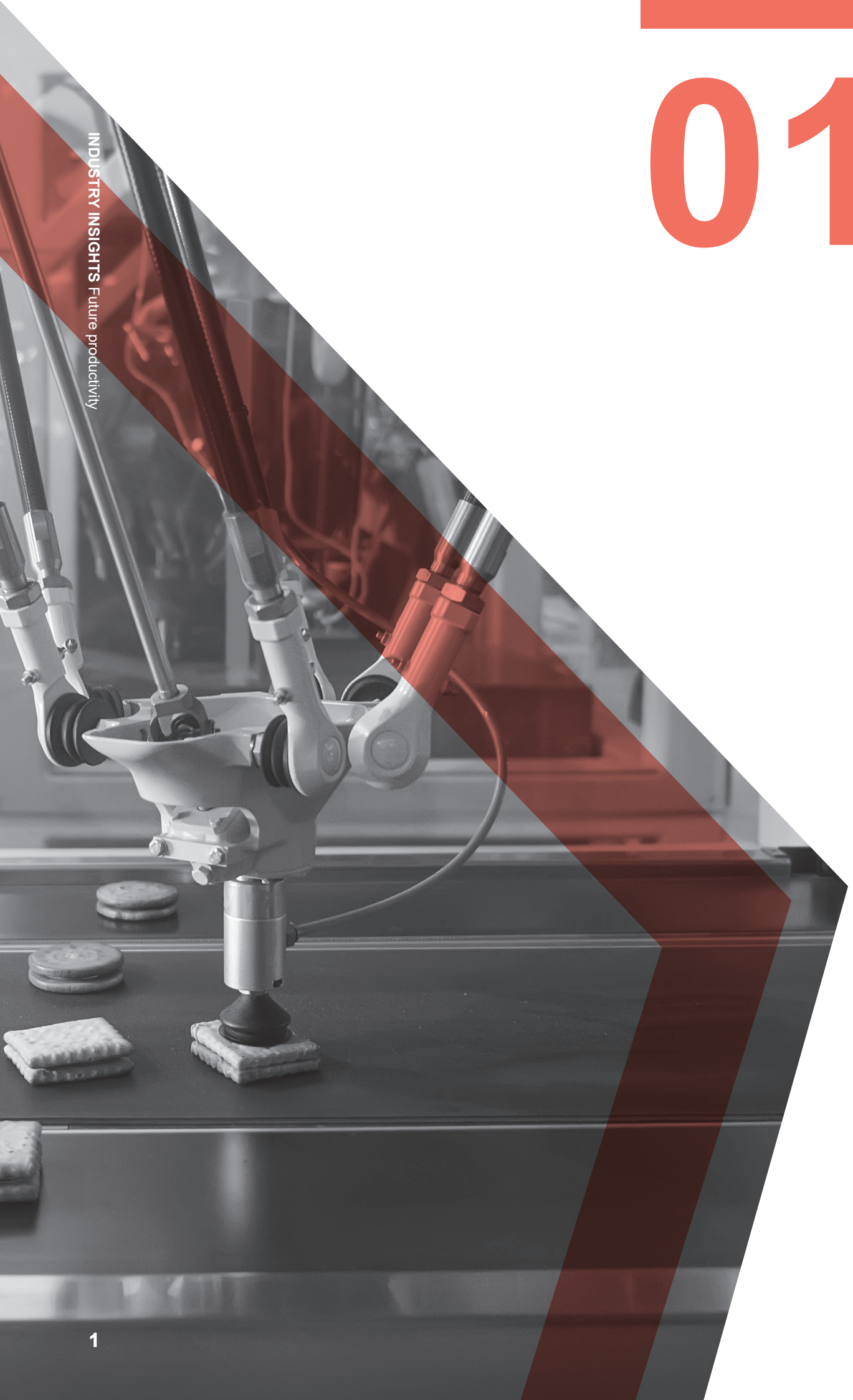


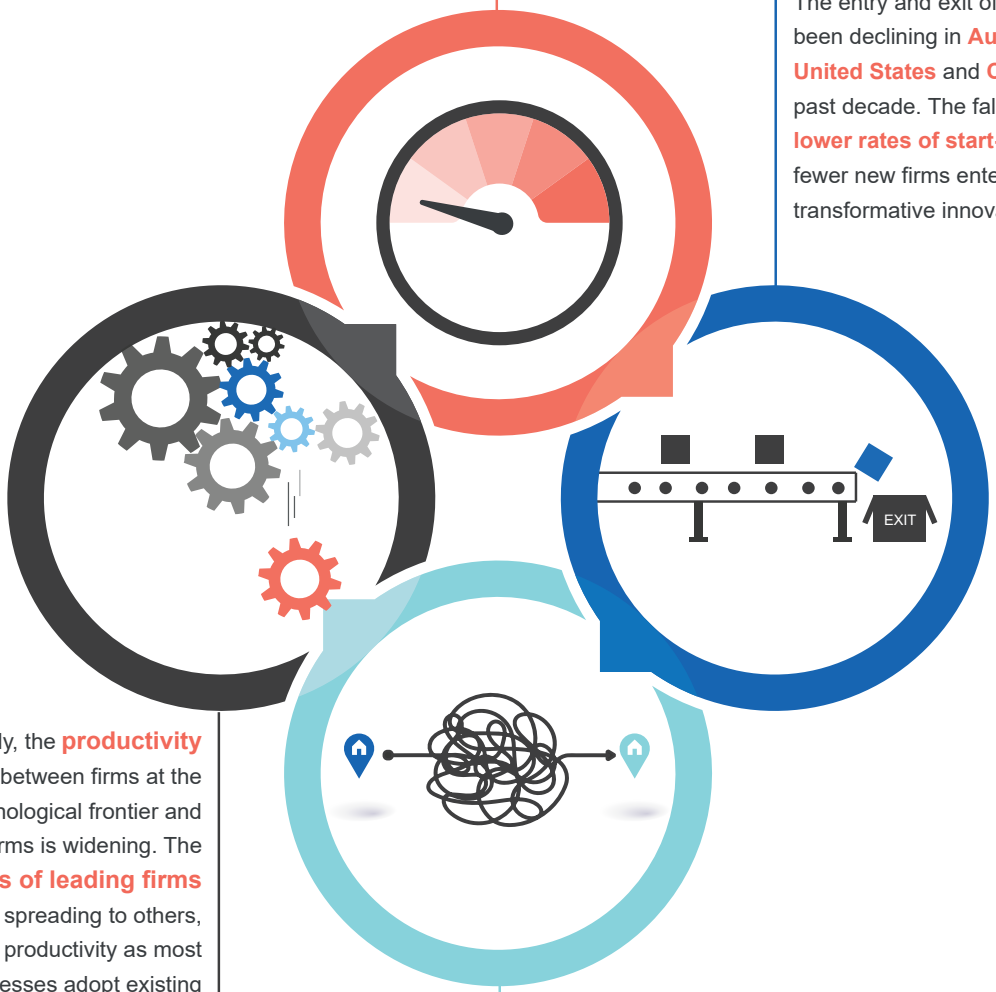
01

Australian Government
Department of Industry, Innovation and Science
Office of the Chief Economist

Declining economic dynamism: implications for productivity

A **slower pace of change** could be driving the weak productivity growth in Australia and advanced economies.

The entry and exit of businesses has been declining in **Australia**, the **United States** and **Canada** over the past decade. The fall is mostly due to **lower rates of start-ups**, meaning fewer new firms entering with transformative innovations.



Globally, the **productivity gap** between firms at the technological frontier and non-frontier firms is widening. The **innovations of leading firms** are not spreading to others, lowering productivity as most businesses adopt existing technologies rather than invent new ones.

Job turnover and the rate of people moving interstate has been falling in **Australia** and the **United States**. Slowing turnover and mobility means people are not shifting jobs as quickly to **productive areas of the economy**.

Productivity reflects the ability to produce more output by better combining inputs, technological innovations and management practices (see Box 1.1: Multifactor productivity). Continued productivity growth matters for the economy and society as it supports ongoing improvements in incomes and living standards.

However, productivity growth has fallen in Australia and across advanced economies since around 2004. This slump has been broad across industries and has coincided with a period of advances in digital technologies.

There is little consensus on the cause of the productivity slowdown. Traditional explanations for the slowdown in Australia include a slowing pace of microeconomic reforms and the rapid increase in mining-led capital investment during the mining boom that resulted in input usage, outpacing output growth. Another less common, but plausible, explanation of low productivity growth is that the pace of change in the economy has declined. Measures of the pace of change (or economic dynamism) include business churn, job turnover, labour mobility and technology diffusion. Lower dynamism is not just apparent in Australia but in other advanced economies, including the United States (US).

