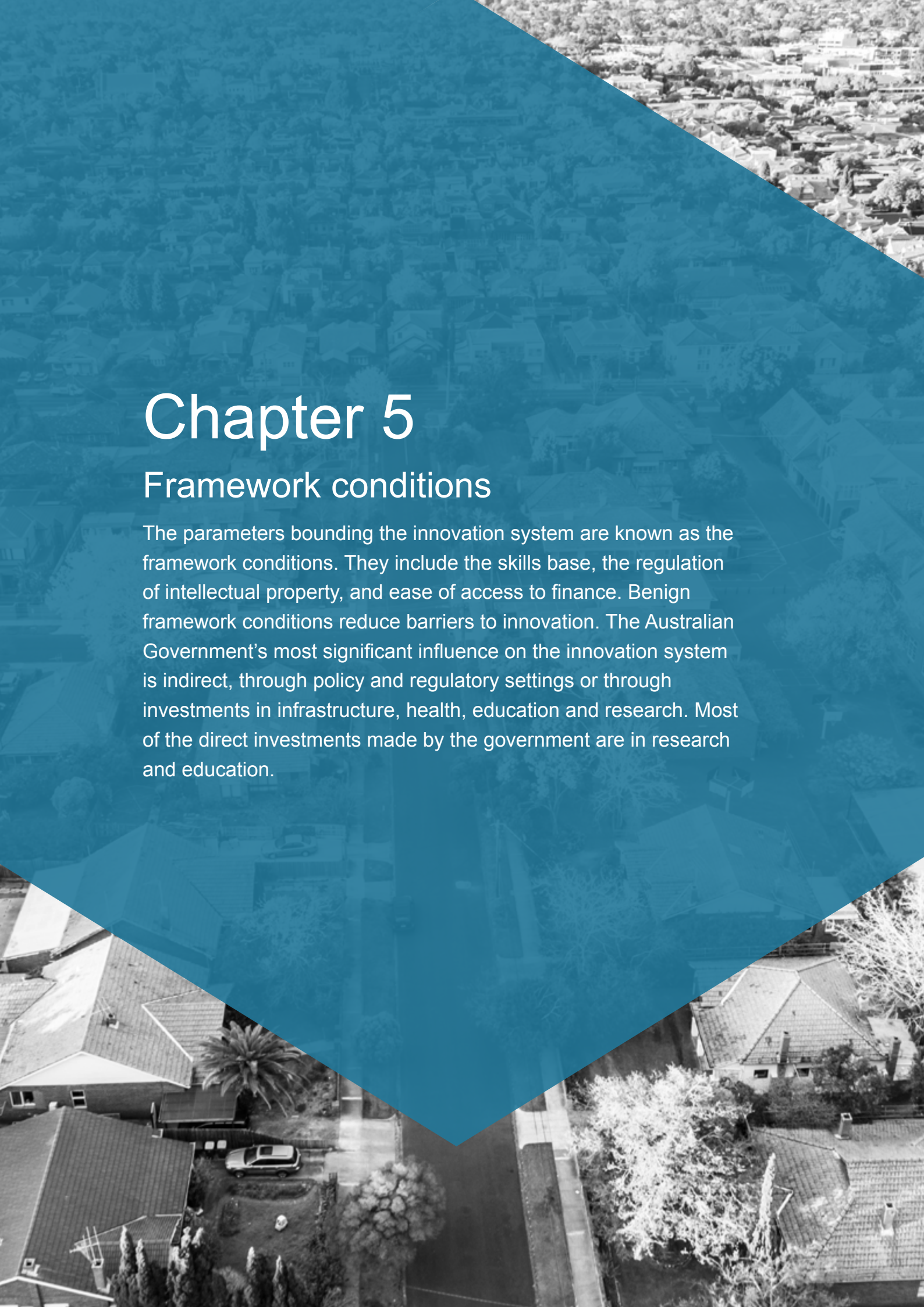


Chapter 5

Framework conditions

The parameters bounding the innovation system are known as the framework conditions. They include the skills base, the regulation of intellectual property, and ease of access to finance. Benign framework conditions reduce barriers to innovation. The Australian Government's most significant influence on the innovation system is indirect, through policy and regulatory settings or through investments in infrastructure, health, education and research. Most of the direct investments made by the government are in research and education.

This chapter discusses a range of innovation system framework conditions, including the availability of human capital (e.g. skills), organisational capital (e.g. employee share schemes), and financial capital (e.g. venture capital and later-stage private equity).

5.1 Broad indicators of framework conditions in Australia

A range of indicators for framework conditions is presented in Table A5. Overall, framework conditions in Australia are strong: the economy is growing, entrepreneurial intentions are at their highest to date, and there is sufficient financing available for business activity. In 2015, the unemployment rate returned to its 2012 level, a decrease of around 0.4 percentage points from 2014 (Table A5).

A side effect of capital intensification and innovation — especially disruptive innovation — can be the temporary displacement of employees. When compared to other OECD countries, Australia has been successful at providing new jobs relatively quickly to these workers, as on average over the period 2002–13 almost 70 per cent of displaced employees became re-employed within one year, and almost 80 per cent found a new job within two years.[52] Re-employment rates are higher in Australia than in most other OECD countries. Notwithstanding, a significant minority of those re-employed do not gain a high-quality job, and finding a new job is more difficult for older, casual or part-time employees.

While employment conditions may be relatively stable, the NAB Business Confidence Survey shows a drop in confidence, with the index falling from 7.0 in 2014 down to 5.4 in 2015 (Table A5). While business conditions are strong, supported by record low interest rates and a slightly more favourable Australian dollar, business confidence is not as resilient due to the prevailing uncertainty in the global economy and financial markets. Businesses have indicated that government policy and regulatory compliance costs are becoming an increasingly important factor affecting confidence in the future.[59]

Nonetheless, in the 2015–16 Global Entrepreneurship Monitor, Australia recorded its highest level of entrepreneurial intentions (the proportion of 18- to 64-year-olds expecting to start a new businesses within the next three years), at 14.4 per cent (up from 10 per cent in 2014). This puts Australia above the USA (12.4 per cent) and the UK (8.2 per cent).[60] This level was below developing regions (Asia and Oceania average 21.6 per cent; Africa 39.3 per cent) where entrepreneurship is more likely to be driven by necessity rather than opportunity. When countries become wealthier and real wages rise, there is a natural decline in entrepreneurship rates as the opportunity cost of starting a new business (as opposed to being a wage earner) increases, particularly if the primary motive for starting a business is economic necessity.[61]

5.2 Intellectual property protection trends in Australia

Intellectual property (IP) protection is an intermediate output measure of innovation, signalling the creation of more novel innovations (see glossary). Innovative exporters[62] are almost twice as likely to invest in IP as non-innovative domestic exporters, and there is generally a high correlation between patenting and trademarking strengths, and the international competitiveness of a sector.

Between 2005 and 2008, Australian businesses that used complexity of design to protect the IP of their innovation were 204 per cent more likely to be introducing new-to-world innovations. Businesses that registered designs or used secrecy/confidentiality agreements were 129 per cent and 92 per cent more likely to be introducing new-to-world innovations respectively.[63] Interestingly, neither patents nor trademarks appeared to have a significant association with innovation novelty; however this economy-wide study did not disaggregate results by industry. Manufacturing uses patents, but many service sectors do not.

