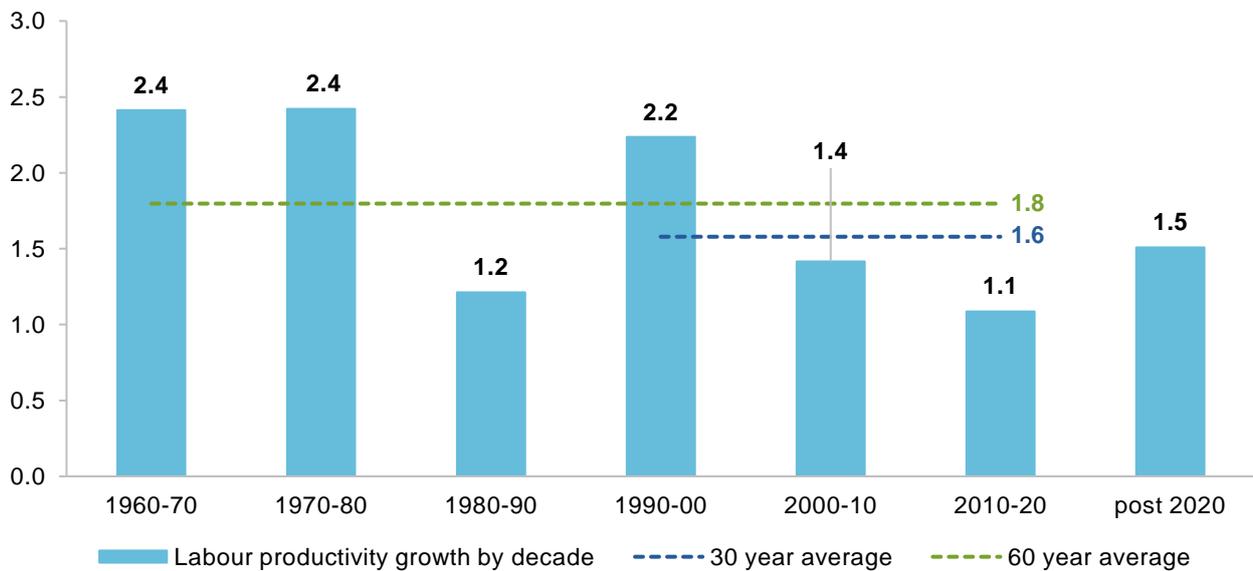
Despite its strong income and consumption performance, Australia's productivity growth has slowed significantly in the past decade, falling to its lowest rate since the 1970s (figure 2.2). To put this in perspective, if, over the decade, productivity had instead grown at an annual rate consistent with the average over the past 60 years (1.7% compared with 1.1%), gross national income per person would have been about \$4 600 higher (6%) in 2020 (ABS 2021a).

Australia's performance should be placed in a global context. There has been a widespread and sizable slowdown in productivity growth across most advanced economies recently.¹² For example, average

¹² Exactly why productivity growth has slowed is contested, as are the implications for future growth. The economics literature identifies a number of potential culprits, which range from measurement error to fundamental changes in the structure of the economy. Key sources include Gordon (2018), Mokyr (2018) and Syverson (2017).

productivity growth among OECD economies since 2005 was about one percentage point per annum below the historical average (figure 2.3).¹³

Figure 2.2 – Australia's labour productivity growth in the past decade has been the slowest in 60 years^{a,b,c}



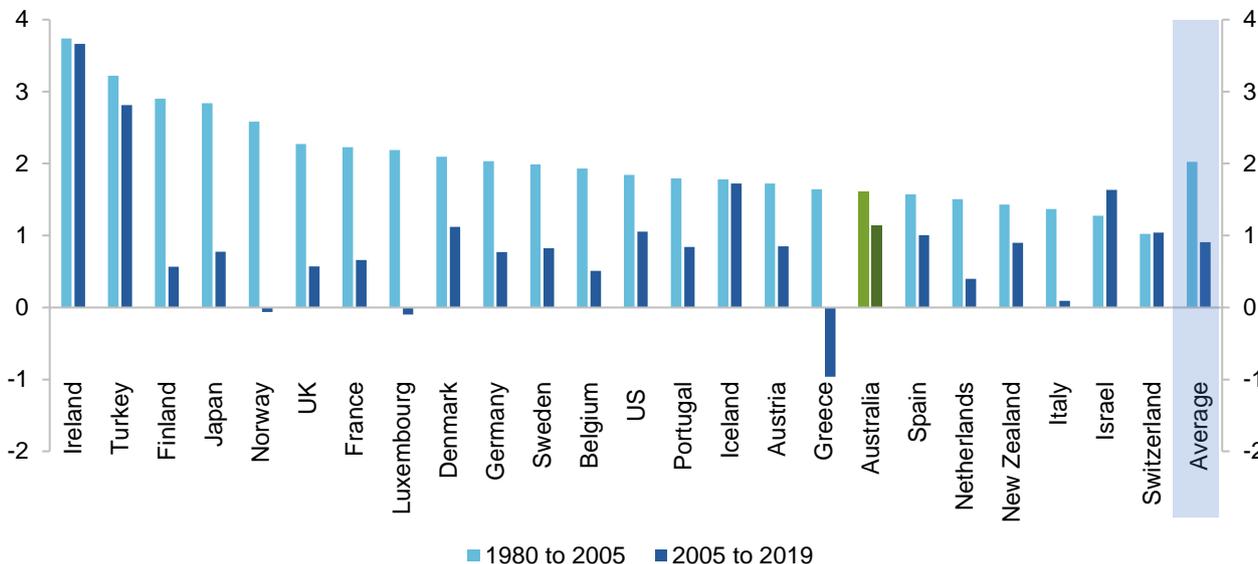
a. Labour hours from 1960 to 1980 come from the Penn World Tables. **b.** All years are the financial year ending in that year. So the range 1960–1970 is actually 1959–60 to 1969–70 but has been shortened for readability. **c.** The period averages are based on the 2021 ABS Annual National Accounts. The average annual productivity growth rate over 30 years to June 2020 is 1.6%, compared with 1.5% reported in the 2021 Intergenerational report (Commonwealth of Australia 2021) for the 30 years to June 2019.

Source: Productivity Commission estimates using ABS (*Australian System of National Accounts*, 2020-21 financial year, Cat. no. 5204.0, table 1); Feenstra, Inklaar and Timmer (2015).

¹³ From a global perspective, the slowdown is particularly evident in advanced economies; developing countries are growing faster than ever before. In fact, global income growth is currently the fastest it has ever been, with the living standards of some of the world's poorest countries improving at the fastest rate on record (Bolt and van Zanden 2020).

Figure 2.3 – Most OECD countries have experienced a productivity slowdown^a

Labour productivity growth in OECD countries (%)



a. Includes only the 24 longest standing OECD countries. For some countries, the average growth rate between 1980 and 2005 could not be calculated due to missing data for the 1980s. Countries where the average growth rate was calculated for a narrow window were: Austria (1995 to 2005), Greece (1983 to 2005) and Israel (1981 to 2005).

Source: OECD (2022b).



Finding 2.8

Productivity is growing at its slowest rate in 60 years

Australia’s productivity is growing at its lowest rate in 60 years, consistent with a broad-based slowdown in productivity growth among advanced economies.

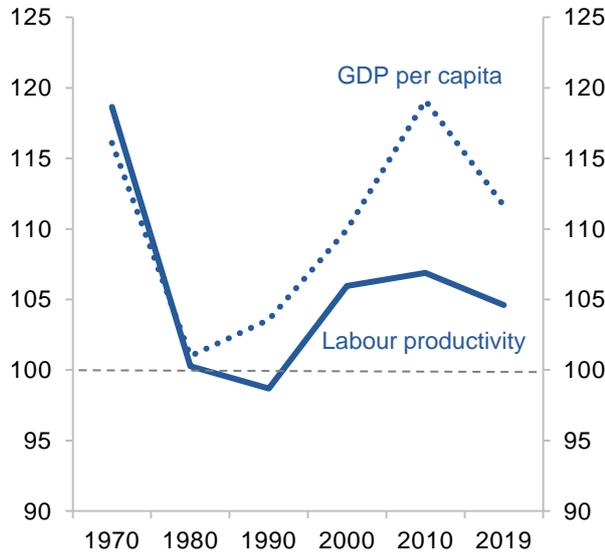
Despite maintaining a high income ranking since the 1970s, there has been a long-term decline in Australia’s relative labour productivity growth performance. Labour productivity has not recovered after falling behind in the three decades to 2000. Between 1970 and 2020, Australia’s labour productivity ranking fell ten places from sixth in the OECD, to sixteenth (figure 2.4).

Australia’s productivity is now about 22% lower than that of the United States — a country typically acknowledged as the ‘global frontier’ economy.

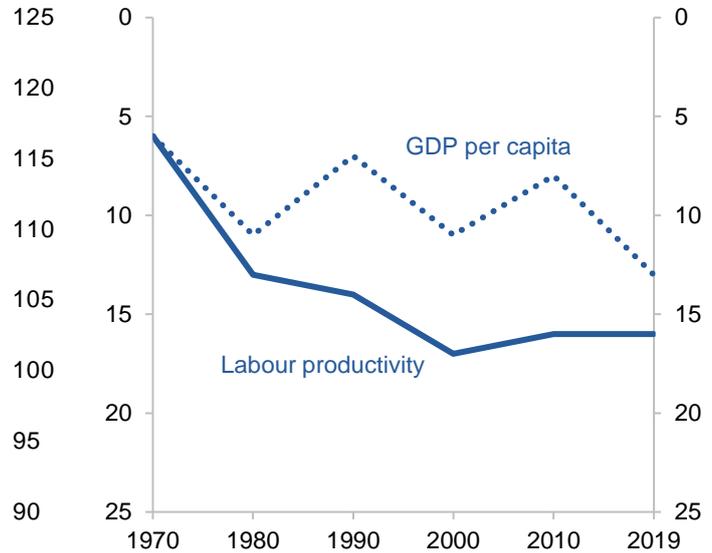
An important reason that the living standards of Australians have remained among the top tier advanced economies despite our middling productivity growth, is that a higher-than-average proportion of Australians work, and they work relatively long hours (figure 2.5).

Figure 2.4 – Australia's income position belies its middling productivity performance^a

a. GDP per capita and productivity % of OECD (OECD = 100)



b. Australia's GDP per capita and productivity by rank amongst OECD countries

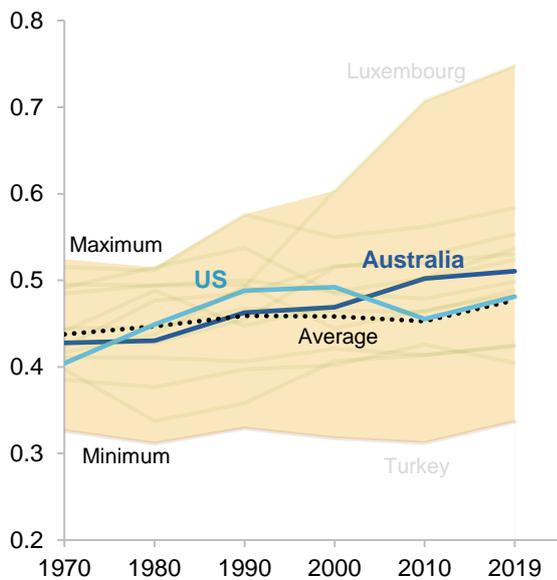


a. OECD membership has changed over time. To reflect this, the group of countries included in the 'OECD' calculations here changes based on the nearest decade at which the country ratified membership. Measured at chained PPPs in million 2017US\$ using data from 2019. OECD average is weighted by total hours.

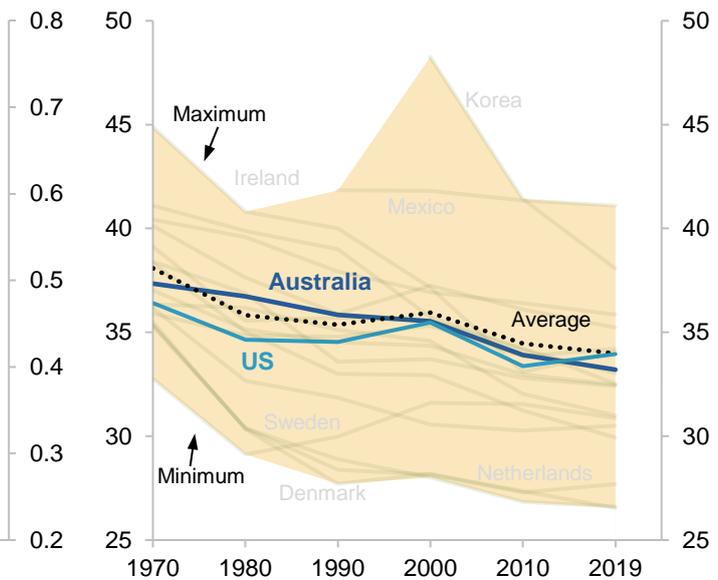
Source: Productivity Commission estimates using the Penn World Tables (eleventh edition).

Figure 2.5 – More Australians work, and they work longer hours^a

a. Employment to population ratio



b. Average weekly hours per worker



a. OECD membership has changed over time. To reflect this, the group of countries included in the 'OECD' calculations here changes based on the nearest decade at which the country ratified membership.

Source: Productivity Commission estimates using the Penn World Tables (eleventh edition).



Finding 2.9

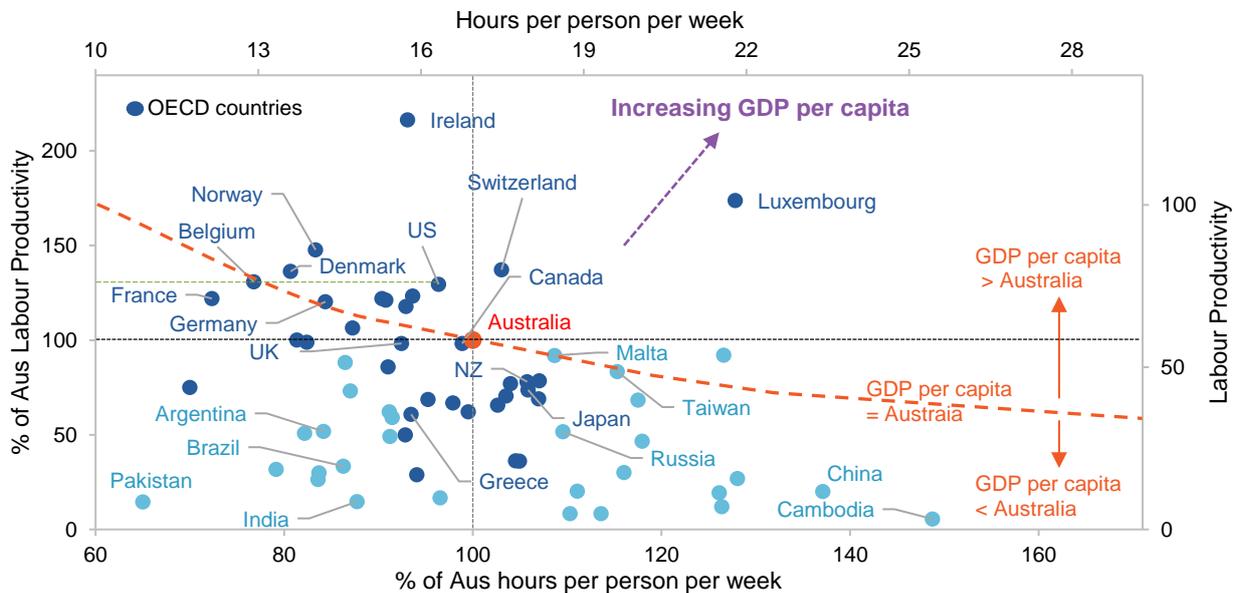
Increasing participation cannot substitute for sustained productivity growth

The increasing share of people in the workforce has shielded Australia from some of the effects of slowing productivity growth, but sustaining an ever-increasing share of people in the workforce (and maintaining their income levels) is neither possible nor desirable.

Australia’s employment to population ratio has increased since 1970, from 42% to 51%, moving from below the average to above the average in the OECD. (This is primarily due to a substantial increase in Australia’s female participation rate over the past 40 years, and a slight fall in the male participation rate (ABS 2022d)). Although average working hours in Australia fell by about 10%, or about 4 hours in the 5 decades to 2019, average hours amongst OECD peers fell more. In some European countries, such as Norway, Belgium and Denmark, average working hours fell by as much as 25% or more, or the equivalent of an entire standard working day for a full-time worker in Australia today (figure 2.6).¹⁴

On a per capita basis, Australians work longer hours than about 60% of their OECD peers. This maintains a relatively high level of GDP per capita (figure 2.6).

Figure 2.6 – Labour productivity and hours worked per head of population^a



a. Labour productivity is GDP per hour worked measured at chained PPPs in 2017US\$.

Source: Productivity Commission estimates using the Feenstra, Inklaar and Timmer (2015).

¹⁴ When making comparisons (and finding ‘learnings’) between Australia and other countries it is important to take the effect of labour utilisation into account. For example, some countries (e.g. France) with higher levels of labour productivity than Australia appear to have labour markets that exclude marginal members of the workforce (lower participation and higher unemployment) and prevent workers from working longer hours where they might be less productive (by restricting the length of the working week). Tax and other policy settings also affect labour utilisation and participation. In some countries, higher measured productivity levels could be the result of policy settings which prevent less productive workers from participating in the labour market.