This chapter will explore Australia's productivity growth since the 1990s and identify domestic and international trends of economic dynamism that have implications for productivity growth. It concludes with a summary of the arguments about future productivity given the rise in digital technologies.

Box 1.1: Multifactor productivity

There are numerous measures of productivity of which multifactor productivity (MFP) is one. In this chapter, discussions are based on MFP and the terms MFP and productivity are used interchangeably.

MFP growth is the increase in output beyond that stemming from changes in inputs used in production processes. It can be thought of as the efficiency with which inputs such as labour and capital are combined to produce goods and services.

Earlier growth in productivity

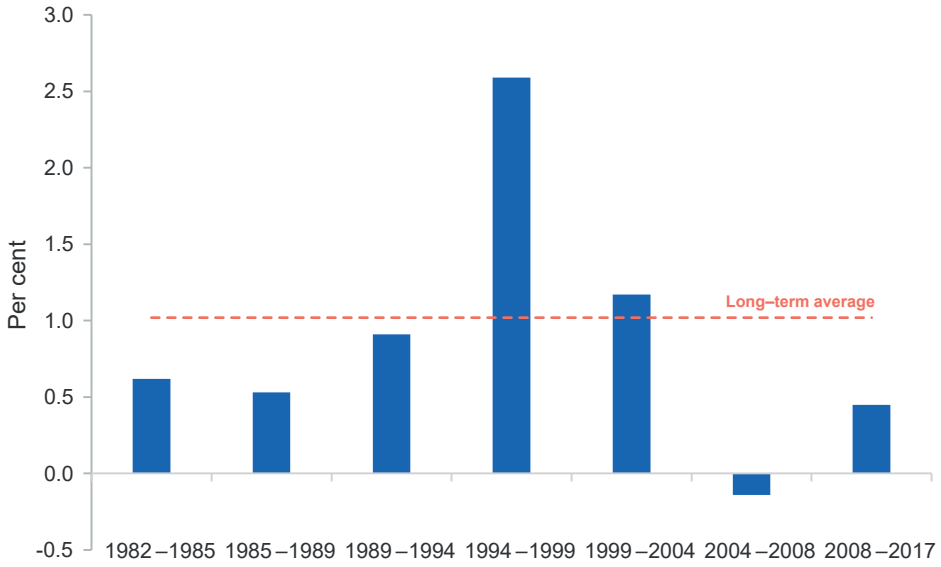
Australia's productivity growth accelerated during the 1990s, playing a vital role in lifting Australia's economic performance during that decade and into the early 2000s. Yet, growth has stalled since around 2004, raising concerns as low productivity growth has implications for incomes and living standards. This section provides an overview of productivity growth over the past three decades.

Productivity growth prior to 2004

Productivity growth over the last 30 years averaged one per cent per year. Between 1993 and 2004, productivity growth exceeded the average following a slump in the 1980s (Figure 1.1). Average yearly growth was 2.6 per cent between 1994 and 1999 and 1.2 per cent between 1999 and 2004.

The period of strong productivity growth in the 1990s was mostly attributed to a series of microeconomic and macroeconomic reforms introduced since the 1970s. In 2005, the Productivity Commission estimated that productivity improvements and price reductions

Figure 1.1: Aggregate market sector productivity growth, 1982 to 2017



Source: Australian Bureau of Statistics, Estimates of Industry Multifactor Productivity, 2016-17, cat. no. 5260.0.55.002

flowing from the National Competition Policy and related reforms raised GDP by 2.5 per cent.[1] The International Monetary Fund estimated that these reforms helped boost Australia's annual productivity growth in the 1990s by 0.5 to 0.9 of a percentage point.[2]

The acceleration in productivity during the 1990s was common across industries in Australia but was mostly led by services — especially information and telecommunications — and utilities.

Deregulation of the airline and financial industries, injecting more commercial focus into government-owned enterprises, and privatisation resulted in greater price competition, lower production costs and improved services. Competition reforms that increased competitive forces helped raise productivity by moving resources to more successful and higher productivity firms. In more competitive economies, average productivity tends to be higher as there is a smaller tail of low-productivity firms.[3]

Compared to policy reforms, broad adoption of information and communications technology (ICT) played a supplementary role with a smaller contribution to productivity growth — estimated at a tenth of a percentage point per year between 1992 and 1997.[4]

ICT adoption may have even been a by-product of the reforms: the liberalisation of trade and capital markets and increased labour market flexibility created a platform for greater investment — particularly in ICT — and innovation. Trade liberalisation also stimulated competition, inducing Australian firms to adopt better business practices to compete

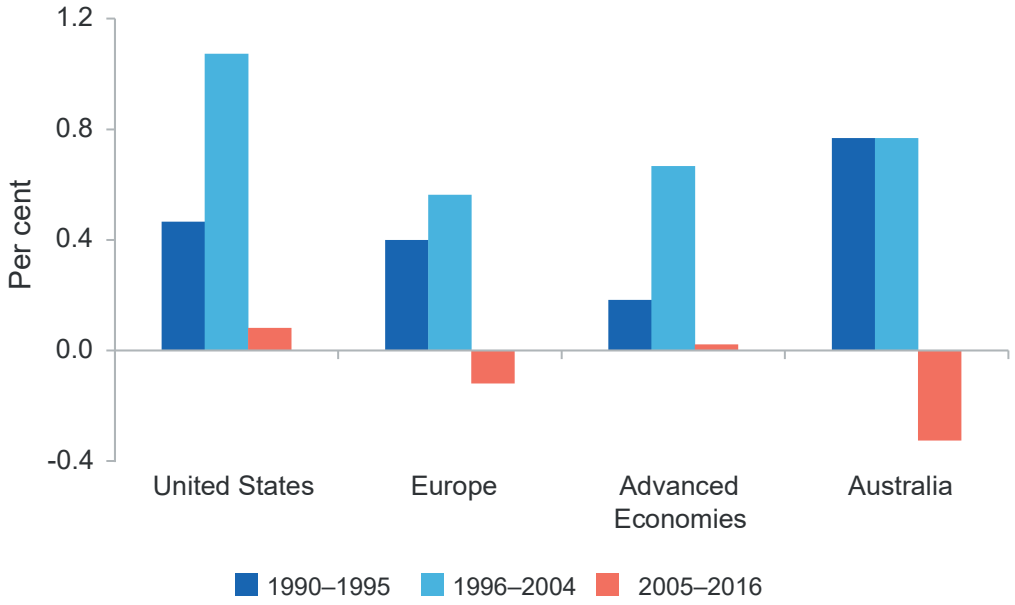
1 Productivity Commission (PC) (2005) Review of National Competition Policy Reforms, Report no. 33, PC, Canberra, pp.366-367

2 Salgado R (2000) "Australia: Productivity Growth and Structural Reform" *in International Monetary Fund (IMF), Australia: Selected Issues and Statistical Appendix, IMF Staff Country Report No. 00/24*, IMF, Washington, pp.3–35

3 Syverson C (2004) "Market structure and productivity: a concrete example" in *Journal of Political Economy*, 112(6), pp.1181-1222

4 Bean C (2000) "The Australian Economic 'Miracle': A View from the North", in: Gruen, D. and Shrestha S. (eds.), *The Australian Economy in the 1990s. Conference Proceedings*, Reserve Bank of Australia, Sydney, pp.90-94

Figure 1.2: Productivity growth in advanced economies, 1990 to 2016



Source: The Conference Board, Total Economy Database: Growth Accounting and Total Factor Productivity, 1990-2016 and Regional Aggregates, 1990-2018

with foreign producers.[5] Services industries — including wholesale trade and finance — transformed business operations using new ICT.[6] Once opened to competition, productivity levels in these industries rose towards the international technological frontier as Australia became a world leader in ICT usage during the 1990s.[7]

Productivity growth since 2004

Productivity growth in Australia and other advanced countries declined from about 2004 (Figure 1.2) and across most industries. The fall was sharper in Australia than other advanced countries, with the mining boom likely to be a major reason for the difference.

The impact of the mining boom helps explain the downturn in some industries in Australia. The mining boom had three distinct but connected stages (Figure 1.3).

- The price phase (2004 to 2012): high economic growth and investment from Asia drove commodity prices to record levels.
- The investment phase (2007 to 2017): mining responded with unprecedented investment to increase production capacity.
- The production phase (2011 to 2019): investment projects were completed and began to generate massive increases in production.