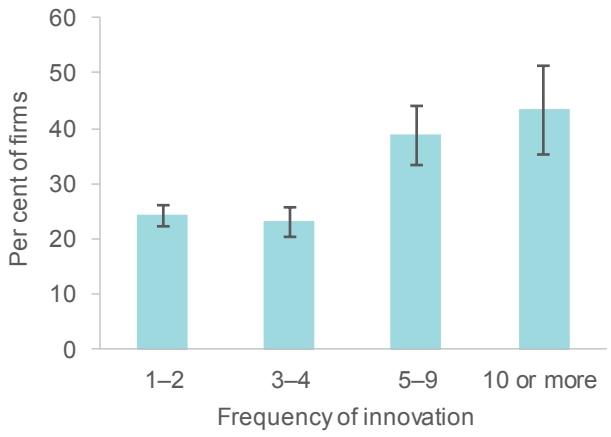
Well-developed and strong IP regimes promote trade as a channel of technology transfer, particularly for industries that are R&D intensive.[64] Research undertaken by IP Australia found that improving IP protection and enforcement regimes in destination countries would increase Australia's exports of elaborately transformed manufactures to those same countries.[65] This finding is consistent with the idea that higher value-added sectors tend to be more R&D intensive, and hence more reliant on IP rights both domestically and internationally. There is a significant correlation between IP protection, R&D, and new-to-market innovation around the world (Chapter 3).

In absolute terms, Australia has seen a significant increase in IP-related applications for 2015.[66] Trademark applications, patents, designs and plant breeder's rights all increased in 2015. However, over the past decade Australia's share of global IP relative to its population has declined (Table A2). This trend is consistent with a decline in new-to-market innovation, but consistent with a large increase in IP application in China as part of the increasing legal convention.

Around 10 per cent of innovation-active Australian businesses applied for patents (ranked at 23 out of 26 countries),[(i)] nine per cent registered a design (ranked at 21 out of 23 countries), 29 per cent registered a trademark (ranked at 15 out of 24 countries) and 31 per cent indicated that they were using trade secrets (ranked at 18 out of 22 countries).

Businesses that innovate ten or more times per year are almost twice as likely to use some type of IP protection, compared to businesses that innovate less than three times a year (Figure 5.1). This effect is particularly true for SMEs, and is consistent with the positive relationship between innovation frequency and new-to-market innovation. Larger businesses also see a positive correlation between frequency of innovation and IP protection, however the increase in the use of IP is less dramatic.

Figure 5.1: Intellectual property protection activity, by innovation frequency, 2014–15



Notes: The error bands show a 95 per cent confidence interval.

Source: Customised ABS data commissioned by the Department of Industry, Innovation and Science

5.3 Venture capital trends in Australia

Young innovative businesses often encounter obstacles in obtaining seed and early-stage financing because of uncertain profit and growth expectations and a general lack of collateral or track record.

In a recent inquiry into business creation in Australia, the Productivity Commission reviewed access to finance for new businesses.[67] The report showed that many new businesses do not require external financing, that innovation-active businesses are more likely to identify access to finance as a barrier to innovation, and that personal finance is the dominant source of finance for micro and small start-up businesses. Drawing on a limited body of conflicting evidence, the Productivity Commission concluded that equity finance, on average, was not an issue for Australian entrepreneurship.

The Treasury's recent financial inquiry (Murray inquiry) found that new SMEs have more difficulty than large businesses accessing bank loans. This is because banks' business models and expertise are more suited to providing debt finance to established businesses, with venture capital more suited to start-up businesses in emerging industries.[68] Often the business concepts and technologies of innovative start-ups that are not yet generating revenue, and that have predominantly intangible assets, are judged by financial institutions as unviable investments.[69]

As a specialised form of private equity finance, venture capital can stimulate innovation, spur entrepreneurship, and enhance productivity growth. Venture capital is a form of private equity used to fund costly, high-risk, high-return technology-based innovative businesses at the pre-seed, seed, start-up, and early-expansion stages of commercialisation.

In real terms, Australian venture capital and later-stage private equity investment in 2014–15 is 82.5 per cent of what it was in 2005–06.[70] Over that period there was a substantial decrease in the amount of venture capital and later-stage private equity being invested in new companies, with capital instead being channelled into follow-on investments in existing companies.

(i) Rankings are based on OECD+ countries.

The value of new investments was three times that of follow-on investments in 2014–15. Before the Global Financial Crisis, this ratio was around four to five times. Australian data[j] indicate that investment commitments have also fallen almost as sharply as actual investment values over the same period. Over the past decade:

- The number of new investments per year declined from 259 to 76 between 2005–06 and 2012–13. However, during 2013–14 and 2014–15 the number of new investments increased to 151.
- The value of total investments (new and follow-on) decreased from $3.0 billion to $1.1 billion in real terms between 2007–08 and 2012–13. Total investments recovered somewhat over the period 2013–2015, with a value of $1.7 billion in 2014–2015.
- *Information media and telecommunications* and *Health care and social assistance* sectors had the highest number of total investments in 2014–15. The *Information media and telecommunication* sector had the highest number of new investments at 49, while the *Health care and social assistance* sector had the highest number of follow-on investments at 34.
- Both the number and value of venture capital and later-stage private equity investments show signs of recovery in 2014–15. The leveraged buyout and initial public offer saw the biggest recovery in real terms, increasing from $16 million to $938 million between 2010–11 and 2014–15.

As expected, the frequency of venture capital investments declines as investment amounts increase (see Table 5.1). This decline is especially visible for the pre-seed/seed/start-up category. Early- and later-stage expansion stages also see a significant decline as investment range increases. This decline may reflect either a decrease in demand or a shortage of funding supply.

Currently, there are no accurate and robust measures of demand for venture capital in Australia. The Department is working with the ABS to further develop the BCS to better estimate demand for debt and equity finance in Australia.

While Australia is performing slightly above the OECD median for later-stage investment as a percentage of GDP, early-stage investment as a percentage of GDP (at 0.007 per cent) is just half the OECD median (0.015 per cent of GDP).[k] Unlike the US, Israel and many other countries in the OECD, Australian venture capital investment is experiencing a delayed return to pre-GFC levels (Table A5).

The rate of venture backing per thousand businesses is on the low side compared with other OECD countries.[71] Although the average investment per business is moderately ranked at US$1.5 million, Australia has the lowest investment in high-risk, early-stage venture capital (i.e. seed, start-up and other early-stage investment) compared with other OECD countries. This is the case both in terms of the number of businesses invested in and the proportion of money invested.

In 2013–14 a major venture capital fund, valued at $250 million, was created by AirTree Ventures. This surpasses the $200 million venture capital fund created last year by Blackbird Ventures. The AirTree fund represents a major increase in venture capital in Australia, accounting for around 21 per cent of new and follow-on investment in 2013–14.

[j] Based on customised ABS data commissioned by the Department of Industry, Innovation and Science.

[k] The ABS reports that Australia's venture capital investment is 0.11 per cent of GDP in *Venture Capital and Later Stage Private Equity, Australia, 2013–14*, catalogue 5678.0. This is different from the 0.0071 per cent of GDP reported by the OECD in *Entrepreneurship at a Glance 2014*. The difference between these two figures is due to differences in their respective definitions and terminologies. The ABS definition of venture capital includes pre-seed, seed, start-up and early expansion investments. The OECD includes as venture capital investment pre-launch, launch and early-stage development.

Table 5.1: Number of investee businesses receiving venture capital and later-stage private equity, by investee stage, by investment range, 2014–15

	Stage of Investee Company		
Investment range	Pre-seed / Seed / Start-up	Early expansion / Late expansion	Turnaround/LBO/IPO
Less than $2 million	126	65	17
$2 million to less than $5 million	9	22	9
$5 million to less than $10 million	4	4	7
$10 million to less than $20 million	–	8	6
$20 million or more	–	12	9
Total	**142**	**111**	**48**

Notes: Missing cells have been confidentialised due to low counts.