In principle, if Australia could close the relative productivity gap it would bring significant benefits for the average Australian in line with the productivity dividend described in chapter 1 (box 1.4). For example:

- if Australia's labour productivity were at the same level as Belgium — a country with a very similar GDP per capita to Australia (the dashed line in figure 2.6) — Australian's per capita hours worked could be about 4 hours fewer per week without any reduction in income. This would translate to about one fewer day per week for each working Australian, other things equal — a leisure dividend
- alternatively, with a shift in productivity such that it was in line with Belgium, but with a more modest reduction in hours worked — about 0.5 hours fewer per capita, or just over an hour per week for the average Australian worker — Australia's GDP per capita would increase by about 25%, in line with the average American — a consumption dividend (figure 2.6).



Finding 2.10

Closing the productivity gap requires working smarter

Closing the productivity gap to our OECD peers requires working smarter so that Australia can have higher GDP per capita without having to work longer.

Goods sector productivity is strong, but services continue to lag

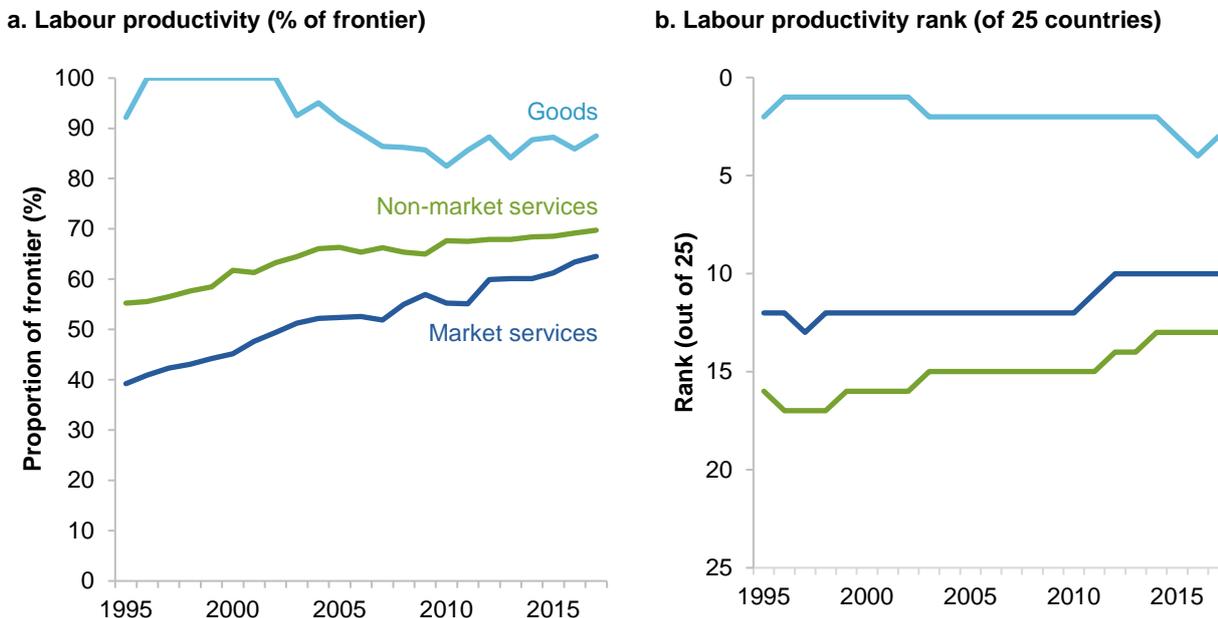
Australia's goods sector has performed relatively well over the past two decades when compared with European countries, the United States and Japan (figure 2.7).¹⁵ The relative performance of the services sector is less impressive, but both sub-sectors (non-market and market) are steadily improving.

Breaking each sector into its component parts shows that in the goods sector, agriculture and mining consistently perform at, or within, the top 5 countries. The ranking for the manufacturing sector — which accounts for about 5% of the Australian economy — has continued to slide after the peak of the mining investment boom in the early 2010s.¹⁶

¹⁵ Cross-country, industry-level, labour productivity statistics are constructed by estimating industry-level purchasing power parity (PPP) adjustments using the most recent internationally available estimates from 2014. These estimates should be interpreted cautiously. Aggregated results (whole economy or sector level) are more reliable than industry-level results due to the uncertainty regarding the pricing differences across countries for particular products and industries. Further, the relative ranking of countries is more robust than the particular estimates themselves. This has been confirmed in comparisons of multi-country productivity datasets which vary significantly in their absolute (and growth) estimates but vary little in their rankings of different countries.

¹⁶ The cause of this decline may be related to 'Dutch Disease', associated with the mining investment boom whereby the strong resources sector raises the value of the Australian dollar and reduces the relative competitiveness of the manufacturing sector.

Figure 2.7 – Australia’s labour productivity performance is strong for goods, but much weaker — although improving — for services^{a,b,c,d}

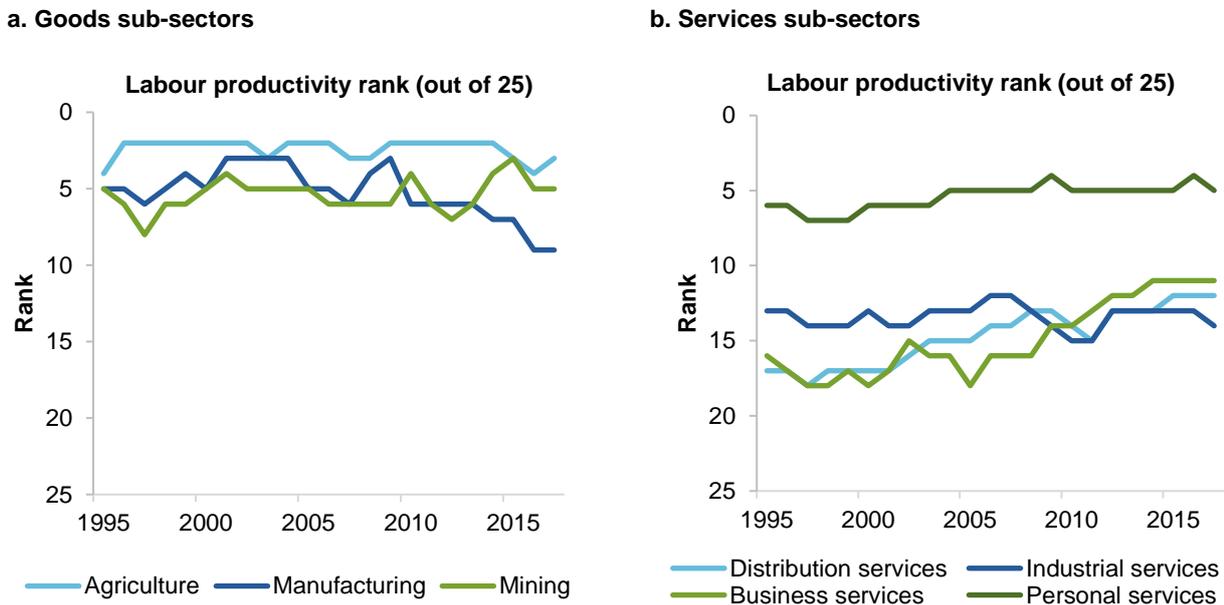


a. ‘Frontier country’ refers to the country with the highest labour productivity in a particular industry or sector in a particular year. Using the frontier country as a benchmark leads to more stable results than a constant benchmark country (e.g. the United States). **b.** Goods encompass manufacturing, mining and agriculture; market services includes all services other than non-market services and non-market services are education, health care and public administration and defence. **c.** The comparator set includes 25 countries, 21 of which are in the OECD (Australia, Austria, Belgium, Bulgaria, Cyprus, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Croatia, Hungary, Ireland, Italy, Japan, Lithuania, Luxembourg, Latvia, Malta, Poland, Slovenia, Sweden and the United States) plus Bulgaria, Cyprus, Croatia and Malta. Data limitations make comparisons to a broader array of countries difficult. **d.** The PPP benchmark year is 2014, these level estimates were then extrapolated using estimates of labour productivity growth. This means results closer to the 2014 benchmark year are more reliable than those well before or well after this date.

Source: Productivity Commission estimates using the World Input Output Tables, UN Comtrade data and unpublished data from the World Bank International Comparisons Program.

Services are characterised by a clear separation in relative performance between *personal services* (such as hotels, cafes and gyms), which ranks consistently in the top 5 countries, and the *professional, non-market and distribution services*, where performance is improving (in the face of the broader advanced economy productivity slowdown) but remains outside the top 10 (figure 2.8).

Figure 2.8 – Manufacturing and industrial services are Australia's productivity laggards



a. Distribution services are transport and postal, IT and telecommunications and retail and whole trade; industrial services are construction and utilities; personal services are food and accommodation and arts and recreation; and professional services are professional, scientific and technical services, real estate, finance and administration and support services. **b.** See notes c and d in figure 2.7.

Source: Productivity Commission estimates using the World Input Output Tables, UN Comtrade data and unpublished data from the World Bank International Comparisons Program.



Finding 2.11

Australia's relative productivity is high in goods but low in services

Australia's relative global productivity performance is strong in the goods sector, which includes mining and agriculture. Services are comparatively less productive on average, but our rankings are improving.

2.2 Forces shaping future productivity growth

As Australia continues to become a more services-centric economy, real wages and national welfare will be increasingly dependent on services sector productivity. But driving productivity growth in (at least parts of) the services sector has, on average, been more difficult compared with the goods sector, which includes agriculture, manufacturing and mining.

In addition to the ongoing challenges presented by climate change and transitioning to a lower carbon economy, the global pandemic has disrupted production processes and service delivery in many industries. In some cases this has led to productivity gains but maintaining this momentum as Australia recovers from COVID-19, and embedding innovation over the long term, represent further productivity challenges.

The dominance of services

The services sector defies definition as it covers such a broad array of products from brick laying to neurosurgery. *The Economist* quipped that services are ‘products of economic activity that you can’t drop on your foot’ (The Economist nd). The services sector is by far the largest part of the Australian economy — almost 90% of Australian workers are employed in the services sector and it accounts for a little more than 80% of economic activity.¹⁷ Both of these figures have grown significantly over the past 70 years — from about 50% in 1950 (PC 2021b, p. 6).

The general increase in the overall size of the services sector, while the goods sector (agriculture, mining and manufacturing) has contracted, is a typical characteristic of the course of economic development in countries (PC 2021b, pp. 5, 7).

Over the past 35 years in Australia, the expansion of employment in the services sector has been mainly in government subsidised and regulated ‘non-market’ services — in particular, health care and social assistance — but also business services. Employment in distribution services (retail and wholesale trade, transportation and warehousing) has contracted. The pattern is slightly different when viewed as a share of the economy: the economic contribution of the difficult-to-measure non-market services has plateaued while the contribution of business services has increased in line with their share of employment (figure 2.9).¹⁸

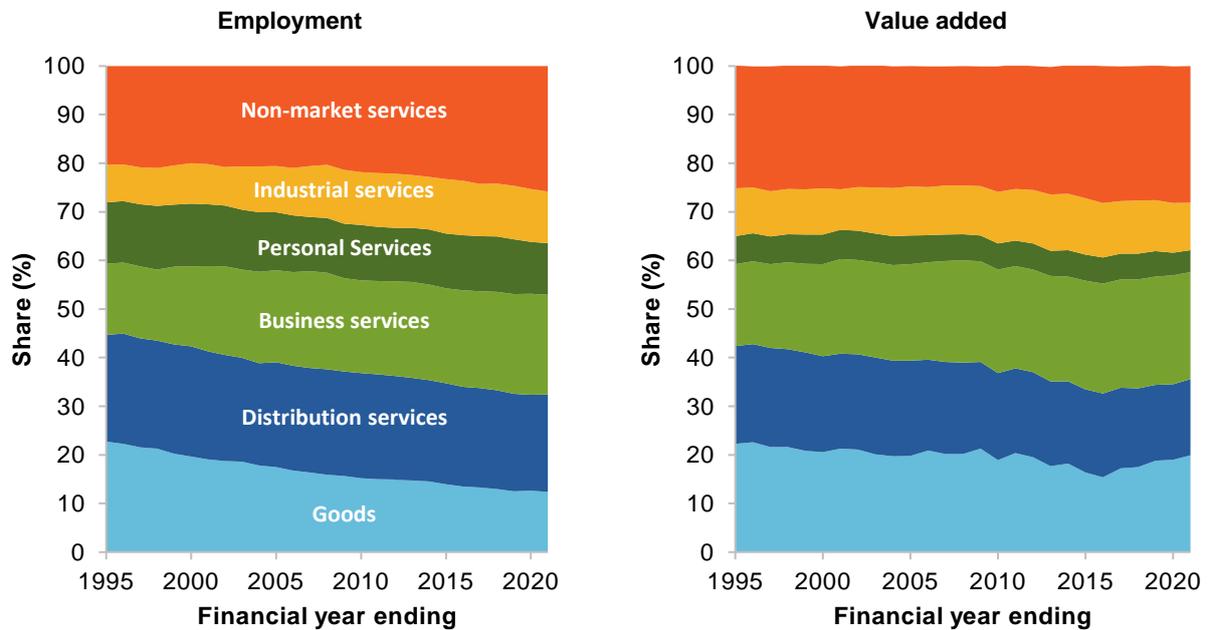
¹⁷ The ABS (2013b, 2019b) defines services as all products in the following divisions of the Australian and New Zealand Standard Industry Classification 2006: The Electricity, Gas, Water And Waste Services (Division D), Construction (Division E), Wholesale Trade (Division F), Retail Trade (Division G), Accommodation And Food Services (Division H), Transport, Postal And Warehousing (Division I), Information Media And Telecommunications (Division J), Financial And Insurance Services (Division K), Rental, Hiring And Real Estate Services (Division L), Professional, Scientific And Technical Services (Division M), Administrative And Support Services (Division N), Public Administration And Safety (Division O), Education And Training (Division P), Health Care And Social Assistance (Division Q), Arts And Recreation Services (Division R), and Other Services (Division S). Services also include Agriculture, Forestry and Fishing Support Services (otherwise part of Agriculture (Division A)); and Exploration and Mining Support Services (otherwise part of Mining (Division B)). The goods sector includes Agriculture, Mining and Manufacturing (Division C) except for Forestry and Fishing Support Services, and Exploration and Mining Support Services.

In this report, each services division is subsequently aggregated into five categories (a slight modification to the categorisation used in Connolly and Lewis (2010)): 1. Business, (Division K-N); 2. Industrial (Divisions D & E); 3. Personal (Divisions H, R & S); 4. Non-market (Divisions O-Q); 5. Distribution (Divisions F, G, I & J).

¹⁸ The productivity of the non-market sector is not regularly reported as part of the national accounts process because there are no market prices — a key building block in measuring productivity. Some irregular experimental measures of multifactor productivity are available for the hospital, higher education and schools sectors, and are very limited in their usefulness, not least because they are largely based on output measures — for example, in the hospital sector, number of diseases treated (PC 2017b).

Figure 2.9 – The increase in the share of the services sector is largely attributable to non-market and business services^{a,b}

Goods sector and services subsector shares of total employment and total gross value added



a. Employment is weighted by hours worked rather than a simple headcount of employees. **b.** See footnote 5 for a description of the categories.

Source: PC (2021b).

The services sector rise reflects our growing prosperity

The rise of the services sector is symptomatic of rising prosperity and productivity growth more broadly.

First, as economy-wide productivity has increased, higher incomes have led to more consumption of services compared with goods (that is, services demand is relatively responsive to income changes). Consumption of holidays, house-cleaning, afterschool care, gyms and home delivered food has grown faster than that of TVs, clothing and sports equipment (Beech et al. 2014).

Second, as productivity growth in goods sectors (such as manufacturing) outstripped the services sector average, the relative price of services rose. This phenomenon is often referred to as 'cost disease', or less pejoratively, 'the Penn effect' (Baumol 1967; Vollrath 2017). Because demand for many services has proven to be relatively unresponsive to price increases, overall spending on services has grown relative to spending on goods. On the supply side, the resources freed up by higher goods sector productivity flowed into the services sector, where productivity growth has been harder to achieve.¹⁹ That is, high productivity growth in 'progressive' sectors has led to a shift of labour and other resources to the less progressive sectors (i.e. those sectors with low productivity growth), which grow as a share of the economy overall. This in turn slows the overall rate of productivity growth across the economy. As economist Charles Jones (2021, p. 31) put it, 'Economic growth is determined not by what we are good at but rather by what is essential and yet hard to improve.'

¹⁹ Given the enormous diversity in services, cost disease does not affect all of them. Some services have not seen significant growth in consumption or prices as the economy has grown either because these services have productivity growth similar to the goods sector (such as distribution services or business services, discussed below) or because demand for these services is not closely tied to income growth, or rather it is responsive to price increases.

Hence, in many respects, the rise of the service sector is really the story of the decline in the relative share of the goods sector as the good sector has become more productive. A stark example of this is the agriculture sector, which has seen large increases in productivity while its share of the labour force has declined (box 2.2).

While the term ‘cost disease’ has negative connotations, it is arguably just a product of rising prosperity and productivity growth in some sectors of the economy.²⁰ So long as other parts of the economy demonstrate the twin properties of demand growing with income and productivity being slower than the economy-wide average, that part of the economy will tend towards some degree of cost disease.

But this does not make slow future productivity growth inevitable. It is simply the context for the productivity challenge. As long as the economy can continually evolve, finding new ways to innovate and raise productivity in those lagging (but growing) sectors, ongoing productivity and income growth is possible.