During the price and investment phases, mining firms employed more workers and invested in capital to unlock bottlenecks and open new mines. Given the long lead times from investment to production in the sector, growth in output did not match the acceleration in inputs, lowering productivity. Prior to the mining boom, productivity growth in the industry averaged 0.7 per cent per year. Yet, during the price and investment phases, annual productivity fell sharply and averaged about -5 per cent per year in both phases.

5 Department of Industry, Innovation and Science (DIIS) (2018) Industry Insights: 1/2018 *Flexibility and growth*, DIIS, Canberra, pp.10-15

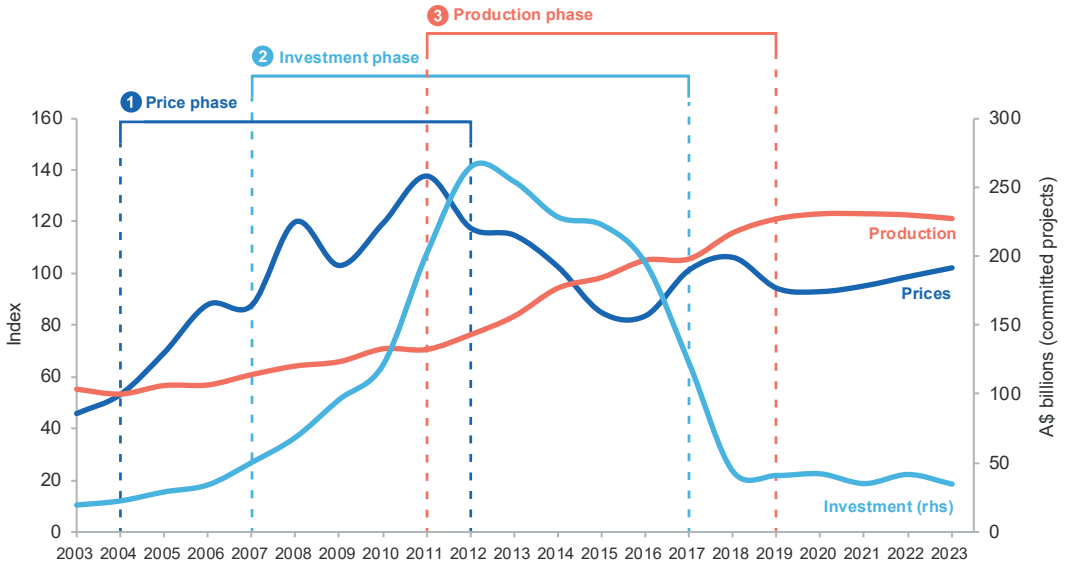
6 Campbell S and Withers H (2017) "Australian productivity trends and the effect of structural change" in *Economic Roundup*, Treasury, Canberra, pp.4-9

7 Dolman B (2009) 'What happened to Australia's Productivity Surge?' in *Australian Economic Review*, 42(3) p.p. 243–263

Productivity in mining is recovering with the transition from the investment to the production phase. Since 2014, production has increased as new capacity has come online and productivity growth has averaged 3.1 per cent per year.

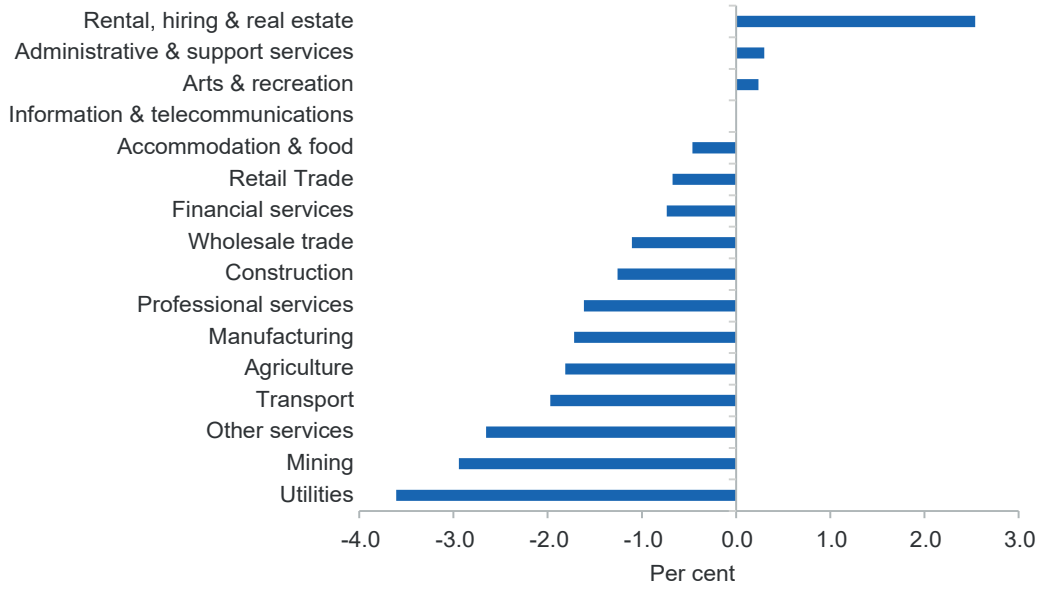
Yet, falling mining productivity does not entirely explain the slow economy-wide productivity growth as mining comprises only 7 per cent of output. Low productivity growth since 2004 was common across most industries (Figure 1.4).

Figure 1.3: The three phases of the mining boom



Source: Office of the Chief Economist (2018) Resources and Energy Quarterly, March 2018

Figure 1.4: Difference between pre- and post-2004 annual average productivity growth, by industry



Notes: Pre-2004 average productivity growth refers to the average annual growth between 1991 and 2004, while post-2004 average productivity growth refers to the average annual growth between 2005 and 2017.

Source: Australian Bureau of Statistics, Estimates of Industry Multifactor Productivity, 2016-17, cat. No. 5260.0.55.002

Since 2004, productivity growth in productivity enabling industries like utilities, construction, transport, information and telecommunications, and finance and professional services has remained at or below the pre-2004 long-term average. These industries comprise a large share of output (around 45 per cent) and also affected aggregate productivity given their roles as inputs into production process.[8]

Numerous factors contributed to the low productivity growth in productivity-enabling sectors. In utilities, heavy but lumpy investment in infrastructure, technology and alternative generation have resulted in higher input requirements per unit of output, reducing productivity.[9] Services are one of the least reformed and trade exposed parts of the economy.[10] The lack of reforms and competition in services could be dragging down aggregate productivity growth given its size, importance as inputs to other industries and impact on productive capacity such as on health and education levels.

A declining momentum of large-scale policy reform could be contributing to lower productivity growth. The fading of the one-off effects of past reforms could also be exacerbating the problem.[11] Beyond the introduction of the Goods and Services Tax in 2000 and changes made as part of A New Taxation System reforms, there have been few large tax policy changes.[12] Fewer regulation reforms, and rises in productivity-stifling regulation and legislation, have also been suggested as contributing to the productivity decline.[13]

The implications for living standards of declining productivity growth is concerning. Yet, the slowdown is not completely explained by causes explored above. It is worth examining underlying factors driving low productivity growth and the slowing pace at which technology is adopted and spread.

The status of underlying drivers of productivity growth

Productivity is intricately linked to the pace of change in the economy, also known as economic dynamism. Dynamism is a productivity-enhancing mechanism that helps allocate resources and spread ideas and innovation in the economy. A slowdown in dynamism is a trend that has been observed in Australia and some major economies.

This section explores whether lower dynamism contributed to the productivity slowdown using three measures: business churn, labour dynamism — including occupation churn and interstate migration — and technology diffusion.

Business dynamism

A healthy flow of business entries and exits — business churn — is important for economic growth. New firms that enter and succeed are likely to have uncovered a new or better quality product, service or process. New entries can increase competitive pressures on existing firms, forcing them to become more competitive or exit the market. This dynamic, known as creative destruction, increases productivity.