Source: Customised ABS data commissioned by the Department of Industry, Innovation and Science

5.4 Product market regulation

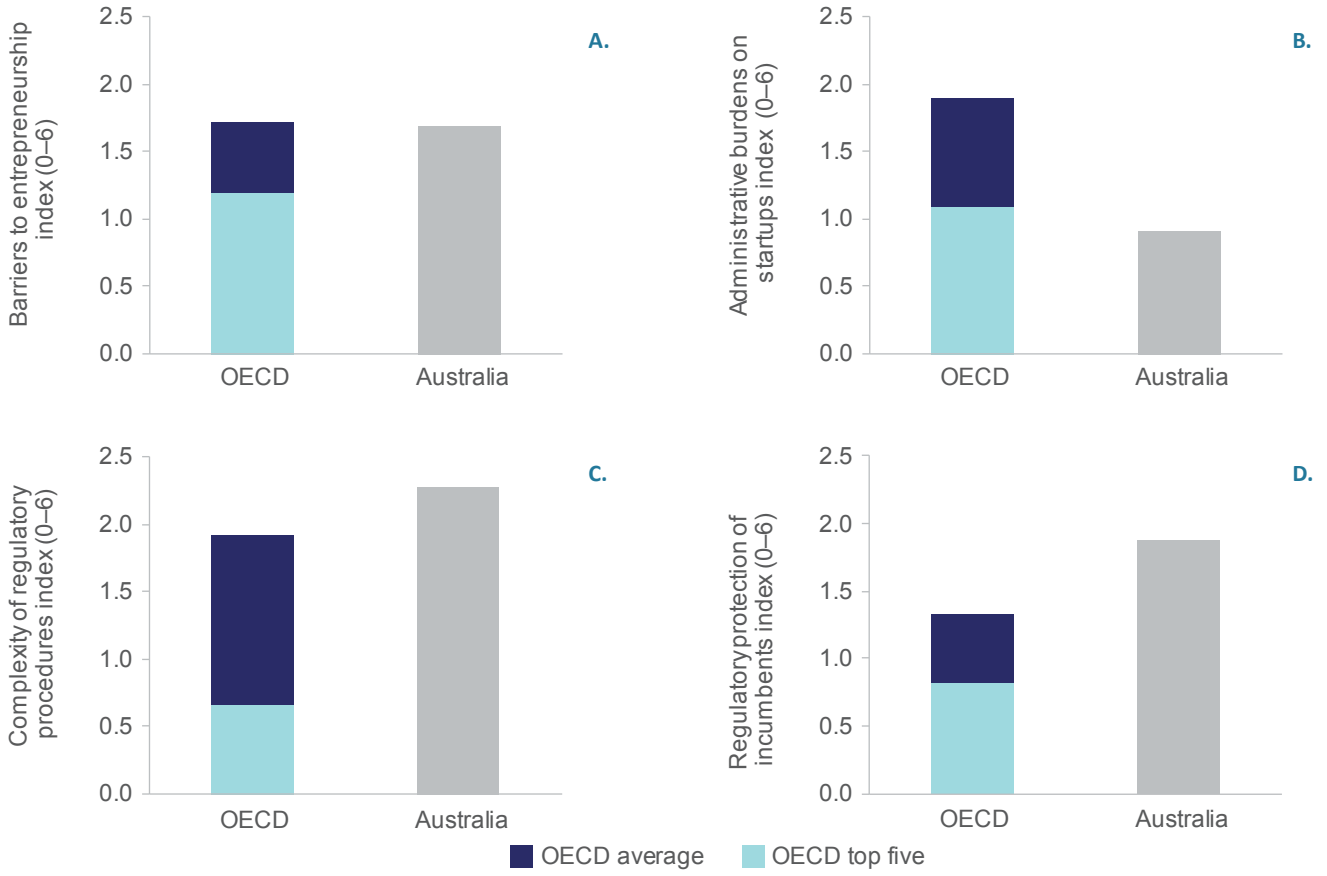
Product Market Regulation (PMR; see glossary) can influence the process of creative destruction by reducing competitive pressures on incumbent businesses and making it harder for new challengers to establish themselves in a market. Research suggests that there are large differences across the OECD in the growth performance of new businesses after they enter the market.[72] These differences may partly reflect the influence of product market regulation.

The OECD measures barriers to entrepreneurship using its Product Market Regulation Database (Methodology 5.1).

Barriers to entrepreneurship include the administrative burdens on start-ups (costs of creating a new business), the regulatory protection of incumbents, and the complexity of regulatory procedures.

In 2013, Australia was ranked 17th out of 34 OECD countries in the overall barriers to entrepreneurship indicator (see Figure 5.2, Panel A). Notwithstanding, the decomposition of the barriers to entrepreneurship reveals that Australia had the lowest burdens on start-ups in the OECD (1st out of 34 countries, Panel B), high complexity of regulatory protection (23rd out of 34 countries, Panel C), and very high regulatory protection of incumbents (32nd out of 34 countries, Panel D). Hence, in Australia there are low initial costs associated with creating a new business, but once created, businesses then have to negotiate higher levels of business regulation, which can become costly. High regulatory protection can favour incumbents, and can make it hard for new businesses to establish themselves in the market.[73]

Figure 5.2: Barriers to entrepreneurship (panel A), administrative burdens on start-ups (panel B), complexity of regulatory procedures (panel C) and regulatory protection of incumbents (panel D), 2013



Notes: Indices range from 0 to 6, where the lower the score, the less of an impediment is the regulatory barrier. The top five countries are thus those with the lowest scores, and are (A) Slovak Republic, New Zealand, Netherlands, Italy and Denmark; (B) Australia, New Zealand, Chile, Switzerland and Netherlands; (C) Portugal, Slovak Republic, Italy, Hungary and Austria; (D) United Kingdom, Estonia, Czech Republic, Austria and Slovak Republic.

Source: OECD (2016) Product Market Regulation Database

Methodology 5.1: The OECD's product market regulation database

Since the late 1990s, the OECD has been constructing a system of indicators to measure ongoing developments in PMR. These indicators have been condensed over time to form a new integrated PMR indicator. The PMR indicator is constructed from 18 base indicators that are grouped into three main components: state control, barriers to entrepreneurship, and barriers to trade and investment.

The disaggregation of the PMR indicator into these three components suggests regulations that inhibit competition are higher in state control (OECD average 2.2) and barriers to entrepreneurship (OECD average 1.7) than in barriers to trade and investment (OECD average 0.5). High scores on barriers to entrepreneurship are usually driven by complex regulations and high administrative burdens on new entrants.