Box 2.2 – Will services productivity follow the path of agriculture?

At the beginning of the twentieth century, about 25% of all Australian employees — 371 000 people — worked in the agriculture sector. Collectively, this workforce produced just over 1 million tonnes of wheat, 239 million kg of wool and included about 9.4 million head of cattle. Flash forward to the end of the century and about 5% of Australian employees — 348 000 people — worked in the agriculture sector. But this workforce (and a lot of machines) now managed to produce almost 25 times more wheat (25 million tonnes) and over two and half times as much wool and head of cattle (642 million kg and 28 million head respectively). This smaller agricultural workforce is also both working more land and making the land they use more productive. In 1900, two hectares of land was required to produce about one tonne wheat, while in 2000 producing a tonne of wheat required about half a hectare of land — that is, the yield quadrupled.

A contracting agricultural workforce is not unique to Australia. In 1500, about 60% of workers in (what is now) the United Kingdom were devoted to agricultural production compared with about 1% in 2019. But how has productivity in the agricultural sector led to such large shifts in the structure of the workforce in Australia and elsewhere?

The main reason agriculture has seen a falling share of employment and output while its productivity has increased is a manifestation of Baumol’s cost disease — a combination of relatively rapid productivity growth within agriculture compared with the rest of the economy combined with consumer preferences. As productivity growth in agriculture increased it became more profitable to replace people with machines — threshers, reapers and tractors do the work of dozens of people (and animals). The other reason is that as agricultural and economy-wide productivity improved, there was increased demand for non-agricultural goods and services that led to higher wages in these sectors, and so attracted the surplus labour from agriculture.

By reducing the amount of labour required in agricultural production, Australia has been able to effectively redeploy additional workers to meet demands for other important needs and wants — doctors, nurses, teachers and even baristas — which were largely unmet in a predominately agricultural economy.

²⁰ A point forcefully made in Dietrich Vollrath’s ‘Fully Grown’ (Vollrath 2019).

Box 2.2 – Will services productivity follow the path of agriculture?

Will services repeat the same trend?

As the services sector grows in importance, the question arises as to whether it (or at least parts of it) will repeat the pattern observed in agriculture. That is, will some part of services have rapidly expanding output while its workforce contracts?

We have already seen the agriculture story play out in parts of the service sector. In 2004, the largest US video rental store, Blockbuster, had about 84 000 employees globally while in 2021 the largest streaming service Netflix, which along with similar companies largely replaced video rental, had only 11 600 employees. At the same time, while official numbers are unavailable, the number of views of video content on Netflix in 2021 was almost certainly higher than the number views of rental videos back in 2004 (with a larger variety and easier access). A similar story has played out in offices with the uptake of computer word processing power — fewer people are employed as typists or secretaries, but far more pages of documents are produced.



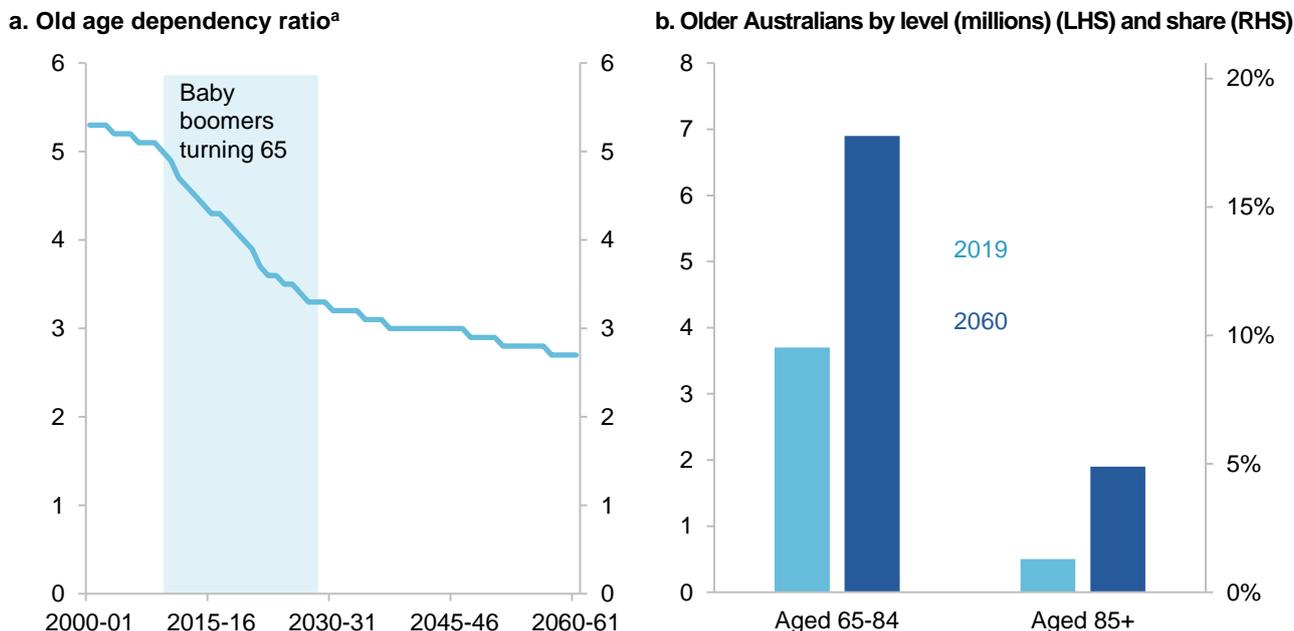
It remains to be seen how widespread the achievement of productivity improvements through similar such labour-saving approaches will be. But it is not obvious that these trends in labour use would necessarily be replicated in all parts of the services sector — particularly in services that involve non-routine tasks or non-cognitive experience — at least in the short term.

Source: ABS (2013a); Blockbuster Inc. (2004); Butlin (1969); Butlin, Dixon and Lloyd (2015); Netflix Inc. (2021); Roser (2013).

There are several other contributors to the increase in the share of the services sector. Global economic factors include the shift of the manufacturing base into East and South East Asia in the late twentieth century, which was driven by access to a large pool of relatively cheap labour. This shift was facilitated in Australia when domestic manufacturing was increasingly exposed to international trade via the removal of tariffs beginning in the 1960s. In some industries, outsourcing meant that a services component (such as sales or marketing) of what was a manufacturing operation, was outsourced and remained in Australia even after the manufacturing moved offshore.

Australia's aging population and shifts in other demographic factors contribute to an expanding services sector, especially the government run- and regulated non-market services. As our population ages, demand for health and aged care services increases, which is likely to weigh on productivity growth. The most recent Intergenerational Report projected that over the next 40 years the share of the population aged over 65 will increase to nearly 23% as the baby boomer generation ages (panel b figure 2.10). This will drive the dependency ratio — the ratio of working age people to non-working age people — down by almost a third, from 4 people today to 2.7 in 2060 (panel a figure 2.10). And consistent with the higher labour force participation of women, demand for childcare services is likely to at least keep pace with working age population growth.

Figure 2.10 – The aging population will further increase Australia’s services sector



a. Number of people of traditional working-age (15-64) for every person aged 65 and over.

Source: Commonwealth of Australia (2021).



Finding 2.12
Services dominate the economy

Similar to other advanced economies, the services sector dominates the Australian economy. This reflects both the impact of higher incomes on consumer preferences, and the fact that productivity gains have been harder to secure in many service industries — making services relatively more expensive. Australia’s industry structure also reflects our areas of comparative advantage (which for example, leads to a reliance on imported manufactured goods) and demographic factors such as an ageing population.

Productivity growth in services tends to lag the goods sector — though there is great variation

On average over the past 35 years, market-based measures of labour productivity have been higher in the goods sector than any subsector within the services sector (figure 2.11).²¹ But as discussed, services are highly diverse, including with respect to productivity growth.

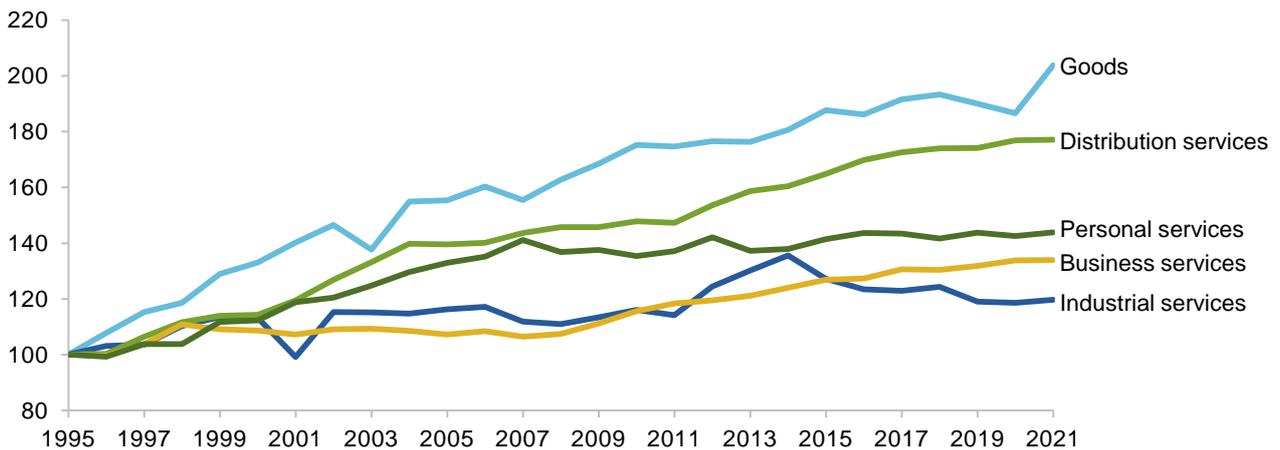
Since 1995, the services sub-sector with the fastest productivity growth was distribution services (which includes retail and wholesale trade, transportation and warehousing, and information media and

²¹ The figures in this section for the services subsector productivity performance differ from those presented in the ‘Things you can’t drop on your feet’ Productivity Insight report (2021b) due to data revisions by the ABS. These reflect, among other issues, the ABS’ move from the use of the labour account (from the labour survey) and revisions to several industries’ historical GVA estimates (ABS 2021b).

telecommunications). Growth in distribution services was about 7 times faster than in industrial services, the slowest growing sub-sector, but still about 15% slower than productivity growth in the goods sector.

Figure 2.11 – Labour productivity growth in Australia by subsector^{a,b}

Index (1995 = 100) between 1994-95 and 2020-21



a. Industries at the ANZSIC 1 digit level were aggregated into sectors by weighting the growth in labour productivity by the hours share of that industry (in the previous year). **b.** See footnote 17 for definition of services aggregation.

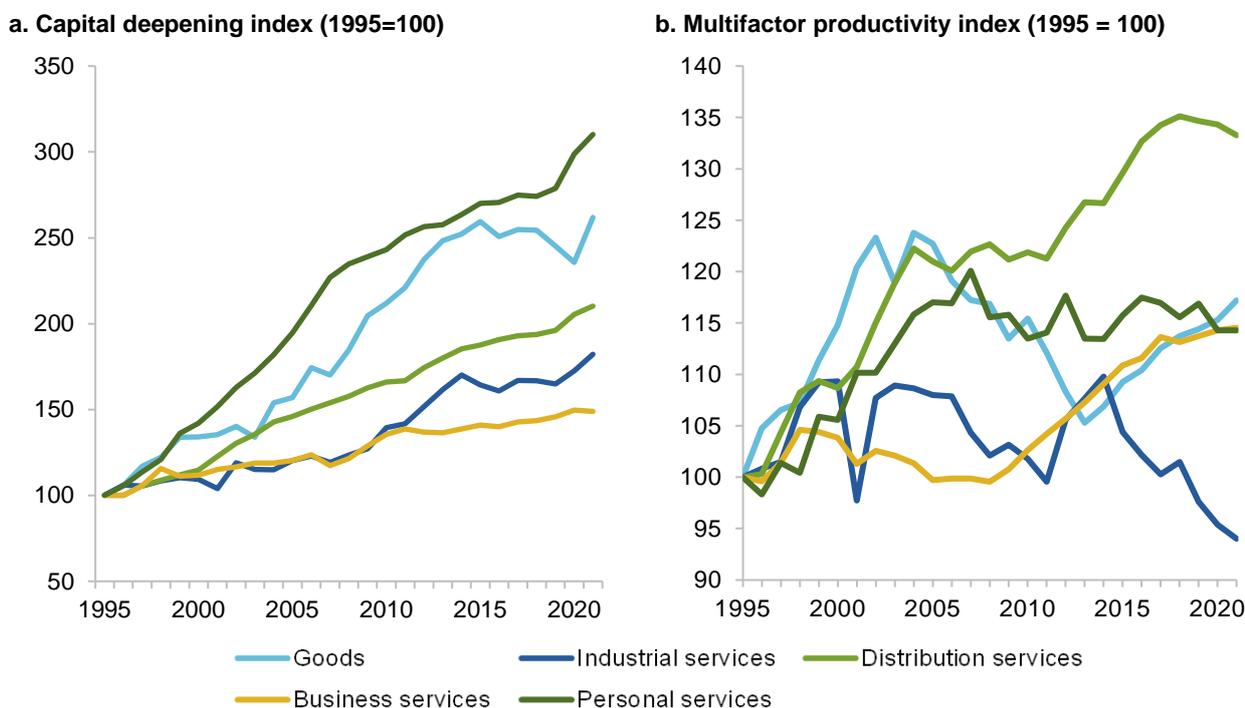
Source: Commission estimates using ABS (*Estimates of Industry Multifactor Productivity*, 2020-21 financial year, Cat. no. 5260.0.55.002, tables 1-19; *Labour Account Australia*, March 2022, Cat. no. 6150.0.55.003, Industry summary table).

The variation across sources of labour productivity growth — multifactor productivity (MFP) and capital deepening (appendix A.1) — for Australia's goods and services industries is significant (figure 2.12).

Since the mid-2000s, the goods sector's MFP growth has been broadly in line with most of the services sub-sectors but significantly slower than for distribution services — where average annual MFP growth was fastest. Ironically, given the broader upside benefits to Australia, a significant driver of the relatively slow goods sector MFP growth was the mining sector. The price shock that caused a terms of trade boom in the 2000s (box 1.3) made extraction of resources from low productivity mines profitable and led to a massive capacity expansion characterised by investment in infrastructure with long, unproductive lead times.

Apart from personal services, which has seen the fastest capital deepening of any subsector of the economy over the past 25 years (possibly reflecting the fact that repair services, a subsector within personal services, has become increasingly capital intensive and computerised), the rate of growth of capital deepening in the services sector has been consistently lower than in the goods sector since at least the mid-2000s. This is particularly true for the business and industrial services sub-sectors, which have also seen large increases in employment in recent decades.

Figure 2.12 – Components of productivity by subsector between 1994-95 and 2020-21^{a,b}



a. MFP growth at the ANZSIC 1 digit level was aggregated into sectors by weighting the growth in MFP by the gross value added share of that industry (two year weighted average). The capital deepening contribution for each sector was estimated by differencing sector growth in labour productivity from sector growth in MFP. Capital deepening itself was then estimated by dividing the capital deepening contribution by industry by its estimated sector labour income share. Sector labour income shares were estimated by multiplying the factor income shares in the ABS MFP statistics by the total factor income for that industry in the national accounts and then adding up the capital and labour incomes. **b.** Subsectors are — *Goods*: Mining, Manufacturing, Agriculture, forestry and fishing; *Industrial services*: Electricity, gas, water and waste services, Construction; *Distribution services*: Transport, postal and warehousing, Information media and telecommunications, Retail trade, and Wholesale trade; *Business services*: Professional, scientific and technical services, Financial and insurance services, Rental, hiring and real estate services, and Administrative and support services; *Personal services*: Accommodation and food services, Arts and recreation services, and Other services.

Source: Productivity Commission estimates based on ABS (2021, *Estimates of Industry Multifactor Productivity*, 2020-21 financial year, Cat. no. 5260.0.55.002).



Finding 2.13

Goods productivity growth is typically faster than services, though with great variation

Productivity growth in the goods sector is faster than in services. However, reflecting their diversity, the variation in growth rates across the services subsectors is substantial.

The large and growing non-market sector could drag on productivity

The large and growing ‘non-market’ sector — including health care, education and public administration²² is characterised by government funded, regulated and often, government operated institutions. The commercial

²² The ABS delineates non-market from market services because extensive government subsidies and funding mean that the prices charged for non-market services do not correspond closely to either the marginal cost or marginal benefit associated with receiving the service.

strictures of the market sector — such as competition and cost reflective pricing — which help drive innovation and productivity growth are effectively missing.

Measured labour productivity growth in this sector has been close to zero since the turn of the millennium (ABS 2021a). While quality may play a bigger role in productivity improvement in certain parts of the non-market sector (especially health care), and such improvements are often poorly measured by statistical agencies (appendix A3), there are several reasons to think that labour productivity is still slower in this sector than for the relatively less heavily regulated market services sectors.

First, the non-market sector drags on productivity in ways not measured by productivity statistics. This drag comes from the fact that as many non-market services are heavily subsidised, their increasing size is likely to require increasing revenue to fund them, which would require increasing taxation and increasing losses of economic activity as a result.²³ Tax reform to reduce the economic burden imposed by taxation could help alleviate this issue, but in the absence of reform, an increasing non-market sector will likely weigh on growth in ways not captured by productivity growth statistics within the sector itself.

