



Australian Government
Department of Industry,
Innovation and Science

Office of the
Chief Economist



Australian Innovation System Report **2017**

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Further information

Manager: Emmanuel Njuguna
Innovation Research
Department of Industry, Innovation and
Science
GPO Box 9839
Canberra ACT 2601
+61 2 6213 6000
Email: InnovationReport@industry.gov.au

Project Team

Mahmoud Alinejad
Antonio Balaguer
Maria Boyle
Stan Bucifal
Francy Bulic
Oliver Cansdell
Paul Drake
Katya Golobkova
David Hansell
Laura Kusa
Laura Ling
Omer Majeed
Nina Miers
Emmanuel Njuguna
Faith Robinson
Tessa Satherley
Monique Shearer
David Turvey

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Foreword

Australia is in the throes of an economic transition. The incredible mining boom of the past 15 years is nearing the end of its final phase: large increases in production volumes as new investment projects have come on stream. While we have avoided this time the boom-then-bust cycle of previous episodes, economic growth has been weak — reflected in four years of living standards at a standstill — held back by population ageing, faltering global trade and the lingering legacy of the global financial crisis.

Despite this, I remain optimistic about Australia's future. Australia has long been an innovative nation, highly capable of adapting to change. Our firms are amongst the most innovation-active in the world and our research has global impact. From what we can see of the future — new digital technologies like 3D printing, quantum computing, blockchain and artificial intelligence — it holds enticing opportunities for our innovators and entrepreneurs to capitalise on.

Who will lead the charge in innovation-led growth in Australia? Businesses, in collaboration with their supply chain partners, financial backers and researchers. While innovation involves a multitude of players, businesses play the vital role of bringing new ideas and better ways of doing things to commercial fruition.

In this year's *Australian Innovation System Report* we explore the businesses that succeed the most, referred to as "high-growth firms". These are, as the name suggests, businesses that make an outsize

contribution to economic growth. But, by how much? The report quantifies the contribution of high-growth firms to the Australian economy and assesses whether innovation plays a role in their growth. Further, it looks at trends in the incidence and attributes of high-growth firms to understand whether they share any typical characteristics.

Given today's pace of change, innovation policy must be reviewed regularly for it to remain relevant, effective and connected. This report explores the policy considerations related to high-growth firms, and looks more broadly at potential areas for improvement in the general business environment. The report brings together a range of indicators and highlights some important aspects of innovation and firm growth to consider in aiming to provide an environment which empowers the innovators of Australia's future.

A handwritten signature in black ink, appearing to read "Mark Cully".

Mark Cully

Chief Economist

Department of Industry, Innovation and Science

November 2017

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Executive summary

The *Australian Innovation System Report 2017* focusses on Australian high-growth firms and their relationship to innovation.

At its simplest, innovation is about novel ideas being put into practice. It drives long-term productivity growth and underpins human progress.

Nearly half of Australian businesses are innovation-active, and this innovation activity is distributed broadly across all industries. Australian firms tend to specialise in modifying innovations introduced by other domestic firms, but new-to-market innovations are not nearly as common. Across a range of metrics on collaboration for innovation, Australia ranks in the bottom half of the OECD. Despite some decline in business dynamism in Australia and some other developed economies, Australia's entrepreneurial attitudes remain positive.

International evidence suggests employment and sales growth is concentrated in a relatively small proportion of high-growth firms (HGFs). This report aims to fill the current information gap and improve understanding of the HGF phenomenon in Australia, including how innovation relates to firm growth.

Australian HGFs make a disproportionate economic contribution compared to other firms. Between 2004–05 and 2011–12, firms with high-growth in employment (Employment HGFs) represented only 9 per cent of all firms but contributed around 46 per cent of net positive employment growth. Firms with high-growth in turnover (Turnover HGFs) represented just 15 per cent of firms, and contributed about 66 per cent of the net positive sales growth and 69 per cent of the net positive value added growth, in the same period.

Firms with high-growth can be found in all industries. On average, they are younger than other firms — typically aged less than eight years. Between 2002 and 2013, their median capital expenditure was 65 per cent higher and they showed a notably larger increase in annual labour productivity growth compared to other firms.

The lack in persistence of high rates of firm growth over time reported in international studies is also evident in Australian firms. Most Australian HGFs will conclude their high-growth episode within four years.

In general, HGFs do not appear to be a type of firm, but rather a phase that some firms go through during their life cycle.

There has been a number of changes in the high-growth firm landscape over the last decade. The proportions of HGFs in the Australian economy has declined. Between 2005 and 2014, the proportion of firms with high-growth in employment declined from 18.6 per cent to 12.5 per cent, and the proportion of firms with high-growth in turnover declined from 17.6 per cent to 14 per cent.

The average turnover growth rates recorded by Turnover HGFs have declined, but these firms have generally become larger in terms of their annual sales revenue. In 2014, the median turnover growth rate of firms with high-growth in turnover was 38 per cent and the median firm in this cohort recorded almost \$184 million in sales revenue that year. By comparison, in 2006, the turnover growth rate of these firms was 68 per cent and their median annual sales revenue around \$116 million.

New evidence confirms that innovation is positive for firm growth. Across all firms, product innovation is estimated to lift turnover growth by an average of 3.3 percentage points, and marketing innovation by around 4 percentage points. There is also a positive relationship between having a business focus on innovation and turnover growth.

Research and development (R&D) by Australia's businesses as a share of GDP has declined sharply since 2008–09, after strong growth in the previous decade. These trends appear to be driven by recent large declines in R&D expenditures in Mining and Manufacturing.

Three industries account for 75 per cent of R&D high-growth firms, but the composition has changed over time. In 2004–05, Manufacturing contributed over half the HGFs. By 2014–15 high R&D growth was much more evenly distributed across industries. R&D high-growth firms are dominated by mature firms and SMEs.

The analysis suggests that R&D expenditure has an overall positive influence on growth in turnover, labour productivity and wages across all industries, but may have a negative effect on employment growth. These effects of R&D expenditure have generally become more pronounced over time, however they are subject to substantial variation across the spectrum of firms.

Given the impressive growth performance and disproportionate economic contribution of HGFs, there has been considerable policy interest internationally in their potential to support job creation and income growth. However, much of the literature argues that HGFs are a difficult target for policy, largely due to their lack of growth persistence and difficulties in predicting which firms will grow. There are a number of 'no regrets' policy approaches that can lay the foundations for high-growth firms to emerge.

For instance, increasing the depth, breadth and relevance of skills available to businesses could strengthen Australia's ability to innovate and make the workforce more capable of capitalising on future opportunities. Business collaboration on innovation is another aspect of the innovation system which could be improved. Evidence suggests the business sector as a whole is not particularly well-connected to the research sector, which means Australia is potentially missing out on the benefits of such collaboration.

Competition and regulation are both framework conditions that can have considerable influence on the innovation system. Digital innovation is also increasingly important. Australia has relatively high rates of entrepreneurship but business dynamism is declining, implying weakening competition. Australia also has a strong regulatory environment which can be both a facilitator and a barrier to innovation. Regulatory reform could aim to reduce barriers to labour mobility, business entry and exit, and improving intellectual property arrangements. Some evidence suggests that access to finance to support innovation is constrained, particularly for innovation-active SMEs. Addressing such issues and maintaining macroeconomic stability will help support business innovation and growth.



Introduction

Since 2010, the annual *Australian Innovation System Report* has been tracking the performance of core components of the innovation system — such as business innovation, research, skills or collaboration — as well as delving deeper into particular aspects of the system.

The 2017 report focusses on Australian high-growth firms and their relationship to innovation. HGFs are defined as firms that experience rapid growth over a three year period, measured in terms of turnover, employment and, novel in this report, research and development expenditure.

To date, evidence on the HGF phenomenon in Australia has been largely lacking. This report takes a step towards addressing this gap by focusing on the specific characteristics and contribution of HGFs in Australia, broadly between 2005 and 2014. For the first time, it presents descriptive and econometric analysis of HGFs in Australia, and their relationship to innovation, based on original research by the Office of the Chief Economist (OCE) using the Business Longitudinal Analysis Data Environment (BLADE — see Box 2.1).

This report is structured as follows:

- Chapter 1: Australia's national innovation system and its recent performance
- Chapter 2: the attributes and economic contributions of Australian HGFs

- Chapter 3: the trends of HGFs over time
- Chapter 4: links between innovation and firm growth
- Chapter 5: R&D in Australia through the lens of R&D HGFs
- Chapter 6: the policy implications of the analysis, and Australia's framework conditions

This report includes empirical data from a range of sources, and serves as a reference document for decision-makers in public policy, business, academia and the expert community. A complete set of innovation indicators is published on the [OCE website](#).^(a) This includes indicators on innovation outcomes, innovation activity and entrepreneurship, collaboration and international engagement, framework conditions, skill base, investment in research, research workforce, research quality and research commercialisation, and in some cases international comparisons. In keeping with data visualisation trends, selected innovation indicators are also available in the [Australian Industry Monitor](#).^(b)

(a) <https://industry.gov.au/Office-of-the-Chief-Economist/Pages/default.aspx>

(b) <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/IndustryMonitor2017/index.html>

Context for the 2017 Australian Innovation System Report

In 2015, the Australian Government launched the National Innovation and Science Agenda (NISA), to develop a more entrepreneurial and innovative economy. The NISA organises initiatives under four key pillars: Culture and Capital, Collaboration, Talent and Skills and Government as an Exemplar. For many metrics used in this report, it is too early to observe the full impact of NISA initiatives.

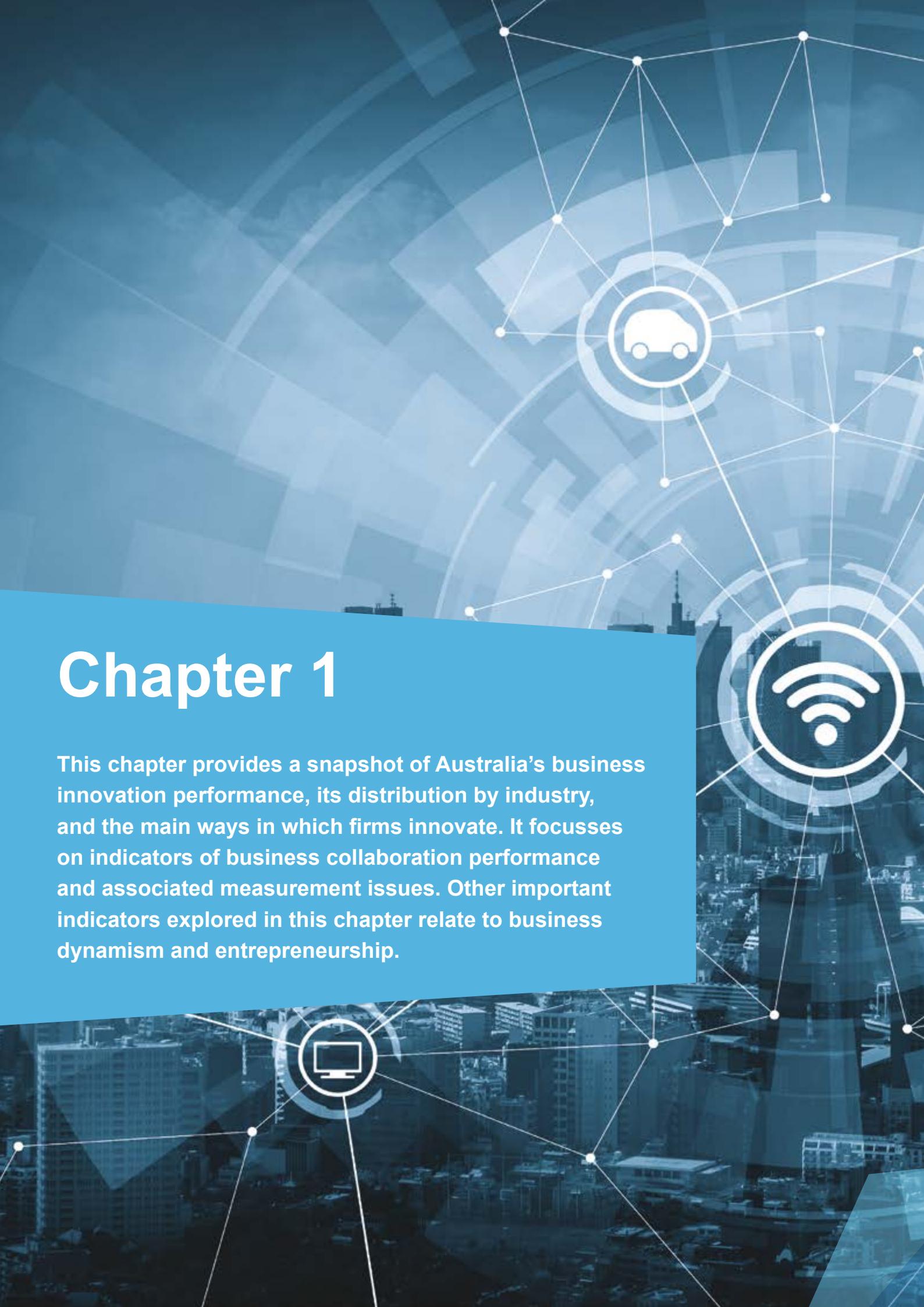
Innovation and Science Australia (ISA) was established under NISA as an independent statutory body for the provision of strategic whole-of-government advice on science, research and innovation. ISA released the Performance Review of the Australian Innovation, Science and Research System in February 2017. ISA will also deliver a 2030 Strategic Plan to help shape the government's objectives for Australia's science and innovation system towards 2030.

The government released the National Science Statement in March 2017. The Statement sets out the government's vision for science in Australia and a long-term science policy framework.

The Australian Innovation System Report series provides vital supplementary evidence to the broader work agenda on innovation measurement and policy development.

Chapter 1

This chapter provides a snapshot of Australia's business innovation performance, its distribution by industry, and the main ways in which firms innovate. It focusses on indicators of business collaboration performance and associated measurement issues. Other important indicators explored in this chapter relate to business dynamism and entrepreneurship.



Australia's innovation system



48%

of all employing firms were innovation-active in 2015–16



Most innovation-active industries in 2015–16

58.3% Manufacturing

58.1% Retail Trade

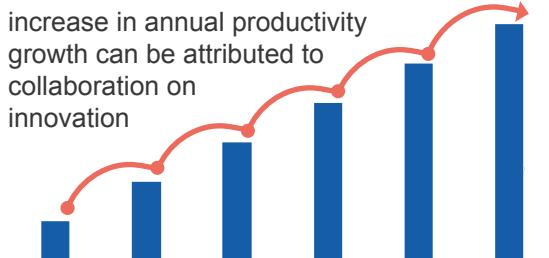
57.9% Arts and Recreation Services

Innovation-active firms specialise in modifying innovations introduced by other Australian firms, rather than creating new-to-market innovations



4 percentage points

increase in annual productivity growth can be attributed to collaboration on innovation



Collaboration
almost half of the publication output for Australia's **top 10** universities had an international co-author



Business entry rates
increased to their highest point in **6 years** in 2015–16



Sources (left to right): 1) ABS (2017) Summary of IT Use and Innovation in Australian Businesses, cat. no. 8166.0; 2) ABS (2017) Summary of IT Use and Innovation in Australian Businesses, 2015–16 and 2007–08, cat. no. 8166.0; 3) ABS (2016) Data analysis based on the BCS commissioned by Department of Industry Innovation and Science; 4) Palangkaraya A, Spurling T and Webster E (2015) Does innovation make (SME) firms more productive?, Paper presented to Reserve Bank of Australia Annual Conference 2015, Sydney; 5) InCites (2016) Clarivate Analytics database; 6) ABS (2017) Counts of Australian Businesses, including Entries and Exits, Jun 2012 to Jun 2016, cat. no. 8165.0



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Australian Innovation System Report 2017

KEY POINTS

- Australia has a relatively high proportion of innovation-active firms by international standards. In 2015–16, an estimated 48.7 per cent of all employing firms were innovation-active. These firms are distributed broadly across industries, with the highest proportion found in Manufacturing.
- Australian innovation-active firms overwhelmingly specialise in modifying innovations introduced by other Australian firms but are not particularly strong at introducing new-to-market innovations. In 2015, Australia ranked 23rd of 31 OECD countries for the proportion of firms engaging in new-to-market product innovation.
- Business collaboration on innovation is generally low in Australia. Across a range of collaboration metrics, Australia typically sits in the bottom half of the OECD.
- Australia's level of entrepreneurial activity is amongst the highest in developed economies. Around 14.6 per cent of the Australian adult population (18–64 years) were actively engaged in starting new businesses in 2016, representing 2.2 million early-stage entrepreneurs.

Why is innovation important?

Innovation delivers substantial benefits to society's well-being and is key to solving some of its most pressing challenges. The benefits of innovation often go well beyond economic benefits, impacting on the quality of day-to-day lives. The living standards of Australians have risen due to innovations including those in healthcare, communication, education, services, infrastructure and environmental sustainability.

The focus of this report is primarily on the economic benefits. Innovation is the most important driver of long-term productivity growth and material living standards. What matters most from an economic perspective is the commercial application and diffusion of ideas; this underwrites long-term competitiveness and growth. According to the OECD, innovation in its various forms accounts for a substantial share of economic growth across its member countries — often around half of total GDP growth over the long-term.¹

In Australia, the economic benefits of innovation can be observed in part by the disproportionate contribution of innovation-active firms to income and employment growth. The *Australian Innovation System Report* series has shown that innovation-

active firms consistently outperform firms that don't innovate on a range of measures, including productivity and profitability.²

1.1 Innovation and the national innovation system

Innovation is about the implementation of novel ideas. An idea only becomes innovation when it is put into practice. Innovation refers not only to the introduction of new products, but also new processes, which can increase the productivity of labour or capital, and organisational innovations, which can improve the efficiency or effectiveness of production (Definition 1.1).

Novel ideas can come from anywhere and they can be applied to any field of human endeavour. The business enterprise sector plays a particularly important role, both as a major source of ideas and, above all, in their commercialisation. In pursuing innovation as a business strategy, firms bring together a range of complementary resources and capabilities, some of which may be internal (such as management capability or firm-specific assets) and others external (such as technical expertise or finance).

Governments also play an important role. By investing in education, training, and public research, and also by influencing the innovation activity occurring in other sectors, governments can help create the right conditions for firms to experiment and invest in the development and commercialisation of novel ideas. Some of the ways in which governments can influence innovation in business include establishing robust intellectual property (IP) frameworks, regulatory and tax settings, and financial systems.

Definition 1.1: Oslo Manual definition of innovation

Innovation is the implementation of a new or significantly improved product (good or service), or process, new marketing method, or a new organisational method in business practices, workplace organisation or external relations.³

Defining the innovation system

There are several alternative analytical approaches to assessing the innovation performance of an economy, each with strengths and weaknesses.^{4, 5} The *Australian Innovation System Report* series adopts the innovation system approach (Definition 1.2). Innovation activities, networks and framework conditions work effectively as a system to generate and diffuse innovations that have economic, social and/or environmental value. Ideas adopted from evolutionary economics, economic history and institutional economics have influenced the innovation system worldview.^{6, 7, 8}

Definition 1.2: The innovation system

An innovation system is an open network of organisations that interact with each other and operate within framework conditions that regulate their activities and interactions. There are three components of the innovation system:

- Innovation activities — the discrete activities that lead to discoveries with commercial potential including R&D, entrepreneurial activity, innovation funding (e.g. venture capital), or the generation of skills for innovation.
- Networks — the formal and informal linkages between people and organisations in the innovation system, including communities of practice (such as medical professionals and software developers), joint research arrangements, industry-research collaboration and public procurement of private sector research outputs.
- Framework conditions — the institutional environment and general conditions for innovation activities, networks and collaboration.

These components collectively function to produce and diffuse innovations that have economic, social and/or environmental value.

Why use the innovation system approach

The innovation system approach:

- is pragmatic and does not rely on any particular theoretical framework
- has a practical focus which appeals to policymakers
- treats innovation as a highly complex economic and social phenomenon, which eludes simple one-size-fits-all measures.