5.5 Australian Employee Share Schemes

Attracting skilled employees is extremely important to enable businesses to innovate and grow. Survey data indicates that the top reason for businesses to introduce an Employee Share Scheme (ESS; Definition 5.1) in Australia is to motivate, attract and retain competitive and valuable employees,[74] so an ESS is a form of organisational capital building. There is also evidence that an ESS programme indirectly encourages risk taking, entrepreneurship and investment — all important factors in fostering innovation.[75]

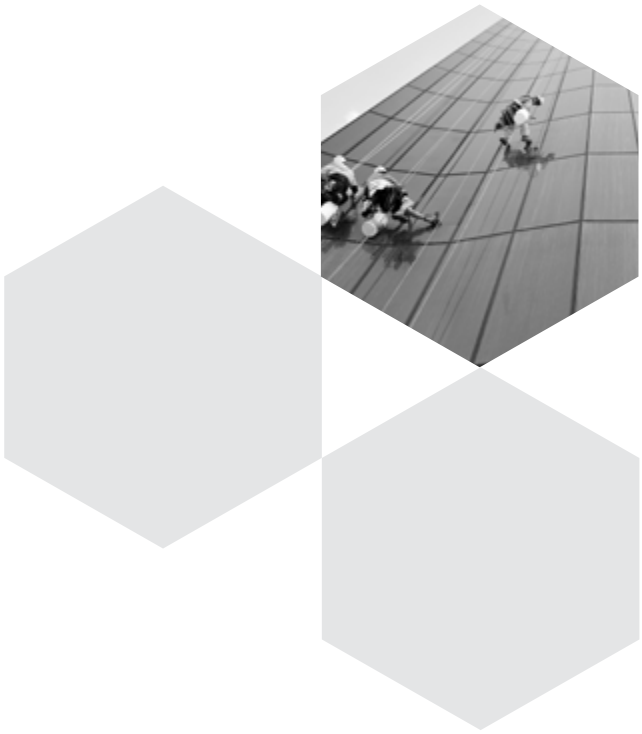
Over the past twenty years there have been two federal parliamentary inquiries[76] into ESS that found, executive remuneration aside, 'very little of a substantive nature is known about employee share plans in Australia at all'.[77] We recently undertook an Australian first research project using cross-sectional and panel analysis of ABS Economic Activity Survey data and Australian Tax Office data (Methodology 5.2) to identify some of the characteristics and performance of businesses engaged in ESS over the period 2006–07 to 2014–15.

ESS activity has been steadily rising in Australia, albeit from a very low base. ESS payments grew to just over $2 billion in 2014–15, and accounted for approximately 0.4 per cent of total wages and salaries in Australia (Figure 5.3). The majority of ESS spending is by mature businesses (86 per cent in 2014–15), particularly large, mature businesses (65 per cent in 2014–15). More specifically, the use of ESS is most common in large, mature businesses in the mining, professional, scientific and technical services, or finance and insurance services industries.

Despite being much less likely to use an ESS, when small businesses do, they have a greater percentage of employees receiving ESS and it represents a significantly higher share of their annual total labour costs. For every dollar spent on wages by SMEs, approximately 25–53 cents were paid as share-based payments, when compared to only three cents for every dollar in large organisations.

Definition 5.1: Employee Share Schemes

An employee share scheme (ESS), also referred to as an employee share option plan, employee share ownership scheme, or an employee equity scheme, is a remuneration scheme under which businesses offer to their employees shares, stapled securities, or rights to acquire them (options).



Methodology 5.2: Measuring the incidence and impact of ESS in Australia

Our study used two main data sources: the BLADE (see glossary) from the ABS, and Australian Tax Office (ATO) data, including Business Activity Statements and Pay-As-You-Go information.

The Economic Activity Survey (EAS) is contained within the BLADE. The relevant survey question of the EAS form asks for employee share-based payments and stock options (analogous to an ESS), expensed to the business or organisation remunerating employees, and accrued during the current period. As such this information does not discriminate between narrow- or broad-based ESS.

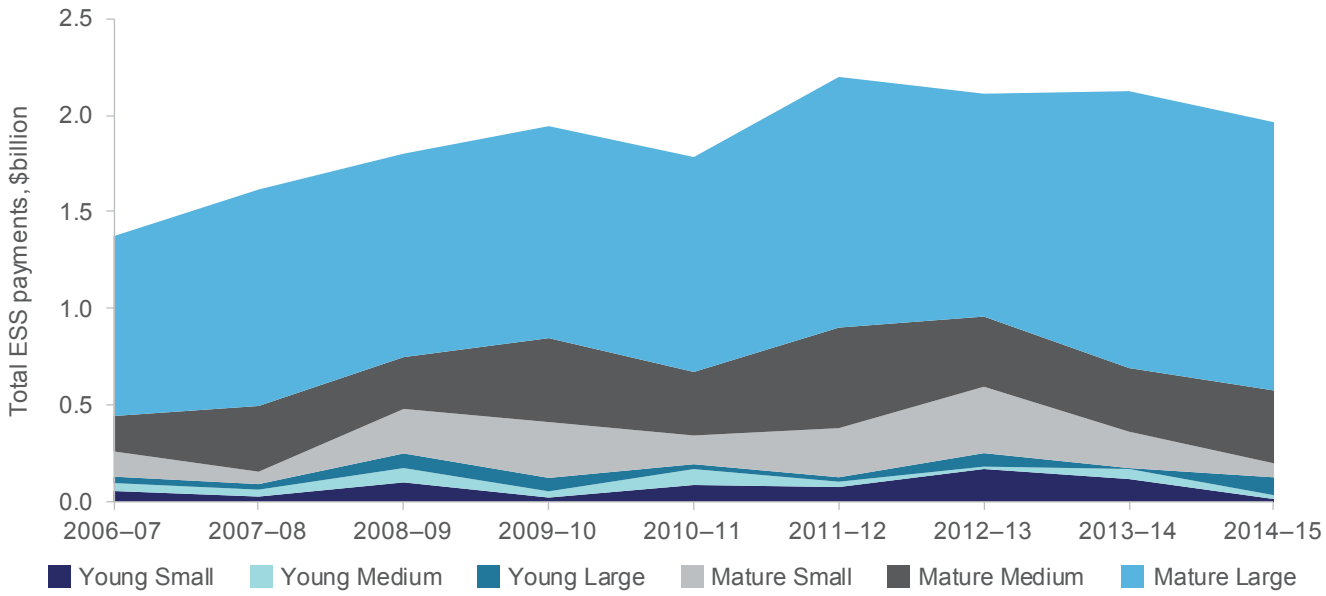
Demographic information such as business age, size or industry classification, are derived by a combination of data from the ABS Business Register and historical ATO reporting patterns.

EAS uses stratified random sampling to produce population estimates of economic activity in Australia as published by the ABS in Australian Industry (ABS cat no. 8155.0). EAS data is collected annually for the fiscal year ending June 30 and each iteration contains approximately 20,000 businesses.

Our study contrasts ESS and non-ESS businesses of the same age, size class and sector, recognising that these businesses are likely to use the same labour market and have similar human resource management practices. Most international studies examining the effects of ESS on productivity use cross-sectional data.

ESS schemes are seen as a way for business owners to attract and retain valuable employees, and enhance employee innovation and productivity. Our research showed that businesses with ESS payments had on average a lower level of employee churn, higher wages per employee, and higher labour productivity, compared to other businesses of a similar size or age (Figure 5.4). This productivity difference was strongest for SMEs.