Second, while health care has almost certainly benefited greatly from unmeasured quality improvements, many of these have come through improved inputs supplied by other industries. For example, better medications have made health care more effective but pharmaceutical manufacturing is a subset of the goods sector.²⁴ In some respects, the organisation of health care itself has changed very little over time compared with the massive transformations of workplaces in other parts of the economy. Consider the thought experiment given by Rohan Mead in which Florence Nightingale comes back from the grave and is taken to a modern acute hospital.

After an hour's in-service, she is almost ready to clock on for a shift. Florence has identified the nurses' station on the ward, seen her fellow nurses fan out to the familiar pattern of patient beds where they check temperatures (with slightly fancier thermometers), dispense medications and manually update patient records. She rankles at the continuing socially conveyed demarcation between doctors and nurses. A century and a half on from the prime of her nursing days, Florence feels at home. (Mead 2017)

This highlights just how much of the innovation within health care has come from the inputs being supplied to the sector rather than changes in business systems within healthcare.

To understand how quickly the non-market sector will continue to grow and what implications this could have for productivity growth, the Commission developed a simple model of the economy out to the year 2060-61 (the timeframe of the Intergenerational Report) under a number of scenarios. This model is outlined in appendix A.5.

It can be seen that in most scenarios, the non-market sector will likely continue to grow as a share of output and employment (figure 2.13).²⁵ And it is likely that labour productivity growth rates will continue to decline as this sector continues to grow (figure 2.14). Indeed, under these projections the assumed labour productivity growth rate of 1.2% used in budgetary papers will not be attained after 2030 (Commonwealth of Australia

²³ Higher taxes can distort economic activity through a number of channels including reduced incentive to work, invest and innovate. Some of these channels are discussed in Volume 3.

²⁴ If a gross output (as opposed to gross value added) approach to multifactor productivity measurement were possible for the non-market sector, this would be able to adjust for these affects and give a more accurate picture of health care performance.

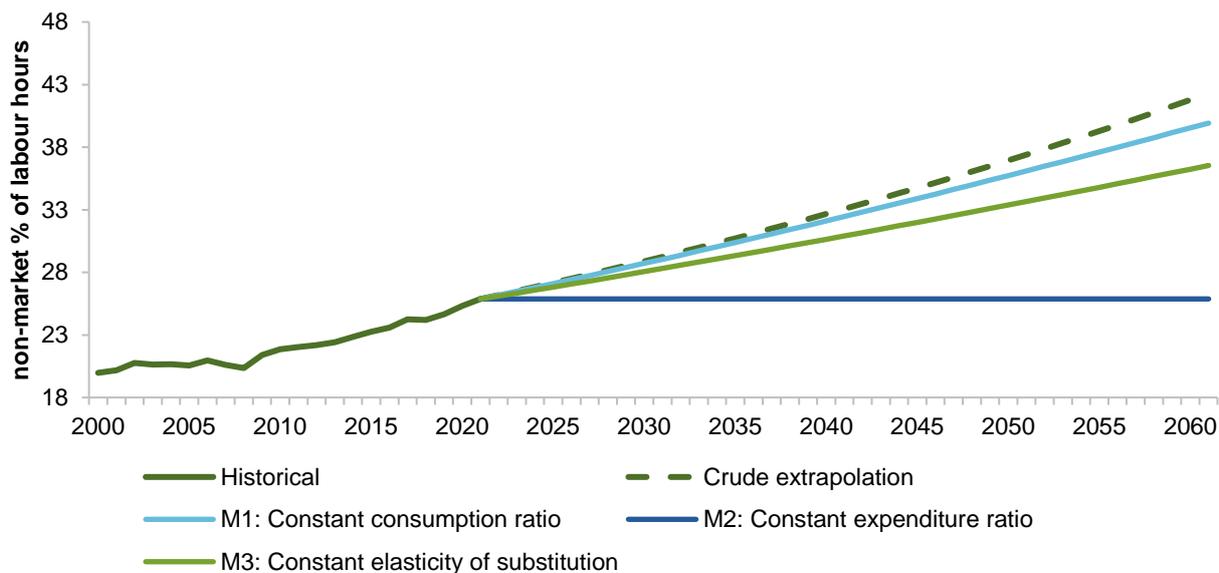
²⁵ In this simple model, the growth in the share of output and employment of the non-market sector are identical.

2022).²⁶ And this is projected to occur under the assumption that market sector productivity continues to improve at a high average rate (1.66%).

The only scenario where the non-market sector did not continue to expand and did not drag down on productivity was where it was assumed that governments and households chose not to spend beyond a fixed proportion of their budget on non-market services. This could occur, for example, if governments decided to cap the proportion of their spending they would allocate to say health or education. However, such a policy would require a reduction in the amount of (per person) services available to Australians, highlighting the difficult trade-offs created by this low productivity growth.

While these forecasts are stylized, they clearly illustrate to policy makers that if the historical rate of productivity growth in the non-market sector does not change (i.e., productivity growth remains close to 0), this sector is likely to continue to grow in size and cost, imposing a significant drag on aggregate productivity growth. The prospects for, and policy settings that would better enable innovation in the non-market sector are discussed in volumes 8 (education) and 5 (non-market innovation).

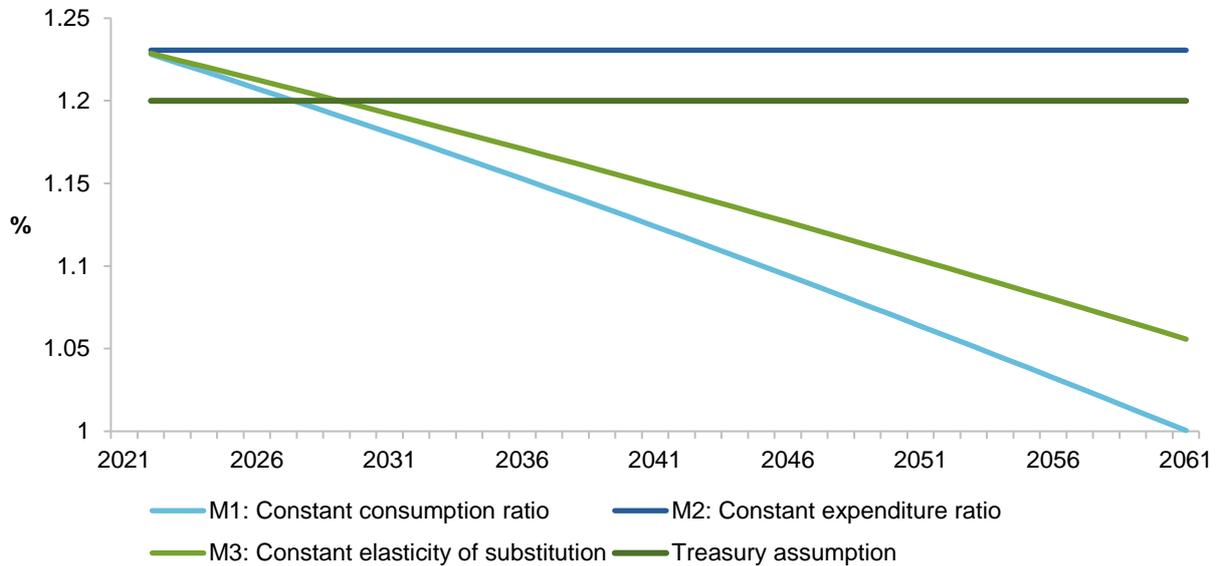
Figure 2.13 – Projected growth of the non-market share
Non-market sector share of the labour force (%) between 2000-01 and 2060-61



Source: Commission modelling (appendix A.5).

²⁶ Only under the assumption that consumers and governments maintain a constant share of their expenditure on non-market services would labour productivity continue to meet or exceed the budget assumptions. However, of the three scenarios, this one is the least realistic (appendix A.5). Indeed, such a scenario could only occur if both private consumers and governments were willing to have real reductions in the amount of non-market services they purchase in order to maintain the same share of expenditure.

Figure 2.14 – The larger non-market sector will likely weigh on productivity growth
Projected whole economy labour productivity growth between 2020-21 and 2060-61



Source: Commission modelling (appendix A.5).

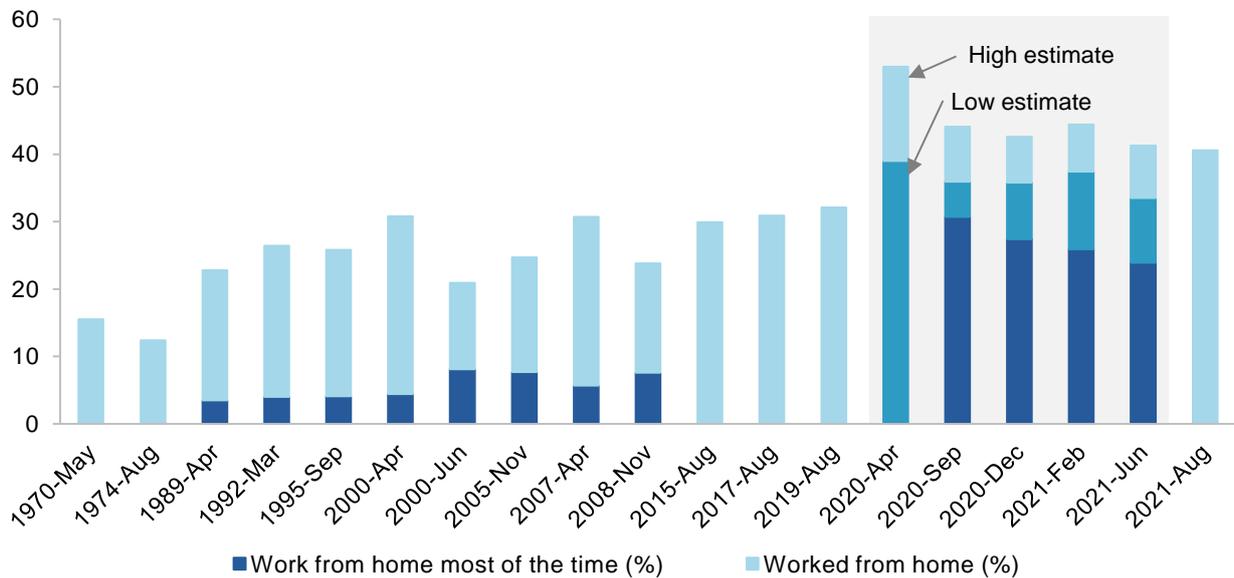
Maintaining momentum in the use of data and digital technologies

A defining characteristic of our COVID-19 times, from March 2020 to the lifting of the last significant restrictions in early 2022, was the hastened adoption of digital technologies to help the economy continue to function. This has been exemplified by governments, businesses and employees alike embracing the move to regular working from home (PC 2021c). The adoption of digital technologies constituted a massive productivity boost, relative to a counterfactual scenario in which such technologies did not exist or were not adopted en masse.

At the height of the outbreak, as many as two out of three people may have been working from home (Baxter and Warren 2021). COVID-19 accelerated the trend of more people working from home, more often. The share of people ‘regularly working from home’ in late 2021 was 40%, about 8 percentage points higher than in 2019, prior to the onset of the pandemic, and about twice what it was a decade prior (figure 2.15). The share of people working ‘most of their hours’ from home was as high as 30% in 2020 (although this has moderated somewhat since then), more than 4 times higher than when it was last measured in 2008.

It is uncertain what proportion of people will continue working from home as the pandemic ends and economic recovery progresses. However, the uplift in online capacity (among both businesses and households) combined with a broader embrace of the innovative potential of digital technology, can transform the way the economy operates — services in particular — with significant productivity benefits. The challenge will be to ensure that policy settings are sufficiently flexible and incentives are appropriately calibrated to support continued uplift as the COVID-19 recovery continues.

Figure 2.15 – COVID-19 accelerated a trend to increasing working from home



Source: ABS (2021c).

Sustaining uptake of online service delivery

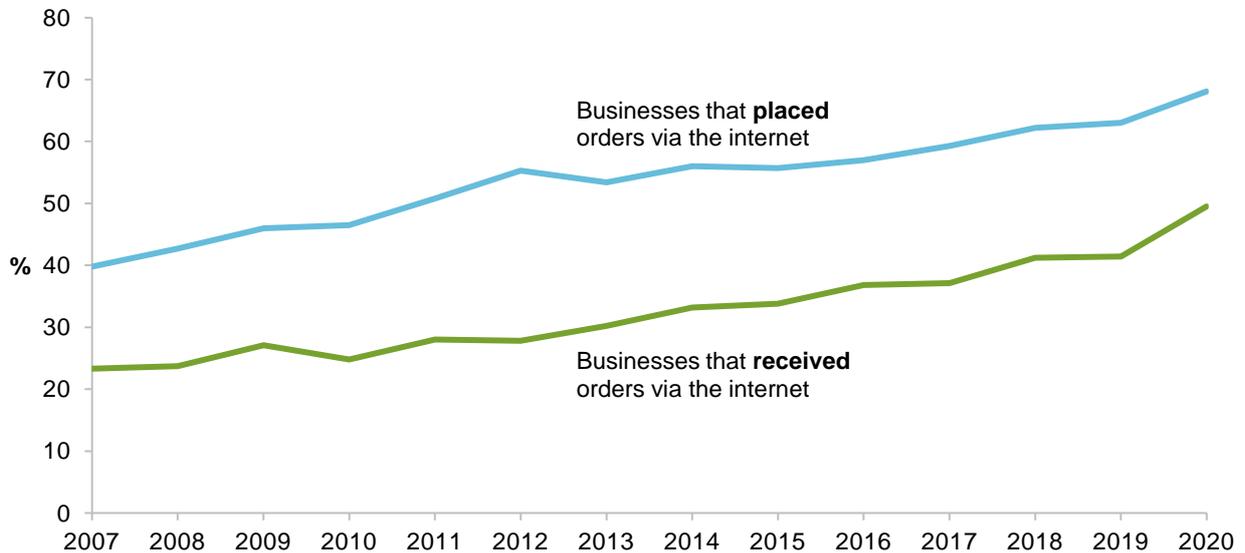
COVID-19 highlighted pre-existing productivity bottlenecks in both the private and public sector, and in some cases underlined how quickly and easily some of these (arbitrary) bottlenecks could be removed by embracing online service delivery. As the Australian economy becomes increasingly dominated by services, embedding these changes into businesses’ and governments’ operations will consolidate longer-term productivity dividends from online activity and services.

Virtual interactions via online platforms provided a crucial substitute to physical face-to-face interactions, which effectively ceased during phases of the pandemic. Across a range of sectors, businesses that had previously only operated from a ‘bricks and mortar’ location invested in online capacity to take orders and payments from customers while also discovering entirely new customer groups, including in overseas markets (figure 2.16). Use of digital documentation and signatures for transactions by legal and financial services that were previously reliant on in-person verification became more widely accepted.

In the government subsidised health care sector, the pandemic highlighted the lack of flexibility in the delivery of some services. The widespread take up of ‘telehealth’ consultations, access to which had been heavily restricted under the Medicare Benefits Schedule funding guidelines prior to March 2020, showed a willingness amongst consumers to engage with telehealth across a variety of services.

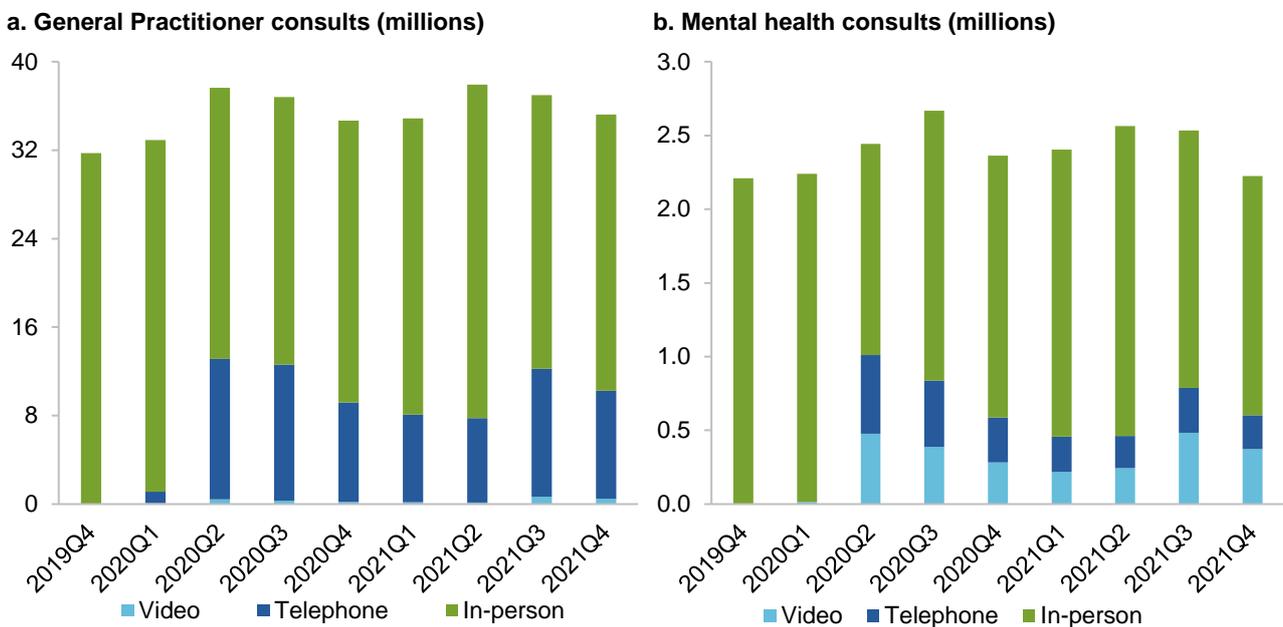
From near zero uptake in late 2019, General Practitioner (GP) telehealth consults jumped to over 12 million in mid-2020 — close to a third of total GP consultations (figure 2.17 panel a) (Snoswell et al. 2022). There was a similarly large impact on mental health consults, including via video conferencing (figure 2.17 panel b). The effect on quality of outcomes for telephone and video consults compared with traditional face-to-face service delivery is, at this point, unclear, although the potential benefits are widely documented (PC 2021a).