The innovation system approach also recognises that innovation occurs in a particular historical and institutional context. Innovation activity relies on a range of complementary investments in different parts of the system and requires the participation of different actors, including from business, universities, and government.⁹ Indeed, across advanced economies, publicly-funded research and government leadership have played a crucial role in the development of transformational technologies and the creation of entirely new markets including in pharmaceuticals, civil aviation, nuclear energy, the internet, nanotechnology, biotechnology and clean energy.¹⁰

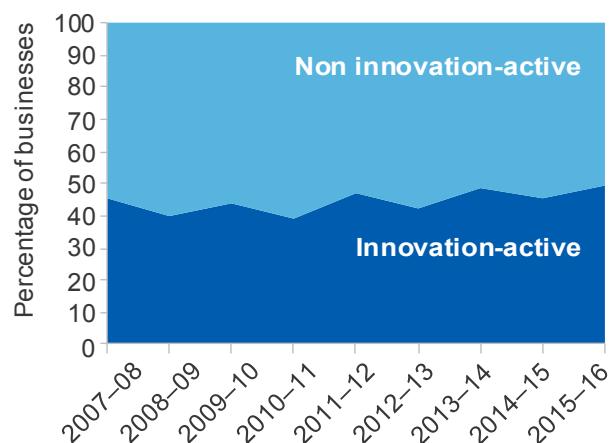
An innovation system approach emphasises the interactions between different parts of the system.¹¹ The focus on interactions and networks acknowledges people and organisations do not innovate in isolation. Networks are important for coordinating the knowledge and resources required for innovation. Networks facilitate the diffusion of this knowledge to be used throughout the economy.¹² They improve the efficiency with which knowledge is used, because a great deal of knowledge is embedded socially, within people, groups and organisations. Attempting to codify all this widely dispersed tacit knowledge would be neither feasible nor practical.

1.2 Australia's innovation activity

Innovation activity in business

One of the broadest measures of innovation performance in an economy is the proportion of firms that identify as being innovation-active.^(c) By international standards, Australia has a relatively high proportion of innovation-active firms. In 2015–16, an estimated 48.7 per cent of all Australian employing firms identified as innovation-active, increasing from 44.9 per cent in 2007–08 (Figure 1.1).^(d) This means nearly half of Australian businesses have attempted to develop or introduce an innovation in the last 12 months.

Figure 1.1: Innovation activity in Australian businesses, 2007–08 to 2015–16



Source: ABS (2017) *Summary of IT Use and Innovation in Australian Businesses*, cat. no. 8166.0

(c) Innovation-active firms are those that have either introduced a new innovation, are currently developing a new innovation, or have abandoned an innovation within the last 12 months.

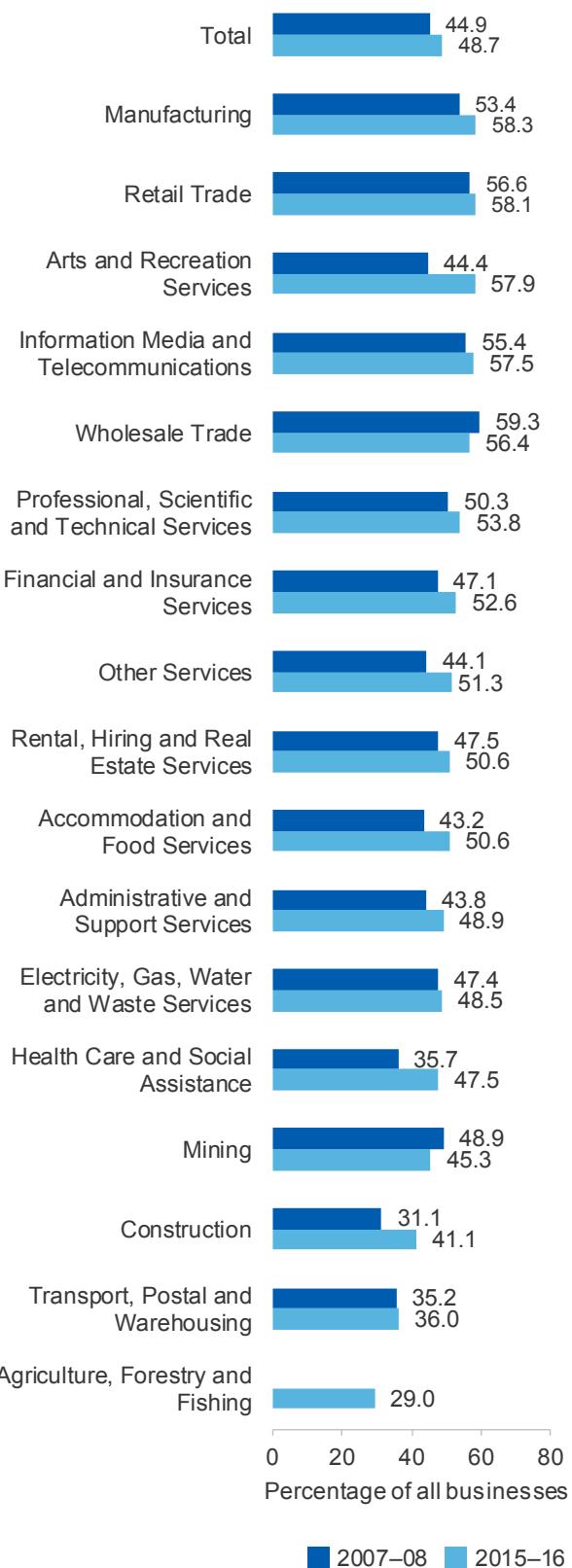
(d) The financial year 2007–08 was chosen for comparison because it was the first year of fully comparable data after the change in ANZSIC classification in 2006.

Innovation activity by industry

Innovation activity in Australia is distributed broadly across industries, led by Manufacturing. In 2015–16, Manufacturing reported the highest proportion of innovation-active firms in Australia. Since 2007–08, only two industry reported a decrease in the proportion of innovation-active businesses; Mining and Wholesale Trade. The industries with the highest increases in innovation-active firms from 2007–08 to 2015–16 were Arts and Recreation, Health Care and Construction (Figure 1.2).

Innovation activity occurs in businesses of all sizes, although it is generally more common in larger firms. More than three-quarters (77 per cent) of large businesses (200 or more employees) were innovation-active in 2015–16. This is almost double the rate of micro-firms (0–4 employees). Large firms reported the largest increase in innovation-active businesses from 70.8 per cent in 2007–08 to 77 per cent in 2015–16 (Figure 1.3).

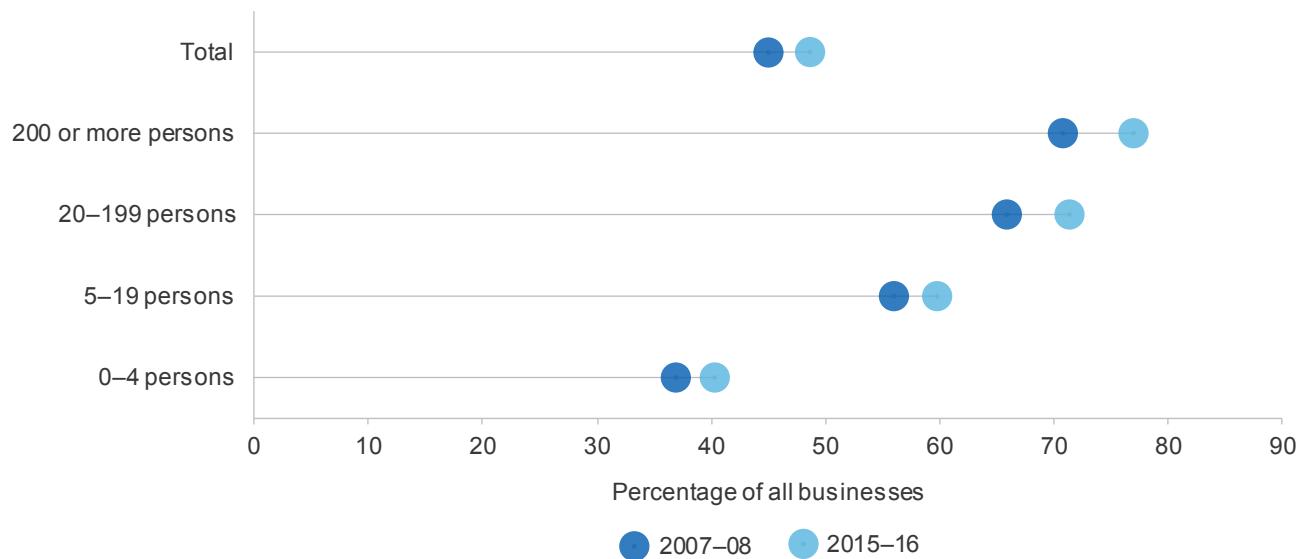
Figure 1.2: Innovation-active businesses, by industry, 2007–08 and 2015–16



Notes: Data for Agriculture, Forestry and Fishing not collected for 2007–08

Source: ABS (2017). *Summary of IT Use and Innovation in Australian Businesses, 2015–16 and 2007–08*, cat. no. 8166.0

Figure 1.3: Innovation-active businesses, by business size, 2007–08 and 2015–16



Source: ABS (2017) *Summary of IT Use and Innovation in Australian Businesses, 2015–16 and 2007–08*, cat. no. 8166.0



Case Study: Empired

UTS Business School



The trend to outsource services has significantly shaped the Australian IT landscape.

"Private and public sector organisations in Australia are increasingly looking to external service providers to provide them with a range of IT services to help meet their business demands," says Russell Baskerville, current CEO of Empired.

Empired is an IT services company specialising in planning, design, implementation and ongoing management of IT systems for medium and large organisations. Established in Perth in 1999, it has grown from a local talent-management software business into an IT services company with global reach. Such achievement, however, required some significant changes to the company's business model.

Empired focussed on two areas:

- 'digital transformation' is its core business, accounting for about 70 per cent of sales. Empired develops bespoke digital platforms for customers, ranging from infrastructure and applications support, such as data centres, through to services including data analytics, mobile applications, networking and data centre management
- 'life cycle services', which covers ongoing support for customer information and communications technology (ICT) systems.

As its priorities and challenges evolved, Empired recognised the need to change its management and human resources strategy to achieve sustainable growth. In hindsight, Russell says he would have acted earlier. These changes occurred in three major phases:

- formation
- introducing professional management
- refreshing senior management.

Formation

During the formation years, technical specialists and consultants established the firm, building expertise and market credibility. The founders focussed on the technological dimensions of the business. In 2002, Empired undertook its first acquisition (Tusk Technologies) and branched into IT services. Russell Baskerville, current CEO, bought out the founders of Empired in 2005. He had previously founded and led two other IT companies.

Introducing professional management

In 2006, following a strategic review, IT services became the primary focus. By then, the business had grown to \$4.5 million in turnover, and Empired recognised the need for professional management. Executive talent was recruited and roles within the senior team were redefined. The firm listed on the ASX in 2007.

The rapid growth between 2006 and 2007 was closely linked with the emergent resources sector in Western Australia. This period also saw Empired realise that it lacked clear processes.

"The early informal approaches did not work for addressing significant change as we grew larger," says Russell.

From 2009 onwards, personnel with IT capabilities and experience in designing and implementing management systems were recruited. By 2011, turnover had reached \$39 million.

Refreshing senior management

Between 2012 and 2015 Empired grew rapidly, with a turnover of \$170 million and about 1,000 staff. After leading growth for years, some members of the executive team sought change. A new Chief Financial Officer, Chief Operating Officer and Global Sales Manager were recruited, all from Australia or New Zealand, to maintain the firm's local character.

Today, Empired is one of the largest Microsoft-dedicated partners in the Asia-Pacific region and counts global corporations such as Toyota Motor Corporation and Rio Tinto among its customers. It maintains a subsidiary in New Zealand (Intergen) and has recently opened offices in Singapore and the United States.

High-performance culture

Empired seeks to attract the best talent and to develop a high-performance culture.

"My approach is to surround myself with talent, hire the best, and pay what is needed to achieve that," Russell says.

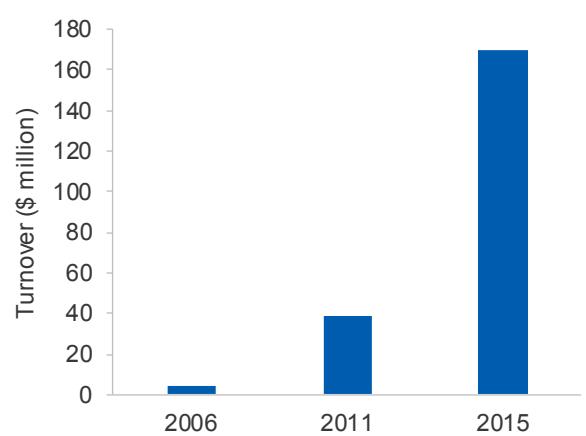
Staff are recruited locally and are often attracted from foreign-owned multinationals in Australia. Empired emphasises the importance of a values-based culture committed to developing talent and expertise among staff and delivering customer solutions. An innovation office identifies opportunities that can be transformed into new products and services. To leverage their strong commercial relationship with Microsoft, Empired also maintains an innovation lab in Seattle, close to where the software giant is based. Staff are given opportunities to rotate between innovative and routine projects to encourage job satisfaction.

Key drivers behind Empired's growth have been:

- the mining boom
- increasing demand from business and government
- acquisitions
- increasing their range of services.

Significant acquisitions include Conducive (2012), OBS (2013), eSavvy (2014) and Intergen (with 300 staff in New Zealand and operations in the US in 2015).

Figure 1.4: Empired turnover, 2006, 2011 and 2015



Source: Empired Annual Report 2015

Meeting increased demand

The growth in cloud, mobile and social ICT applications and use, along with the increasing dependence on contracted managed services for system design, installation and support has driven increasing demand for Empired's services. Changes in the way organisations source IT services have also benefited Empired.

"The structuring of IT outsourcing agreements has been moving away from the traditional large single-supplier contracts to a more selective outsourcing model, where a number of suppliers each deliver specific components based around their core competencies," says Russell.

As outsourcing service agreements are generally multi-year contracts, the recurring revenues have provided a level of certainty that supports capital investment and recruitment decisions.

Reflecting on over 10 years of leading a fast-growing firm, Russell says he has learned some valuable lessons:

- Confront issues, particularly those that involve conflict, underperformance or changing management in acquisitions. “It is better not to sweat on decisions,” he says. “Consider, decide and act.”
- Assimilate acquisitions quickly. Russell says, “Rapid expansion not only places pressure on operational processes and systems, but changes the fundamental personality of an organisation, as a range of new leaders, management and staff from myriad backgrounds and cultures are brought together into one organisation. Resolve the uncertainty and capture the momentum by integrating acquisitions sooner rather than later.”
- Ensure that the firm is always customer-focussed. “There is always a risk of over-engineering when the majority of employees are technical people.”
- Don’t underestimate how much energy is needed to drive growth, and the impact this has on leadership teams. “It will be essential to bring in new and fresh talent,” he says, “but you also need to back them and give them space to develop their approach.”
- Build the platform of management systems that are needed to manage growth. “I would have done this earlier if I had realised how critical it was.”

1.3 How do Australian firms innovate?

Types of innovation

Australian firms tend to specialise in modifying innovations introduced by other Australian firms. In 2014–15, the overwhelming majority of Australian innovators across all business sizes were domestic modifiers (Figure 1.5), and this has been the case since at least 2008–09.¹³ This strategy requires firms to seek out existing innovations, absorb them, and make the required modifications before deploying them commercially. The ability of so many Australian firms to successfully execute this relatively simple strategy is arguably a strength of Australia's innovation system.¹⁴

However, the excessive focus on domestic modification may adversely affect Australia's international competitiveness, since domestic modification involves a lower degree of novelty than other strategies.¹⁵ In particular, new to market innovation (Definition 1.3) is generally more valuable since it involves a higher degree of novelty, which in turn reflects a higher degree of competence, sophistication and knowledge. In Australia, the estimated proportion of firms undertaking new to market product innovation is relatively low, ranking Australia 23rd of 31 OECD countries in 2015.¹⁶ The challenges of transitioning Australia's food and agribusiness industry from one of predominantly domestic modifying firms to Businesses of Tomorrow which introduce new to world innovations is discussed in the feature article in Section 2.3.

Definition 1.3: Output-based innovation models

New to market international innovators: These firms have introduced a product (good or service) and/or process innovation that is new to international markets.

New to market domestic innovators: These firms have introduced one or more product innovations that are new to domestic markets only.

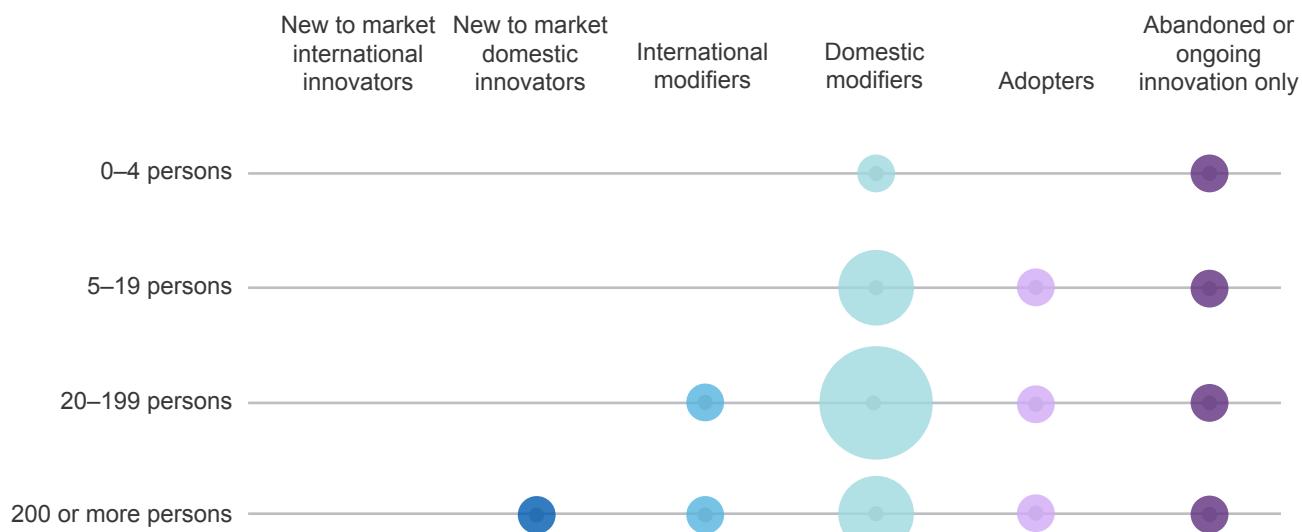
International modifiers: These firms have introduced a modification in-house of one or more products or processes already available on international markets.

Domestic modifiers: These firms have introduced a modification in-house of one or more products or processes that exist already on domestic markets.

Adopters: These firms have adopted one or more products or processes that already exist internationally and domestically. Unlike modifiers, adopters do not develop products in-house, but acquire innovations from others without making modifications to them.

Abandoned or ongoing innovation: These businesses have undertaken innovation projects or activities that have either been abandoned or have not yet been finalised.¹⁷

Figure 1.5: Different types of innovators in Australia, by business size, 2014–15



Notes: Size of the bubble indicates the percentage of businesses engaging in each type of innovation.

Source: ABS (2016) Data analysis based on the BCS commissioned by Department of Industry Innovation and Science

1.4 Collaboration and networks

Networks are essential to an innovation system. They provide a practical means for collaboration on innovation (Definition 1.4), which in turn contributes to business performance. A recent firm-level study of 7,000 Australian SMEs found an association between collaboration on innovation and productivity growth: collaboration on innovation increased annual productivity growth by 4.1 percentage points in the firms studied.¹⁸ International studies also show the importance of collaborative R&D on firm performance.¹⁹

Definition 1.4: Collaboration

- Collaboration describes arrangements where partners work together for mutual benefit, including sharing some technical and commercial risk. It is not necessary for each participant in a collaboration to benefit commercially.
- This definition of collaboration follows international guidelines developed by the OECD's *Oslo Manual* for the collection and use of data on innovation activities in industry. Pure contracting out of work (outsourcing) is explicitly excluded from the definition of collaboration.
- Collaboration refers not only to commercial relationships between firms in related industries in the business enterprise sector (business-business collaboration), but also the extent to which businesses engage with universities and public research organisations (business-research collaboration), and universities collaborating with other universities and public research organisations (research-research).
- Collaborative arrangements can involve both domestic and international organisations, and they can vary in their degree of formality.

Source: OECD (2006) *Oslo Manual*, 3rd Edition, OECD, Paris; and Authors' note.

Business collaboration

Notwithstanding a number of measurement challenges (see Methodology box 1.1), indicators from a variety of sources suggest Australia ranks low on most OECD collaboration measures. Using the broadest scope of collaboration activity, which includes collaboration for purposes other than innovation, it is estimated that 86.3 per cent of Australia's innovation-active businesses undertook no collaboration at all in 2015–16 (Table 1.1).