8 Department of Industry, Innovation and Science (DIIS) (2015) Australian Industry Report 2015, DIIS, Canberra

9 Parham D (2012) Australia's Productivity Growth Slump: Signs of Crisis, Adjustment or Both? Visiting Researcher Paper, Productivity Commission, Canberra

10 Productivity Commission (PC) Shifting the Dial: 5 Year Productivity Review, Inquiry Report, PC, Canberra

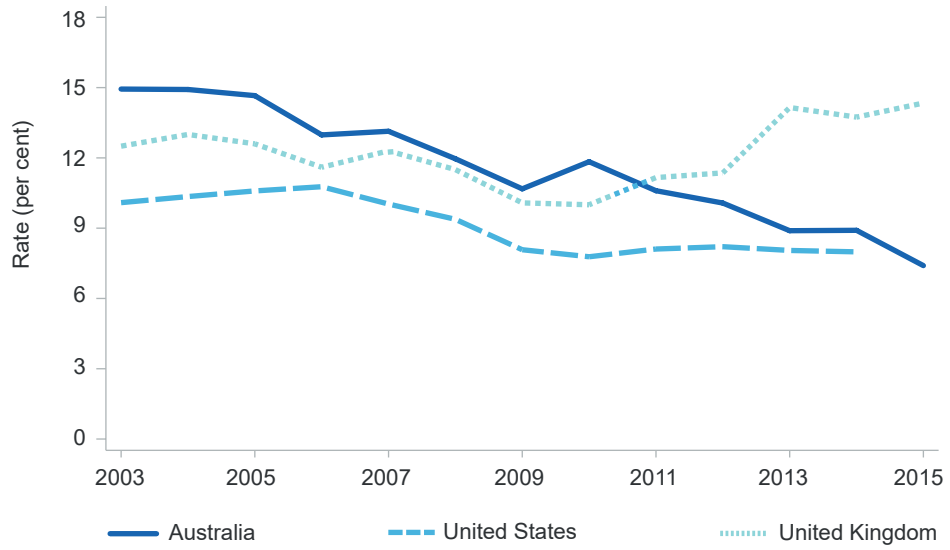
11 Connolly E and Gustafsson L (2013) "Australian productivity growth: trends and determinants" in The Australian Economic Review, 46(4), pp.473–482

12 Garnaut R (2010) Climate Change, China Booms and Australia's Governance Struggle in a Changing World, Hamer Oration, Melbourne

13 Eslake S (2011) Productivity: The Lost Decade, Paper presented to Reserve Bank of Australia conference on The Australian Economy in the 2000s, Reserve Bank of Australia, Sydney, pp.223-254

Business churn has been declining in Australia, the US and Canada over the past decade. Lower business churn is primarily the consequence of decreasing rates of entrepreneurship (Figure 1.5).[14] The decline is broad across industries, including the productivity-enabling sectors. Entrepreneurship has also declined in professional and technical services, which is associated with advanced technology use and entrepreneurs that transform markets and create jobs.[15]

Figure 1.5: Business entry rates, 2003 to 2015



Source: Bakhtiari, S (2017) Entrepreneurship Dynamics in Australia: Lessons from Micro-data

A key significance of entrepreneurs and young firms is their contribution to job creation and labour reallocation.[16] In Australia, the fall in entrepreneurship is being matched by lower job creation rates (Figure 1.6). Between 2004 and 2014, the job creation rate fell from 20 per cent to 14 per cent, while the job destruction rate was stable at around 14 per cent.[17]

Given the key role that new entrants have in employment and output growth,[18] declining entry may slow the creative destruction process which underpins productivity growth.

Since research on business entry and job creation was published in 2017, new data shows business entry rates rose 1.7 percentage points in the two years to 2016-17,[19] coinciding with strong employment growth. Yet, even factoring in these new observations, there is still a longer term downward trend.

14 Bakhtiari S (2017) *Entrepreneurship Dynamics in Australia: Lessons from Micro-data*, Department of Industry, Innovation and Science, Office of the Chief Economist Research Paper, Canberra, pp.10-13. The paper uses a restricted definition of business entry to better associate business entry with entrepreneurship and control for non-entrepreneurial reasons for starting a business.

15 Ibid.

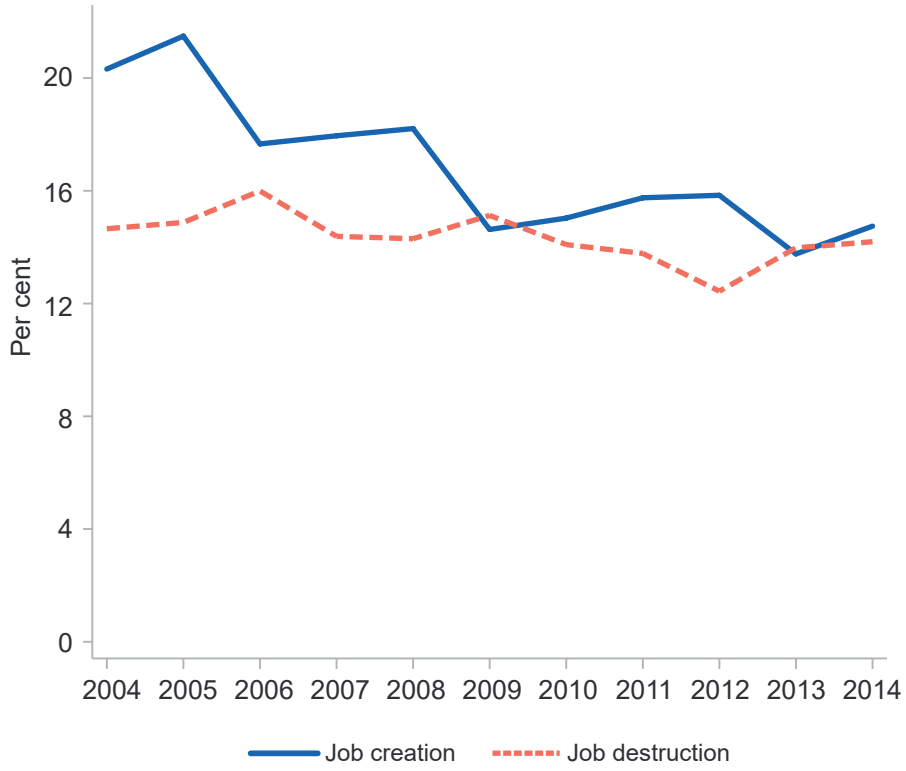
16 Haltiwanger J, Ron S.J, and Javier M (2013) "Who Creates Jobs? Small vs. Large vs. Young," *Review of Economics and Statistics*, 95(2), pp.347–361

17 Bakhtiari S (2017) *Entrepreneurship Dynamics in Australia: Lessons from Micro-data*, Department of Industry, Innovation and Science, Office of the Chief Economist Research Paper, Canberra, p.30

18 Ibid.

19 Australian Bureau of Statistics (2018) 8165.0 – *Counts of Australian Businesses, including Entries and Exits, Jun 2013 to Jun 2017*, viewed 12 November 2018, http://www.abs.gov.au/ausstats/abs@.nsf/mf/8165.0

Figure 1.6: Job creation, 2004 to 2014



Source: Bakhtiari, S (2017) Entrepreneurship Dynamics in Australia: Lessons from Micro-data

Turnover high-growth firms (business that grow their turnover by 20 per cent or more for three years running) are also becoming less prominent in Australia. These firms contribute significantly to sales growth, net value-added, productivity and capital investment. Since the mid-2000s, both the magnitude of the growth rates of these firms and the proportion that experience high growth episodes have been declining.[20]

In Europe, productivity growth during the 2000s was weaker in industries with larger declines in the share of young firms and in start-ups.[21]

There is also evidence of falling business exits. Total company insolvency per 100,000 companies rose temporarily leading up to and during the height of the Global Financial Crises (GFC) but has since declined (Figure 1.7). Further, average annual change in company insolvency has been trending downwards since the early-2000s. The pattern is similar for total personal insolvencies per 100,000 working-age persons, which includes bankruptcies of small businesses.