Figure 2.16 – Businesses are increasing their digital presence
Proportion of businesses that have placed and received orders on the internet



Source: ABS (*Characteristics of Australian Businesses*, various editions, Cat. no. 8167.0).

Figure 2.17 – Funding changes and lockdowns led to a large jump in the number of telephone and video consultations during COVID-19^a



a. Includes services provided by a GP, clinical psychologist, psychologist, occupational therapist or social worker.

Source: Snoswell et al. (2022).



Finding 2.14

Maintaining the gains in digital technology uptake through COVID

COVID-19 prompted an acceleration in the general uptake of digital technologies and showed that in a crisis, governments, businesses and households can adapt quickly. The challenge is for Australia to achieve a sustained productivity dividend following the pandemic by embedding the efficiency gains from online activity and services.

The nature of innovation is changing in a services-dominated economy

Innovation is about more than just high-tech research and development (R&D) laboratories generating new 'things'. And in an economy increasingly dominated by services, there is another, more immediately practical, side to innovation — the process of changing the way a business operates. The former might require specific, advanced technical skills (such as STEM), but the latter requires a combination of strategic understanding, creativity, drive, risk appetite, emotional intelligence and adaptability. Both forms of innovation are fundamental to productivity growth in a modern economy.

The challenge for Australia is that, historically, innovation in goods-producing industries such as agriculture, mining and manufacturing has usually meant changes to production processes that are far removed from direct consumer interactions. But services sector innovation can be altogether different; for example, by changing a user interface to improve customer experience and service quality.

While scientific breakthroughs feed into such innovations, they are only part of the story. The other part consists of the diffusion, adaption and implementation of such breakthroughs to the needs of consumers and businesses. To achieve this, the exchange of ideas, some scientific, some business and most a hybrid of the two, may be much more important than a focus on the generation and commercialisation of research.

Pivoting the policy thinking on innovation as the economy becomes more dominated by services could be challenging, but the past decade has brought a range of illustrative examples. Vehicle ride sharing apps, online banking and telehealth are all examples of digital technologies being used to disrupt the way consumers access some services. Returning to the Netflix example (box 2.2), online streaming services completely replaced brick and mortar video rental stores. And in doing so, produced a much better product: greater variety that can be accessed from their living room (or anywhere, via their mobile phone), at any time and with no late fees and no waiting (for a DVD to be returned by another customer).

In addition, COVID-19 brought both business adaptation and widespread technology diffusion. Further to the increase in online service delivery discussed above, there were notable examples of businesses rapidly switching the nature of their production during COVID-19, including by changing both business models and business activities simultaneously. Such changes were made to continue using capital equipment, keep workers employed and provide an ongoing income stream. From distilleries that switched to making alcohol-based hand sanitisers, to stage production companies that switched to construction of home office equipment, the adaptability and resilience of private businesses was potently demonstrated.

Despite these past successes, Andrews et al. (2016) noted there is an increasingly large gap between firms at the top and bottom of the productivity distributions, which the authors interpreted as being a defect within the process of diffusing new innovative ideas. And some parts of the services sector face particular headwinds; for instance, while government-funded services — such as health care and aged care — supported the diffusion of technology during COVID-19, their longer-term capacity to adapt their business

models is fundamentally limited by their regulation and funding (volume 5). Finding ways to enable these firms and services to embrace innovations will be important for their future contribution to productivity.



Finding 2.15
Innovation in services may look different

Innovation in services industries is less about inventing 'things' and relies more heavily on diffusing ideas and adapting business models. But this can be difficult for businesses operating away from the productivity frontier, and in sectors where government funding and regulation have a heavy influence.

Data must be used, not just produced

Data has increasingly been used in recent decades to fine-tune and customise production and maintenance processes and enable the creation of new models for business operation (box 2.2). Data use can improve productivity by enabling more competition (as consumers make more informed purchase decisions) and increasing allocative efficiency (as businesses and governments better direct resources to higher-value uses).

Deriving productivity dividends from the increasing data volumes produced in today's economy and society requires individuals, businesses and governments to use data to improve decision making. Effective use of data to improve productivity goes hand-in-hand with widespread adoption of the digital technologies that draw upon and ensure the safe use of data. But while Australia compares well internationally as a data producer and consumer (Chakravorti, Bhalla and Chaturvedi 2019), it performs poorly in its use of data-driven technologies, such as artificial intelligence and data analytics (OECD 2022a, 2022b).

The COVID-19 policy response provided several good examples where data was effectively used to improve health and economic outcomes. There was a great need for consistent quality near-real time data to inform rapid decision making in a range of public services (such as health, public safety and employee financial support) and commercial services (including logistics and supply chain management). The challenge for Australia will be to build on this momentum and accelerate data use in other sectors and contexts, so that we can maximise the value gained from data produced in our increasingly digitised and services-oriented economy.

Volume 4 examines how Australia could get more value out its data holdings and further cash in on the dividend of digital technology.



Finding 2.16
Getting more out of our digital holdings

The large volumes of data produced by our increasingly digitised and services-oriented economy can be used to improve productivity. While there were good examples of effective data use during the COVID-19 response, Australia compares poorly internationally on use of data-driven technologies.

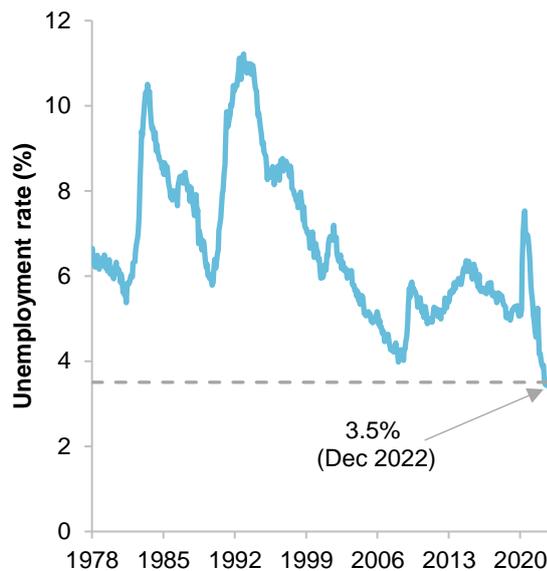
Access to skilled labour

The economic recovery from COVID-19 has been rapid, and this is evident in the current tightness of the labour market. The unemployment rate has reached its lowest level in almost 50 years (panel a figure 2.18) and the relationship between job vacancies and the unemployment rate is at an unprecedented point,

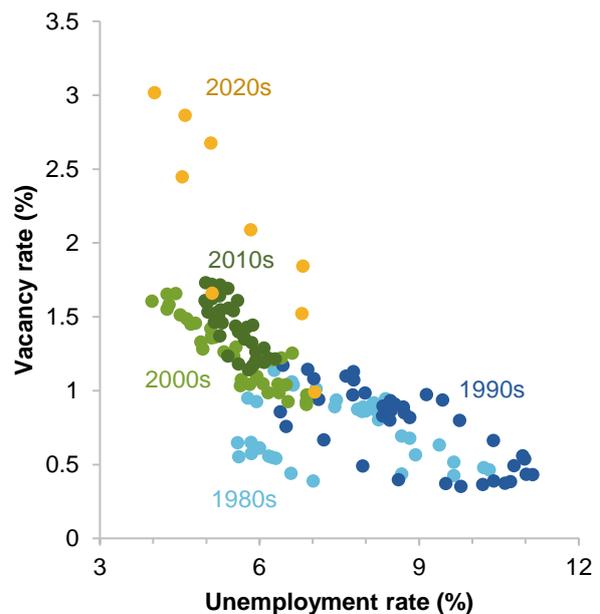
suggesting a very tight labour market (panel b figure 2.18). The fact that the employment to population ratio is also at its highest level in 70 years — more than a percentage point higher than at the start of the COVID-19 pandemic in early 2020 — suggests that the tightness may remain for some time.

Figure 2.18 – The Australian labour market is particularly tight

a. Unemployment rate (seasonally adjusted)



b. The Beveridge curve for Australia



Source: ABS (2022d).

The scarcity of workers can be a spur to productivity improvement, creating strong incentives to invest in new capital and innovate to make better use of labour. In this environment (and with inflationary pressures evident) ensuring labour and other resources flow to their highest value use remains of critical importance.

A highly skilled workforce, proficient in non-routine cognitive tasks is even more valuable in a rapidly changing service economy

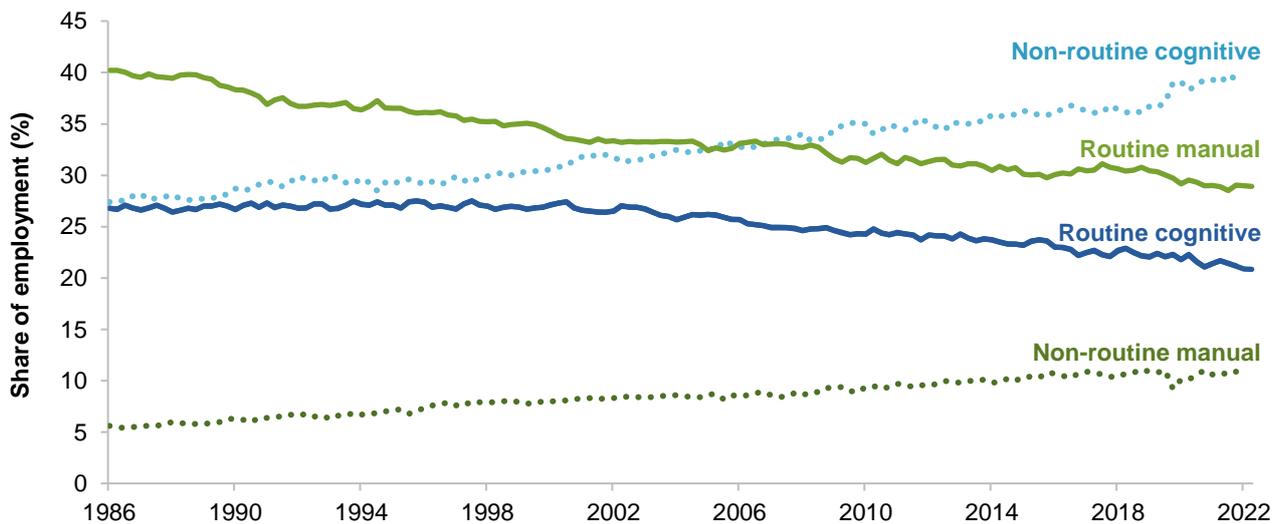
The Australian economy of a few generations ago — where manufacturing and agriculture accounted for nearly half of aggregate production (Butlin, Dixon and Lloyd 2015) — had different skills and educational needs. Those sectors provided relatively high average incomes with a workforce that was largely trained on the job, with fewer requirements for formal education. As services (including high tech and human services) continue to expand as a share of economic activity (and goods production increasingly requires highly skilled labour), jobs in the Australian economy increasingly involve non-routine tasks (figure 2.19). The diffusion of technology has supported these trends. AlphaBeta (2017, p. 13) estimated that about 70% of the ‘automation’ expected over the next 15 years will involve automating tasks within jobs (rather than replacing entire jobs). The capacity of professionals and other vocations to perform tasks will be enhanced by in-time delivery of analytical insights and information.

While these non-routine services jobs often require more formal education in the first instance, the evolving nature of the modern economy also means that the workforce needs to be able to easily upskill and reskill as job roles change including because of the introduction of new technologies. Meeting this challenge requires academic and vocational education systems that can provide the workforce with both solid foundational skills — such as the ability to problem solve and to think critically — as well as equipping workers with the specialist (or vocational) knowledge required for specific roles.

Volume 8 discusses the importance of quality education and training systems for providing skills and adaptability of the workforce.

Figure 2.19 – Non-routine roles are on the rise

Job types in the labour force (share of total)^a



a. Based on a mapping from ABS labour force to Australian and New Zealand Standard Classification of Occupations job classifications. Non-routine, cognitive: Managers, Professionals; Non-routine, manual: Community and Personal Service Workers; Routine, cognitive: Clerical and Administrative Workers, Sales Workers; Routine, manual: Technicians and Trades Workers, Machine Operators and Drivers, Labourers.

Source: ABS (2022d, table 7); Leal, Lai and Rosewall (2019).



Finding 2.17

The future workforce will involve a different set of skills

A high skilled workforce is more important in an economy where jobs increasingly involve non-routine tasks, and use of digital technologies and data manipulation.

Skilled overseas workers can support productivity

The Australian border has now reopened to migration after being closed for almost two years, which could help satisfy the current unmet demand in the domestic labour market. However, tightness in the labour market is not unique to Australia. Labour markets in most advanced economies are at, or above, full employment. This suggests that Australia may face greater competition in attracting skilled labour post COVID-19.

Migration has long been a defining characteristic of Australian cultural and economic life. The benefits of migration in a productivity context are numerous.

- Migration complements the education sector to supply skills to the Australian labour market. This allows Australian firms to become more productive, by hiring the best available workers, but also increases competition amongst employees, which can provide incentives for workers to improve their skills.

- Migration can help to provide a diversity of skills and facilitate the diffusion of innovation, particularly where foreign work experience helps Australian firms adopt global best practices, or where foreign workers may be necessary to implement technology that is new to Australia.
- Migration can also play a role in filling skill gaps in occupations with standardised (competency-based) licensing, or in regional areas that rely on either international or interstate migrants.

At the same time, migration can have unintended effects on productivity. Some businesses may face reduced incentives to provide on-the-job training, while others may only seek migrant workers who will accept lower wages (rather than improve the quality of output). And unexpectedly rapid population growth that is concentrated in particular areas can create congestion in the provision of some services, as well as pressure on infrastructure. Immigration should not be seen as the solution to every case where an employer cannot find an employee at the prevailing wage.

Attracting the best and brightest migrants may be more difficult post COVID-19. Global migration patterns have not returned to those observed prior to the pandemic and it is not guaranteed that Australia will remain as attractive to working migrants as it was previously (CEDA 2015). Recent evidence suggests that enrolment levels for international students in Australian universities (previously a source of considerable low skilled labour in the food services and hospitality sectors) may remain subdued in the near term (DESE 2022).

The number of skilled employees who are working overseas while undertaking tasks online for businesses based in Australia may have increased during COVID-19 in line with the increased uptake of working from home. In the short term, this is an avenue to alleviate some existing labour market pressures, and in the longer term — if its use by employers increases — it could lower the reliance on the formal skilled migration system and have potentially significant implications for the way in which businesses access skilled labour.

Australia's migration settings, and how they could be improved, are discussed in chapter 2 volume 7.



Finding 2.18

Tight labour markets mean that efficient allocation of labour is more important than ever

Tight labour market conditions in Australia strengthens the need for workers to be allocated to their highest valued use. It also highlights the importance of access to skilled labour from other countries, which can help alleviate demand pressures and enhance productivity by improving the quality and diversity of skills in the labour market.

The challenges of climate change and decarbonising the economy

Climate change and the associated need for decarbonisation of the Australian economy could dampen future productivity growth, particularly if the transition is not appropriately managed.

Climate change itself poses a threat to the Australian economy through various channels, and by some measures this threat may be larger than for other major economies (figure 2.20). These risks are most pronounced for industries that depend directly upon the natural environment as a key input, such as agriculture, tourism and construction. The ways in which these industries adapt to the effects of climate change will influence their potential for productivity growth — a challenge compounded by the continued effects of past carbon emissions.

The need to decarbonise the economy over a relatively short timeframe has implications for productivity. On the one hand, it reduces a production cost (carbon emissions) but could also reduce measured productivity growth due to:

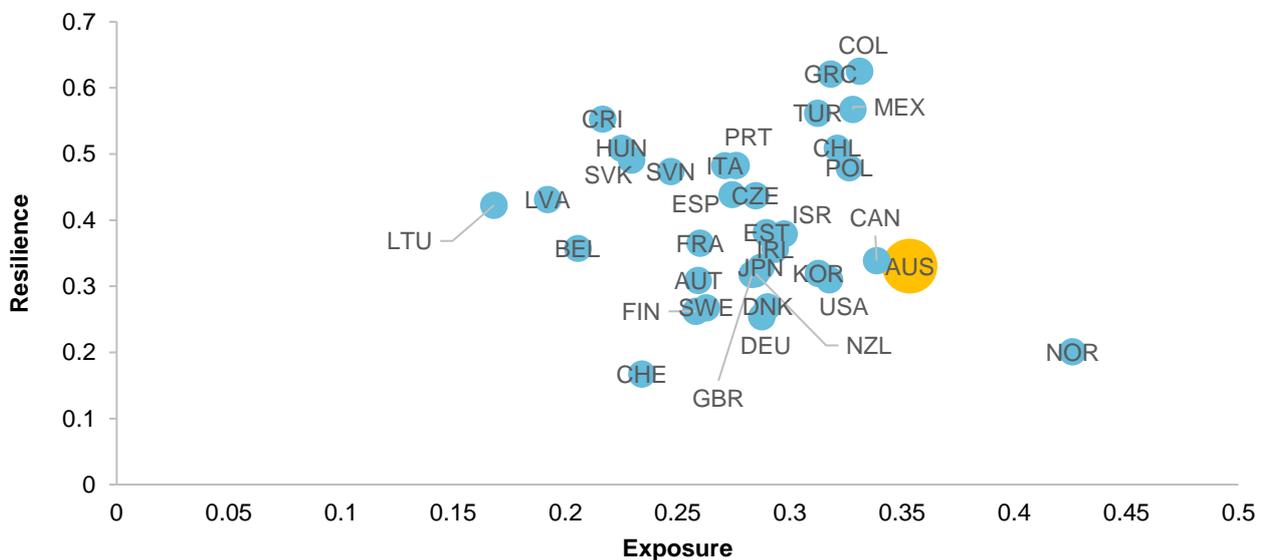
- the costs associated with developing and implementing new technologies to achieve decarbonisation (for example, replacing fossil fuel-based energy generation with alternative sources — effectively investment to replace, rather than increase, the economy's existing capital stock)
- the move away from some existing low-cost production methods (for example, switching away from using coal to produce steel)
- reducing production of goods that do not have carbon-free production methods (for example, if no carbon-free fuel sources are found for commercial flights).