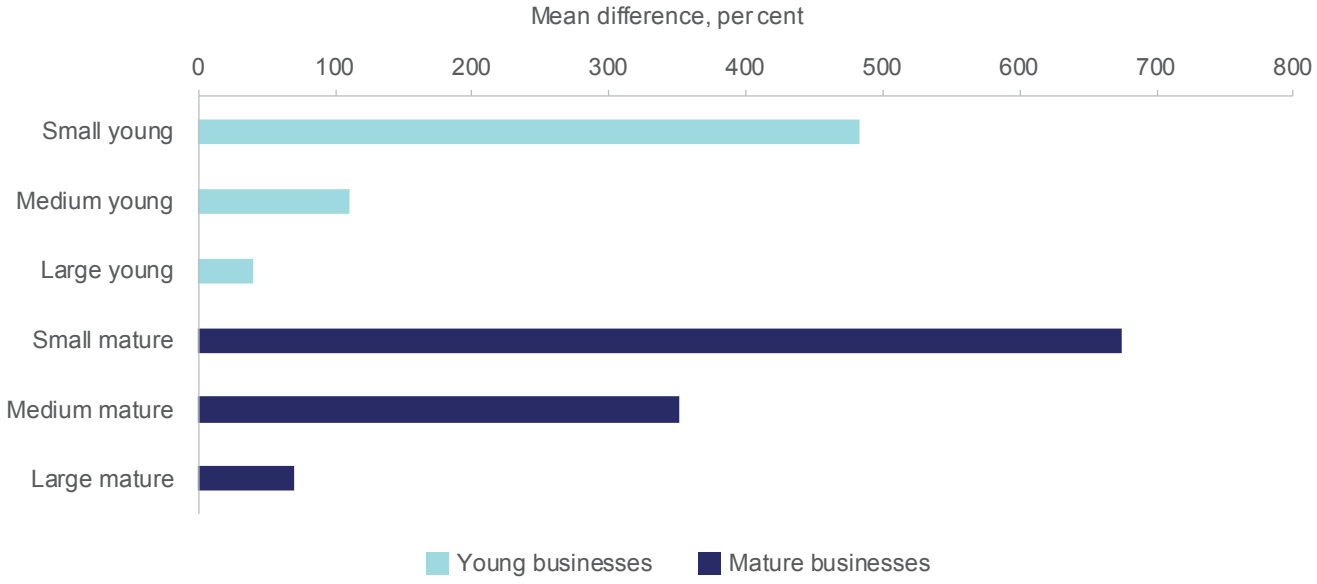
Figure 5.3: Total share based employee share payments by business size and age class, 2006–07 to 2014–15



Notes: Data is the weighted sum of employee share-based payments and stock options, expensed to businesses/organisations for remunerating employees accrued over each financial year. Small businesses have 1–19 employees, medium businesses have 20–199 employees and large businesses have 200+ businesses. Young businesses are less than six years old. Mature businesses are 6+ years old. Averages incorporate all industry classes.

Source: ABS (2016) Economic Activity Survey, 2006–07 to 2014–15

Figure 5.4: Mean difference of value added per employee between ESS and Non-ESS businesses, by size and age class, 2006–07 to 2014–15



Notes: This figure shows the differences between means (ESS minus non-ESS) in percentage terms. For example small, young businesses with ESS had almost five times greater labour productivity than their non-ESS counterparts. Small businesses have 1–19 employees, medium businesses have 20–199 employees and large businesses have 200+ businesses. Young businesses are less than six years old. Mature businesses are 6+ years old. Averages incorporate all industry classes.

Source: ABS (2016) Economic Activity Survey 2006–07 to 2014–15

ESS programmes can be either narrow-based (e.g. targeting the CEO and executives) or broad-based (targeting most or all employees). The international evidence is mounting that broad-based ESSs generate greater benefits to business performance if regularly offered to employees than narrow-based schemes do. Our data suggests that the greatest impact of ESS is seen in Australian SMEs. The data may suggest that ESS tax policy in Australia should generally exclude narrow-based ESS schemes (executive remuneration) for large businesses where any productivity dividend from public support would be expected to be the lowest.

Future work could examine the impact of broad-based versus narrow-based ESS schemes on financial performance of SMEs and large businesses in Australia. Such analysis would be possible if the ABS and the ATO collaborate to clean and connect ATO ESS data to the BLADE. The Economic Activity Survey could also be refined to differentiate between narrow- and broad-based schemes using a dummy variable.[78]

To find out more about this research, click here.[79]

5.6 Australia's skills base is growing

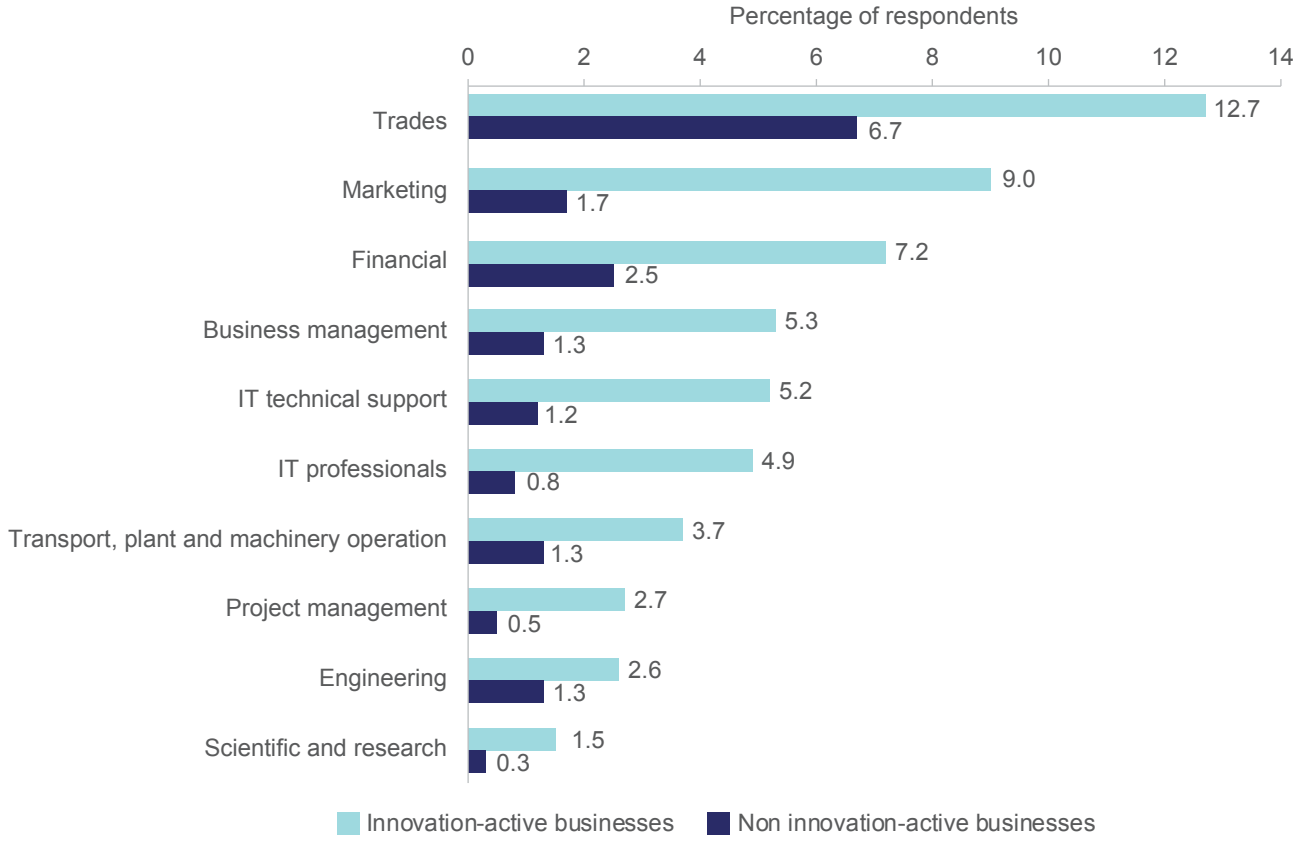
Innovation-active businesses report high usage and shortages/deficiencies in all skill types, not just science, engineering and technology skills (Figure 5.5).[80] Lack of access to skills was the second-highest barrier to innovation in 2014–15, but this percentage has been steadily declining over the past decade.