In terms of business-business collaboration on product and process innovation, Australia ranks 25th out of 32 OECD countries, with less than one in four innovative firms collaborating (Table 1.1). The ranking is lower still (26th) in terms of collaboration between innovative firms and their suppliers. In terms of R&D-active firms as a proportion of innovation-active businesses, Australia ranks 27th of 27 OECD+ countries, with around one fifth of firms engaging in collaboration.^(e) This suggests the majority of R&D activities are in-house, not involving partnership with other organisations.

In 2012–14 (latest internationally comparable data)^(f), Australia ranked last of 29 OECD countries for the proportion of SMEs collaborating with universities or other non-commercial research organisations. Large Australian firms performed better, ranking 27th out of 29 OECD countries. The estimated collaboration rates driving these rankings have fluctuated considerably from year to year around a very low base rate. Further evidence suggesting Australian firms are generally disconnected from the largely public university research sector is in the low proportion (3 per cent) of innovation-active businesses reporting higher education institutions as a source of innovative ideas.

Researchers employed in industry are an important channel for establishing collaborative research with their networks of peers. Comparative data from the OECD shows that only 4.7 per 1,000 employees in Australian industry are researchers. On this indicator, Australia ranked 21st out of 36 OECD+ countries in 2013–14, well behind leading countries Israel (21.6 researchers per 1,000 employees), Sweden (13.9) and Denmark (12.9).²⁰

Only 7.8 per cent of innovation-active businesses report lack of access to knowledge or technology as a barrier to innovation.²¹ This suggests most businesses do not collaborate with research institutions because either they do not perceive it is beneficial to them or they are simply unaware of how such collaboration might improve their business performance — a view supported by the department's BizLab Discovery Project on collaboration (see Box 1.1).

In contrast to the above, Australia performs better than many other OECD countries in industry providing funding to the public research sector. The share of higher education expenditure on R&D (HERD) financed by industry was 5.1 per cent in 2014, and peaked at 6.8 per cent in 2006. Australia ranks 18th out of 36 OECD+ countries on this indicator, ahead of France and the UK but behind Germany and Belgium.

Australia ranks 7th out of 32 OECD countries for the percentage of government expenditure on R&D (GOVERD) financed by industry (Table 1.1). This favourable result may reflect stronger links between business and non-university publicly funded research organisations (PFROs), such as CSIRO. Industry's contribution to GOVERD increased from 7.7 per cent in 2012 to 9.9 per cent in 2014, ranking Australia ahead of the US, where industry finances only 0.4 per cent of GOVERD, but behind Germany and The Netherlands, with 11.2 per cent and 16 per cent respectively. Australia also ranks 9th out of 35 OECD countries for the proportion, 1.23 per cent, of Patent Cooperation Treaty (PCT) applications filed by businesses with a university (whether domestic or foreign).

(e) International comparisons of collaboration measures should be interpreted with caution (see Box 5.3 and *Australian Innovation System Report 2016*, p. 40).

Table 1.1: Business collaboration indicators

Collaboration indicator	Value	Year	Ranking	Number of OECD+ countries
Collaboration on innovation (as a percentage of product and/or process innovative firms)	22.5	2014–15	25	32
Collaboration with suppliers (as a percentage of product and/or process innovative firms)	13.3	2014–15	26	32
R&D-active firms collaborating (as a percentage of innovation-active firms)	19.5	2014–15	27	27
Innovation-active businesses with no collaboration arrangements (per cent)	86.3	2016	–	–
Percentage of HERD financed by industry	5.1	2014	18	36
Percentage of GOVERD financed by industry	9.9	2014	7	32
Innovation ideas sourced from higher education institutions (as a percentage of total)	3	2015	–	–
Percentage of innovation-active SMEs collaborating on innovation with higher education or other non-commercial research institutions	2.7	2014–15	29	29
Percentage of innovation-active large businesses collaborating on innovation with higher education or other non-commercial research institutions	6.2	2014–15	27	29
Business researchers per thousand employed in industry	4.7	2013	21	36
Percentage of PCT applications with a domestic business collaborating with a university (domestic or foreign)	1.2	2000–15	9	35
International co-invention in patents (as a percentage of total patents)	9.7	2013	18	31

Notes: OECD+ includes all 35 member countries of the OECD, as well China, Taiwan and Singapore (where data is available).

Source: OECD (2017), *Science, Technology and Industry Scoreboard 2017*; ABS (2016), *Innovation in Australian Business, 2014–15*, cat. no. 8158.0; OECD (2016) *Main Science and Technology Indicators*; OECD (2017), *OECD Economic Surveys: Australia*; European Patent Office (2016), PATSTAT database.

Methodology 1.1: The challenges of measuring collaboration

Collaboration measurement is challenging, largely due to the depth of engagement and breadth of the activities described by collaboration.

Difficulties arise from the scope of collaborative activity that is measured — a hierarchy of collaboration activities can be described according to:

- their complexity
- the engagement of the respective parties
- the risks shared.

At the apex, a consortium with multiple partners working on pre-competitive R&D in frontier technologies would be a collaboration of high complexity and high risk. Other collaborations, such as R&D contracts or the placement of a researcher in a business, might involve lower levels of engagement with the research sector.

Another measurement challenge is differences in the international collection of innovation data. Most of the widely referenced figures on Australia's business-research collaboration are based on a comparison with other OECD countries, many of which rely on Eurostat's Community Innovation Survey (CIS).^(g) Australia's business collaboration data comes from the Business Characteristics Survey (BCS) collected by the ABS. The BCS surveys firms on their innovation and collaboration activity over a single year, but the CIS covers the previous three years.

The shorter reference period for Australia would be expected to produce lower rates of collaboration compared to businesses in countries responding to the CIS. However, when the ABS formerly used a two-year reference period, the proportion of innovating businesses collaborating, was 26 per cent (for 2004 and 2005). This is a considerable

increase on the 15.9 per cent recorded in 2006–07 when the BCS moved to a single year reference period.²²

The survey population from which estimates are derived is further reduced by other adjustments necessary to make Australia's collaboration data comparable with OECD member countries.²³

The OECD defines small to medium enterprises (SMEs) as businesses with 10–249 employees. In Australia, SMEs are defined as businesses with fewer than 200 employees. These and other scope adjustments reduce the population from which collaboration is estimated to around 6 per cent of the total starting population. However, they merely place Australian industry on the same measurement basis as other OECD countries in the CIS. They do not distort Australia's collaboration rate, unless Australian collaboration is highly concentrated in the omitted industries or in micro and small firms.

Stratification of the reduced population to estimate business-research collaboration at industry level results in small numbers of businesses and a highly variable annual collaboration rate (Table 1.1), with relative standard errors associated with the estimates often too large to warrant publication. The collaboration rate is not a design variable in the BCS, and it is not practical or cost effective to make it so.

In an effort to improve the quality of estimates of Australian business collaboration on innovation, the Department of Industry, Innovation and Science, in partnership with the ABS, has introduced a new question in the BCS that asks respondents to identify barriers to collaboration. As a result, the 2016–17 data collection will likely enable a more differentiated identification of the specific barriers to collaboration. These results, expected in late 2018, will provide more insight into the business collaboration issue.

(g) The CIS does not use the word "collaborate" in its survey; businesses are asked about their "co-operation" on innovation

Collaboration in the research sector

Australia's research sector shows a strong collaboration performance on a range of indicators. In the proportion of the world's top 1 per cent of highly cited publications that have an international co-author (Table 1.2), Australia ranked 7th across all disciplines, 5th for Humanities, Arts and Social Science and 8th for Natural Sciences and Engineering among 38 OECD+ countries from 2013–15. During the same period, almost half of the publication output from Australia's top ten universities (ranked by publication output) had an international co-author (43–50 per cent).²⁴

Australia's share of the world's top 1 per cent of highly cited publications which included to international collaboration has dramatically increased over the last decades. While this indicator for all disciplines was only 1 per cent in 1995, it has increased to 5.7 per cent in 2015. This applies both to Humanities, Arts and Social Sciences and to Natural Sciences and Engineering.

Analysis by IP Australia on co-filing of patent and trademark applications shows strong collaborative activity between Australia's universities and CSIRO, with a dense web of linkages between these PFROs.²⁵ When measuring university-to-university collaborative activity, Australia ranks 15th of 35 OECD countries, with 2.5 per cent of PCT applications originating in Australia co-filed by two or more universities.

Table 1.2: Research sector collaboration indicators

Indicator	Value (per cent)	OECD+ Ranking
Share of world's top 1 per cent highly cited publications attributed to international collaboration (2013–15)		
All disciplines	5.7	7
Humanities, Arts and Social Science	5.1	5
Natural Sciences and Engineering	5.9	8

Notes: OECD+ includes all 35 member countries of the OECD, as well China, Taiwan and Singapore (where data is available).

Source: InCites (2017), Clarivate Analytics database.

Box 1.1: Business research collaboration: the BizLab discovery project

The Department of Industry, Innovation and Science undertook a research project using design thinking to better understand the barriers and drivers for businesses from collaborating with PFROs. Interviews with 30 businesses of varying sizes and sectors were conducted around Australia.

Key findings include:

- Collaboration is integral to commercial success. For many businesses interviewed, fee for service and student internships were the primary form of collaboration with PFROs.
- Some businesses are not aware of the availability or benefits of government support. Others have difficulty finding research partners, managing projects and translating research outcomes.
- PFROs are not always responsive to business needs and many lack business acumen.

The department will explore the following design questions in the next phase of the project:

- How can government improve marketing of programmes and raise awareness?
- How can government better connect businesses and PFROs?
- What approaches could be taken to build SME innovation and management capability?
- How can government support more businesses to collaborate on shared problems?

1.5 Business dynamism

Business dynamism refers to the rate at which firms continually enter or exit the market, expand or contract, and reallocate resources between firms. An economy with high business dynamism tends to be more productive, adaptable and capable of sustained economic growth. The role of new HGFs in encouraging business dynamism and innovation is discussed in the feature article *New firms, innovation and economic change: let us count the ways*.

Entrepreneurs play a key role in this process. In a highly dynamic economy, innovators and entrepreneurs are constantly commercialising new ideas and business models, keeping incumbents alert.²⁶

Business dynamism is a key driver of resource reallocation and productivity growth. OECD evidence suggests business entry and exit and job churn mirror the economy's ability to reallocate resources from less to more productive firms.²⁷

In Australia, business entry rates have been relatively flat for some years, showing a modest downward trend between 2003 and 2015 (Figure 1.6).²⁸ Over this period, relatively fewer entrepreneurs were creating new firms, and they were more likely to exit than firms entering the market in earlier years. The overall downward trend in entry rates is more pronounced for entrepreneurial businesses.^(h)

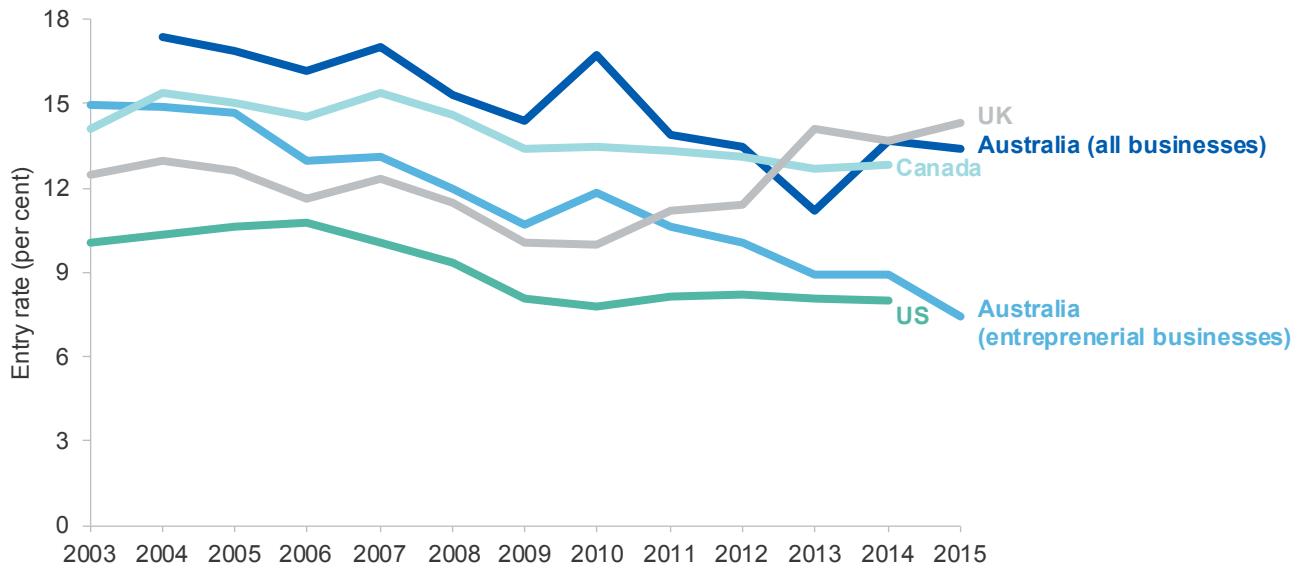
In 2015–16 business entry rates increased to their highest point in 6 years (14.6 per cent). From June 2015 to June 2016 the number of actively trading businesses in the market sector increased by 2.4 per cent (an increase of over 50,000 businesses). The rates of entry and exit were highest for firms without employees (16.6 per cent and 15.1 per cent respectively) and lowest for medium-sized businesses (2.3 per cent and 3.9 per cent).²⁹

Most Australian industries recorded an increase in the number of firms in the year to June 2016:

- Construction had the largest increase, with the number of firms growing by 11,967 (3.5 per cent)
- Financial and Insurance Services, increased by 8,705 (4.7 per cent)
- Professional, Scientific and Technical Services, increased by 5,826 (2.3 per cent)
- Agriculture, Forestry and Fishing recorded the largest decrease, falling by 2,737 firms (1.5 per cent).³⁰

(h) 'Entrepreneurial businesses' are new businesses that are not subsidiaries or spin-offs from existing businesses, and are not in the financial investment or superannuation industries.

Figure 1.6: Entry rates of actively trading businesses, 2003 to 2015



Source: Bakhtiari, S. (forthcoming) *Entrepreneurship Dynamics in Australia: Lessons from micro-data*, Department of Industry, Innovation and Science, Office of the Chief Economist Research Paper

Entrepreneurial attitudes and opportunities

Despite a declining trend in entry rates of Australian entrepreneurs since the global financial crisis (GFC), the overall picture of the entrepreneurial climate and activity in Australia is positive.³¹

The 2016 Global Entrepreneurship Monitor (GEM) publishes a number of measures of entrepreneurship in Australia, the most notable being Total Early-stage Entrepreneurial Activity (TEA), which measures emerging entrepreneurship activity.

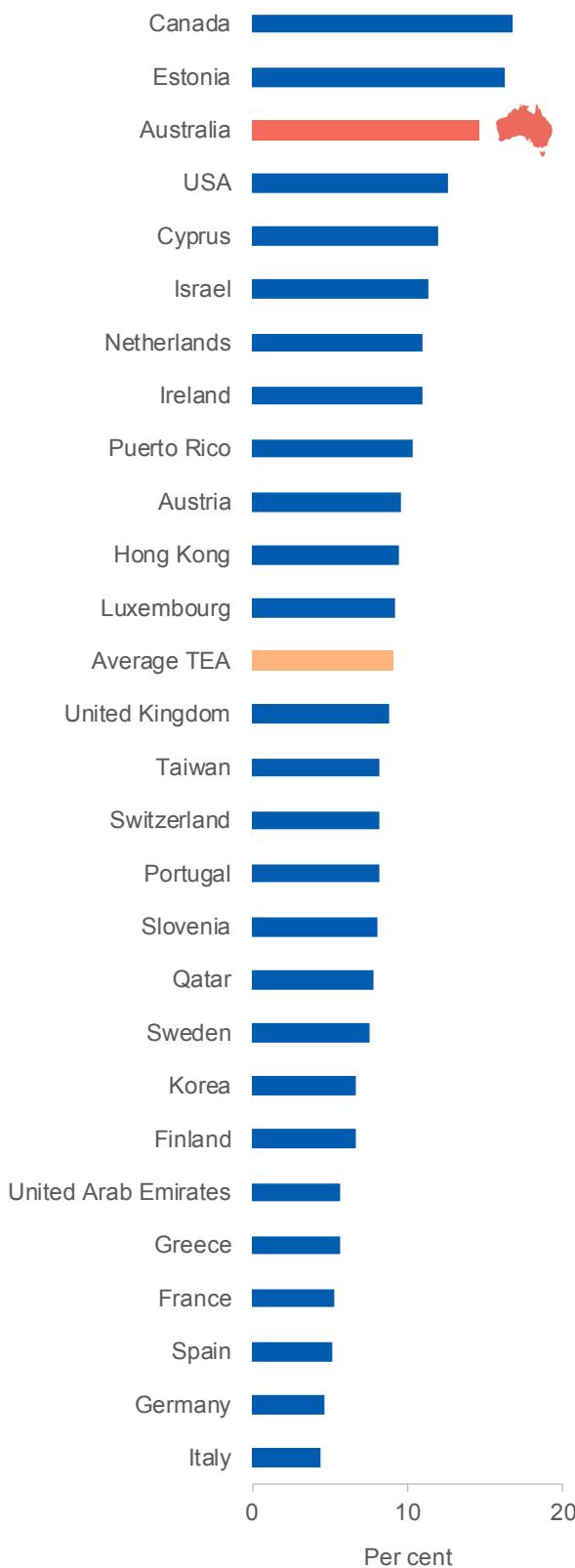
According to the 2016 GEM report, Australia's TEA index was 14.6 per cent, representing 2.2 million early-stage entrepreneurs. Australia's TEA is among the highest of all developed economies, slightly higher than the US (12.6 per cent) but below Canada (16.7 per cent) and Estonia (16.2 per cent)³² (Figure 1.7).

Definition 1.5: Total Early-stage Entrepreneurial Activity

Total Early-stage Entrepreneurial Activity (TEA): Percentage of the adult population between the ages of 18 and 64 years who are in the process of starting a business or who have just started a business which is less than 42 months old.

Source: The GEM Consortium (2017) *Global Report 2016*, Global Entrepreneurship Research Association, London

Figure 1.7: Total Early-stage Entrepreneurial Activity (TEA) in innovation-driven economies, 2016



Source: GEM Consortium (2017) Global Report 2016/17: Global Entrepreneurship Research Association, London

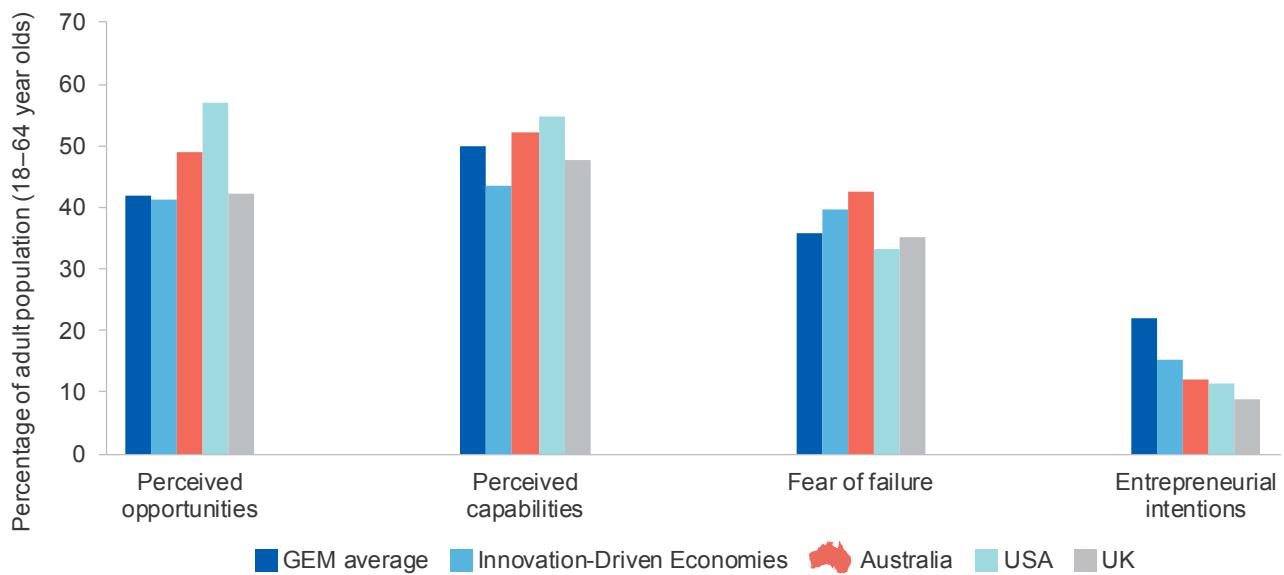
The 2016 GEM findings suggest a combination of perceived business opportunities and entrepreneurial skills drives the high quantity and quality of entrepreneurship in Australia (Figure 1.8).⁽ⁱ⁾ Approximately 49.3 per cent of Australians perceive good founding opportunities exist for a start-up venture and 52.3 per cent believe they have the necessary skills to start a business. Both measures are above the average of comparable innovation-driven economies (41.3 per cent and 43.8 per cent respectively).³³

Entrepreneurial intentions expressed by non-entrepreneurs are lower in Australia (12.3 per cent) than the average for all innovation-driven economies (15.4 per cent).^(j) Less positively, 42.9 per cent of non-entrepreneurial Australians reported perceived fear of failure as a reason why they would not start their own business. This is about ten percentage points higher than similar fears of failure in the USA and UK (33.3 per cent and 35.2 per cent, respectively) and three percentage points higher than the average of innovation-driven economies (39.8 per cent).³⁴

(i) Perceived opportunities reflect the percentage of individuals who believe there is occasion to start a venture in the next six months in their immediate environment, whereas perceived capabilities reflect the percentage of individuals who believe they have the required skills, knowledge and experience to start a new venture.