These costs need to be balanced against the benefits of decarbonising the economy in line with Australia's commitment to net zero emissions by 2050. The policy challenge is to ensure that the process of decarbonisation is undertaken in the most cost-effective way.

This task is made more difficult by the considerable uncertainty about the cost of reducing emissions (or failing to reduce emissions enough), the desirable pace of decarbonisation and the lowest cost method of achieving it. Technologies and methods of decarbonisation will need to be developed and selected in an environment where full knowledge of the associated costs and benefits will only be apparent in the future.

Volume 6 discusses how Australia could achieve net-zero carbon emissions at least cost.

Figure 2.20 – Australia's comparative preparedness for a low-carbon transition^a
Economic exposure and resilience to transitional risk in Australia and OECD countries



a. OECD country abbreviations are: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), Colombia (COL), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Mexico (MEX), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Slovak Republic (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), United Kingdom (GBR) and United States (USA).

Source: Peszko et al. (2020).



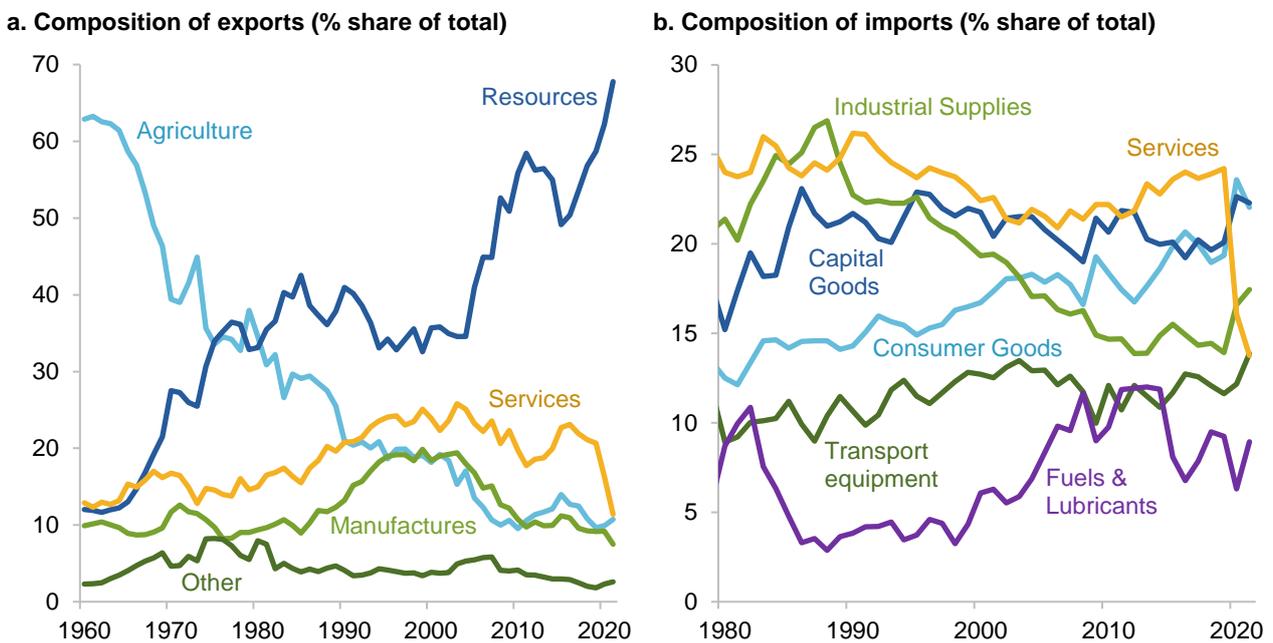
Finding 2.19
Climate change is a productivity challenge

Climate change presents risks to the Australian economy, especially for industries that utilise the environment as a key input. Selecting forms of abatement and mitigation to cost effectively achieve Australia’s net zero by 2050 commitment will be challenging given the inherent uncertainty about future technological breakthroughs.

Vulnerability to international headwinds

As a small economy, Australian businesses and consumers are heavily reliant on, and have benefited enormously in the past from, foreign investment and trade. Much of our agricultural production (beef, wool, wheat, forestry and fishery products) and resource and energy outputs (such as iron ore and coal) have been sold on global markets. Many of our consumer goods (from televisions to toasters to smartphones to overseas holidays and clothing and footwear) and production inputs (including those in the form of the latest technologies embodied in capital) have been brought in from overseas (figure 2.21).

Figure 2.21 – Australia is heavily reliant on resource exports, but imports are balanced across a range of consumer and business goods and services



Source: RBA based on ABS (2022b, tables 1, 5, 6 and 10).

Historically, Australia’s domestic savings have been insufficient to fund the numerous investment opportunities available, and we have typically run a current account deficit. For this reason, Australia has relied on foreign investment to fund infrastructure and other capital, which has allowed the economy to grow faster than our relatively small pool of domestic savings would otherwise have allowed. Even to the extent Australia can meet

its overall capital needs²⁷ using domestic savings, foreign investment is still desirable because it brings new expertise, innovations and novel types of capital to Australian firms. Investment, domestic and foreign, will continue to be critical enablers of growth in Australian living standards into the future.

Recent global developments could add to the productivity growth challenge. The reappraisal of supply chain risks could see firms incur costs to achieve greater certainty. Global tensions have disrupted trade flows, added complexity to foreign investment policy and led to a degree of technological decoupling. All these effects could add costs and impede productivity growth to some extent. They could be compounded by policy responses that further move away from openness and multilateralism. Australia has not always been as open as it is today. Following Federation, the newly created Australian Government embraced protectionist policies: erecting tariffs, protecting manufacturing, centralising wage arbitration and adopting the White Australia policy. The latter two had the effect of reducing labour market flexibility and the size of the potential pool of foreign labour that could be accessed, while tariffs had the effect of 'taxing' both domestic consumers and other Australian exporters²⁸ while also reducing the incentives for productivity improvement in trade exposed- industries.²⁹

For a while, any negative effect of 'Fortress Australia' on living standards was not obvious in the aggregate statistics. Strong global demand for Australian resources meant that prosperity could be found via a 'ride on the sheep's back'. But from the 1950s onward, Australia's productivity performance consistently lagged the OECD, and Australian living standards began to fall relative to our peers: in 1950 Australia was ranked 5th in the world in terms of GDP per person, but it was 9th by 1973 and 15th by the late-1980s (Banks 2005). Such movements in relative rank reflect both domestic policies — several studies have argued that the fast productivity growth experienced by Australia in the 1990s can be linked with the preceding microeconomic reforms (including significant trade liberalisation) (Parham 2004; PC 1999) — as well as a host of factors unrelated to domestic policy (not least of which is catch up from a number of other economies).

'Fortress Australia' was born of a time of increased global instability and deep scepticism of reliance on international trade and capital flows for economic development. It highlights the economic (and cultural) costs of turning inwards, still relevant in a world where external threats — threats to national and cyber security, critical supply chains to name a few — seem abundant. Chief among these costs is that it can create powerful, often mutually reinforcing, avenues for rent seeking that are difficult to unwind once created.³⁰

This policy episode has clear parallels with the contemporary international trade environment. Disadvantage in areas affected by trade liberalisation, increasing political tensions between major global powers and a series of supply-side disruptions resulting from the COVID-19 pandemic appear to have cooled enthusiasm for multilateralism. The challenge for Australia moving forward will be to maintain the stance of unilateral free

²⁷ Australia has run a current account surplus since September 2019 — the first surplus since 1975 — on the back of an elevated terms of trade.

²⁸ Tariffs have the effect of decreasing demand for foreign imports, which reduces the demand for foreign exchange and appreciates the domestic currency. This makes Australian exports less competitive, effectively placing a 'tax' on them (Dornbusch 1974; Furceri et al. 2018).

²⁹ Trade openness improves productivity growth through a number of channels: i) increased competition leading to resource allocation away from unproductive firms and towards productive ones; ii) increased market size for exporting firms raises the return on both developing and adopting new innovation; and iii) increased economic integration creates more opportunities for knowledge flows, leading to faster diffusion of innovation (Acemoglu and Linn 2004; Crespi, Criscuolo and Haskel 2008; Melitz and Trefler 2012).

³⁰ For example, early in the Fortress Australia period, there were instances where an industrial court (one of the key components in centralised wage arbitration) would increase minimum wage requirements for import-competing firms, who would then lobby for governments to increase tariffs to preserve their profitability. However, higher protectionism itself was then often used as an argument to increase minimum wages by industrial courts, leading to a spiral of ever greater protectionism (Wilson 2014).

trade that has been demonstrated as the best policy response even when other countries increase their trade barriers (PC 2017a, p. 79).

Chapter 3 volume 3 discusses how Australia trade and foreign investment policy should evolve in light of increased global tensions.



Finding 2.20

The opportunities of a service-based economy

As an increasingly services-based economy, Australia can benefit from greater global trade and integration in many service industries.

Appendix

A. Productivity and how it is measured

A.1 What is productivity?

Recall the definition of productivity given at the start of section 1.2 in chapter 1:



This raises the question: what should be treated as inputs and what should be treated as outputs? How this question is answered creates different methods of measuring productivity. The most commonly reported measures of productivity are 'labour productivity' (the ratio of output to the number of work hours used in production) and 'multifactor productivity' (the ratio of output to a combination of both hours worked and capital). The difference between the two is the definition of 'inputs'. Output always refers to the production of goods and services minus the value of goods and services purchased from other firms, or 'gross value added'. At the whole economy level, 'output' is gross domestic product (GDP). Box A.1 contains a stylised example of labour productivity.

Box A.1 – Jared and the chocolate factory: a stylised example of labour productivity

Jared works in a chocolate factory. Jared's boss, Colin, wants to measure the labour productivity of his workforce to make operational improvements at the factory. Colin estimates that during a 40 hour work week, Jared produces 2000 chocolate bars. Colin calculates Jared's labour productivity as:



While this allows Jared's performance to be compared with other employees in the chocolate bar branch, Colin cannot compare Jared to employees in the chocolate biscuit division. To allow for comparison, Colin notes that chocolate bars each sell for \$2 and Jared produces 2000 of them, so the total value of

Box A.1 – Jared and the chocolate factory: a stylised example of labour productivity

Jared's production is \$4000. Using this instead of just the number of chocolate bars, Colin calculates Jared's labour productivity as:



In this report we are interested in the enablers of productivity growth, which cover a broad range of actions by firms and individuals, as well as policy and institutional settings. For statistical purposes, we often divide productivity growth into two (slightly stylised) categories: capital deepening and multifactor productivity (MFP).

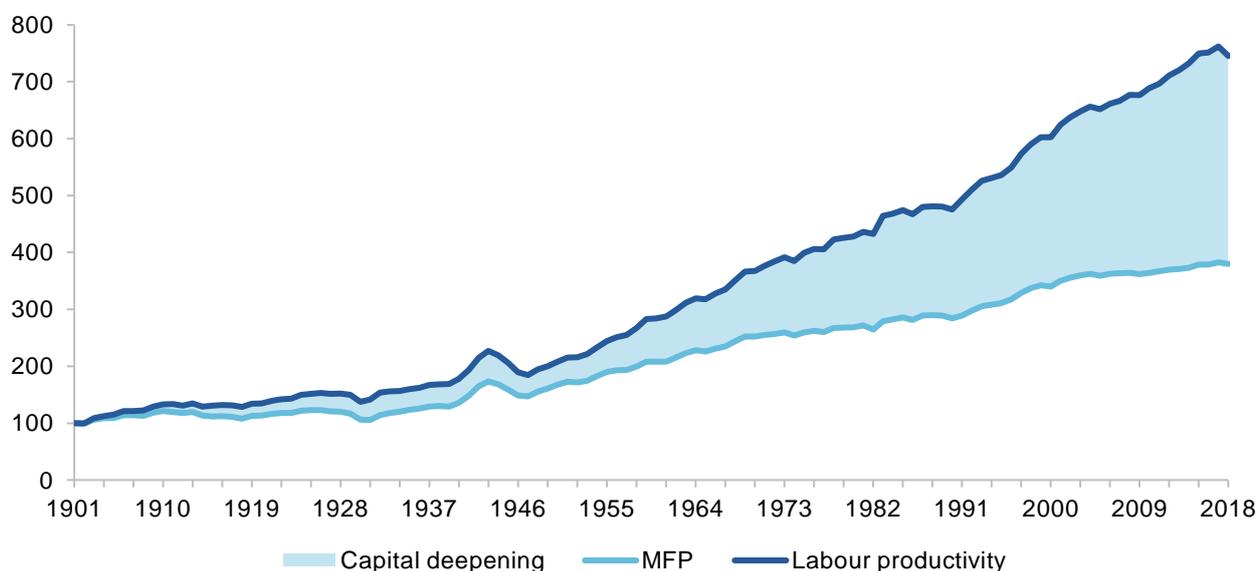
- Capital deepening is the process of investing to increase the stock of buildings, machines and intellectual property relative to labour. Capital deepening accounts for about 45% of labour productivity growth since 1901 (figure A.1).³¹
- Multifactor productivity describes how productively firms combine both capital and labour and accounts for about 55% of labour productivity growth since 1901.

The distinction between these two sources of growth is clearer when considered from the perspective of a company and the business manager. A business manager has a choice in how much 'capital' (machinery, equipment and buildings) to allocate to each employee. For example, the manager of a retail store must decide how many automated checkouts to install for each checkout employee. As the number of automated checkouts increases, each employee is more productive (the number of customers served, and the value of output generated per day, rises) as they no longer have to scan and bag grocery items, but can instead concentrate on troubleshooting when the automated checkouts make mistakes. So, each additional automated checkout machine raises the labour productivity of each existing checkout worker.

This process of increasing the ratio of capital (in this case automatic checkout machines) to labour (checkout staff) is called 'capital deepening'. Eventually, as the number of machines per employee increases beyond a certain point, the additional profit created by each machine will fall. This could be because staff cannot, in a timely manner, supervise an ever increasing number of machines when mistakes occur, giving rise to 'diminishing returns'.

³¹ Based on estimates of labour productivity, GDP per capita and MFP in the *Long-Term Productivity Database*. Note that this dataset uses capital services that impose a constant (exogenous) rate of return on different kinds of capital, which differs from capital services measures used by modern statistical agencies.

Figure A.1 – Australian labour productivity growth due to capital deepening and MFP^a
Index (1901=100)



a. Capital deepening is the difference between growth in labour productivity and growth in MFP.

Source: Bergeaud, Cette and Lecat (2017).

If the retail manager rearranged the machines, or perhaps added signals that quickly alerted staff about malfunctioning machines, this would make the staff *and* the machines more productive. This is an example of an MFP improvement. Once this is done, it then becomes profitable to add even more automatic checkout machines per staff member. That is, as the MFP of the store increases, the more profitable capital deepening becomes.

In many ways, the distinction between capital deepening and MFP is stylistic — a simplification of a highly complex real world process. It is but one lens through which to view the path of productivity growth. But it can shed some light on sources of past productivity growth in the Australian economy.

MFP growth can come from a number of sources, including the introduction of new technology in the production process, and redesigns of the systems of production (for example, changing the physical orientation of factories or the structure of supply chains). If there is an increase in MFP, then this means the profitability of *new* capital (machines, equipment etc) increases and so businesses invest more, leading to an increase in the amount of capital per employee in the economy (the capital to labour ratio). In this way, an increase in MFP encourages more capital deepening, making MFP growth a necessary condition for continued labour productivity growth as it pushes out the point of diminishing returns on new capital.

The various measures of productivity are summarised in box A.2.

Box A.2 – How do we measure productivity?

What do all measures have in common?

There are many ways to measure productivity, but they all compare the ratio of output produced by firms to the inputs used. Where they differ is in the particular inputs and outputs that are examined and whether market prices or other methods are used to weight particular products and inputs.

Labour productivity and quality adjusted labour productivity

Labour productivity is a commonly produced, intuitive measure of productivity. It is the ratio of output (usually measured as gross value added derived in respective countries' system of national accounts) to the number of hours worked (labour) to produce this output. A complementary capital productivity measure is more difficult to produce, because capital services data is often harder to collect (and harder to compare across time and across countries). Labour productivity is often used for cross-country and cross-industry comparison, and is more easily available than multifactor productivity measures.

In addition to calculating labour productivity using labour hours, some statistical agencies also calculate quality adjusted labour hours by weighting the growth in labour hours in different occupation-skill combinations by their different wages. This has the effect of giving higher weight to growth in hours worked in occupation-skill combinations that demand higher wages.