Table A6 shows a range of indicators that measure the performance of Australia's skills and education system. Australia's adult literacy rates and problem-solving skills rank relatively highly in the OECD, and Australians are highly educated overall, with the proportion of the adult population (aged 25–64) attaining tertiary education reaching 43 per cent in 2015. The number of qualifications completed in the vocational education and training sector has almost doubled over the past decade. However, it is worth noting that Australia is ranked 7th out of 22 OECD countries on skills mismatch, which is consistent with business sentiment reflected in business surveys regarding access to skills.

The proportion of the population aged 25–34 with a bachelor degree or higher was 37 per cent in 2015, so university graduates make up the bulk of the 48 per cent of this particular age cohort who attained some form of tertiary education (Table A6). The rapid rise in university qualifications has been remarkable: a greater percentage of people aged 25–34 graduated with a bachelor degree or higher in 2015 than with any form of tertiary qualification in 2000.

Australia competes globally on attracting skilled migration to the country. In 2013, Australia had a net inflow of around 75,710 permanent migrants, of which 41 per cent were skilled migrants. DHL's Global Connectedness Index ranked Australia 26th of 37 OECD+ countries on its global connectedness of people flows index, due to a combination of migration and international student numbers (Table A3). Australia also has a high share (22 per cent) of university students in Australia coming from abroad,[81] and was ranked 3rd out of 36 OECD+ countries on its share of the international education market.

Figure 5.5: Skill shortages or deficiencies reported by all businesses, by skill type, by innovation status, 2014–15



Source: ABS (2015) *Selected Characteristics of Australian Business, 2013–14*, cat. no. 8167.0

Methodology 5.3 Employee Earnings and Jobs (EEJ) Dataset

The ABS has developed an experimental Employee Earnings and Jobs (EEJ) dataset containing Personal Income Tax and Business Tax data from the Australian Tax Office for 2011–12. This dataset can provide detailed and accurate information on employees such as earnings and its components, occupation levels, and the dynamics of jobs in regions and by industries. It also contains limited business financial information. The dataset is part of the ABS' move towards developing a longitudinal Linked Employer-Employee Database (LEED).

Without a longitudinal dimension, the potential for the EEJ dataset to contribute to business dynamics research is currently limited.

With a longitudinal aspect, the LEED would assist industry policy development by helping us understand the impact of organic versus acquisitive entrepreneurship on aggregate employment and economic growth. Further integrating the LEED with the BLADE will provide rich data about employers as well as employees.

With an expanded data coverage and integration with the BLADE, the LEED would allow us to more accurately measure the contribution of different skills or occupations to business innovation and growth.

5.7 Academic research trends

Tables A8 to A10 provide performance indicators of Australia's research system. While R&D expenditure can be volatile, Australia's research workforce and research outputs (measured by publications) have been steadily rising. Overall, research in Australia is relatively strong, and Australian universities have risen in global rankings over the past decade. According to the Academic Ranking of World Universities, Australia has increased the number of its top 500 universities from 13 to 23 since 2003.[82]

Outputs: academic publications

The volume of academic publications serves as a proxy measure for the stock of knowledge being generated and diffused, with the number of associated citations demonstrating their value. Australian academic publications accounted for 3.9 per cent of global market share in 2015 (Table A9). This proportion has increased steadily over the past decade, and Australia now ranks 9th out of 37 OECD+ countries. However, in terms of relative citation impact, which measures the impact of national research compared to the impact of global research, Australia's rank is lower but still above the OECD+ average at 14 out of 37 OECD+ countries.

The different ranking between publication volume and citation impact may reflect the different topics and subjects being published across countries, or that Australian universities value (and are rewarded for) publication volumes rather than necessarily their quality or commercial application.

Nonetheless, Australian research publications comprise over seven per cent of the world's top one per cent highly cited publications across all disciplines (Table A9). Of Australia's most highly cited publications, three-quarters were attributed to international collaboration. Australia's engineering and natural science publications take a greater share of the top one per cent of highly cited publications than the OECD+ average. They account for less than those related to social sciences and humanities.

Outputs: graduating students

The number of students completing higher degrees by research in Australia has grown slowly but consistently in recent years, almost doubling between 2000 and 2014 (Table A8). International students have been responsible for much of the observed growth in the completion of research degrees. Indeed, from 2010 to 2014 the number of international students increased at an average rate of 1.74 per cent per annum, compared to an average of only 0.34 per cent for domestic students.

Appen: A case study of an innovative, high-growth firm

Authors: UTS Business School MCS Research Team and Abasi Latcham.

How do people and machines 'talk' to one another? For example, search engines, e-commerce sites and navigation systems all need to be able to communicate accurately in an increasingly wide range of natural languages. Appen is a world-leading provider of high-end speech, text and language technology services. Using its expertise in speech, search and linguistics, Appen assists clients with applications in devices and technology that interact with humans across the globe.

Many innovative companies start with a specific customer demand that leads to a custom 'solution', which in turn offers a glimpse at a wider opportunity. The starting point here happened in the 1990s, when US technology company Nuance approached Dr Julie Vonwiller. As a linguistic expert at the University of Sydney, her assistance was required to improve the voice recognition functionality of Nuance's systems. Appen's co-founder and current Chair, Chris Vonwiller, who had been an engineer and senior manager in Telstra, brought corporate experience and an awareness of the opportunity of the increasing role of natural language in the human-machine interface. Their combined expertise, and the dual market-technology insight that it shaped, led to the formation of Appen. Through periods of fast and slow growth, Appen's turnover grew to over $82 million. From the outset Appen was managed by executives with extensive prior industry experience. It listed in 2015.

Appen had to develop a unique business model for a rapidly evolving business. The combination of linguistic and technological expertise is its key asset, but in the early years it was difficult to find skilled human resources to keep up with growth. Appen used networks among academic and professional linguists, and tried different forms of contracting before developing its global network.

While Appen now has a core staff of over 230, it has built a global network of over 350,000 individuals to whom it can outsource specific language tasks — its selective 'crowd'. It has also developed the capability to grow, select and manage this diffuse asset, combining competition among suppliers with strong internal quality control. The capacity to recruit individuals with language skills and then mobilise its crowd enables Appen to respond rapidly and flexibly to customer demand. Australia's multicultural and multilinguistic population is a strong locational asset for Appen.

Appen's founders saw the market was clearly global, and at an early stage looked for entry to the US economy. Finding a US customer was the first step to establishing a US presence. Although the US is still the major market, Appen has customers in Europe and supports its international network of independent contractors from an operation in the Philippines.

In 2009 the private equity group Anacacia invested in Appen and began facilitating international acquisitions. In 2011, Appen acquired a complementary US business, Butler Hill, which focused on the application of linguistics to internet-based search and text analytics. In 2012 Appen acquired the business Wilkman Remer. Butler Hill, and its major client Microsoft, strengthened Appen's position in the US market, although it also led to a high level of dependence on a single customer.

'We have very little revenue derived locally,' CEO Mark Brayan says. 'A third of our resources are local and the other two-thirds are around the world. The success of Australian tech businesses often depends on how effectively and quickly they can go offshore to reach bigger markets'. Even for web-based businesses, proximity to customers is important, particularly to generate sales.