(j) Entrepreneurial intentions are expressed as the percentage of individuals who expect to start a business within the next three years.

Figure 1.8: Entrepreneurial perceptions and intentions, 2016



Source: GEM Consortium (2017) Global Report 2016/17: Global Entrepreneurship Research Association, London

While Australia generally ranked highly relative to benchmark economies, the 2016 GEM report highlights areas where entrepreneurial activity could improve. For example, Australia compares poorly to other developed nations with respect to the level of international opportunities being pursued. Australia's percentage of Youth TEA (18–24 year olds) was almost half that of the top ranking nations.³⁵

Although Australia ranks third behind only Canada (13.3 per cent) and Estonia (11.7 per cent) in terms of female entrepreneurship among the innovation-driven economies, there is a significant gender gap, with female entrepreneurial participation in Australia only 65 per cent that of males.³⁶



Feature Article: New firms, innovation and economic change: let us count the ways

Paul D. Reynolds

Visiting Research Scholar

Australian Centre for Entrepreneurial Research; Queensland University of Technology

New firms are a major source of economic adaption and change, often through contributions to innovation. These benefits reflect the multiple roles of new firms of all sizes in economic adaption.

There has been substantial research on two issues:

- There is a strong positive relationship between the presence of new firms and subsequent increases in total jobs, economic growth, change in the economic structure and — a favourite among economists — total factor productivity^(k).³⁸ It appears that new firm creation is an important intervening variable, reflecting the responses of individuals and teams to changes in production technology, input costs, or new customer tastes.
- There is much evidence that if a cohort of new firms is tracked over time, say for five or ten years, the majority of the contributions in the final years — particularly job creation — is provided

(k) Recent policy prescriptions emphasize encouraging new, rather than small, businesses.³⁷

from a small proportion of high-growth new ventures.³⁹ This latter finding is now considered a 'stylised fact' or 'empirical generalisation' and has led some to propose that public policies should focus exclusively on high potential new firms; some commentators have proposed that lifestyle or small scale firm creation should be discouraged.⁴⁰

Leaping from data to policy

There are several complications with this latter leap from 'data' to policy recommendations.

One critical issue is that contributions are measured within the cohort of new firms. Using such information as the basis for policy proposals reflects an assumption that this reflects overall job creation for the host economic system.

As economic growth of the host region has not been determined, this may or may not be the case. A direct approach would be to determine the presence of new firms and the jobs in the host region. This could be followed by tracking the firms' developments over a given time, say five years, and then assessing the growth of the new ventures and concurrent regional job growth.^(l) Apparently there have been very few efforts to implement such an assessment.^(m)

One analysis compared the effects of firms born small (less than 20 jobs), medium (20 to 100 jobs) and large (over 100 jobs) on subsequent job growth in 382 U.S. labor market areas.⁴³ No significant impact on regional job growth from the prevalence of new large firms was present, but there were consistent positive associations with the prevalence of new small firms.

Birthing businesses

While much attention is given to the role of firm creation in making positive contributions to economic wellbeing, it is not often recognised that business churning is an ongoing feature of most business populations; firms are constantly created, expanded, contracted and shut down. There are positive correlations among the levels of firm births, expansions, contractions, and quits; the prevalence of firm births measures one aspect of this churning

(l) There is, however, extensive research on regional characteristics that affect the prevalence of business creation or entrepreneurship.⁴¹

(m) One overview of the history of development of entrepreneurial research suggests that the effects on economic growth deserve more attention.⁴²

activity. Those regions or economic sectors with greater churning are generally the ones with greater economic growth and adaptation.⁴⁴

Innovating the establishment

Another major finding is that most growth firms are in established sectors, often providing well-established products in new or more efficient ways⁽ⁿ⁾.⁴⁵ The proportion of growth firms that lead to an expansion of economic markets — creating new goods or services with strong customer acceptance — is generally small and impossible to predict. Further, the growth of individual firms may reflect increasing market share, either by absorbing the competition or driving them out of business. The result may be quite positive for the individual growth firm, but create little change in overall economic growth. The most spectacular growth firm in the United States has been WalMart, created in the 1960s, and which, 50 years later, has 1.4 million employees. While consumers may have benefited, retail employment in the United States has not grown, it has only been redeployed to different firms.

Creation makes a contribution

The mass of new ventures that do not achieve high-growth nevertheless make a number of contributions.

First, regions with a high prevalence of business creation are those where it is an acceptable career option and knowledge of how to implement new ventures is widespread; an entrepreneurial culture exists. This will encourage many to pursue firm creation, particularly those with innovative ideas with untested potential.

Second, a large proportion of jobs are short-term, and new firms are a major source of these temporary positions. This reflects the short life of many business opportunities, which may be profitable for a short period of time, after which they are disbanded and the resources (physical assets, capital, management, and employees) redeployed, perhaps in other new ventures.

Third, much adaptation and innovation is incremental, and new ventures with a short life span are often taking advantage of a temporary opportunity. In retail it is not unusual for specialized outlets to expand rapidly until the market is saturated or a fad loses appeal; the outlets are then shut down.

Fourth, much innovation is provided by new, small firms and once its value is demonstrated the venture is absorbed — intentionally or covertly — by large established firms. The venture creating the innovation disappears, its contribution incorporated into the economy by known business entities.

Finally, almost every nascent entrepreneur thinks they are creating a different kind of business, even if the only difference is a change in a restaurant's menu, a better delivery system or a new price structure.

Unpredictable growth

Some recent assessments have suggested that since rare, fast growing new businesses are responsible for the vast majority of new firm contributions, these initiatives are the only ones that should be encouraged and promoted with public resources.^{46, 47}

But the inability to predict the growth potential of new ventures, along with the small proportion that provide net job gains and the many contributions from a mass of business creation activity, suggests this is short-sighted.

Until it is possible to predict, with some accuracy, the future potential of nascent ventures, it would seem that the social good is best served by encouraging a robust, diverse entrepreneurship sector.

(n) High growth spurts also tend to occur several decades after initiation.



Chapter 2

This chapter looks at high-growth firms as part of the innovation system. It provides some new evidence on the phenomenon of high-growth firms in Australia. The evidence is consistent with international findings that a relatively small proportion of firms in the economy are responsible for a significant share of growth in employment and turnover. The chapter outlines some key characteristics of Australian HGFs in terms of their number, age, size and industry.

High-growth firms in Australia

Only 11,000

out of the more than **121,000** businesses in Australia with 5 or more employees were employment HGFs between 2004–05 and 2011–12



46%

of employment growth came from only **9%** of all employing firms in scope

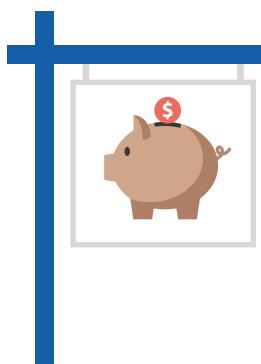


23.5%

of net positive employment growth came from Large Employment HGFs which represented only **0.4%** of firms in scope



HGFs spend more on capital, and have higher labour productivity growth than non-HGFs

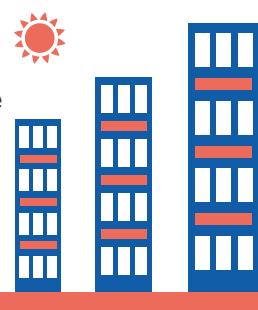


66%

of the net positive sales growth came from only **15%** of firms in scope

42.5%

of net positive sales growth came from Large Turnover HGFs which represented only **0.5%** of firms in scope



Source for all figures: ABS (2017) Business Longitudinal Data Environment (BLADE), Data analysis commissioned by the Department of Industry, Innovation and Science



Australian Government
Department of Industry,
Innovation and Science

Office of the
Chief Economist

Australian Innovation System Report 2017

KEY POINTS

- Across developed economies often a relatively small proportion of firms (typically between 2 to 4 per cent) generate a disproportionately large share of all net employment growth.
- In Australia, Employment HGFs contributed about 46 per cent of net positive employment growth from 2004–05 to 2011–12, despite representing only 9 per cent of all firms with five or more employees.
- Similarly, Turnover HGFs represented 15 per cent of all firms with five or more employees, and yet contributed about 66 per cent of the net positive sales growth and 63 per cent of the net positive value added growth from 2004–05 to 2011–12.
- Turnover HGFs tend to be of all ages, although HGFs between the ages of 3 and 8 years are most common, compared to an average of 10 to 13 years for non-HGFs. HGFs are more likely to be medium-sized businesses.
- Turnover HGFs spend relatively more on capital expenditure than non-HGFs, although the difference is modest in absolute dollar terms. Between 2002 and 2013, median capital expenditure of Turnover HGFs was \$71,132 compared to \$44,954 for non-HGFs.

2.1 Defining HGFs

HGFs first came to popular attention based on a landmark report by the UK's National Endowment for Science, Technology and the Arts (NESTA) which suggested that a 'vital 6 per cent' of fastest-growing businesses in the UK were responsible for 54 per cent of national jobs growth.¹ While later studies revealed additional complexity and variability around measuring the contribution of HGFs, policymakers remain interested in their potential to boost employment and productivity growth.²

The use of different definitions (from HGFs to 'high impact firms' and 'high-growth young firms') and applications across studies highlights the competing areas of interest around HGFs. While different studies adopt different definitions of HGFs, the OECD/Eurostat definition is used most commonly. It defines HGFs as firms that show an average annual growth in turnover or employment of more than 20 per cent per year over three consecutive years, and only firms with 10 or more employees are in scope. The finance sector and non-market sectors are excluded.

In this report, the scope of the OECD/Eurostat definition is expanded to include firms with five or more employees. This was done because the exclusion of firms with 5–9 employees would leave out an important part of the Australian economy. Indeed, 8 per cent of employment, and 6 per cent of income, wage and salaries, and value added are represented in Australian firms with 5–9 employees.³ While micro businesses (0–4 employees) also make an important contribution to the Australian economy, unfortunately it was necessary to exclude these businesses from the analysis as their lower starting base caused high levels of volatility in the data, particularly for employment growth. In this report, all market sectors are analysed.^(o).

(o) All units that are in Standard Institutional Sector Classification of Australia. (SISCA-08) — 3000, 6000, and 2000 are excluded from FTE and sales growth counts. These are mostly government, financial corporations and rest of the world. Financial Corporations were removed in the analysis by the ABS, for concerns regarding accurate accounting of sales. All units that are in ANZSIC-06 — subdivisions 75, 77, 80, 81, 82, groups 624, 633, 954, 955 are excluded from FTE and sales growth counts.

Definitions of HGFs adopted in this report are as follows:

- **Employment HGFs:** Firms with annual turnover higher than \$75,000 that achieve more than 20 per cent average annualised growth in the number of full-time equivalent (FTE) employees over a three-year period. For a firm's annual data to be included, the firm must have at least five FTE employees for the year analysed.
- **Turnover HGFs:** Firms with annual turnover higher than \$75,000 that achieve 20 per cent average annualised growth in turnover over a three-year period. For a firm's annual data to be included, the firm must have at least five FTE employees for the year analysed.
- **Non-HGFs:** Firms which do not meet the HGF definitions above because their growth rate is lower. In the analysis, non-HGFs is a shorthand term which inherits its meaning from the context in which it is used. For example, in the context of a discussion on Employment HGFs, non-HGFs refers to lower employment growth. Similarly, in the context of a discussion on Turnover HGFs, non-HGFs refers to lower turnover growth. For a firm's annual data to be included in scope, it must achieve annual turnover of more than \$75,000 and the firm must have at least five FTE employees for the year analysed.

It is helpful to view HGFs as a cohort, rather than a group of specific businesses. Firms that are defined as HGFs may not necessarily continue to experience high-growth in subsequent periods, which means that the composition of the HGF cohort is also likely to change over time (see Section 3.1). For example, if a firm was a Turnover HGF in 2007 (that is, it achieved more than 20 per cent average annualised growth in turnover over 2005, 2006 and 2007), but subsequently its growth rate declined to 20 per cent or below then it will be classified as a non-HGF from 2008 onwards. Also, if a firm temporarily drops out of the HGF cohort and then later returns to it within the time period of interest, then both its high-growth episodes are captured in the analysis of the HGF cohort.

2.2 The economic contribution of HGFs in Australia

HGFs make an important contribution to Australia's economy. Despite representing only 9 per cent of the firms in scope, Employment HGFs contributed about 46 per cent of net positive employment growth in the period 2004–05 to 2011–12.^(p) Turnover HGFs represented 15 per cent of all firms in scope, yet they contributed about 66 per cent of the net positive sales growth and 69 per cent of the net positive value added growth during the same period (Table 2.1).

Large HGFs account for the lion's share of growth in the Australian economy, but represent a very small fraction of the firms in scope.^(q) Between 2004–05 and 2011–12, large Employment HGFs represented only 0.4 per cent of firms in scope, yet they contributed 24 per cent of positive employment growth. Similarly, large Turnover HGFs represented 0.5 per cent of firms in scope, and contributed 43 per cent to positive sales growth and 40 per cent to positive value added growth (Table 2.1).

Medium-sized firms are most numerous among HGFs, both by employment and turnover growth. They are also the second most important contributor to net growth in all three variables. Between 2004–05 and 2011–12, medium-sized HGFs contributed 18 per cent to net positive growth in employment and sales, and 22 per cent net positive growth in value added (Table 2.1).

(p) Total firms includes firms with more than 5 employees and with turnover of more than \$75,000 per annum.

(q) On average over the period 2004–05 and 2011–12, around 121,680 firms were in scope under the employment growth definition, and 120,600 firms were in scope under the turnover growth definition (see Section 2.1).

Table 2.1: Contribution of HGFs to employment in the market sector economy, by firm size 2004–05 to 2011–12

Size (FTE)	Employment HGFs		Turnover HGFs		
	Proportion of HGFs (per cent)	Contribution to FTE net positive growth (per cent)	Proportion of HGFs (per cent)	Contribution to net positive sales growth (per cent)	Contribution to net value added growth (per cent)
5–10	1.2	1.3	5	2.5	3.4
11–19	2.9	3.3	4.3	2.7	3.8
20–199	4.4	17.9	5.4	18.2	22
200 +	0.4	23.5	0.5	42.5	40.2
All industries	9	46.1	15.2	65.9	69.4

Notes: The contribution to employment growth has been calculated using the definition of Employment HGFs, as indicated in Section 2.1. Turnover HGF definition is used for calculating the contribution of HGFs to sales growth and value added growth. Contributions are calculated as the average of the whole period 2004–05 to 2011–12. However the scope of this analysis excludes businesses with less than 5 FTE employees in the first year of the relevant three year period.

The size category of 1–10 should be interpreted with care (see Section 2.1). The scope restriction for this analysis removes firms with fewer than five employees in the base year. Further, it still includes firms that started with 5 or more employees, but have subsequently declined below the five employee threshold.

Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Data analysis commissioned by the Department of Industry, Innovation and Science.

Methodology 2.1: Business Longitudinal Analysis Data Environment (BLADE)

The dataset used in the analysis of Turnover and Employment HGFs is based on BLADE. BLADE is a methodology developed by the ABS that links business datasets such as the Business Characteristics Survey (BCS) Super Main Unit Record File (SMURF), which includes cross-sectional and panel units, and administrative data sourced from the Australian Taxation Office (ATO), such as Business Activity Statements (BAS), Business Income Tax (BIT) data and Pay As You Go (PAYG) data. BLADE uses the Australian Business Register (ABR) as the main link to datasets. This report uses data from 2002 to 2014.

2.3 Attributes of HGFs

The growing policy interest in HGFs has given rise to a number of myths, including that HGFs are all high-tech firms or that HGFs are all small and young. In fact, international evidence suggests remarkable diversity in the HGF population.⁴ This section describes the typical attributes of Australian HGFs and supports the finding in other studies that HGFs can be found in every industry, size and age cohort.

Number

Considering the economic contribution of HGFs, the most surprising attribute was their number. For the population of firms in scope, i.e. Australian businesses with five or more employees, on average only 11,000 were Employment HGFs and 20,000 were Turnover HGFs in each year between 2004–05 and 2011–12 out of a potential population of roughly 121,000 firms.

On average over the period there were 492 large Employment HGFs and 615 large Turnover HGFs. Despite being small in numbers, these larger firms made the greatest contribution across all measures over the period. Medium-sized businesses were most common in both types of HGFs (Table 2.2).

Table 2.2: Average number of Employment and Turnover HGFs in each cohort, by firm size, 2004–05 to 2011–12

Size (FTE)	Average number of Employment HGFs (per year)	Average number of Turnover HGFs (per year)
1–10	1,410	5,970
11–19	3,525	5,108
20–199	5,438	6,516
200+	492	615
Total	10,960	18,210

Notes: The number of HGFs in each cohort has been calculated using the definition as indicated in Section 2.1. However the scope of this analysis excludes businesses with less than 5 FTE in the first year of the relevant three year period.

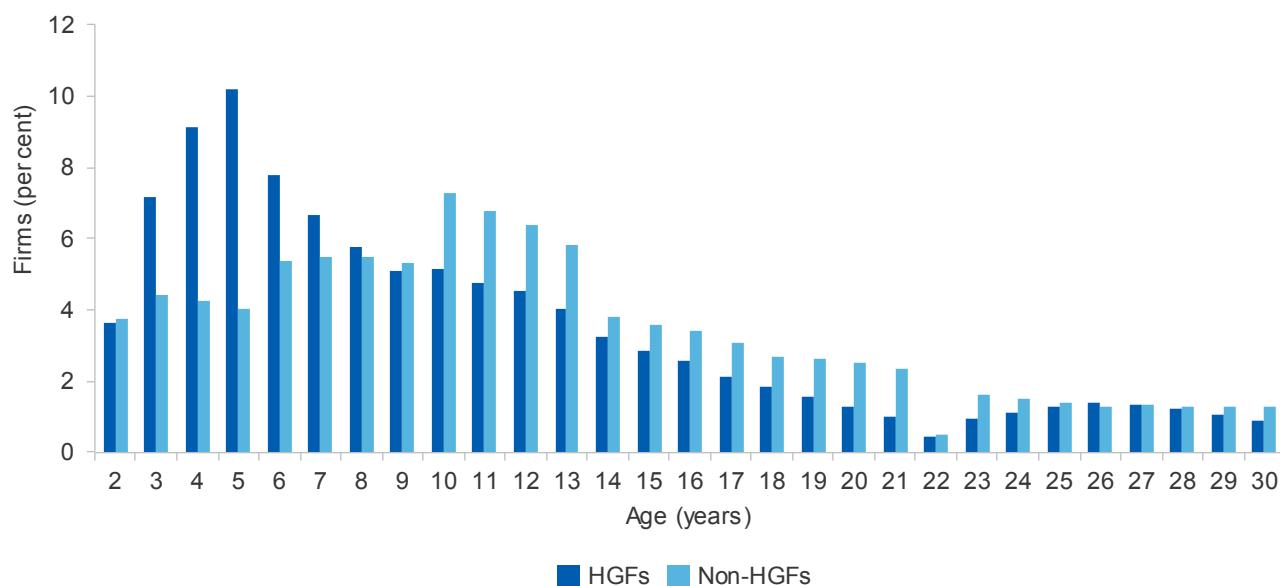
Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Data analysis commissioned by the Department of Industry, Innovation and Science.