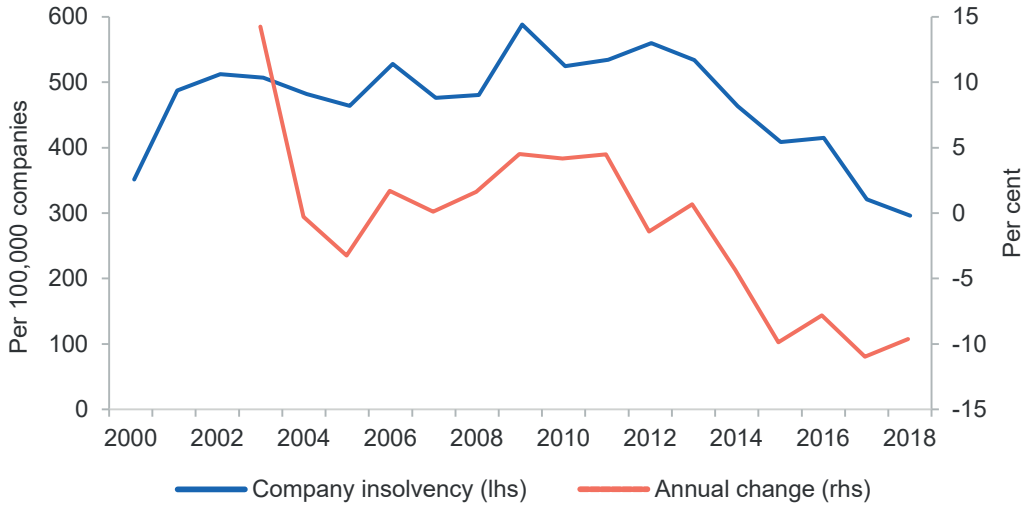
Falling insolvencies could increase the likelihood that labour and capital remain locked in inefficient firms or "zombie firms", slowing the productivity-enhancing reallocation of resources as well as the spread of ideas and know-how. Insolvency or bankruptcy laws that penalise failure are negatively associated with productivity growth and the share of high growth firms in capital-intensive industries.[22]

20 Department of Industry, Innovation and Science (DIIS) (2017) *Australian Innovation System Report 2017*, DIIS, Canberra, pp.26-50

21 Organisation for Economic Co-operation and Development (OECD) (2015) *The Future of Productivity*, OECD, viewed September 2017, http://www.oecd.org/eco/OECD-2015-The-future-of-productivity-book.pdf

22 Bravo-Biosca A, Criscuolo C, and Menon C (2016) "What drives the dynamics of business growth?" in *Economic Policy*, 31(88), pp.703-742

Figure 1.7: Company insolvency per 100,000 companies and annual change in insolvency, 2000 to 2018



Notes: Company insolvency is the proportion of total companies registered with the Australian Securities & Investments Commission entering external administration and total registered companies multiplied by 100,000. Growth represents the three-year moving average in the annual change in company insolvency.

Source: Australian Securities & Investments Commission

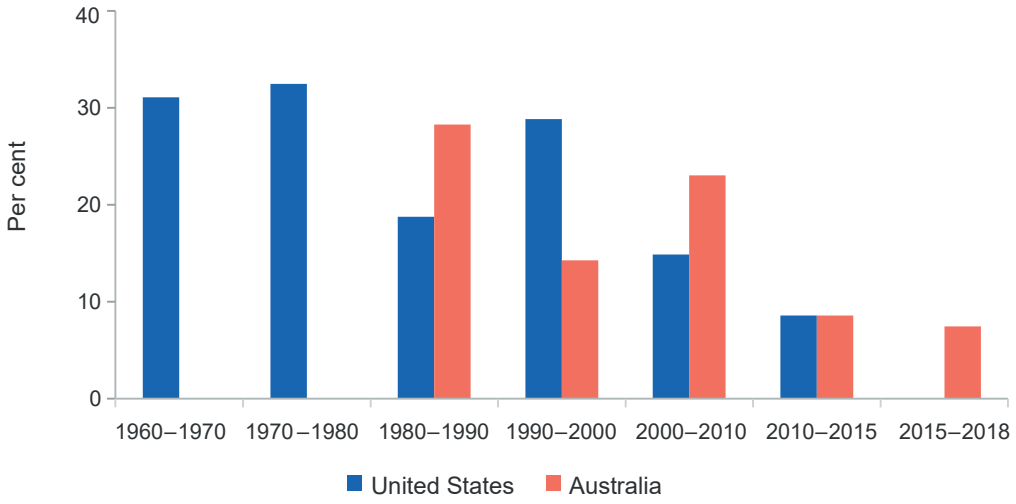
Labour dynamism

A fast changing labour market can allocate labour to where they will add most value. By transitioning labour efficiently to the most productive jobs and regions, a changing labour market helps increase productivity. This section explores labour dynamism looking at two proxies, occupation churn and regional mobility.

Occupation churn[23] — a measure of the rate of labour reallocation in the economy — has been falling in Australia and the US, despite perceptions that technological change is increasing the pace of change (Figure 1.8). This period of slower labour market dynamism has negative implications for productivity.

23 Occupation churn is equal to the absolute value of the sum of jobs created and jobs lost in a particular period as a share of total jobs in the economy in the base period.

Figure 1.8: Occupation churn, Australia and the United States, 1960 to 2018



Notes: The level of occupation churn rates for Australia and the United States are not directly comparable due to differences in classifications and type of data sources used to estimate the rates. Data for Australia for decades prior to 1980 was not available.

Source: ABS, 6202.0 - Labour Force, Australia, September 2018; Atkinson R and Wu J (2017)

In the US, occupation churn has fallen from over 30 per cent in the 1960s to less than 10 per cent in 2015. A similar trend is observed in Australia where occupation churn has fallen by 20 percentage points over the past 40 years.

There is no clear answer why occupation churn has slowed in Australia and other advanced economies. The impact of the GFC on firm capacity use has been posited as contributing to the declining churn after 2008: firms may have responded to the deterioration in demand during the GFC by underutilising labour.[24] In Australia, the underutilisation rate rose over 3.5 percentage points to 13.6 per cent.[25] Ten years on, underutilisation has remained stubbornly high at slightly under 14 per cent.[26]

The movement of labour across regions signals that labour supply is responding to the changes in the location of jobs, an aspect of labour market flexibility that facilitates productivity growth. More efficient job matching has been linked to residential reallocation.[27]

24 Oulton N and Sebastiá-Barriel M (2013) "Long and short-term effects of the financial crisis on labour productivity, capital and output" in *Bank of England working papers*, p. 470

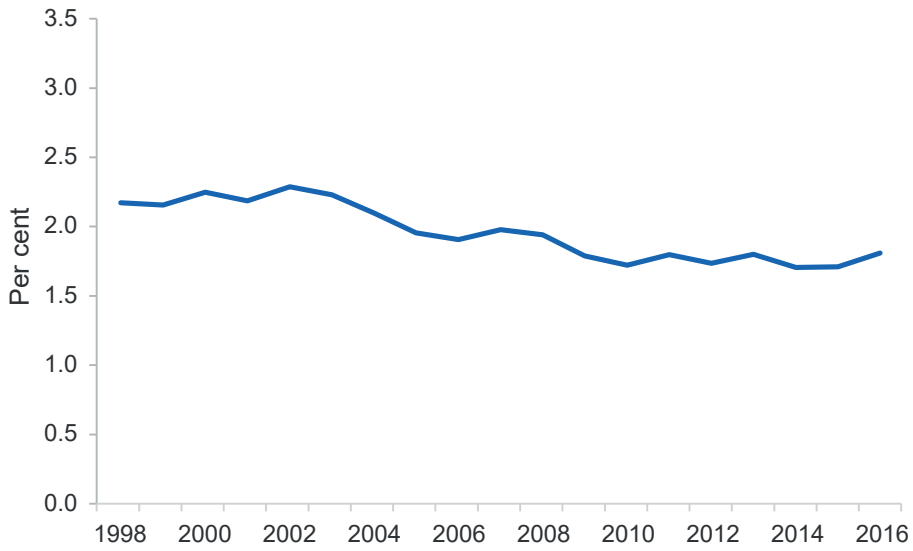
25 The labour force underutilisation rate is the sum of the number of persons unemployed and underemployed expressed as a percentage of the labour force. It is an indicator of unused capacity of labour.

26 Australian Bureau of Statistics (2018) *6202.0 - Labour Force, Australia, September 2018*, viewed 18 September 2018, http://www.abs.gov.au/ausstats/abs@.nsf/mf/6202.0

27 Organisation for Economic Co-operation and Development (OECD) (2015) *The Future of Productivity*, OECD, viewed September 2017, http://www.oecd.org/eco/OECD-2015-The-future-of-productivity-book.pdf

However, the proportion of working-age population migrating between states has declined steadily from 2.3 per cent in 2002 to around 1.8 in 2016 (Figure 1.9). The fall was despite the mining boom, which increased mining wages and encouraged workers to relocate to mining-intensive states like Western Australia and Queensland. The decline is apparent among all working-age group cohorts, but largest for the younger and the prime-working age.[28]

Figure 1.9: Interstate mobility, proportion of working age population, 1998 to 2016



Notes: Working age population refers to those between 15 and 64 years of age.