Mark sees three foundations for sustained high growth at Appen:

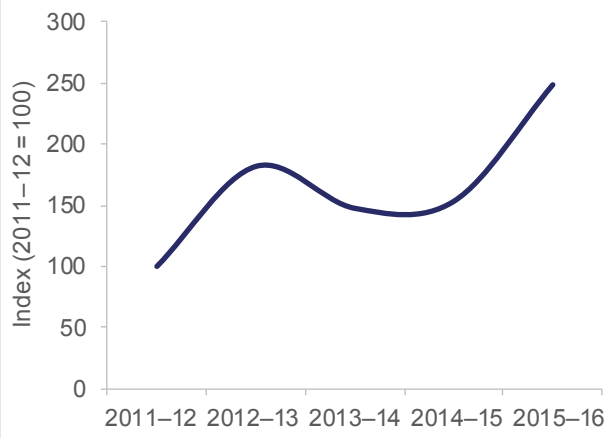
- **High demand:** 'Our services have been in high demand due to the growth in interaction between people and technology, and the need to extend accurate language interpretation to include more and more languages'.

- **Capability and flexibility:** 'We have built, and continue to strengthen, a capability base that provides both a high level of expertise across all relevant languages — and the application of our linguistic capability to information technology applications — and a high level of flexibility, through the use of "managed crowd-sourcing"'.
- **Scale:** 'And our business model is scalable'.

Growth, particularly the transformation into a public company, led to the need to formalise corporate management. In 2015 Mark Brayan was appointed CEO, bringing extensive experience in leading IT businesses. Mark notes: 'more recently a CFO, Head of HR and Recruiting and Head of IT were recruited. Since listing, our culture is very results oriented'. Nevertheless, for an organisation dependent on the specialist expertise of its staff, Appen consciously seeks to maintain a 'happy ship': staff engagement is assessed, individuals have performance plans and management incentives in the form of shares.

Appen aims to maintain its high growth by entering and increasing its position in more international markets, finding markets in other applications in the IT industry, expanding into government markets, and making further acquisitions. However, Appen faces competition in its two main markets. In the 'speech' market, its competitors are either university consortia or smaller, regional businesses that focus on a specific language or group of languages. In the 'search' market, the main competitors are the large localisation businesses. Nevertheless, Mark is confident that Appen's strong technical capabilities and global network are up to the challenge: 'Our breadth of linguistic capability and our high level of quality assurance are critical to maintaining our competitiveness'. Disruption is always possible, if not inevitable, in the IT sector, and in the longer run improvements in machine learning may impact the market.

Figure 5.6: Appen's turnover growth, indexed, 2011–12 to 2015–160



Notes: Turnover is indexed from 2011–12. 2011–12 is 100. The line has been smoothed.

Source: Appen Ltd (2015) *Annual Report 2015*, Appen Ltd; Appen Ltd (2014) *Prospectus*, Appen Ltd.

5.8 The role of government in the innovation system

Governments across Australia play an important role in supporting innovation (Figure 5.8). People typically think of innovation policy as direct grant support for R&D or commercialisation projects, but this is a simplistic view.

Governments' abilities to influence rates of innovation through direct financing of innovation projects is limited. The percentage of Australian businesses receiving public support for innovation is low and, at seven per cent, is currently the lowest in the OECD (Figure 5.7).[83]

Innovation policy encompasses many elements of research, industry, social inclusion, education, competition, and trade policy that have an impact on the innovation system. The Australian Government's recently announced NISA is an example of broader, co-ordinated innovation system policy.[84]

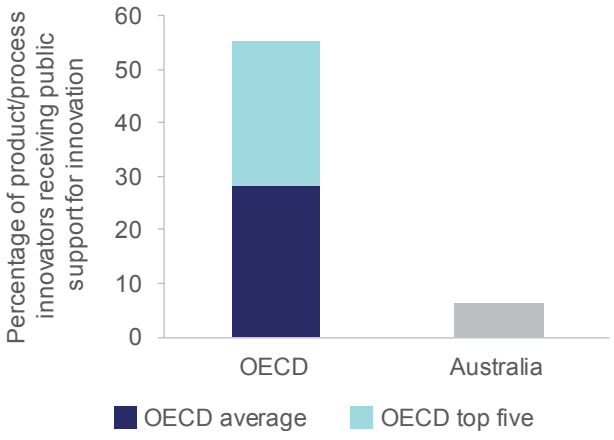
Currently, the Australian Government's most significant influence on the innovation system is indirect, through policy and regulatory settings or through investments in infrastructure, health, education and research. Most of the direct investments made by the government are in research and education. Historically, the government has directly supported innovation activity in cases where the private or community sectors do not have sufficient economic incentives to invest, for example through the provision of early-stage venture capital and tax incentives for R&D. Other aspects of the innovation system have increasingly been supported, for example by building SME management capability and through the procurement of innovative goods and services.

The government sets an example of innovative entrepreneurship by investing in high-risk, high-reward research and transformative approaches.

The government creates a stream of new insights and technological breakthroughs through its R&D investment, many of which will be commercialised by the private or community sectors. Education policy creates a skilled workforce, crucial for innovation, and government-built physical and digital infrastructure is not only fundamental to economic activity but also enables new goods, services and business models to develop.

Previous AIS reports have shown that businesses are the major investors in innovation for economic development by using R&D expenditure as an imperfect proxy for investment in innovation (see further below). Nonetheless, governments make complementary R&D investments in areas that are high risk, for basic research, or where business R&D investment is relatively limited, for example, in defence, health and environmental protection.[85]

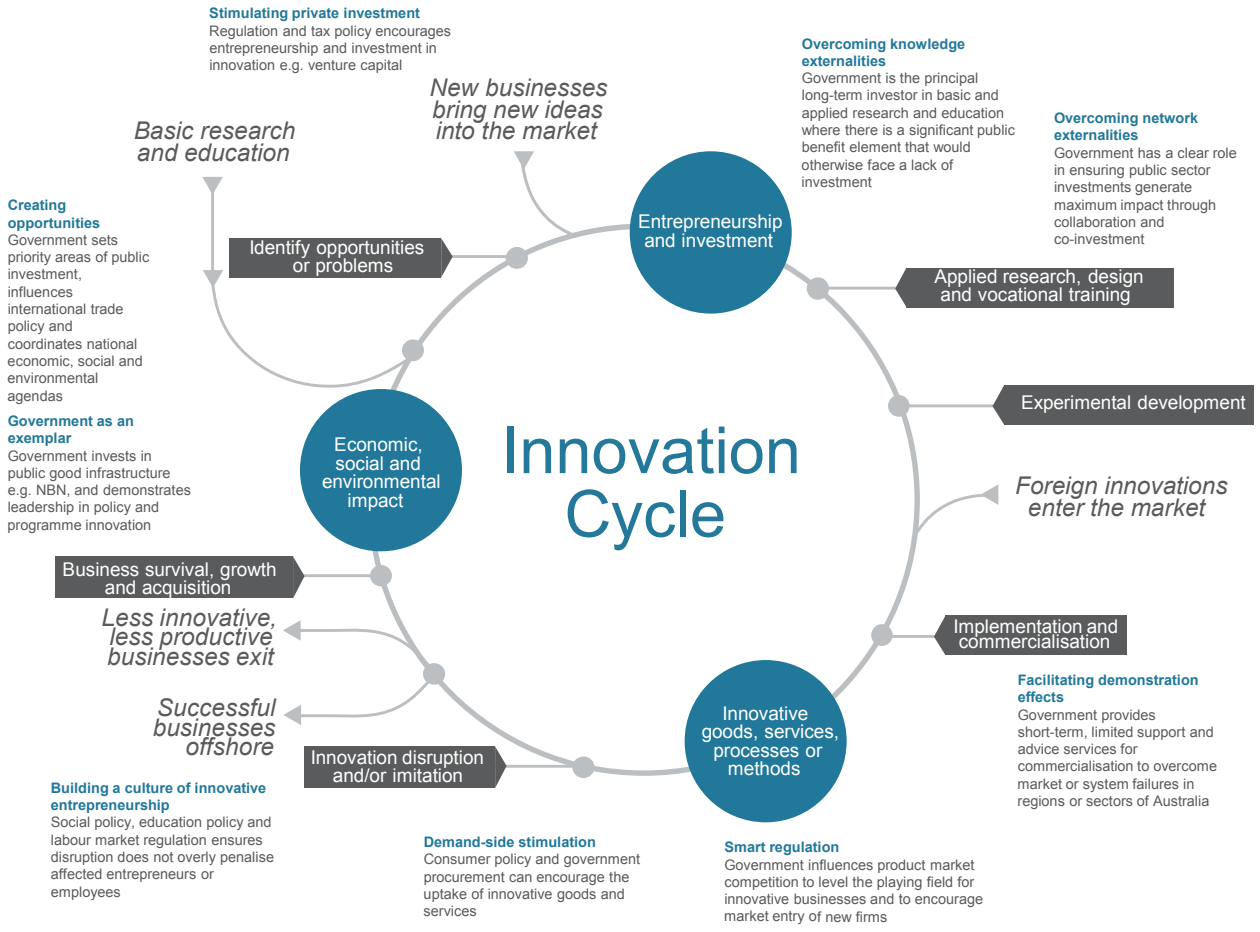
Figure 5.7: International ranking on public support for innovation, 2010–12