Multifactor productivity

Multifactor productivity (MFP) measures the ratio of output to a combination of labour and capital services. Generally, MFP is calculated as a growth rate and the growth in combined inputs is the weighted average of labour hours and capital services growth with the labour and capital shares of income being used as the weights respectively.

Capital services are typically calculated as a weighted average of growth in different capital assets with different asset types in different industries given different weights based on market profits, depreciation rates and several other factors. Because these weights are different for different countries in different years, it makes levels comparisons of MFP across countries (or industries) difficult.

KLEMS productivity

When calculating labour productivity or multifactor productivity, the measure of 'output' is typically the value of goods and services produced by a firm ('gross output') minus the goods and services they bought from other firms ('intermediate inputs'), which is referred to as 'gross value added'. An alternative is to use gross output as the measure of output and add intermediate inputs as an additional input along with capital and labour. KLEMS productivity measures take this a step further and split out the intermediate inputs into services, materials and energy. The advantage of this approach is that it gives insight into how a particular industry uses the energy, materials and services of other firms to produce its output. A major disadvantage is that KLEMS analysis only makes sense at an industry or firm level because at the whole economy level there are no 'intermediate' inputs only capital and labour.

Non-index methods

The above measures of productivity are referred to as 'index methods' and are the approaches used by national accounts agencies. While these methods are well suited to the measurement of aggregate progress, they have the shortcoming that they require market prices to weight different goods and services. Certain 'non-market' services such as public services, health care and education are often

Box A.2 – How do we measure productivity?

provided at free or discounted cost due to extensive government subsidies and so using national accounts methods is not appropriate.

For these services, economists often use alternative methods to measure productivity such as Data Envelopment Analysis, Stochastic Frontier Analysis and several others. These methods compare productivity of firms by focusing on a narrowly defined industry and rather than using prices and cost shares to weight different outputs and inputs, they make assumptions about the way different inputs and outputs can be combined by firms (as well as about how random noise and productivity improvements can be separately identified). For example, an economist might create a stochastic frontier model by assuming firms have constant returns to scale and use a Cobb-Douglas production function with the relative efficiency of firms being half-normally distributed. These assumptions may be strong but they remove the need to have market prices to compare firms within narrowly defined industries.

Source: Sickles and Zelenyuk (2019).

A.2 The elusive quest for the causes of growth

The past 70 years have seen the development of numerous ‘growth’ models that attempt to explain the underlying drivers of economic growth (and hence, productivity) at the aggregate level.

The task has several challenges. First, it is an attempt to explain what (many) economists regard as an ‘unexplained residual’ — that is, the observed tendency for output to grow by more than can be accounted for by the growth in capital and labour inputs. Second, it is an attempt to sum up in a single variable (or very few) the underlying cause or driver of growth, whereas in reality growth comes from multiple, disparate, uneven processes.

Candidate variables have included capital accumulation, an externally determined rate of technological advance, improvements in human capital, and the generation and sharing of ideas that add cumulatively to the stock of knowledge across the economy.

While such models have been used to explain some of the massive divergence in economic growth experienced across countries and time, none of them completely succeeds in predicting or, even ex-post explaining, the rates of growth of most countries. And in most cases they are of limited use as a guide for comparing specific policies. In particular, they are not a substitute for rigorous project evaluation and cost benefit analysis of government programs. But the aspects of economic growth they do manage to explain and — often more importantly — the aspects they *do not* manage to explain reveal much about both the nature of economic growth itself and the strengths and limits of formal models in identifying the underlying drivers of the growth process.

There are some key takeaways from these models.

- Once a country achieves high income status, all further economic growth will tend to be driven by a ‘residual’ term — multifactor productivity — which includes the effects of innovation (technological progress) and better resource allocation (Aghion and Howitt 1998, p. 16, 2009, p. 39). However, explaining the *source* of innovation was the main gap in older economic models.

- The MFP residual is partially due to the steady acquisition of skills and experience by the workforce. Known as ‘human capital’, this also captures the direct effect of formal education (Lucas 1993; Mankiw, Romer and Weil 1992).
- Some early models emphasized the role of a common stock of scientific knowledge, produced through public funding of research, as underpinning, or enabling, private innovation (Arrow 1962a; Nelson 1959).
- Other models of growth emphasise the role of ideas more broadly in explaining residual MFP growth. Because one’s use of an idea does not prevent others from also using it (ideas are ‘non-rivalrous’) the stock of ideas can grow exponentially (Arrow 1962b; Romer 1986). Some of these ideas are generated via a process of ‘learning by doing’ and are often embedded in new capital (Arrow 1962b), but markets may undervalue the provision of this learning and so less is achieved than socially desirable.
- More recent growth models emphasise the process by which knowledge is shared across an economy, highlighting that the transfer of knowledge is not an automatic process (Lucas 1993).
- Another class of models emphasise ‘creative destruction’, an ongoing process characterised by new innovations leading to the replacement of older products and production techniques (Aghion and Howitt 1992). These models implicitly embrace the unevenness and unpredictability of productivity growth, highlighted in chapter 1 as a central driver of MFP growth, and as an explanatory factor for differences in income levels between economies. There are various explanations for how creative destruction occurs and its nature.
 - Markets provide price signals about the value of innovation and the design of market structures can moderate the strength of this signal (Aghion and Howitt 1998, pp. 205–225).
 - Education plays an indirect role in lowering the cost of undertaking or engaging with innovation (better educated workers can more easily adopt and improve on new scientific concepts in an applied setting) (Aghion and Howitt 1998, pp. 327–356).
 - The closer an economy comes to the technological ‘frontier’, innovation efforts should focus less on ‘catching up’ and more on novel breakthroughs to drive continued growth (Aghion and Howitt 1998, pp. 67–69).
- Some newer models also emphasise the role of general purpose technologies (GPTs, such as steam power or electricity) to drive rapid, prolonged periods of productivity growth (Bresnahan 2010; Bresnahan and Trajtenberg 1995; Brynjolfsson, Rock and Syverson 2018).
 - The information and communications technology (ICT) revolution was the most recent example of a GPT. Some suggest that newer digital technologies (such as artificial intelligence) will be the next GPT (Brynjolfsson, Rock and Syverson 2017).
- Institutional settings that underpin markets are an important ingredient that influence the pace of economic and productivity growth by encouraging and rewarding risk-taking and providing a test bed for ideas via price signals and the free flow of resources across the economy (North, Wallia and Weingast 2006).

Some papers even question whether productivity growth is even exponential. For example, Philippon (2022) has found that a linear model of multifactor productivity appears to fit the data better than a geometric model, implying that slowing multifactor productivity growth is not a bug so much as a feature of the economic system itself. This might be the case, for example, due to the accumulation of ideas itself inherently following an additive, rather than multiplicative, process.

A.3 Changing prices make productivity measurement challenging

Measurement of real productivity (and GDP) growth is complicated by changing prices. More straightforward is the measurement of nominal productivity growth, which only requires adding up the total dollar value of goods and services produced in the economy and dividing by some measure of inputs (usually number of hours worked).

Constantly changing prices creates problems for productivity measurement because prices are used to weight the importance, or value, given to a particular good or service. If a product has a high price, then it receives a high weight under the assumption that this product is valued highly by consumers. But what if a product has a high price in one year and a low one in the next? Which set of prices should be used? The first or the second year's prices?

A simple solution is to use the prices from the first year to weight goods produced in the first year and prices from the second year to weight goods produced in the second year. But this approach has two issues. First, it ignores 'inflation', the general increase in the price level of goods and services. To see why this is a problem, imagine all goods and services uniformly increased in price by 2% between the first and second year. If the prices for the first year are used to weight goods in the first year and prices in the second for products in the second year, then this will lead to productivity measures also increasing by 2% even if actual production remained unchanged. This is because all of the prices will increase by 2% even if the quantity does not. The second issue is that this approach does not deal with the issue of products that are lacking prices either in the first period (because the product was invented in the second period) or in the second period (because the product became obsolete in the second period after being replaced by a new product).

The various measurement challenges for productivity created by changing prices can be grouped into a few distinct types:

- *substitution bias* — when the price of a good changes, should we use the old price or the new price? As discussed below, the answer turns out to be somewhere in the middle
- *outlet bias* — the emergence of discount outlets creates issues as to which price (the common retail price or the discount price) should be used to weight a particular good
- *quality and new product bias* — new products or products whose quality has improved have the challenge of not having past prices. Likewise, products that are no longer sold had prices in the past but no longer have them.

Each of these challenges and their consequences (and potential solutions) for productivity measurement will be discussed below.

Substitution and outlet bias

Substitution bias is the potential to over or underestimate inflation (and hence productivity) because of changing relative prices. To understand substitution bias, consider a simple example involving apples and oranges: both apples and oranges were \$2 last year but now apples have risen in price (perhaps because of a flood) to \$4 while oranges are still \$2. If we use the first year's prices in both years, this will tend to underweight apple production in the second period and if we use the second year's prices, this will tend to overweight apple production in the first year. In either case, productivity and inflation will be mismeasured.

A good way to solve this issue is to take the geometric average of the two prices.³² Such a measure of prices is called ‘superlative’, meaning it is symmetrical between prices of the two periods (Hausman 2003, pp. 33–35). Another approach to mitigate substitution bias is to have more frequent collection of data on prices and quantities.

Outlet bias refers to the potential bias caused by the existence of discount outlets that offer almost identical products at lower prices. Unlike substitution bias, this issue cannot be resolved using a different formula to calculate the weights given to particular goods. Instead, more frequent and detailed collection of price and quantity data for both outlet and non-outlet stores is necessary (Hausman 2003, pp. 32–33).

Quality improvements and new products

The consumer benefits of both quality improvements and new products were discussed previously (chapter 1). The reason these two kinds of improvement are often underestimated in productivity statistics is that both require statistical agencies to know the size of the consumer welfare gain (or ‘consumer surplus’) due to either the quality improvement or the introduction of a new product/variety. However, these welfare gains cannot be inferred from the changes in prices alone, information is needed about how much consumers would have been willing to pay for either the quality improvement or the new product (which is typically *more than* the current market price) (Hausman 2003, pp. 25–32).

Box A.3 gives an example of the issues created by the introduction of new products.

Box A.3 – Why do new products present problems to GDP measurement?

Quality improvements and the introduction of new products present no problems to the measurement of *nominal* output and productivity but can distort measures of *real* (inflation adjusted) output. In order to understand how, consider how chain-weighted GDP growth (the most common method) of GDP is calculated:

$$\text{real GDP growth} = \frac{\sum p_j^0 q_j^1}{\sum p_j^0 q_j^0} * 100 - 100$$

Where p are prices of a product, q are the quantities of products, j is the subscript for a particular product and superscript 0 and 1 refer to periods 0 (yesterday) and 1 (today).

In order to calculate the growth in production between two periods of time, the price of all j products needs to be known for the first period. But for goods that did not exist in the previous period either because they are new products that were introduced in the current period or because their quality changed enough that the prices at their previous levels of quality are not appropriate, this creates the problem of what price to apply.

A case where a whole new product is introduced is shown in the table below. Here only apples and widgets were ever produced, with widgets being invented in the second period and not existing in the first period. This means there is no market price for widgets for period zero and so it is unclear how to calculate real GDP. Improvements in quality that are not incorporated in prices create similar issues.

³² The approach of using the first year’s prices as weights is called a ‘Laspeyres’ index while using the second year’s prices is called a ‘Paasche’ index while using the geometric average of the two is called a ‘Fisher’ index.

Box A.3 – Why do new products present problems to GDP measurement?**Example of introduction of new products**

	Widgets		Apples		Nominal GDP
	Price (\$)	Quantity	Price (\$)	Quantity	
Period 0	?	0	1	10	10
Period 1	2	2	1	5	9
Growth	-	-	-	-	-10%

Looking at nominal GDP growth, it would look like GDP *fell* but how do we know if this is also true of real GDP? One approach, is to determine what the price of widgets would need to have been in period 0 in order for the quantity consumed to be zero. Under this approach, say we determined that based on observed demand this price would have to be \$10 per widget. In this case, we can calculate real GDP as:

$$real\ GDP\ growth = (10 * 2 + 1 * 5) / (10 * 0 + 1 * 10) * 100 - 100 = 150\%$$

So once the price of the new good is properly accounted for, real GDP actually increased substantially due to the introduction of the new product.

What is the net effect of these price-related measurement challenges on wages growth?

Beginning with the Boskin Commission, a range of papers and public inquiries have examined the effect of various measurement issues on estimates of consumer prices (table A.2). With the exception of substitution bias, most of these issues in the measurement of consumer prices pass onto issues in the measurement of productivity (box A.4); however, all of the studies considered here are for estimates in the United States (US) economy. It is unlikely that Australian estimates differ significantly for consumer prices but they may with respect to productivity (consumer product sales tend to be more similar across advanced economies than production patterns due to international trade of consumer goods). The only Australian estimate of consumer price index bias that can be directly compared with the United States estimates are those of ‘upper level’ substitution bias. According to the ABS, this was about 0.22 percentage points annually between 1995-96 and 2015-16, which is broadly similar to the range of 0.15-0.3 percentage points estimated for the US (ABS 2017; Moulton 2018, p. 31).³³

Assuming estimates of the bias in the consumer price index for the US due to quality improvements and the introduction of new products are applicable to Australia (say at the lower end of the range, about 0.37 percentage points per year), then this implies that Australian wage growth over the past twenty years (June 2001 to June 2021) was about double its measured amount — measured real wages (the wage price index deflated by the consumer price index) rose about 20%, while mismeasured quality means real wages may have grown by about 38%.³⁴

³³ ‘Upper level’ substitution bias refers to substitution bias between broad classes of products, say apples and oranges. While ‘lower level’ substitution bias refers to substitution bias between more granular classes of products say between different types of apple.

³⁴ Calculations using ABS (2022a, 2022e).

Assuming that all the sources of bias listed in table A.2 are applicable to the Australian consumer price index over the past twenty years (June 2001 to June 2021), then real wage growth may have been about 52% over this period, or about one and a half times as much as the published estimates.

These kinds of direct calculation cannot be performed for productivity due to differences in the way that the GDP deflator and consumer price index are calculated. Nonetheless, it is likely that if these estimates of the mismeasurement of consumer price index inflation due to quality improvement/new products are accurate, then productivity is likely underestimated by a similar margin to real wage growth.

Table A.2 – Estimates of the degree of overestimation of the consumer price index due to quality mismeasurement and other sources^a

Bias in the CPI due to quality/new products, outlet bias, substitution bias and total bias (percentage points)

Paper	Quality and new products	Outlet bias	Substitution bias	Total CPI bias
	Percentage points	Percentage points	Percentage points	Percentage points
Boskin Commission (1996)	0.6	0.1	0.45	1.1
Lebow and Rudd (2003)	0.37	0.05	0.35	0.85
Gordon (2006)	0.4	0.1	0.4	1.0
Moulton (2018)	0.37	0.08	0.3	0.87
Total range	0.37-0.6	0.05-0.1	0.3-0.45	0.85-1.1

a. Substitution bias adds the estimated effects of both 'upper' and 'lower' level substitution bias.

Source: Boskin Commission (Boskin Commission 1996); Gordon (2006); Lebow and Rudd (2003); Moulton (2018).

Box A.4 – CPI vs the GDP deflator: why mismeasured consumer prices do not always lead to mismeasured productivity

Why is there more than one measure of aggregate price changes?

Above it was discussed why estimates of productivity growth and economic growth more broadly need to be adjusted for changes in prices. Loosely speaking, the changes in prices of goods and services over time can be aggregated into a single measure that tries to capture the average change in prices across the economy, which is referred to as a measure of 'inflation' (price growth).

There are two main kinds of 'inflation' that are of most interest: changes in the prices of goods produced in Australia and changes in the prices of goods most commonly consumed by Australians. Generally, the former is measured using the 'implicit GDP deflator' while the latter is measured using the 'consumer price index' (CPI).

How does this affect productivity growth?

The GDP deflator is used to convert nominal (not adjusted for price changes) measures of productivity into 'real' (price change adjusted) measures of productivity while the latter is used to (among many other

Box A.4 – CPI vs the GDP deflator: why mismeasured consumer prices do not always lead to mismeasured productivity

things) convert nominal measure of wages into real measures of wages. So while the flaws in the measure of CPI discussed in this section have a one-to-one effect on the measurement of consumer prices they do not always affect measured productivity. There are two reasons for this. First, the GDP deflator has a different basket of goods to the CPI; the GDP deflator contains all the goods and services produced in the Australian economy while the CPI has only the prices of the most commonly consumer goods and services. Second, the methods use different formulas to assign weights to different goods and services and update those weights at different intervals.

The overall effect of these differences on the mismeasurement of productivity compared with the measurement of consumer prices is difficult to determine and no systematic attempts have been made to estimate this difference.

Source: ABS (2015, 2019a).