Source: ABS.Stat: Estimated resident population, Interstate migration: Arrivals, departures and net

The experience of lower regional migration is not unique to Australia. Internal migration within the US has fallen continuously since the 1980s. Similar to Australia, the decline — from a peak of 3.8 per cent in 1990 to 2.1 per cent in 2017 — predates the GFC.[29]

A slowdown in job turnover and population ageing may be driving the steady drop in interstate labour migration. Taxation policy — particularly stamp duty — housing costs and state-based occupational licensing can also create barriers to labour flows across regions.[30]

Technology diffusion

An additional measure of a dynamic economy is the rate of technology diffusion. Diffusion spreads the benefits of productivity-enhancing technology from frontier firms to others.

New, frontier technologies do not diffuse to all firms straightaway. Evidence suggests firms below the technology frontier only receive the benefits of new technologies after they have been diffused to national frontier firms, and tested and adapted to country specific circumstances by them.[31]

28 Department of Industry, Innovation and Science calculations

29 Liu P, Nunn R, and Shambaugh J (2018) *How Declining Dynamism Affects Wages*, The Hamilton Project, Brookings, viewed 30 October 2018, https://www.brookings.edu/wp-content/uploads/2018/02/es_2272018_how_declining_dynamism_affects_wages.pdf

30 Productivity Commission (PC) (2017) *Shifting the Dial: 5 Year Productivity Review, Inquiry Report*, PC, Canberra

31 Andrews D, Criscuolo C, and Gal PN (2015), *Frontier Firms, Technology diffusion and Public Policy: Micro Evidence from OECD Countries*, OECD Productivity Working Papers No. 22, OECD Publishing, Paris

Moreover, adoption and diffusion of technology matters more for the majority of firms than direct investment in research and development.[32] This finding resonates with the innovation traits of Australian businesses: the vast majority of Australian businesses adopt technologies, products or processes already introduced by other businesses and few introduce new-to-market technologies or innovations (Figure 1.10).

Figure 1.10: Proportion of Australian firms introducing innovation, by novelty status, 2016–17

Source: ABS, 8158.0 - Innovation in Australian Business, 2016-17

Studies on cross-country firm-level data show that declining global productivity could be the result of the slower pace of technology diffusion across firms.[33] Productivity growth in firms that are at the global frontier of technological change has remained robust over time, but has stagnated for firms below the frontier. Consequently, the productivity gap between frontier and non-frontier firms has widened (Figure 1.11).

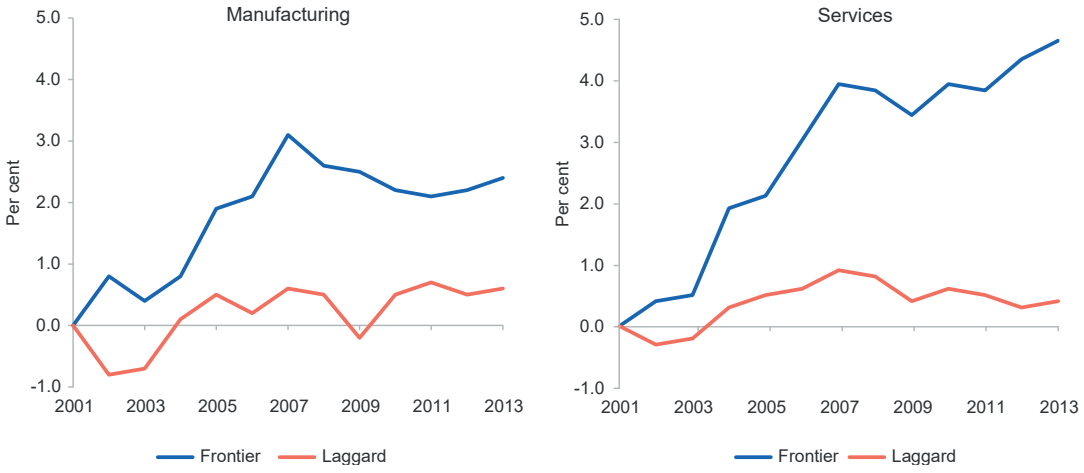
The widening productivity gap has been found to be more pronounced in ICT intensive services and information-based industries — industries that are an important source of productivity growth.[34] Widening dispersion in firm-level productivity is potentially a sign that firms are facing increasing friction in adopting the technologies of firms on the productivity frontier.

32 Rodrik D (2016) Innovation Is Not Enough, Project Syndicate, June 9, 2016, viewed 3 September 2018, https://www.project-syndicate.org/commentary/innovation-impact-on-productivity-by-dani-rodrik-2016-06

33 Andrews D, Criscuolo C, and Gal PN (2016) *The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy*, OECD Productivity Working Papers No. 5, OECD Publishing, Paris

34 Decker RA, Haltiwanger J, Jarmin R, and Miranda J (2016) *Declining Business Dynamism: Implications for Productivity?*, Center for Economic Studies, US Census Bureau, Working Paper

Figure 1.11: Productivity growth, global frontier and laggard firms, 2001 to 2013



Notes: Global frontier firms are defined as the average productivity of top 5 per cent of most productive firms in each two-digit industry in each year across 24 countries. Productivity of laggard firms is the average productivity of all other firms in each two-digit industry in each year across the 24 countries. Services refer to non-financial, business sector services.

Source: Andrews, Criscuolo and Gal (2016)

In Australia, there is some evidence of slower technology diffusion. Small and medium-sized businesses in Australia appear to have difficulties and high costs of imitating larger businesses.[35] Imitation refers to the ability of an individual business to grow by mimicking the success of others. Lack of access to skilled labour appears to be a barrier to growth for both small and mid-sized businesses, with around 22 per cent of small business and a quarter of mid-sized businesses reporting this factor as a barrier.[36] Further, almost 20 per cent of small businesses reported lack of access to funding as being a barrier to growth.[37]

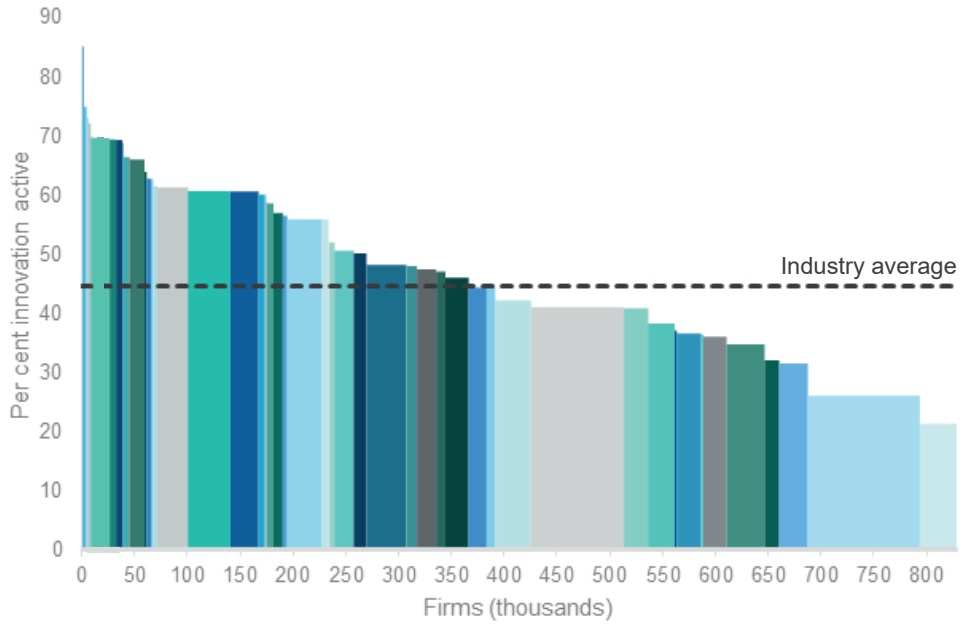
The ability of small and medium-sized businesses to grow is further constrained by the most capable business owners and managers gravitating towards large businesses. Of note is that Australia has a high concentration of small firms. In addition, most of Australia's innovation activity is concentrated in larger businesses, with a long tail of small firms that tend not to be innovative (Figure 1.12).

35 Cully M (2017) *Stuck in the middle? Mid-sized enterprises in the Australian economy*, Department of Industry, Innovation and Science, Office of the Chief Economist presentation

36 Australian Bureau of Statistics (2018), *8167.0 - Selected Characteristics of Australian Business, 2016-17*, viewed 22 November 2018, http://www.abs.gov.au/ausstats/abs@.nsf/mf/8167.0

37 ibid.

Figure 1.12: Australia's innovation active firms by number, size and industry, 2016–17



Notes: Data is included for firms with one or more employees only.