Age

Turnover HGFs tend to be distributed across all ages, although HGFs between the ages of 3 and 8 were most common in the period 2002 to 2013, compared to a range of 10 to 13 for non-HGFs (Figure 2.1). The median firm age of a Turnover HGF during the period was 8 years, compared to 11 years

for non-HGFs. This isn't surprising, given younger firms start from a lower base and have a greater capacity for growth than established firms. The most common age category for Turnover HGFs was around 5 years i.e. they were aged 5 years in their first period of consecutive turnover growth.

Figure 2.1: The age of Turnover HGFs and non-HGFs, 2002–13



Notes: For HGFs, the chart shows a firm's age at the beginning of its high-growth episode. A given firm that enjoys multiple high-growth episodes can be counted multiple times. For a discussion on the persistence of individual HGFs, see Section 3.1. Top and bottom percentiles of the data are removed to preserve confidentiality.

Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science

Size

Unlike age, there seems to be little difference in the distribution of employment size between Turnover HGFs and non-HGFs. Between 2002 and 2013, Turnover HGFs employed a median of 26.2 FTE employees, compared to 27 FTE employed by non-HGFs. Some international studies have found similar results — indeed some evidence suggests that once firm age is accounted for, there is no systematic relationship between firm size and growth.⁵

Industry

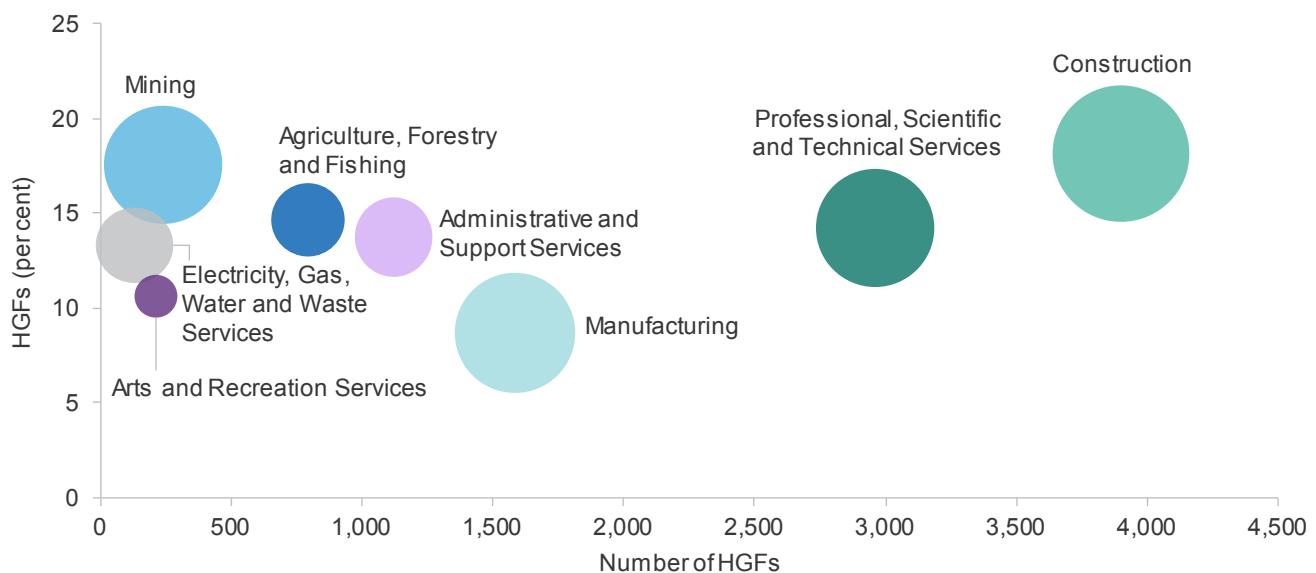
HGFs can be found in all industries. Figure 2.2 shows the proportions of Employment HGFs in 2014 for eight selected industries and the absolute number of HGFs in those industries. Manufacturing had the lowest proportion of HGFs (8.7 per cent), and Construction had the highest (18.2 per cent). The

proportions of HGFs in each industry, therefore, were distributed within this range of 10 percentage points.

The Construction and Mining industries had similar proportions of Employment HGFs but the number of HGFs in each industry differs by more than 3,600. Electricity, Gas, Water and Waste Services had the median proportion of HGFs for the cohort (13.3 per cent), though the smallest absolute HGF count at only 131 Employment HGFs.

Mining, Construction, Manufacturing and Professional, Scientific and Technical Services all make significant contributions to the Australian economy, though their proportions and number of Employment HGFs differ substantially (Figure 2.2). The size of the bubbles represents the contribution of each industry to GDP.

Figure 2.2: Number, proportion and value added of Employment HGFs, selected industries, 2014



Notes: The size of the bubble represents the share of value added in GDP for each industry.

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Customised data analysis commissioned by the Department of Industry, Innovation and Science.



Feature Article: Dynamics shaping the Australian food and agribusiness industry

Dr Mirjana Prica

Managing Director

Food Innovation Australia Limited (FIAL)

The food and agribusiness industry in Australia is highly fragmented and operates in a diverse, dynamic, and complex landscape. It spans growers, raw material producers, manufacturers, packaging, sales, marketing and retail providers, through to final users or consumers of the sector outputs.

Key facts about the industry

The industry is a significant contributor to the Australian economy. Key facts about the food and agribusiness industry:^(r)

- \$164 billion in total sales and service income, equivalent to 5.9 per cent of all Australian industries in 2013–14
- \$59.1 billion of industry gross value added in 2015–16, representing 3.6 per cent of all industries

(r) Calculations are based on Australian Bureau of Statistics (ABS) Australian National Accounts: National Income, Expenditure and Product, 2014–15, cat. no. 5204.0, Table 5; ABS (2017) International Trade in Goods and Services, Australia, May 2017, cat. no. 5368.0, Table 12a; ABS (2017) Counts of Australian Businesses, including Entries and Exits, Jun 2012 to Jun 2016, cat. no. 8165.0; ABS (2017) Labour Force, Australia, Detailed, Quarterly, May 2017, cat. no. 6291.0.55.003.

- exports of \$37.7 billion, representing 14.8 per cent of 2016 Australian exports
- 177,200 businesses in 2016, of which 120,200 were non-employing (67.8 per cent of total businesses)^{7, (s)}
- employed approximately 523,000 people in 2016, most of them in regional Australia.

Key challenges for the industry

There are many challenges facing the industry, including:

- food security
- availability of arable land
- how to manufacture products to meet the needs of the growing middle class in Asia, as it demands more nutritious and healthy foods.

Within the sector, FIAL has also identified two distinct types of businesses shaping the landscape:

- Businesses of Today — generally less growth-oriented and often work to maintain market share. They tend to view a direct interest or involvement in overseas markets as outside their ‘need to know’ area. As a result, they rely heavily upon the downstream processors or exporters to manage access to supply chains and markets.
- Businesses of Tomorrow — actively pursue new markets and are more inclined to take risks to secure those new markets. Many of these businesses are directly connected to their end markets and continuously invest in building capability and knowledge in these markets.

The different culture, beliefs and values of these distinct business types are impacting the scale and scope of innovation undertaken by the industry. Qualitative evidence gathered by FIAL over the past three years suggests Businesses of Today are more focussed on new-to-firm innovations, whereas Businesses of Tomorrow are more motivated by new-to-market or new-to-world innovations.^(t)

(s) Over half of these non-employing businesses are beef and sheep farmers who are “owner managers without employees”. While in the food manufacturing sector, a significant portion of these are made up of small wineries and local bakeries. The remaining 56,956 employing businesses are mostly SMEs that employ fewer than 200 employees; with large or multinational businesses that employ more than 200 employees only representing 0.1 per cent of the total number of employing businesses in the sector.

(t) FIAL has gathered much anecdotal information on the different types of businesses operating in the landscape from the different workshops, seminars and industry consultations organised by FIAL over the past three years. Please see reports published at www.fial.com.au.

FIAL also has empirical evidence that of approximately 57,000 employing businesses in the sector, only around five per cent, or 3,000 businesses belong to the cohort of Tomorrow Businesses. This means the Businesses of Today are dominating the landscape dynamics, and shaping the industry culture — making it difficult to create a collaborative culture that fosters and encourages innovation, high-growth and ambition.

Showcasing industry innovation

The observation that the adoption and modification of innovations developed elsewhere are more widespread than delivering new-to-market or new-to-world innovations is further supported by the food and agribusiness innovations showcased in the book: *Celebrating Australian Food and Agribusiness Innovations*, published by FIAL in June 2016. The book, a first of its kind for the sector, showcases fifty innovations in the food and agribusiness industry launched during 2014, as chosen by a panel of technical experts from industry, academia and research.

This book also showcases many Businesses of Tomorrow. Two of the companies featured, Gourmet Garden and Lotus & Ming, are great examples of businesses with an appetite for risk and willingness to invest in capability and capacity. They also spend time understanding end consumers or markets, and use the insight gained from this process to develop highly differentiated products that meet the needs of end customers. Jacqui Wilson-Smith of Gourmet Garden says, “the consumer must be the leading force behind innovation”. The industry needs more businesses like these to shift the innovation paradigm.

Furthermore, of the 50 innovations showcased, only one was identified as a new-to-world innovation by the panel of experts. Such a low percentage is consistent with the Australian Innovation System Report 2014, which reported only 5.7 per cent of all Australian businesses introduced new-to-market innovations in 2012–13.⁶ The report also highlights that new-to-market innovations have greater impact on a business’s competitive advantage and likelihood of increasing exports than for businesses that only introduce new-to-firm innovations.

Transitioning from Today to Tomorrow

The challenge for the food and agribusiness industry is to establish a framework encouraging and supporting businesses to acquire the capabilities and capacity necessary to transition from a Business of Today into a Business of Tomorrow — into a HGF. Creating a greater cohort of Tomorrow businesses, would build momentum and confidence across the industry, enhancing the sector’s international competitiveness and increasing participation in global value chains.

2.4 Performance characteristics of HGFs

Turnover

In addition to having high rates of turnover growth, Turnover HGFs also tend to have higher turnover levels (i.e. annual sales revenue), compared to non-HGFs. For small firms in 2014, median turnover levels in 2014 were 9.3 per cent higher for Turnover HGFs than for non-HGFs. For large firms, this gap was 24 per cent (Table 2.3). These differences shouldn't be too surprising given the comparison is between a cohort of firms that have sustained a large turnover growth rate, against those that haven't. Moreover, the median revenue of Turnover HGFs has increased for all firm sizes since 2005, despite growing less common in Australia since then (see Section 3.3). For a discussion on the growth rates of Turnover HGFs, see Section 3.4.

Table 2.3: Turnover level of Turnover HGFs and non-HGFs by firm size category (median values), 2014

Size (FTE)	Turnover HGFs (\$ millions)	Non-HGFs (\$ million)	Difference (per cent)
Small (5–19)	1.7	1.6	9.3
Medium (20–199)	8.1	7.8	3.6
Large (200+)	174.4	140.6	24.1

Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

Employment

On top of their impressive turnover growth rates, Turnover HGFs also make significant contributions to employment growth. Between 2002 and 2013, Turnover HGFs had a median average growth in employment of 27.6 per cent compared to just 0.1 per cent for non-HGFs (Table 2.4). These findings are broadly consistent with a study on younger HGFs in the US, which showed high-growth in revenue is positively associated with high revenue and employment growth in subsequent years.⁷ Employment generation by Turnover HGFs further shows the importance of these firms to the economy.

Table 2.4: Employment growth for Turnover HGFs and non-HGFs (median values), 2002–13

	Turnover HGFs	Non-HGFs
Employment growth (per cent)	27.6	0.1

Notes: Three year compound average

Source: ABS (2017) Business Longitudinal Data Environment (BLADE), Business Characteristics Survey (BCS) data linked to firm-level financial data. Analysis by Department of Industry, Innovation and Science.

Capital expenditure

Turnover HGFs were characterised by a relatively higher median capital expenditure than non-HGFs, although the actual difference in terms of the absolute dollar amount seems to be modest across all firm categories. Between 2002 and 2013, median capital expenditure of Turnover HGFs was \$74,132, compared to \$44,954 for non-HGFs (Table 2.5).

Looking at median capital expenditure rates by firm size, in the period 2002 to 2013, small Turnover HGFs spent 187 per cent more on capital expenditure than small non-HGFs. The difference in capital expenditure between the growth categories declined as firm size increased, with large HGFs spending only 10 per cent more than large non-HGFs in the same period.

Mature firms generally undertook more capital investment than young firms. Also, Turnover HGFs undertook more capital expenditure than non-HGFs. Between 2002 and 2013, the median capital expenditure of mature Turnover HGFs was 147 per cent higher than mature non-HGFs. In the same period, young Turnover HGFs also had higher (64 per cent) capital expenditure than non-HGFs (Table 2.5).

Table 2.5: Capital expenditure of Turnover HGFs and non-HGFs (median values), 2002–13

Firm category	Turnover HGFs (\$)	Non-HGFs (\$)	Difference (per cent)
	Size (FTE)		
Small (5–19)	15,195	5,293	187
Medium (20–199)	122,966	75,179	64
Large (200+)	2,588,557	2,352,473	10
	Age (years)		
0 to 5	19,652	12,020	64
6 plus	138,536	56,118	147
Total	74,132	44,954	65

Source: ABS (2017) Business Longitudinal Data Environment (BLADE), Business Characteristics Survey (BCS) data linked to firm-level financial data. Analysis by Department of Industry, Innovation and Science.

Labour productivity

Turnover HGFs tend to have higher labour productivity growth. In the period 2002 to 2013, Turnover HGFs had a similar level of labour productivity (median turnover of \$153,673 per FTE) compared to non-HGFs (median turnover of \$154,079 turnover per FTE). However, the median labour productivity growth of Turnover HGFs was much higher (2.7 per cent) than non-HGFs (−1.2 per cent) (Table 2.6).

Younger and smaller firms are more common among firms that undergo rapid periods of labour productivity growth. During the period 2002 to 2013, small Turnover HGFs had the largest difference in labour productivity growth (6.7 per cent) compared to non-HGFs (−0.8 per cent), with this difference decreasing with firm size. By firm age, young firms showed the highest growth in labour productivity (4.2 per cent) compared to mature firms (3 per cent).

Increased labour productivity growth in Turnover HGFs is a result of their turnover growth outpacing their employment growth. Between 2002 and 2013, the median growth in turnover in Australian Turnover HGFs was 45 per cent, and (as seen in Table 2.4) their employment grew by 28 per cent. This enhances the labour productivity of Australian Turnover HGFs, when measured by turnover per FTE employee.

Table 2.6: Labour productivity growth by Turnover HGFs and non-HGFs (median values), 2002–13

Firm category	Turnover HGFs	Non-HGFs
	Size (FTE)	
Small (5–19)	6.7	−0.8
Medium (20–199)	2.3	−1.1
Large (200+)	1.7	−0.7
	Age (years)	
0 to 5	4.2	−0.5
6 plus	3.0	−0.9
Total	2.7	−1.2

Notes: Labour productivity here is the amount of turnover per FTE employee. Growth is calculated on a three year compound average.

Source: ABS (2017) Business Longitudinal Data Environment (BLADE), Business Characteristics Survey (BCS) data linked to firm-level financial data. Analysis by Department of Industry, Innovation and Science.



Case Study: Booktopia

UTS Business School



How do you capture 15 per cent of Australia's online book sales without an initial vision or business plan?

It took the start-up Booktopia three days to sell its first book — now it sells one book every eight seconds and ships more than 4 million per year.

"Ten years ago, we were in 60 square metres in North Sydney; now we're in 13,000 square metres. It's been quite a journey," says Booktopia co-founder and CEO Tony Nash.

Starting out

Booktopia was founded in 2004 after Tony's internet consulting firm was hired by Angus & Robertson to optimise its website for the online search engines. He set up a competing website with his brother, sister and brother-in-law to start selling books, with a marketing budget of just \$10 a day, and relied on another company to manage the website and fulfil the orders.

"Initially, we didn't have a plan to build a major company, so we didn't invest in our website or in our own capacity [to fulfil orders]," says Tony.

"It was an experiment."

Self-funded growth

Previous experience in facilitating business start-ups and expertise across sales, finance and IT gave Booktopia's founding team a competitive advantage and balance in key functional areas. This enabled them to achieve self-funded, sustainable and organic growth.

The founders' prior experience in internet marketing in particular, was critical for making early decisions about priorities. Tony identifies three critical aspects to the company's growth:

- focus on what customers want
- ensure the founding team has the skills to make the right decisions
- set ambitious but achievable growth goals.

Goal-setting

Booktopia operates based on goals rather than long-term planning. The firm aims to increase sales by 30 per cent per year and then works out how to achieve this.

"When you set yourself a destination you force yourself to dream up strategies. You start to think about different things. We are sales-driven: we don't have a business plan, but we do have a goal," Tony says.

Managing success

Tony remains careful to not take on more than the firm can manage. Growth led to some major structural changes within the firm. When sales hit \$2 million in 2007, the founders decided to fully commit, building their own website and fulfilling their own orders. In 2014, Booktopia moved to its current warehouse, involving a \$5 million investment in automation, conveyors, packing machines and scanners. The company acquired Angus & Robertson in 2015.

"We came full circle", says Tony.

Booktopia continues to operate Angus & Robertson under a separate brand, with all order fulfilment done at Booktopia's Sydney warehouse. The firm also acquired an online camera and optics company (Dirt Cheap Cameras) in the same year.

Today, Booktopia employs over 150 staff, and sales growth has increased from \$2 million to over \$100 million in 2016-17. On average, the firm has grown by 30 per cent in most years since 2004 —

five times as fast as the expanding online book market in Australia (which is growing at about 6 per cent per year).

Booktopia has been listed in BRW's Fast 100 for seven years, and has won many other awards, including the Telstra Business Award for Medium Sized Businesses in NSW in 2014 and in 2016 and 2017 was voted Best Book Retailer in Australia at the Australian Book Industry Awards.

Recruitment to flourish

Employees were recruited gradually as the firm grew. Recognising the need for more professional staff, management recruited them — even before Booktopia could easily afford it.

"I like to think of Booktopia as its own organism. I see it as its own entity. Like a child, you have to ask, what does it need to sustain itself, to flourish and grow?" says Tony.

The growth of the business and a workforce of over 150 has led to a need for a more formalised set of roles, and the firm now has a Chief Financial Officer, Sales Director, Chief Operating Officer, Chief Commercial Officer and Chief Technology Officer.

Sustained growth has meant that long-term employees have had opportunities for career growth inside the firm and, perhaps as a result, staff retention is high.

Preparing for competition

Booktopia is now facing competition from Amazon and its 2011 UK acquisition, The Book Depository — but it has set in place several elements to prepare for this.

Booktopia has built a dominant position in the Australian online book market by developing a large catalogue focussed on Australian content, an effective website and a high-volume, custom-made dispatch system. As many readers have strong interests in specific authors or topics, Booktopia works to engage those readers with information about books and audio-visual interviews with authors.

Have a heart

Corporate social responsibility is another factor which may contribute to the company's customer attraction and retention.

Booktopia maintains an intensive philanthropic programme that supports literacy initiatives and events. Book donations play a key role in the company's approach to corporate social responsibility. Since 2011, Booktopia has donated over \$300,000 worth of books to the Cathy Freeman Foundation project on Palm Island for Indigenous literacy, and has also provided over \$250,000 worth of books to other schools and charities needing books for their fundraising.

The firm has also sponsored industry conferences, including the Australian Society of Authors National Writers' Congress and the Australian Romance Readers Convention, as well as industry events like the Australian Book Industry Awards and the Australian Book Design Awards. Tony suggests that such corporate social responsibility inspires customers, because they know Booktopia gives back to the community.