A.4 The impact of measurement error

Productivity growth not coinciding with increased individual wellbeing can result from flaws in the way productivity is measured. These measurement issues include:

- non-market production — home cooked meals, looking after one's own children, cleaning one's house and undertaking own repairs of property all produce goods and services valued by individuals but they are not recorded in GDP or productivity statistics. This can become an issue where government policy reduces non-market production and increases market production but with a potentially ambiguous effect on wellbeing
- marginal verses average — productivity growth cannot always distinguish between the marginal and the average. For example, if a barrier to labour force participation is reduced and the result is that a previously marginalised group of people join the labour force this might reduce average measured productivity if the productivity of this new group of workers is lower than the economy average. However, if this group of people had previously wished to work but were prevented from doing so due to discrimination, then this likely enhances welfare and the economy itself while reducing measured productivity
- stocks verses flows — productivity and GDP measure the flow of new goods and services being produced but they do not account for the destruction of existing assets. So for example, in some circumstances, a natural disaster, or wars, can (assuming it does not severely damage the productive capital stock) actually lead to an increase in measured GDP and productivity growth but are clearly hugely destructive to individual and economic wellbeing
- utilisation of inputs — while capital stocks can be measured with a reasonable degree of accuracy, measuring the degree to which this stock is being productively utilised is very difficult. As a result, statistical agencies typically assume the capital stock is being fully utilised, which tends to result in productivity being underestimated during recessions (when capital utilisation is falling) and overestimated in economic recoveries (when utilisation is rising). A similar issue arises in measuring mining productivity where measured capital services increase steadily as a mine is being built rather than when the mine is made operational, leading to underestimation of productivity in periods of heavy mining investment and overestimation in subsequent periods of heavy extraction

- sensitivity to environmental factors — agricultural, mining and transport productivity are all affected by the state of the natural environment. For example, whether there is heavy rainfall or drought in a particular year will have a strong effect on agricultural productivity. Likewise, the productivity of mining can depend on how difficult it is to extract particular deposits
- quality changes and new goods — the bias created by new goods and quality improvements to productivity measurement were discussed in chapter 1.

A.5 Projecting the growth of the non-market sector in a simple model

The growth of the non-market sector is likely to have significant consequences for Australian productivity growth into the future. One way to try and understand the productivity growth impact is to model different non-market sector growth scenarios with its productivity relatively stagnant.

The model presented in this appendix uses a simple stylised model of the economy with only two sectors — market and non-market — to show that, depending on assumptions made about consumer preferences, continued productivity stagnation in the non-market sector (even in the presence of strong productivity growth in the market sector) is likely to drag on aggregate productivity growth.

The types of consumer preferences analysed are all relatively simple in the sense that only the relative prices of market and non-market products change consumption behaviour — so long as relative prices stay constant, income has no separate effect on relative non-market services consumption. This is likely an oversimplification, as there is likely an independent effect of income on relative consumption of non-market services as well but inclusion of this effect would likely reinforce rather than weaken the findings presented here.

This model also abstracts from the issues of capital and trade, which would likely also be impacted by the rise of the non-market services sector.

This model is a variant of one presented in Vollrath (2019) and Jones (Jones 2020) that both drew inspiration from the works of Baumol (Baumol 1967, 1982) on cost disease.

The model

Production

There are two sectors, market (M) and non-market (N) that each produce a single output (Y). Each use a share of homogenous labour (L) which they use as their sole input and have an assumed rate of labour productivity in any particular period (A) [this has been set based on the historical rate of 1.66% in the market sector and zero for the non-market sector]. In this model, all output is consumed immediately (no investment) and the economy is closed (no international trade).

Intuition: in this model, only labour is used in production so the only thing determining relative prices of products is how much labour they need. Under the assumption that labour is paid the same no matter where it works, the market sector requiring less and less labour as its productivity rises means that its relative price falls and the relative price of non-market services rises.

Each sector has the same production function:

For the market sector

$$Y_M = A_M L_M$$

For the non-market sector

$$Y_N = A_N L_N$$

Firms receive price (P) for their output.

Labour markets

Each sector pays the same wage and labour is paid its marginal value:

$$w_M = w_N = P_M A_M = P_N A_N$$

Combining these equations we have:

$$\frac{P_N}{P_M} = \frac{A_M}{A_N}$$

This means that prices are completely determined by productivity and that the (relative) price of non-market services will tend to rise as market sector productivity rises and non-market sector productivity does not.

Consumption

Depending on what assumptions we make about consumer preferences, we can get different solutions to the above model.

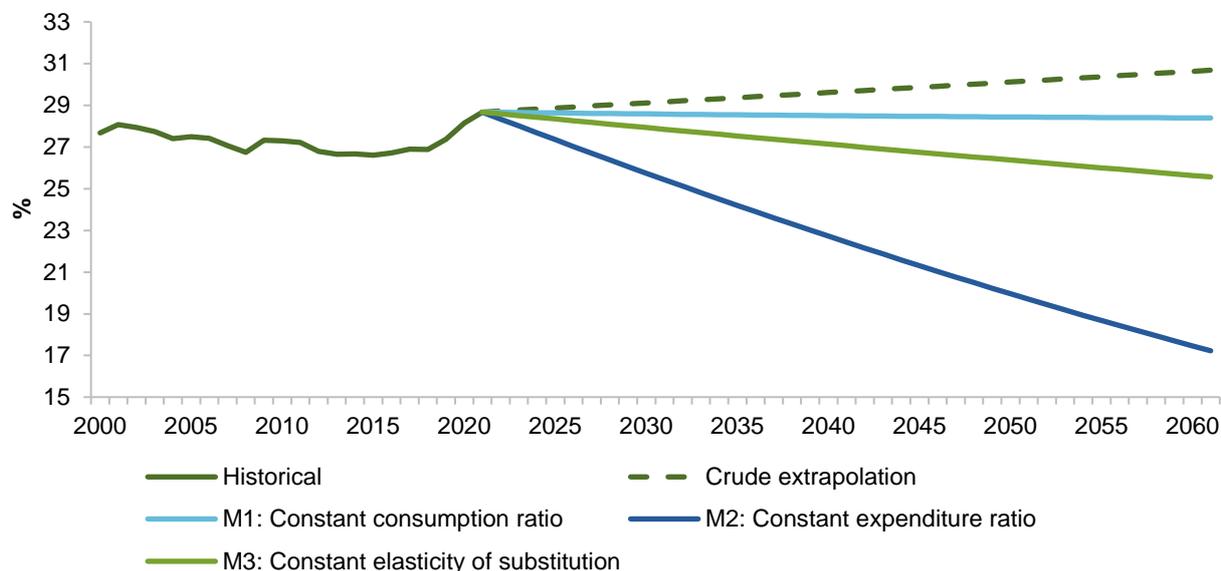
Intuition: given that relative prices are entirely determined by productivity, the only question is how will consumers and governments respond to non-market services getting more expensive? We model three scenarios of varying realism. Note, in all three scenarios there are no pure income effects, consumers only respond to relative price changes.

Projected growth of the non-market GVA share

A feature of this model is that the nominal share of total economic activity of the non-market sector will be identical to its labour share³⁵ so will be the same as shown figure A.3. However, the real share of the non-market sector in total economy GVA tends to either stay constant or fall for all of the models (figure A.2), which is not very different from the historical experience (real relative consumption of total non-market services has increased only marginally). Note that because output and consumption are identical in this model, this is also the real ratio of consumption of non-market to total consumption in the economy.

³⁵ This occurs because the growth in relative prices is equal to the inverse of the growth in productivity, so the necessary terms cancel out and only the share of the labour force determines the industries share of GVA.

Figure A.2 – The non-market sector is not predicted to grow as a share of real GVA
Predicted share of the non-market sector in whole economy GVA by model



Source: Productivity Commission modelling.

When we combine the information from figures A.3 and A.2, one picture that quickly emerges is that as productivity grows in the market sector, Government will have to increase their share of economic activity (and hence taxation) just to maintain the *same* real spend on non-market services let alone increase their real share of expenditure.

One way of interpreting these three models is as four different decision rules for government and consumers to manage rising costs of non-market services:

1. If governments and households grows their expenditure share of non-market services at historical levels, then the crude extrapolation is the result.
2. If governments and households provides the same real quantity of non-market services regardless of growing cost than the result is M1.
3. If governments and households decide that they are unwilling to increase the non-market share of their total expenditure on services (and the share of taxation in the governments' case) in order to fund the same real level of services, then real services will decline in line with M2.
4. If governments and households are about as responsive to price in their purchasing as they have been historically, then the result will be roughly what is seen with M3, a slight fall in the proportion of the economy devoted to nonmarket services.

Model 1: Constant real consumption ratio

Intuition: one extreme is to assume consumers never adjust their consumption based on price and always consume a fixed ratio of market and non-market services. This represents the lower bound of consumer responsiveness and the upper bound of the expected growth of the non-market sector.

Assuming consumers always consume the same ratio of market to non-market goods (C) regardless of price, we can write this as:

$$\frac{C_M}{C_N} = K$$

But all output is consumed ($C=Y$) so:

$$\frac{Y_M}{Y_N} = K$$

Inserting our production functions we get:

$$\frac{L_M}{L_N} = K \times \frac{A_N}{A_M}$$

So the non-market sector will expand as a share of the labour force as the market sector becomes increasingly more productive. This situation can be thought as being similar to a Leontief production function, consumers always want the same ratio of real market and non-market consumption and adjust consumption one-to-one with price changes to maintain this ratio.

Model 2: Constant expenditure ratio

Intuition: the opposite extreme to the above is to assume that consumers will respond one-to-one to any price increases by decreasing real consumption in order to maintain the same share of their budget on non-market goods. This could occur, if for example, governments set a maximum percentage of GDP they were willing to allocate to health or education. This represents the lower bound to the growth of the non-market sector.

Under a second set assumptions consumers allocate a constant proportion of their budget to non-market services. Mathematically:

$$\frac{P_M C_M}{P_N C_N} = K'$$

Rearranging and combining we get:

$$\frac{L_M}{L_N} = K'$$

So the ratio of non-market to market labour is constant over time because consumers do not respond to prices by changing their fixed budget allocations.

Model 3: Constant elasticity of substitution

Intuition: a more realistic assumption is to assume consumers/governments respond to the rising cost of non-market services by cutting back, but not by very much. For example, assuming the elasticity of 0.21, for every 100% increase (doubling) in the price of apples relative to oranges, a consumer will increase her relative consumption of oranges by 21%.

Assuming a constant elasticity of substitution, we can model consumer preferences as:

$$\frac{C_M}{C_N} = K'' \times \left(\frac{P_N}{P_M} \right)^\sigma$$

Where: $0 < \sigma < 1$ is the constant elasticity of substitution. This parameter was set to mimic the historical data as well as possible (this came out to about 0.21, which is relatively unresponsive to prices). K'' is also adjusted to match the historical data.

Results

In most cases, model 1 (M1) with constant consumption represents the upper bound of realistic projections where consumers are assumed to be invariant to price changes (Leontief). Model 2 (M2) could be thought of

the as the lower bound of realistic projections where consumers respond to all relative price changes by cutting consumption proportionally. Model 3 (M3) is a bit of an in between that is slightly more realistic.

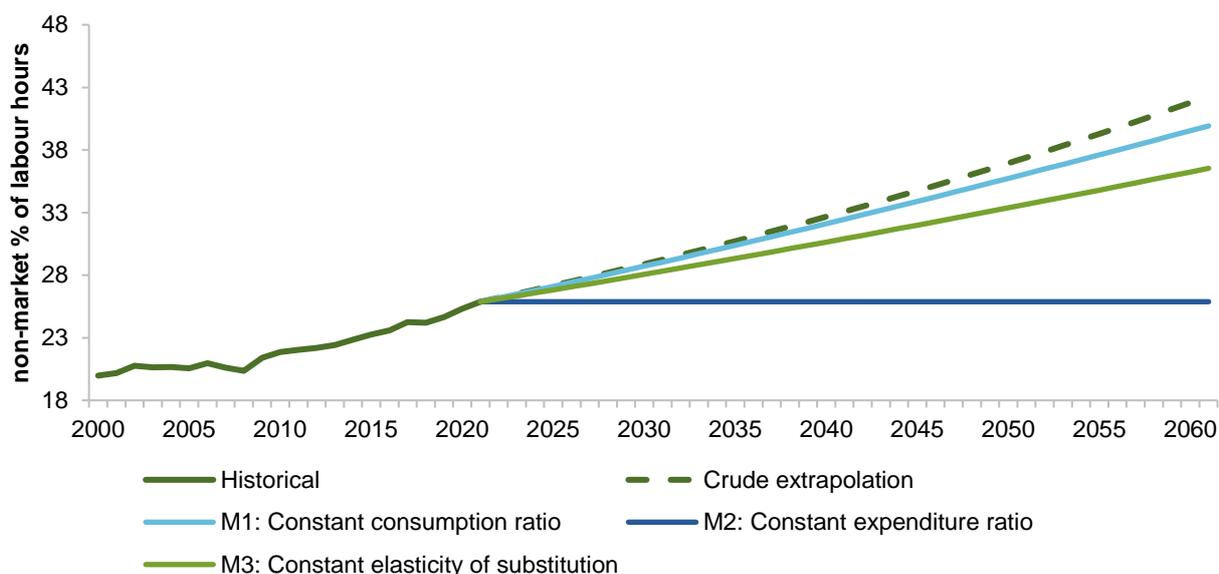
Projected growth of the non-market labour share

All three of these models can be used to project the share of non-market labour over the horizon of the IGR under the assumption that market sector productivity grows at a constant rate (set at 1.66% here) and that non-market productivity does not grow.

Figure A.3 shows that when these assumptions are made, two of the three models are broadly consistent with both each other and the crude projection (which was based on extrapolating past trends outwards). That said, both M1 and M3 appear to give slower expansions of the non-market sector than is implied by simply extrapolating the real world data. The likely reasons for this are that the model is a vast oversimplification of reality and that, historically, the slow growth of non-market labour productivity has not been the sole force driving the expansion of the non-market sector (it is likely that ageing, women entering the workforce³⁶ or international demand for Australian higher education and tourism services have also been contributors).

Figure A.3 – Non-market sector employment is predicted to grow as its relative productivity falls

Non-market sector share of the labour force (%) between 2000-01 and 2060-61



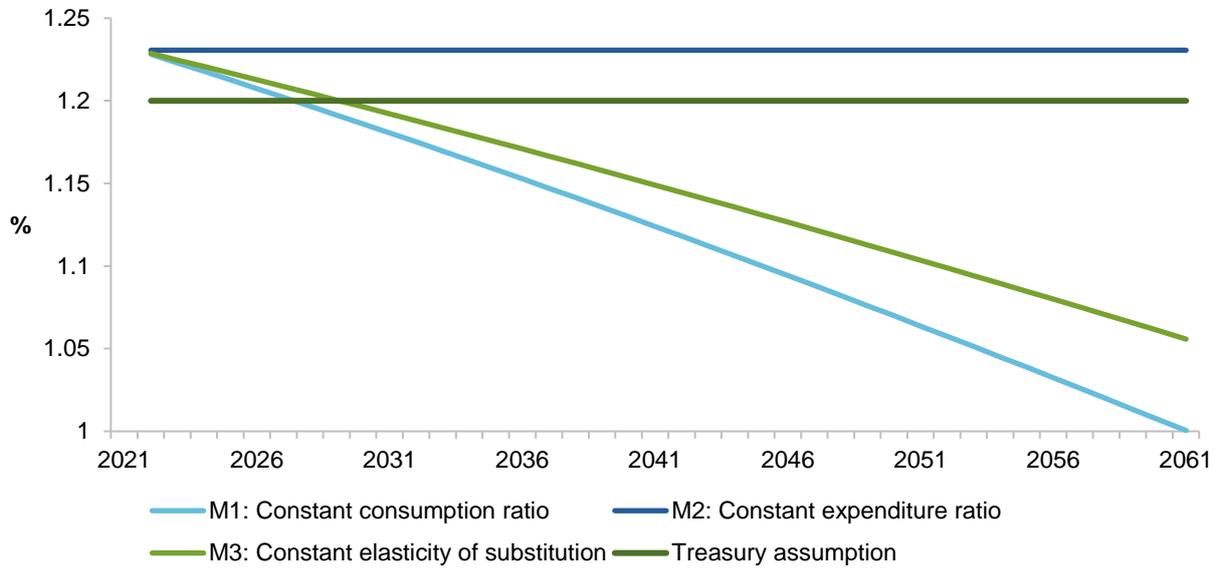
Source: Productivity Commission modelling.

Projected whole economy productivity growth

The shares of the labour force projected by the various models imply different aggregate rates of labour productivity growth across the whole economy (figure A.4). Generally, the faster the non-market sector is predicted to grow, the slower aggregate labour productivity growth will be.

³⁶ Women entering the workforce (or intensifying their participation) reduces the supply of home production and creates demand for replacement market services.

Figure A.4 – Aggregate productivity will fall as the non-market sector expands
Projected whole economy labour productivity growth between 2020-21 and 2060-61



Source: Productivity Commission modelling.

Abbreviations

ABS	Australian Bureau of Statistics
AI	Artificial Intelligence
AIFS	Australian Institute of Family Studies
AIHW	Australian Institute of Health and Welfare
CEDA	Committee for Economic Development of Australia
CFC	Chlorofluorocarbons
CPI	Consumer price index
DESE	Department of Education, Skills and Employment
DISER	Department of Industry, Science, Energy and Resources
DVD	Digital Optical Disk
GDP	Gross Domestic Product
GNI	Gross National Income
GP	General Practitioner
GPT	General Purpose Technology
GVA	Gross Value Added
ICT	Information and Communication Technology
KLEMS	K-capital, L-labor, E-energy, M-materials, and S-purchased services productivity.
MFP	Multifactor productivity
OECD	Organisation for Economic Co-operation and Development
PC	Productivity Commission
PPP	Purchasing Power Parity
R&D	Research and Development
RBA	Reserve Bank of Australia
STEM	Science, Technology, Engineering and Mathematics
UK	United Kingdom
UNICEF	United Nations Children's Fund
USD	United States Dollar

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