Source: ABS, 8158.0 – Innovation in Australian Business, 2016-17

Future productivity: the uncertain road

Whether future productivity growth will return to the high levels of the 1990s or remain low is unclear.

Two fields of thought dominate the discussion about the future of global productivity growth. The techno-pessimists argue that emerging advances are less revolutionary than past changes and will only lead to low productivity growth. Techno-optimists argue that the wave of technologies will be substantial and will generate high growth. But future productivity growth may also follow a third path, where high productivity growth proceeds as waves — history suggests it does.

Techno-pessimists and a low growth future

The techno-pessimist arguments are best characterised by the works of Robert Gordon and Tyler Cowan. They argue that each successive industrial revolution has resulted in a smaller and smaller impact on the economy.

The Fourth Industrial Revolution (4IR) is the 4th major industrial era since the initial industrial revolution of the 18th century.[38] The pessimist view proposes that the impact of 4IR technologies will be less revolutionary and general purpose compared to past major advances such as the motor vehicle, electricity, radio, antibiotics and commercial air travel.

Understanding the 4IR requires some historical context. The First Industrial Revolution used water and steam power to mechanise production processes. The second used electric power to create mass production. The third used electronics and ICT to automate

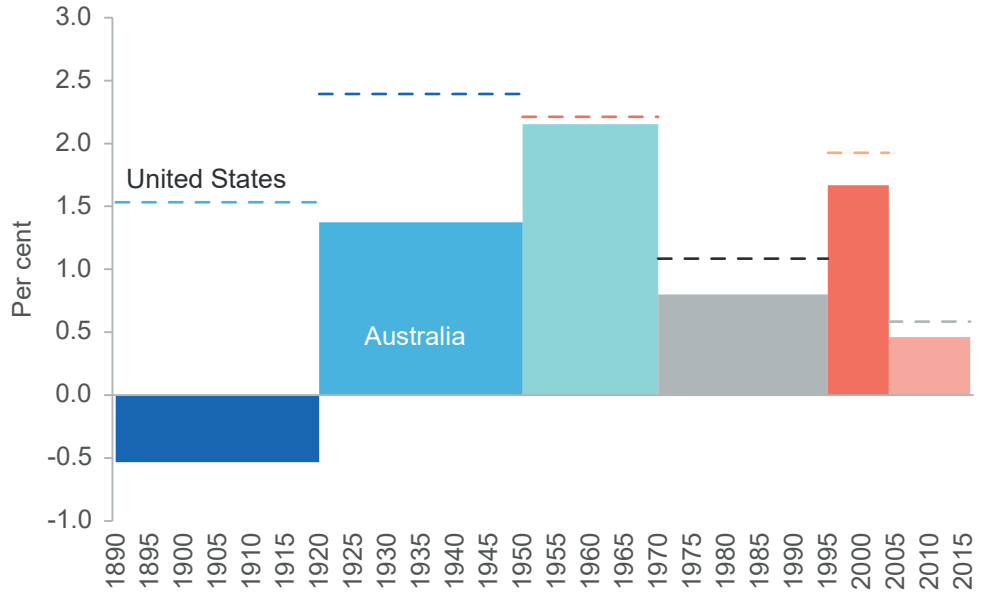
38 McKinsey (2017) *Digital Australia: Seizing opportunities from the Fourth Industrial Revolution*, McKinsey & Company, Australia, p.6.

production and improve communication. The fourth has been marked by the emergence of robotics, artificial intelligence, nanotechnology, quantum computing, biotechnology, the Internet of Things, 3D printing and autonomous vehicles.

Arguments of the techno-pessimists are based on the declining productivity impact of each of the first three revolutions. Between 1920 and 2016, most of the productivity growth in Australia and the US occurred in the five decades between 1920 and 1970 — primarily a product of the second revolution (Figure 1.13). In Australia, the impact was lagged, with productivity growth accelerating between 1950 and 1970. In the US, between 1920 and 1950 and between 1950 and 1970, average annual growth was 2.4 per cent and 2.2 per cent respectively. The US productivity spike associated with the third revolution manifested between 1996 and 2004 and averaged 1.9 per cent per year. In Australia, a similar pattern is observed: productivity growth associated with the third revolution (1.7 per cent per year) was lower compared to the second (2.2 per cent per year).

The observations suggest that improvements in computing power and the widespread adoption of internet technologies have facilitated a smaller and shorter-duration of productivity spike than past revolutions.

Figure 1.13: Average long term productivity growth during the industrial revolutions, Australia and the United States, 1890 to 2016



Source: Data from Bergeaud, A., Cette, G. and Lecat, R. (2016), *Productivity Trends in Advanced Countries between 1890 and 2012*, Review of Income and Wealth, vol. 62(3), pages 420–444.

Techno-optimists and a high-growth future

The second field of thought, the techno-optimists such as Andrew McAfee and Erik Brynjolfsson, argue the opposite. The optimists argue that the scale, scope and complexity of current and future technologies will dramatically transform economies. They propose that the current 4IR wave of technological developments holds significant promise for productivity growth.

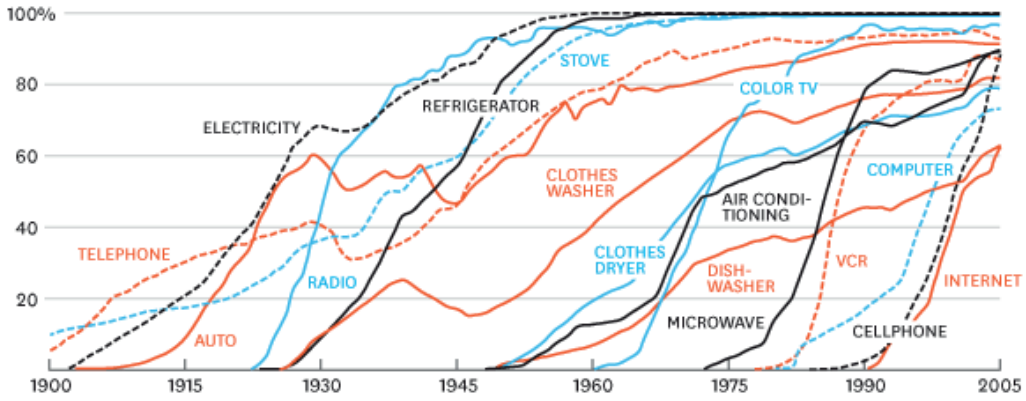
Glimpses of the potential of the effect of 4IR technologies are present globally and in Australia. For example, in Australia, over the past 20 years, productivity in digital-intensive

industries[39] grew by an average of about 2 per cent a year, compared to marginally above zero per cent in the rest of the economy.[40] These digital intensive industries currently account for only about 20 per cent of the Australian workforce and less than a quarter of output. Digital catch-up in the rest of the economy has the potential to significantly bolster productivity.

Chapter 2 further highlights the current and potential effects on output, sustainability and productivity growth of digital technology penetration in Australian industries.

In terms of households, the adoption rate of new technological devices has been increasing for some time, with smartphones and internet diffusing rapidly (Figure 1.14). Electricity took 30 years to achieve a 10 per cent adoption rate, while smart phones reached 40 per cent penetration in just 10 years.

Figure 1.14: Household diffusion of selected technologies



Source: Michael Felton, New York Times

The third path

History suggests productivity improvements from general-purpose technologies (GPT) — technologies that shape economies and lead to protracted increases in aggregate productivity — appear in an S-shaped curve. The curve has three phases:

- low productivity growth as GPTs are invented and trialled but without widespread adoption
- high productivity growth as GPTs become cheaper and more effective, leading to wide adoption (Figure 1.14) and business practices transforming to better incorporate new technologies
- slowing productivity growth as take-up rates near saturation and the transformational benefits of the GPT peak.

Some argue the current slow growth may simply be the result of economies worldwide being at the last phase of the third revolution and the early phase of the fourth. Like previous revolutions, there will be a long lag before current 4IR technologies diffuse throughout the economy. Organisational know-how — particularly managerial capability — is needed as it enables business to absorb, adapt and reap the full benefits of new technologies (see Chapter 3). There can be costly and time-consuming adjustments before productivity

39 Digital-intensive industries include information and telecommunications and financial, professional and administrative services. The main output in these industries can be provided easily in a digital form and readily delivered worldwide.

40 Department of Industry, Innovation and Science calculations.

gains come through.[41] Gains are unlikely to arise until new technologies and business practices are fully embedded within firms and across the entire supply chain, including in how businesses connect with customers.

What next for Australia?