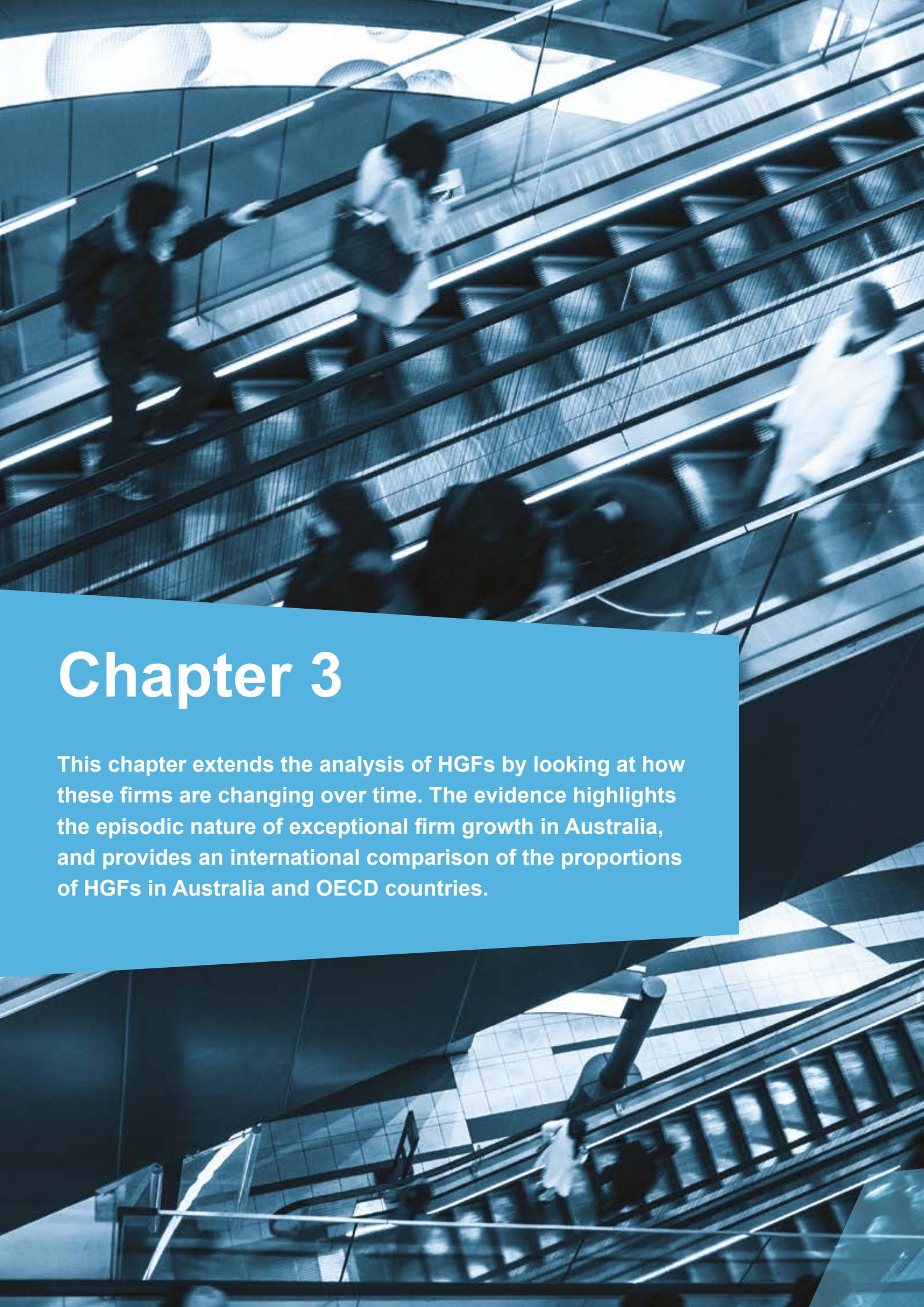
Personal development

Committed to personal development, Tony was a member of the CEO Institute and has benefited from its peer group discussions and networking.

"I have always been concerned about building business value, with a view to an IPO or sale at some point. We have used PwC for auditing, and went into the Telstra Business Awards, because the health checks they involve identified issues we need to address," he says.

Reflecting on 13 years of leading a fast-growing firm, Tony lists some key lessons:

- identify the opportunity, focus on one thing and do it well. Recognise that it will require entrepreneurship and innovation to pursue it
- hire and empower — or you will stay small
- focus on customer needs and have customer demand drive the business
- improve constantly. Don't be too anxious about complaints, but act on them
- keep an entrepreneurial but professional and reasonable mindset — avoid the excessive highs and lows.



Chapter 3

This chapter extends the analysis of HGFs by looking at how these firms are changing over time. The evidence highlights the episodic nature of exceptional firm growth in Australia, and provides an international comparison of the proportions of HGFs in Australia and OECD countries.

Trends of high-growth firms in Australia

The majority of HGFs end their high growth episode within
4 years



12.5%

of Australian firms were Employment HGFs in Australia in 2014, compared to **18.6%** in 2005

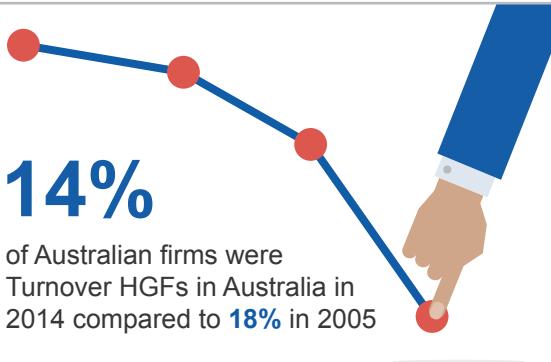


Turnover HGFs have increased their median revenue from under **\$120 million** in 2005 to over **\$184 million** in 2014



14%

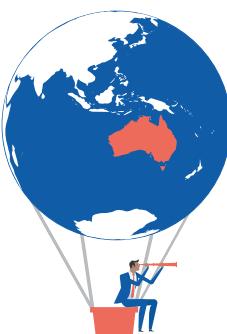
of Australian firms were Turnover HGFs in Australia in 2014 compared to **18%** in 2005



Median revenue **growth rate** of Turnover HGFs has fallen from **68%** in 2006 to **38%** in 2013



Australia has more Employment HGFs than the **OECD average**



Sources (left to right): 1–5) ABS (2017) Business Longitudinal Data Environment (BLADE), Data analysis commissioned by the Department of Industry, Innovation and Science; 6) OECD.Stat, SDBS Business Demography Indicators (ISIC Rev. 4); Rate of High-Growth enterprises (20% growth based on employment); ABS (2017) Business Longitudinal Analysis Data Environment (BLADE), Analysis by Department of Industry, Innovation and Science



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Chief Economist

Australian Innovation System Report 2017

KEY POINTS

- Few firms can sustain outstanding rates of growth for long. The majority of HGFs end their high-growth episode within four years.
- The proportions of HGFs in Australia's firm population have declined over time. Between 2005 and 2014, the proportion of Employment HGFs declined from 18.6 per cent to 12.5 per cent, while Turnover HGFs declined from 17.6 per cent to 14 per cent.
- At the same time that the proportion of HGFs has been declining, the median growth rate of HGFs has slowed down. Between 2006 and 2013, the median three year compound rate of growth in turnover for Turnover HGFs has declined from 68 per cent to 38 per cent.
- Turnover HGFs are getting larger in terms of their turnover levels. In 2014, Turnover HGFs reached a median turnover of \$184.2 million, which is 45 per cent higher than in 2005 after adjusting for inflation.
- The decline in Employment HGF proportions between 2005 and 2014 has been broad-based, affecting all industries — and this general pattern is also observed for Turnover HGFs.

3.1 The episodic nature of high firm growth

The composition of HGF cohorts in the Australian economy is constantly changing as different firms move in and out of the cohorts. This movement is related to business dynamism and the process of resource reallocation, which involves not only the entry and exit of firms but also their growth and decline.

Few firms can sustain outstanding rates of growth for long. More than half of HGFs end their high-growth episode within four years. After four years of high-growth, 51 per cent of the 2005 cohort remained Turnover HGFs, and 42 per cent of the 2009 and 2011 cohorts remained HGFs. After seven years of high-growth, only 14 per cent and 11 per cent of Turnover HGFs from the 2005 and 2009 cohorts, respectively, were still growing fast enough to remain classified as HGFs (Figure 3.1). A similar pattern of growth rates that are exceptionally high but short-lived can be seen in the Business Review Weekly (BRW) Fast 100 companies (see Box 3.1).

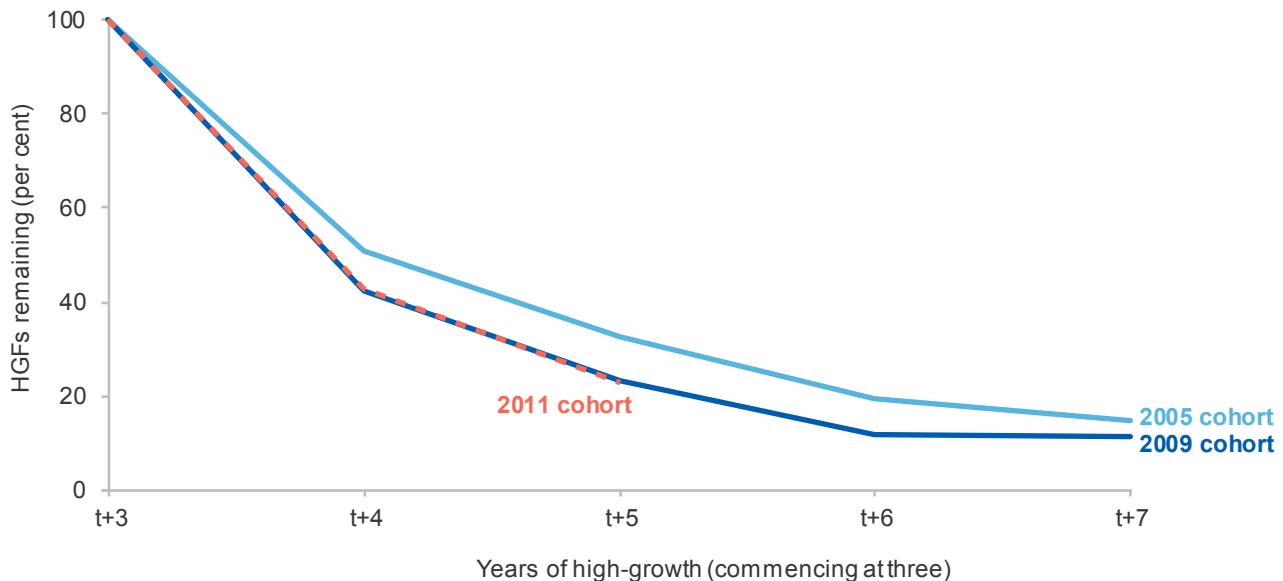
Box 3.1: BRW Fast 100

The BRW Fast 100 is a list of Australian-owned fast growing companies with a turnover greater than \$500,000. The companies are ranked according to their growth rate, based on their revenue and average annual growth. Fast 100 companies submit four years of financial data and are ranked according to their annual growth. Fast Starters (newer firms) submit two years of financial data and are ranked according to revenue. Entries are signed off by an independent auditor.

In 2016 the number one ranked company was TripADeal — its first year on the list — with an impressive growth rate of 401.7 per cent. The average annual growth rate for companies on the list hit its peak in 2014 at 90.5 per cent, but has since declined to 81.8 per cent in 2016.

Exceptional growth rates are rarely sustained. From 2013 to 2016, only six of the 100 companies consistently reappear on the list, and even these have bounced around in their rankings (Figure 3.2). Apart from their shared success in achieving high-growth, there are few discernible common traits between the companies appearing on the BRW Fast 100 list.

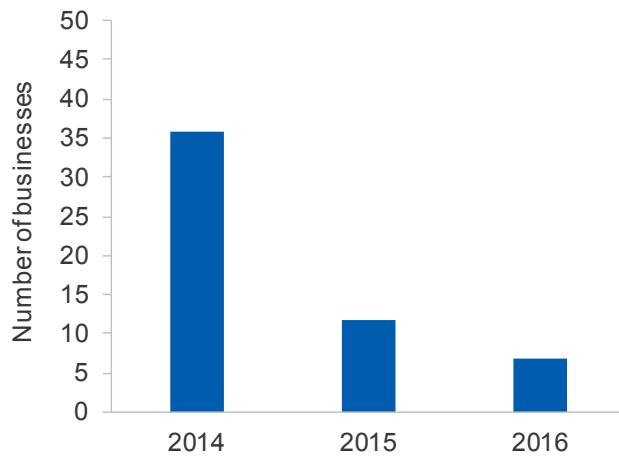
Figure 3.1: Amount of time Turnover HGFs remain in high-growth category, 2005–09, 2009–13 and 2011–13



Notes: t = Initial year of a firm's high-growth episode, with t+3 being the year in which they were identified as a HGF

Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

Figure 3.2: Firms reappearing on the BRW Fast 100 list after 2013, 2014–16



Source: <http://www.afr.com/leadership/afr-lists/fast-100>, accessed 25 July 2017.

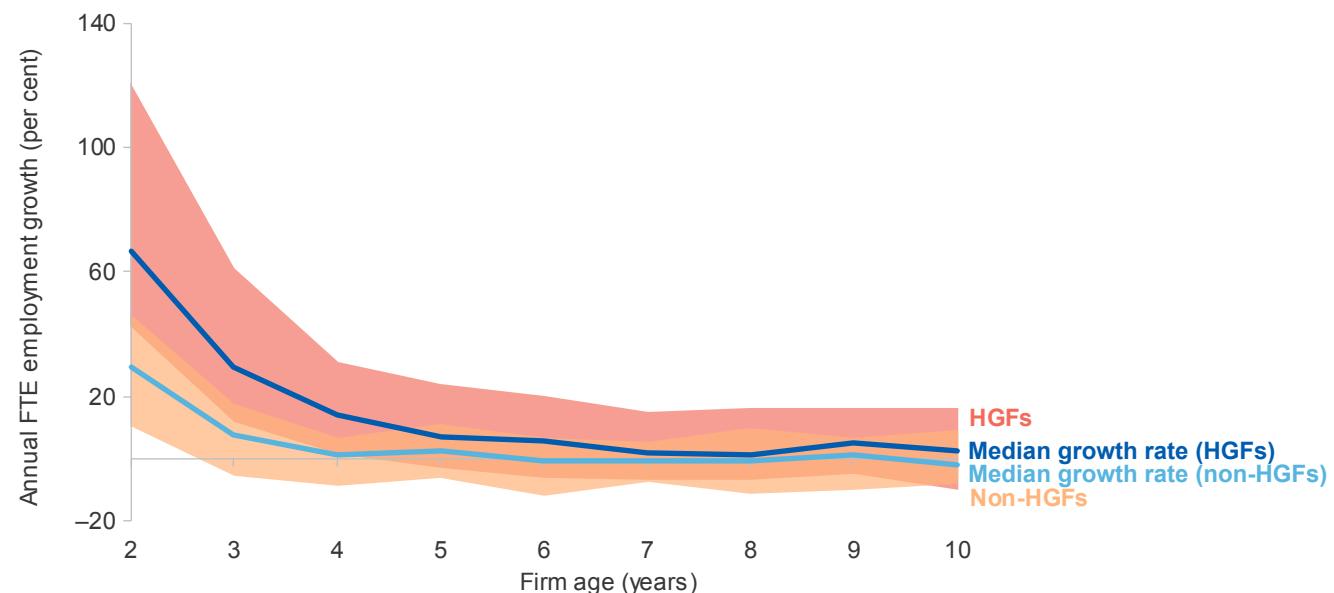
3.2 Dispersion and overlap of growth rates

What happens to the firms that leave the HGF cohort each year? In some cases, they may re-enter a subsequent HGF cohort. Others decline, and even exit, not long after their high-growth episode. Most former HGFs, however, are likely to revert to normal rates of growth. Between 2002 and 2013, the employment growth rates for each cohort of Employment HGFs converged over time, suggesting that after leaving the HGF category, growth rates of most former HGFs gradually trend downwards to eventually resemble those of ordinary non-HGFs (Figure 3.3).

The episodic nature of firm growth is further underscored by some non-HGFs briefly achieving higher annual growth rates than former HGFs. Between 2002 and 2013, while the median annual growth in employment was consistently higher for Employment HGFs, in any given year the fastest-growing 25 per cent of firms that never achieved HGF status consistently outperformed the slowest-growing 25 per cent of firms that did (Figure 3.3).

Furthermore, the extent of this overlap increases as firms grow older. The growth rate of the bottom quartile of HGFs becomes negative after four years. In contrast, the top quartile of the non-HGF group sustains positive year-on-year growth over all ages, never dropping below 5 per cent. A similar pattern is observed for Turnover HGFs (data not shown).

Figure 3.3: Dispersion and overlap of employment growth (FTE) of Employment HGFs and non-HGFs, by age, 2002–13



Notes: HGFs here includes all firms that were Employment HGFs at any point between 2002–13. Bands represent interquartile ranges (25th–75th percentiles). This analysis was confined to firms that had observations of any growth for at least eight years and entered during the period, and is not intended as a representation of growth persistence.

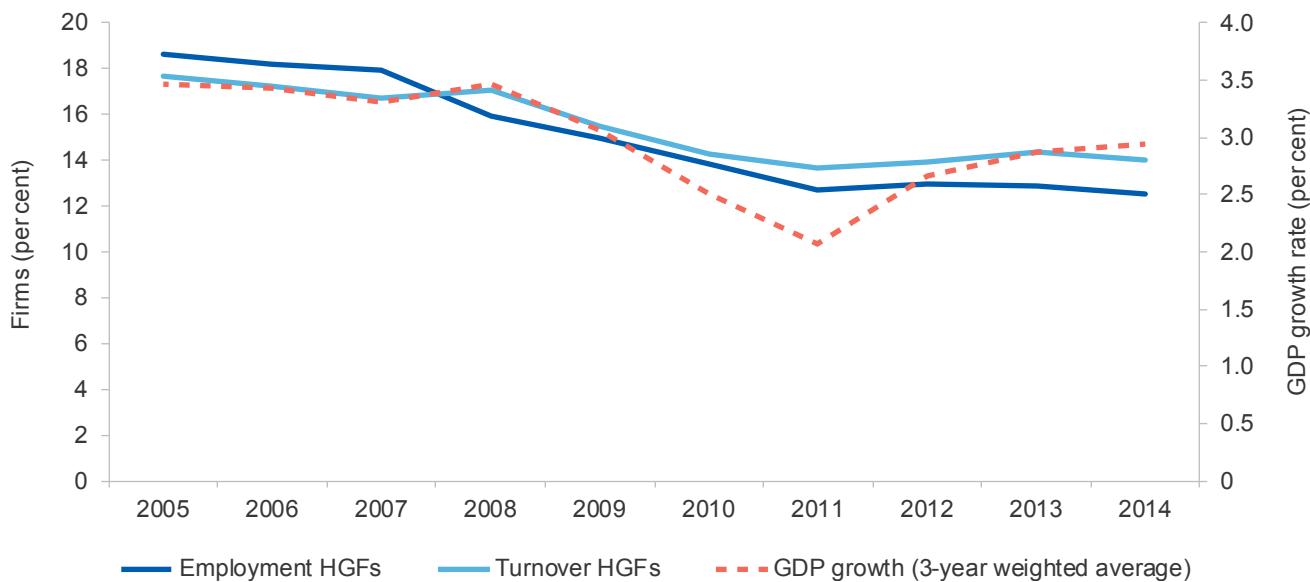
Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

3.3 Australia's HGF proportions have been declining

The proportions of both Turnover and Employment HGFs have been declining since 2005. Between 2005 and 2014, the proportion of Employment HGFs has declined from 18.6 per cent to 12.5 per cent of all firms. Turnover HGFs have declined over the same period from 17.6 per cent to 14 per cent of all firms (Figure 3.4).

The decline in HGF proportions appears to coincide with the decrease in the GDP growth rate over the same period, suggesting there may be a connection (Figure 3.4). Given the disproportionate contribution of HGFs to value added, such a connection may be expected to exist. The declining proportions of HGFs may be impacting on GDP growth, but it is equally plausible the connection works in the opposite direction, with declining GDP growth impacting on the growth prospects of HGFs. This relationship may be worth investigating further if the correlation continues to hold into the future.

Figure 3.4: Employment and Turnover HGF proportions in Australia, with GDP growth rate comparison, 2005–14



Notes: GDP growth rate is a 3-year moving average.