Notes: OECD comparisons exclude businesses with fewer than ten employees. Industry core coverage includes ISIC Rev. 4 Sections and Divisions B, C, D, E, G46, H, J, K, M71–72 and 73. Only enterprises with 10 or more employees are covered. The OECD top five countries are Canada, Korea, France, Netherlands and Hungary.

Source: OECD (2015) *Innovation statistics and indicators*, http://www.oecd.org/innovation/inno/inno-stats.htm

Figure 5.8: The innovation cycle and the role of government



Source: Department of Industry, Innovation and Science (2016)

The Australian Government's role in supporting R&D

The Australian Government supports R&D in a number of ways, both directly and indirectly. The government expects to spend $10.1 billion on R&D in 2015–16, including $3.2 billion through the R&D Tax Incentive. This is spread across multiple sectors of the economy and multiple policy portfolios. Australia is ranked 11th out of 33 OECD countries on its government funding of R&D (Figure 5.9).

Historically, publicly-funded research has been essential to a range of significant innovations that turned out to have large economic returns. Notable examples include aviation, nuclear energy, the internet, pharmaceuticals, GPS navigation, biotechnology, artificial intelligence and robotics. In recognition of the crucial role of public funding, the OECD emphasises that a long-term and stable approach to public research funding is essential to future innovation.

The main rationale for government support of R&D is the large gap between private and social returns to R&D investment. Private returns to R&D refers to benefits generated by R&D that are fully captured by the business undertaking the R&D. Social returns happen when the R&D performed by the business spill over to individuals and other businesses (Definition 5.2).

Research has found a statistically significant and positive association between government assistance and business innovation.[86] The challenge for public policy is to support private R&D investments that would not otherwise have been made, and that generate total private and social returns that sufficiently exceed the costs.

Definition 5.2: Identifying R&D spillovers

R&D activities of private businesses generate widespread benefits enjoyed by competitors, suppliers, consumers and society at large. As a result, the overall economic value to society often exceeds the economic benefits that innovating businesses enjoy as a result of their R&D activities. The difference between the social rate of return that the society enjoys and the private rate of return captured by R&D performing businesses is described by economists as a positive externality or spillover of R&D. These spillovers imply that private businesses will invest less than is socially desirable in research, with the result that some desirable research projects will not be undertaken, and others will be undertaken on a smaller scale than the socially optimal level.

Studies of US, French and Japanese businesses have found private returns on R&D investment may be as high as 30 per cent and social returns are higher than 70 per cent. [87]

For public R&D, the social returns appear to be highest in basic research.[88] Public R&D spending includes higher education R&D (HERD) and government agencies R&D (GOVERD) as a proportion of GDP, and remained stable for a decade until 2004. Since then it has increased, driven by HERD, to reach 0.87[(i)] per cent of GDP in 2013 (Table A7). However, private R&D spending (including business BERD and non-profit R&D) as a percentage of GDP has decreased since 2008 to reach a value of 1.25 per cent of GDP in 2013 after sustained growth for 15 years.

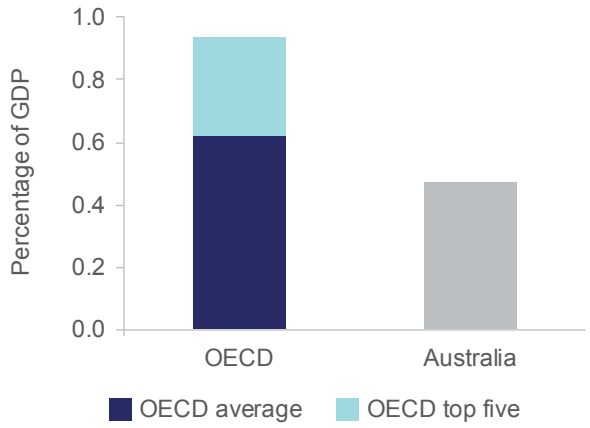
[(i)] This figure of public expenditure as a percentage of GDP is a calculation of HERD as a percentage of GDP plus GOVERD as a percentage of GDP

Tax incentives and subsidies

The public sector can play a major role in stimulating R&D. Tax credits and direct subsidies for R&D have been found to have positive effects on business' R&D investment. However, care should be taken in using tax credits and R&D subsidies because they can sometimes introduce risks of crowding-out and can disproportionately support incumbent businesses.[89] Australia has a relatively high share of indirect funding in terms of tax incentives compared to other countries. For 2011, Australia was ranked 3rd out of 31 OECD countries in terms of tax incentives given to the industry sector as a percentage of GDP (Figure 5.10).

Many developed countries have set, or are considering, ambitious GERD over GDP ratio targets as national goals. However, evidence to date shows that only a few countries have successfully achieved their self-imposed GERD targets.[90] Australia currently does not have a R&D target.

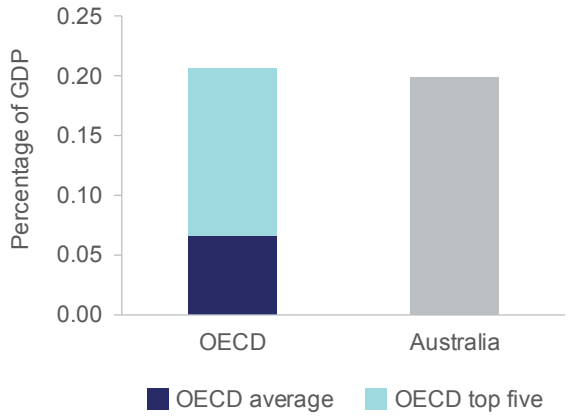
Figure 5.9: Government-financed GERD as a percentage of GDP, 2011 or latest year



Notes: The OECD top five countries are Iceland, Austria, Korea, Finland and Sweden.

Source: OECD Main Science and Technology Indicators 2015

Figure 5.10: Indirect funding, R&D tax incentives, 2011



Notes: The OECD top five countries are France, Canada, Australia, Korea and Belgium.

Source: OECD Main Science and Technology Indicators 2015