Techno-optimist and pessimist arguments attract much attention because their views on future productivity growth are polarising. While the impact of coming technology advances is likely to be significant, history suggests that extreme outcomes are unlikely.

The productivity trajectory in Australia and advanced economies worldwide could follow the typical S-bend as they move into the 4IR. Productivity is expected to grow as digital technologies become cheaper, better, and diffused in production processes. Yet, the full effects of emerging technologies are unlikely to be realised without improving economic dynamism in Australia. Prolonged periods of weak dynamism will hamper the adjustment process, making the transition to the 4IR more time consuming and less beneficial.

Waning dynamism in Australia has implications for government policy that shape productivity. Reforms that increase the pace of dynamism will be consistent with the government's role in removing barriers to the economy adjusting to structural change.

Government policies encouraging competition, global integration, and removing barriers to investment and experimentation will create better conditions for reallocating labour and capital through the entry of productive firms.

In Australia, competition is not uniformly strong across the economy.[42] Competitive pressure can be enhanced through policies preventing the misuse of market power and reducing entry barriers across sectors — particularly in the productivity-enabling sectors such as financial, information and telecommunications and logistics and distribution. Increased information and ease for consumers to switch between providers and control their own data will further boost competition.[43]

Well-designed insolvency laws encourage entrepreneurship and sharpen firm incentive to experiment with and adopt technologies and alternative business practices. Business churn in Australia may increase as a result of the changes made through the Bankruptcy Amendments Bill 2017, introduced in October 2017, which aims to reduce the costs of closing a business.

Greater reforms in services and exposing the sector to more competition is likely to boost productivity. This is especially so given the industry is the largest in the economy and growing. Further, services are an important input into production processes of other industries. Research suggests that regulations in retail trade and professional services have remained relatively stringent in OECD countries. Reforms equivalent to that experienced in telecommunications would reduce the productivity gap between frontier and other firms by up to 50 per cent,[44] increasing aggregate productivity growth.

Tax arrangements, such as stamp duties, can add to the costs of individuals or firms relocating. Occupational licensing can constrain the flow of skilled labour and exacerbate skills mismatches. Further reforms to taxation, employment and workplace relations laws could reduce impediments to labour relocation and occupation churn.

41 Productivity Commission (PC) (2004) *ICT Use and Productivity: A Synthesis from Studies of Australian Firms*, Commission Research Paper, PC, Canberra, pp.5-6

42 Minifie J (2017) *Competition in Australia: too little of a good thing?*, Grattan Institute, viewed 12 November 2018, https://grattan.edu.au/report/competition-in-the-australian-economy/

43 Ibid.

44 Andrews D, Criscuolo C, and Gal PN (2016) The Best versus the Rest: *The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy*, OECD Productivity Working Papers No. 5, OECD Publishing, Paris.

The productivity outlook

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Productivity growth rates have fallen for most nations over the past decade. In this sense Australia is not unique. What does appear to separate Australia from at least some nations, including the United States (US), is that Australian policymakers are having a conversation about the problem and potential solutions; as evidenced in this chapter. This is critical because productivity growth is the main determinant of long-term improvements in living standards.

However, effectively delving into productivity policy is like traveling to a new and strange land; many of the landmarks that guide conventional neoclassical economics are of less use here. Unlike understanding the dynamics of a recession, for example, understanding the causes of a productivity slowdown are much more difficult, and require an analysis and understanding of at least two key factors: organisations and technology, neither of which are the speciality of most macroeconomists.

This is particularly important because most conventional recommendations to improve productivity are usually focused on improving the business climate (trade, competition, tax, monetary policy, regulation, etc.) and firm factor inputs (e.g. skills, infrastructure, research). But these are no longer enough to significantly move the needle on productivity. To be sure, nations need to get them right, but given that many already do, they are now table stakes in the productivity game.

Moreover, some conventional recommendations may be misguided. A case in point is the view that reviving firm start-ups will drive productivity growth. As Michael Lind and I highlight in *Big is Beautiful: Debunking the Myth of Small Business,*[45] not only are large firms more productive than small firms in virtually every nation, but the decline in firm start-ups, at least

44 Atkinson R and Lind M (2018) *Big Is Beautiful: Debunking the Myth of Small Business*, The MIT Press, Massachusetts.

in the US, does not appear to be the cause of declining productivity. If anything, the decline, at least in traditional 'mom-and-pop' small businesses, has spurred productivity growth. Case in point is the retail industry where the expansion of more efficient 'big box' and 'big internet' retailers has made it harder for less productive small retailers to enter.

Formulating more effective productivity policy requires deeper enterprise and industry-level analysis than traditional macroeconomic analysis is used to engaging in. Fundamentally, productivity slowdowns occur in organisations (firms, non-profits and governments), and it is there that solutions must be found. As such, nations need to understand and craft sectoral productivity policies that reflect the unique differences between industries. This is important because when it comes to productivity, industries differ in significant ways and broad-based business climate and factor input policies generally do not reflect these differences. Case in point is the construction industry, an industry with negative measured productivity growth in the US. Many aspects of the industry impede productivity: lack of scale, weak incentives to improve productivity, variations in building codes making it hard to achieve scale economies. Moreover, many of the new technologies that could boost productivity, such as building information modelling and information technology (IT) enabled integrated supply chains, suffer from chicken-or-egg challenges where firms don't adopt them because other firms in the supply chain don't adopt. Broad-based tax, regulatory and trade policies will do little to address these challenges. But a national construction strategy, as I discuss in the report *Think like an enterprise: Why nations need comprehensive productivity strategy*, could help. Likewise, strategies for other industries, including health care, financial services, and state and local government services, can also help.

Better understanding of the process and trajectory of technology innovation, particularly the current state and evolution of general purpose technologies, is the second key component. Making this difficult is the fact that duelling 'pundits' now proffer completely contradictory visions of where technology is going, from the overly pessimistic end-of-growth prediction from Robert Gordon to the exaggerated and breathless forecast of a massive Fourth Industrial Revolution from World Economic Forum head Claus Schwab.[46]

A better model for understanding technological change is the neo-Schumpeterian model that holds that technological innovation, at least with regard to powerful general-purpose technologies (like the steam engine, steel, electricity, and IT), proceeds in waves.[47] The conventional view of innovation is that the process is linear and is exogenous to economic models. But in fact, technological innovation appears to follow a pattern of repeating S-curves with waves of new technology systems emerging, powering growth and then stagnating before the emergence of the next wave. This is what Joseph Schumpeter was referring to when he wrote that 'each of the long waves in economic activity consists of an "industrial revolution" and the absorption of its effects.'[48] Perhaps the most important question today is where are we on the current 5th wave information and communications technology (ICT) technology S-curve. If we are in the middle, then we could likely enjoy at least a decade or two of robust growth before the expected slow-growth intervening period before the next big technology wave. But I believe we are closer to the end, which explains today's slow productivity growth. But it is likely that a 6th wave, grounded in general purpose technologies of machine learning, robotics and autonomous systems, will emerge and drive a productivity increase. But despite the claims of countless enthusiasts who say we are already in this new wave, I believe that we are not, because for a general purpose technology to truly take off and power productivity, prices have to fall dramatically and functionalities increase significantly, a point we are not at yet. For example, truly self-driving cars at a price point people can afford are likely at least 15 years off.

45 Gordon RJ (2016) The Rise and Fall of American Growth, Princeton University Press, New Jersey; Schwab K (2017) The Fourth Industrial Revolution, Crown Publishing, New York.

46 Atkinson RD (2004) The Past and Future of America's Economy: Long Waves of Innovation that Drive Cycles of Growth, Edward Elgar Publishing, Massachusetts.

47 Schumpeter JA (1942) Capitalism, Socialism and Democracy, Harper Perennial, New York, p. 67.

This suggests that nations have two tasks when it comes to technology. The first is to ensure that most organisations are adopting and effectively using best-in-class technologies. This means keeping capital input prices low (e.g. eliminating tariffs on ICT goods and services and expanding tax incentives for businesses to invest in machines) while also raising the price of labour (e.g. setting a higher minimum wage). The second is to help accelerate the innovation and adoption of new, risky next-wave technologies, in part by having government be a lead adopter, encouraging organisations to coordinate where there are 'chicken-or-egg' adoption challenges, and spurring more research and development (R&D) through tools like R&D tax incentives.

It may very well be that the productivity frontier for most developed nations, including Australia, will be lower than optimal over the next decade or so. But that doesn't mean that nations should not develop national productivity strategies and work to increase growth levels. The first steps to doing this are to admit there is a challenge, and to begin the analysis and dialogue around potential solutions.


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