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Customised data analysis commissioned by the Department of Industry, Innovation and Science (BLADE DH/ABS analysis), and ABS (2017) Australian National Accounts: National Income, Expenditure and Product, March 2017, cat. no. 5206.0

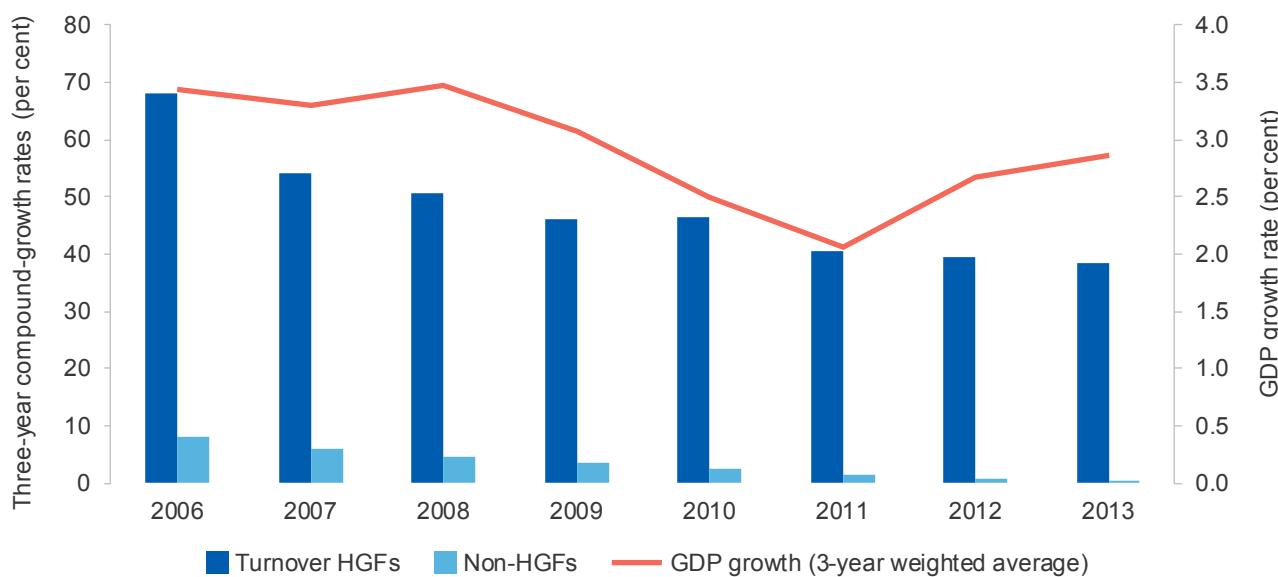
3.4 Growth rates of Turnover HGFs have declined

Although the median turnover growth rates for Turnover HGFs are impressive, they have declined over time. Between 2006 and 2013, the median three-year compound growth rate for Turnover HGFs declined from 68 per cent to 38 per cent (Figure 3.5). This decline has occurred broadly in line with the decline in GDP growth rates over the period, which

appears to lend support to the idea discussed in Section 3.3 that there may be a connection to macroeconomic conditions.

Notwithstanding the observed decline, a 38 per cent growth rate is still substantially higher than the growth rate for non-HGFs, which has come down from around 8 per cent to close to zero over the same period. Indeed, a growth rate of 38 per cent translates to an increase in the level of turnover by more than 2.5 times for the typical Turnover HGF over a three-year period.

Figure 3.5: Turnover growth rates for Turnover HGFs and non-HGFs (median values), with GDP growth rate comparison, 2006–13



Notes: GDP growth rate is a 3-year moving average.

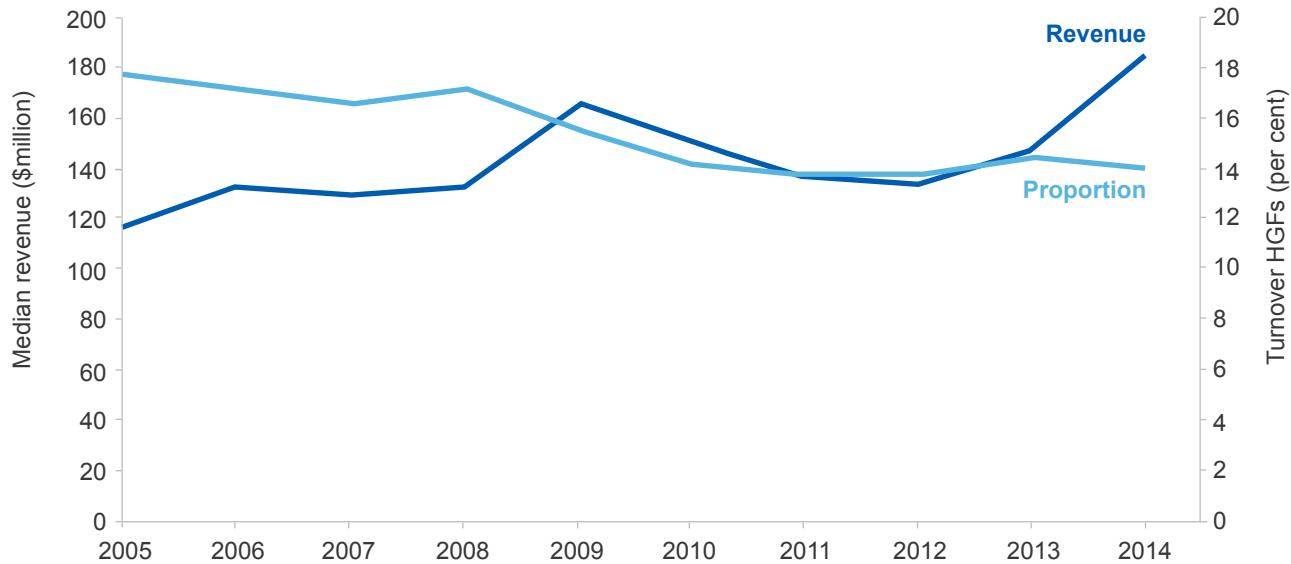
Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Customised data analysis commissioned by the Department of Industry, Innovation and Science.

3.5 Revenue income of Turnover HGFs is getting larger

Turnover HGFs have generally become larger in terms of turnover levels. In 2014, Turnover HGFs had a median turnover of \$184.2 million, which is 45 per cent higher than in 2005, even after adjusting for

inflation (Figure 3.6). When broken down by firm size (i.e. by employment), large HGFs drove the majority of this change over the period, with median turnover of large HGFs increasing from \$108.9 million to \$174.4 million (up 60 per cent). Small-sized HGFs increased their median turnover from \$1.4 million in 2005 to \$1.7 million in 2014 (24 per cent), and medium-sized HGFs increased their turnover from \$6 million to \$8.1 million (36 per cent). All these estimates are adjusted for inflation.

Figure 3.6: Median turnover and proportions of Turnover HGFs, 2005–14



Notes: Turnover levels have been adjusted for inflation based on 2005 values.

Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

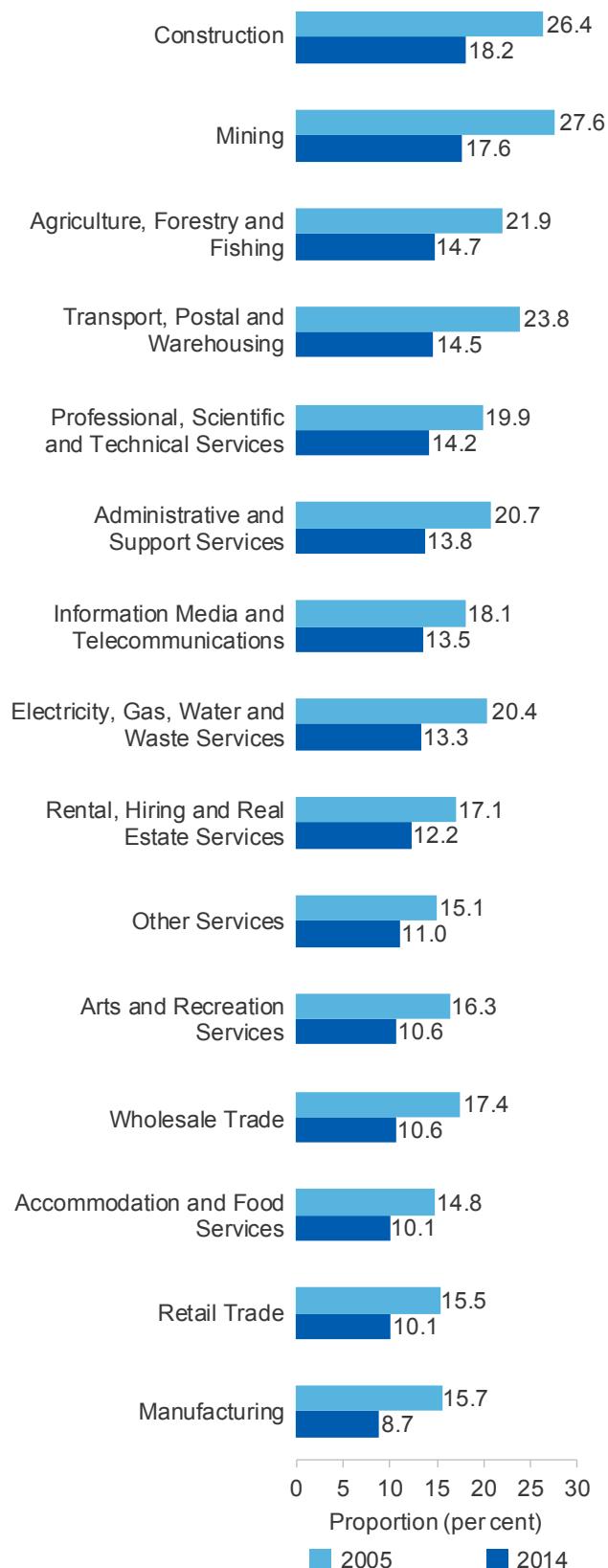
3.6 HGF proportions have declined in all sectors

The decline of Employment HGF proportions between 2005 and 2014 has been broad-based, affecting all industries (Figure 3.7) — and this general pattern is mirrored by Turnover HGFs (data not shown).

The Mining sector, which maintained the highest proportions of HGFs out of three selected industries over the period, declined after 2008 and temporarily rebounded around 2011. HGF proportions were possibly boosted by the surge in mining investment projects coming to completion at that time, followed by a pickup in commodity export volumes.¹ However, the rebound was relatively short-lived, with HGF proportions (both Employment and Turnover) declining sharply from 2013 as the mining investment boom ended (Figure 3.8).

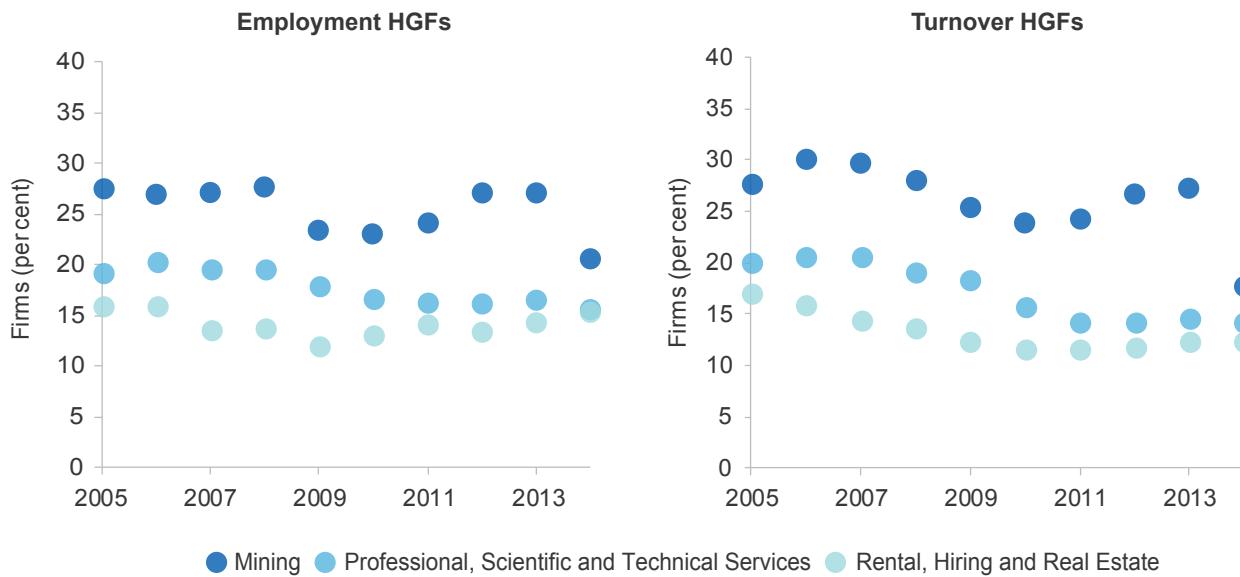
Manufacturing and Retail Trade have recorded below-average Turnover HGF proportions compared to national averages. Between 2005 and 2014, Retail Trade usually had the lowest Turnover HGF proportion of all industries, except in 2009, when Manufacturing had the lowest proportion. Wholesale Trade has followed a similar trend to Retail Trade, though its HGF proportions (both Employment and Turnover) have been consistently above Retail Trade, dipping below the national average only in 2010 (Figure 3.9).

Figure 3.7: Employment HGF proportions by industry, 2005 and 2014



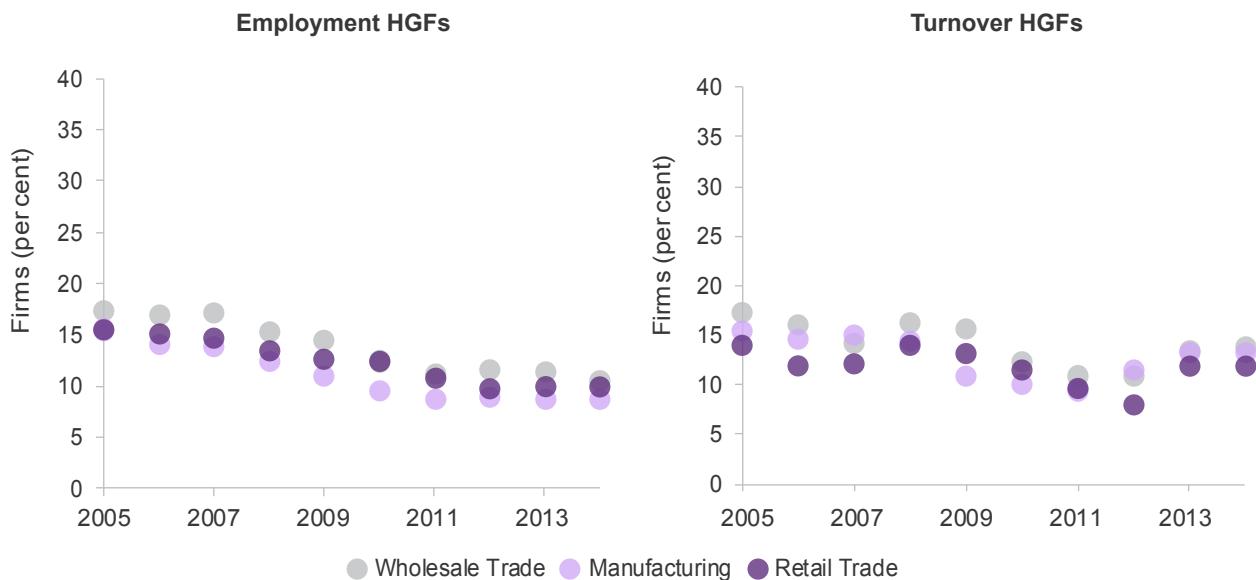
Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Customised data analysis commissioned by the Department of Industry, Innovation and Science.

Figure 3.8: Turnover and Employment HGF proportions for Mining; Professional, Scientific and Technical Services; and Rental, Hiring and Real Estate Services, 2005–2014



Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Customised data analysis commissioned by the Department of Industry, Innovation and Science

Figure 3.9: Turnover and Employment HGF proportions for Manufacturing; Retail Trade; and Wholesale Trade, 2005–14



Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Customised data analysis commissioned by the Department of Industry, Innovation and Science



Case Study: Sliced Tech

UTS Business School

Abasi Latcham

*Department of Industry, Innovation
and Science*



When cloud computing emerged as an alternative way to manage IT services in Australia, Sliced Tech's current CEO Jason McClure had a vision. He wanted to address unmet market needs by developing new technology.

"When we established Sliced Tech, a lot of companies were equating cloud with web hosting or using it as a marketing term to sell products. They weren't delivering cloud. We saw an opportunity for cloud to become a real enabler — if you deliver true cloud," he says.

Complementing your skills

Jason had a clear understanding of his own strengths and weaknesses, and founded the firm in 2011 with two business partners who would complement his skills.

"It is essential to put ego aside. I don't have a monopoly on the best way to do things. I wanted to build a strong firm," he says.

With its main office in the ACT, Sliced Tech provides managed IT services and cloud solutions for

business and government. The firm's success is built on experience, flexibility and executive coaching.

Business model evolution

The company was started with minimal capital, which eventually led to the evolution of Sliced Tech's current business model.

Jason knew that initial customer acquisition would be a challenging task. From day one, he was prepared to change direction if required. To allow for this flexibility, management didn't seek venture capital funding or take on permanent employees for the first two years, relying on contracted staff.

Sliced Tech merely focussed on contracting technical specialists, with no marketing budget, and no marketing or sales staff. The founders saw it as critical for the firm to offer what they could deliver, emphasising a lean, technically-focussed operation and close communication with potential customers.

"We could not be sure of our direction as we experimented with the market, so we needed to be flexible and acquire skills as we needed them," Jason reflects.

Critical decisions

In the first year of operation, Sliced Tech faced a critical decision. The management's expectation that the private sector would adopt cloud computing faster than government proved wrong, and the company lacked the resources to cater to both sectors.

Sliced Tech decided to focus on the public sector and began to build its reputation, remaining conscious of the risk of taking on too much and failing to deliver. However, the team's previous experience and knowledge of IT systems and government sector requirements (particularly in relation to security and compliance) allowed Sliced Tech to enter this niche market.

Before the end of its first year, Sliced Tech had secured its first government-sector customer — an agency "dipping their toe in the water in cloud computing" says Jason.

"In competing for our first contract we took on more risk than established players would, but the government agency was experimenting and wanted a capable but flexible partner. We could make the most of our agility and be a responsive partner."

This first deal established Sliced Tech's credibility as the firm competed against other highly successful information and communications technology (ICT) providers. Five years on, with annual growth rates of over 100 per cent, Sliced Tech has reached annual revenue of about \$4 million and employs 20 staff. Sliced Tech has never lost a customer to a competitor.

Foundational focus

Today, Sliced Tech's major market is the Australian Government in Canberra, but it also works with state governments and private enterprise. The firm focusses on foundational elements, such as infrastructure, platforms, applications and engineering services, and collaborates with partner firms to provide services aimed at delivering customer solutions.

Sliced Tech is one of only two ICT service providers fully certified in cloud and gateway operations by the Australian Signals Directorate. This means a key aspect of its value proposition is its capacity to provide Australian Government-certified internet gateways, clouds and security-as-a-service. This proficiency can then be used by other parts of the market that have compliance requirements, such as state governments, financial services and health care.

Another key success factor is the company's determination to assist customers to get "real benefits of the cloud", including rapid and flexible access to server capacity as needed, and pay-as-you-go resources.

Recruitment strategies

Since the firm started employing permanent staff, Sliced Tech has instituted a disciplined approach to recruitment, which emphasises potential employees' alignment with the values of the company, rather than just skills and knowledge.

"This has allowed us to attract people with strong personalities who want to shape change," says Jason.

The approach attracts individuals who are prepared to take initiative, enjoy responsibility and seek to become an integral part of the business. This values-based approach to service, management and recruitment is reinforced through regular reviews that link performance and challenges to the company's foundation values.

Mentoring and executive coaching

Mentoring is deeply embedded into Sliced Tech's approach to executive management.

Paul O'Dwyer, one of Australia's most experienced trainers and coaches in the ICT industry and the founder of numerous IT firms, has helped the firm to rework its strategy. He facilitates assessment and planning at the monthly executive meetings and participates in the final interviews for new staff. Paul is a major contributor to Sliced Tech's success.

"Our coach drills into us all the time, but it is not about how many zeroes, it is about how you make the decisions. We have become very disciplined; regardless of the size of the deal, the way we qualify the sales is the same, the way we deliver is the same," says Jason.

Staying competitive in recruitment

Attracting and retaining talented staff in Canberra, however, remains a key challenge. Compared to Sydney and Melbourne, there is a limited pool of ICT talent to recruit from in the national capital. This often leads to an expectation of higher wages. At the same time, Sliced Tech relies on hiring the best people in order to deliver the high-quality customer service it promises.

To overcome labour shortages, Sliced Tech depends on referrals from within the firm, on top of traditional direct recruitment and recruitment specialists. Existing employees are encouraged to refer people they feel may be an asset to the company. Sliced Tech also collaborates with its contractors and partner ICT firms to fill gaps in capability where required.

Keep the excitement alive

To attract and retain staff, Sliced Tech's management emphasises the need to maintain excitement at work, such as by giving people the opportunity to develop projects of particular interest to them. Sliced Tech seeks to reinforce team culture by equally sharing successes through bonuses and other activities across the firm, communicating the message everyone is contributing to the company's overall success.

"Every new win is attributed to everyone's contribution, not just the sales team," says Jason. "Without delivery we don't get the references we need to win against our competitors".

Careful cash flow

Another key challenge for Sliced Tech has been financing capital and operational expenses, particularly with the company's rapid growth. In the initial absence of tangible company assets, bank loans have generally not been available. This has made careful management of cash flow and costs even more crucial. Although Sliced Tech has moved into a position of greater access to financial facilities, this may not be sufficient for the next stages of growth, and equity partnerships may be necessary.

Processes to share the load

While strategic and operational flexibility were essential in the formative years, formalising internal processes has now become vital. Management has realised the need for processes to support staff and share the load, rather than depending on individuals to solve problems.

Sliced Tech is moving towards standardising its new services, (developing fully tested, supported and marketed products and services from a product or service initially customised to one business) so all employees know what is required, and newly recruited staff are contributing to the implementation of more-mature internal processes.

Box 3.2: International comparison

Using the OECD definitions of HGFs (see Section 2.1), around 4.7 per cent of Australian firms in the business economy were HGFs measured in terms of employment growth in 2014.^(u) This is above the 4 per cent mean of the group of 17 OECD countries (where data is available) and compares favourably against other commodity-exporting countries, such as Canada (2.7 per cent) and New Zealand (4.2 per cent) (Figure 3.10).

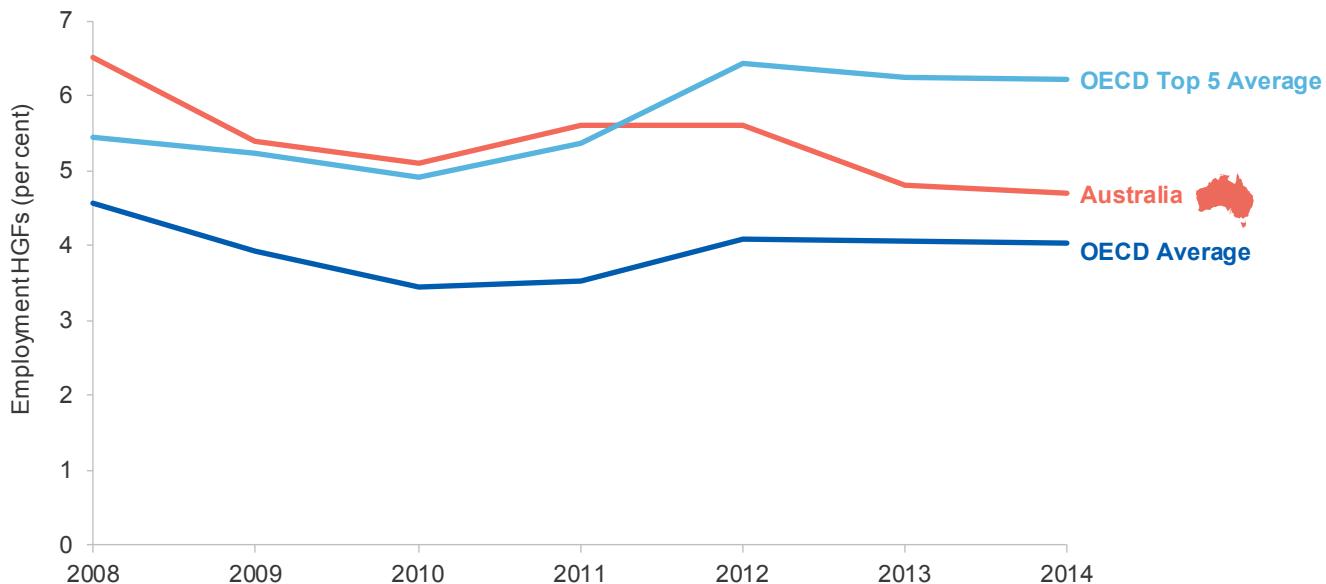
Strong Employment HGF proportions across the business economy have seen Australia ranked

in the top five or six countries in the OECD's Structural and Demographic Business Statistics database every year since 2008.² Based on latest available data Latvia, France, the Netherlands and Sweden are the only OECD countries with a higher Employment HGF proportion than Australia.

Since 2008, the Employment HGF rate has declined across several OECD countries. While Australia's Employment HGF proportion has been gradually declining, Australia's Employment HGF proportion was still above the OECD average in 2014 (Figure 3.10).

(u) See Glossary for a definition of 'business economy' and the sectors it includes.

Figure 3.10: OECD comparison of Employment HGF proportions among firms with 10 or more employees in the business economy, 2008–2014

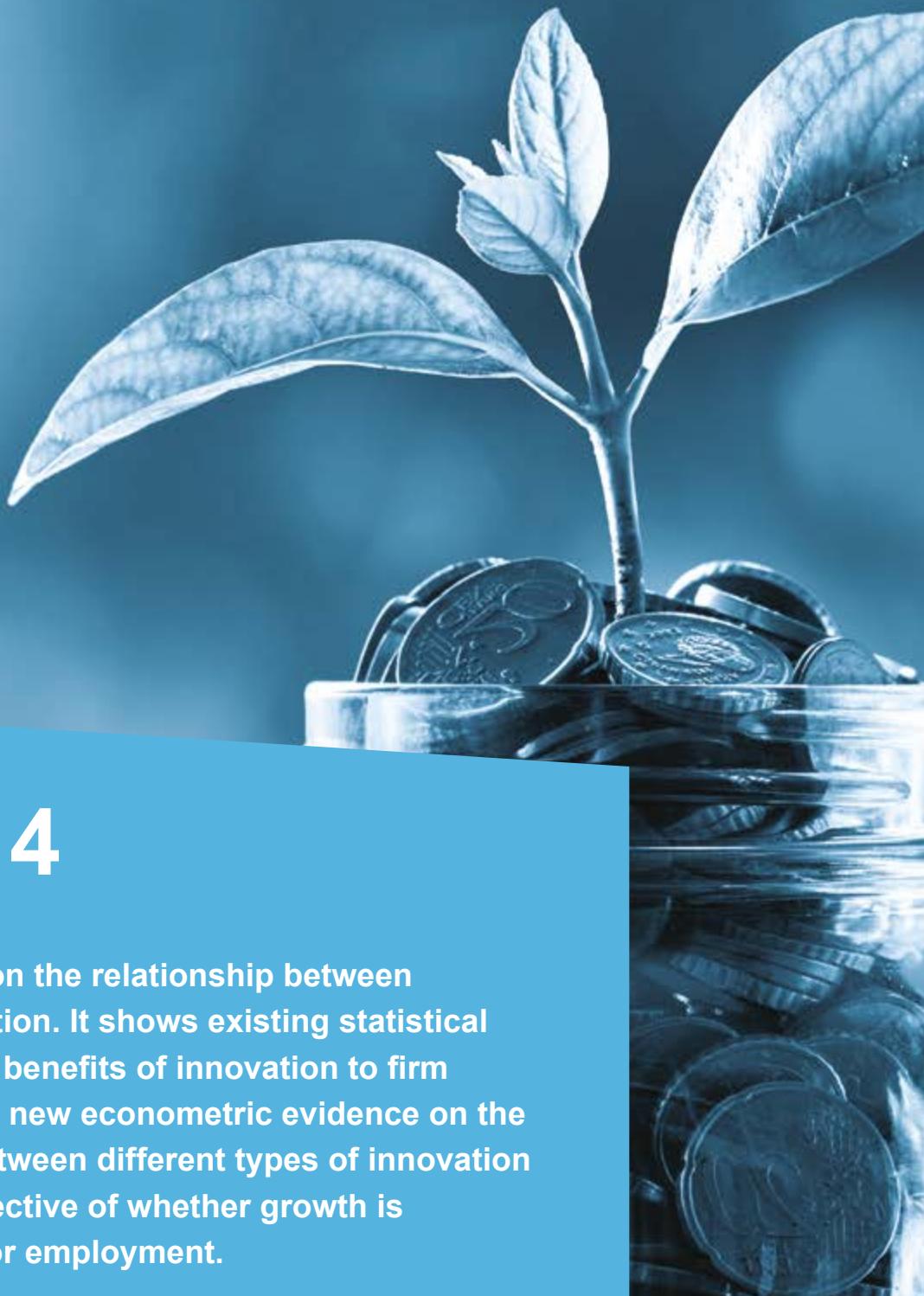


Notes: Latest available HGF data for each country at the time of writing. The OECD mean and OECD top-five mean are calculated across the countries in the SDBS dataset, including Australia.

Source: OECD.Stat, SDBS Business Demography Indicators (ISIC Rev. 4): Rate of High-Growth Enterprises, data on HGE_R — Rate of High-Growth enterprises (20 per cent growth based on employment). ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Customised data analysis commissioned by the Department of Industry, Innovation and Science.

Chapter 4

This chapter focusses on the relationship between firm growth and innovation. It shows existing statistical evidence of the general benefits of innovation to firm performance, as well as new econometric evidence on the positive relationship between different types of innovation and firm growth, irrespective of whether growth is measured by turnover or employment.

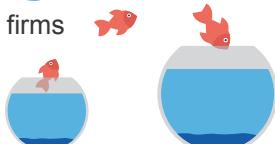


The impact of innovation on firm growth

Innovation-active businesses report greater increases in

sales profitability productivity

than non innovation-active firms



Innovation in goods and services increased firm turnover growth by **3.3 percentage points**



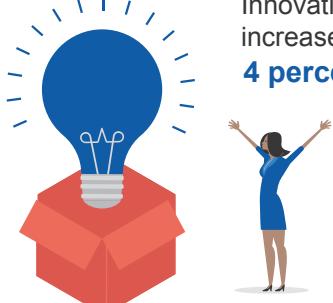
Firms focussing on innovation performance increased turnover growth by **4 percentage points**



The more a firm innovates, the more it grows. Persistent innovators generated **4x** the employment growth and **5x** the sales growth of regular innovators



Innovation in marketing increased firm growth by **4 percentage points**



Turnover HGFs focussing on innovation performance increased turnover growth by **9.7 percentage points**



Sources (left to right): 1) Department of Industry, Innovation and Science (2016) Australian Innovation System Report 2016, Office of the Chief Economist, Canberra, p. 30–31; 2–6) ABS (2017) Characteristics of Australian Business, 2015–16, cat. no. 8167.0; ABS (2017) Business Longitudinal Analysis Data Environment (BLADE), Analysis by Department of Industry, Innovation and Science



Australian Government
Department of Industry,
Innovation and Science

Office of the
Chief Economist

Australian Innovation System Report 2017

KEY POINTS

- Innovation-active firms are more likely to report increases in sales, profitability, productivity, firm size, and other growth-related measures than firms that don't innovate.
- Across all firms, innovation in goods and services increased firm growth by an average of 3.3 percentage points, while innovation in marketing increased turnover growth by around 4 percentage points.
- For Turnover HGFs, goods and services innovation increased the turnover growth rate by around 7.4 percentage points. However, Turnover HGFs did not seem to derive extra benefit from marketing innovation or operational process innovation.
- There was also a positive relationship between the strategic focus on business innovation performance and firm growth — turnover growth rates were boosted by an average of 4 percentage points for all firms and 9.7 percentage points specifically for Turnover HGFs.

4.1 Innovation is related to firm growth

There is extensive international evidence on the importance of innovation to firm performance. In Australia, compared to firms that don't innovate, a higher proportion of innovation-active firms consistently report increases from the previous year in their sales, profitability, productivity, other growth-related performance measures. Innovation-active firms were also three times as likely to report improved performance in export markets they targeted (Figure 4.1).

The *Australian Innovation System Report 2016* suggested this relationship was causal, whereby innovation had a direct positive influence on firm growth.¹ Looking at innovation over a period of time, rather than as a snapshot, showed the influence on firm growth becomes stronger the more a firm innovates. Put another way, the frequency of innovation matters.

This report extends the evidence on the link between innovation and firm growth, by examining the specific types of innovation which might be causally related to turnover growth. Based on econometric analysis conducted by OCE (see Methodology 4.1), the results suggest that after controlling for various other influences, only goods and services innovation seems to be related to high turnover growth (see Section 4.3).

Definition 4.1: Low-, medium- and negative-growth firms

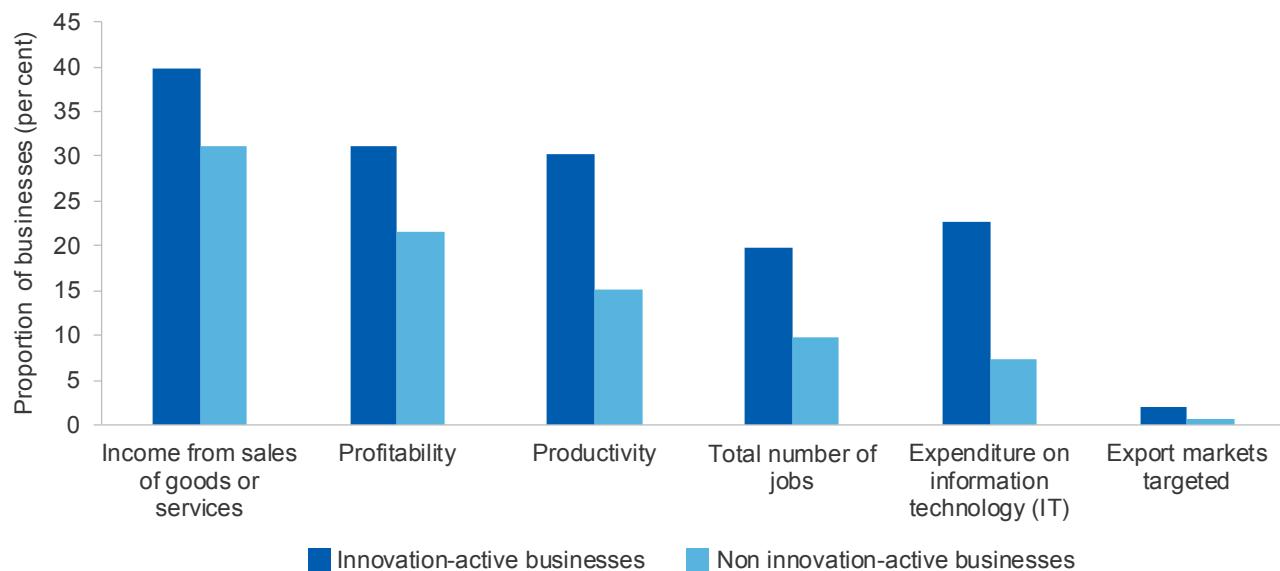
This chapter includes a comparison of the following growth categories:

High-growth firms: Refers to the HGF cohort as described in Section 2.1.

Low/medium-growth firms: Firms with at least five employees and turnover higher than \$75,000, with an average annualised turnover growth greater than 0 but less than 20 per cent over a three-year period. For employment growth, only firms with at least five employees are in scope. For turnover growth, only positive turnover firms are in scope.

Negative-growth firms: Firms with at least five employees and turnover higher than \$75,000 with an average annualised turnover growth over the three-year period of 0 per cent or negative. For employment growth, only firms with at least five employees are in scope. For turnover growth, only positive turnover firms are in scope.

Figure 4.1: Businesses reporting improved performance on various metrics since the previous year, by innovation status, 2015–16



Source: ABS (2017) *Characteristics of Australian Business, 2015–16*, cat. no. 8167.0.

4.2 HGFs are generally more innovation-active

Over the period 2005–2013, around three in five firms were innovation active, and this was the case for both Turnover HGFs and non-HGFs.^(v) When disaggregated by the type of innovation and the rate of growth, the differences are slightly more pronounced (Figures 4.2[a] to [d]).

For most types of innovation (Definition 4.1), firms undertaking innovation are more common in the high and low-medium growth categories and less common in the negative growth category, compared to firms that do not innovate. Marketing innovation was the exception to this pattern — firms undertaking marketing innovation were more common in the low-medium growth category compared to the high-growth category.

For employment growth, the relationship between innovation and growth is very similar to turnover growth. Generally, all types of innovation show positive relationships with firm employment growth, and this relationship appears to be most pronounced for goods and services innovation.

(v) Here the definition of HGFs in Definition Box 2.1 is used. Analysis of innovation activity by the ABS, including all employing firms, shows 46.7 per cent of Turnover HGFs and 41.7 per cent of other firms were innovation-active in 2015–16.

Definition 4.2: Types of innovation

Good and services innovation: A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user-friendliness or other functional characteristics.

Operational process innovation: A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.

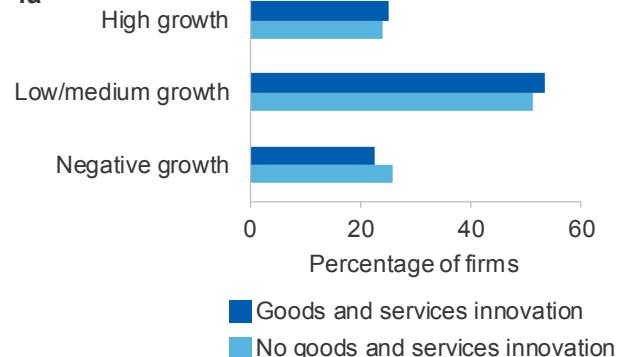
Organisational/managerial innovation: A new organisational method in business practices, workplace organisation or external relations.

Marketing innovation: A new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

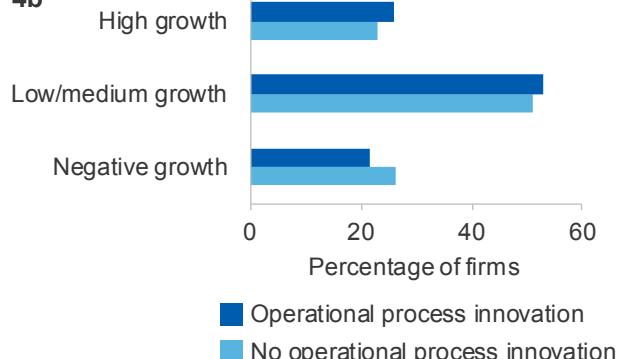
Source: OECD (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition*, OECD Publishing, Paris.

Figure 4.2: Innovation activity in firms, by turnover growth category and innovation type, 2005–06 to 2012–13

4a



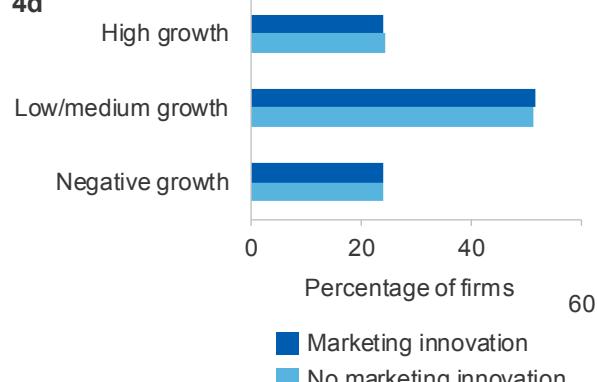
4b



4c



4d



Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.



Feature Article: Uncovering Australia's high-growth companies of tomorrow

CSIRO Data61



Lack of skills is a barrier to innovation frequently cited by businesses. At the same time, students entering the labour market with new skills often struggle to find suitable jobs.

Recognising this matching problem, CSIRO Data61 has created a new online marketplace called [Ribit.net](#) to connect students with digital skills to career-related work and internships while they are studying.

To help boost Australia's innovation ecosystem, CSIRO Data61 is researching the possibility of using data and analytics to uncover young companies on a high-growth hiring trajectory before they become successful and connect them with the best students that have the digital skills to help them scale up rapidly.

Researching the relationship between digital maturity and growth of ASX200 companies

In 2016, CSIRO's Data61 undertook a pilot research project that found there were clear relationships between digital maturity and the growth and success of ASX-listed companies.

Digital maturity refers to the combination of a company's investment in technology-enabled initiatives meant to change how the company operates (its digital intensity) and its investment in the leadership capabilities needed to create digital transformation within the business.² The research analysed data relating to the 200 largest ASX-listed companies, including established measures of online authority, engagement, advertising and use of modern digital technology platforms.

Data for each company was collected and a composite index of customer-facing 'digital maturity' was calculated for each company and relative to its peers within its sector — recognising sectoral differences affect digital maturity. Consumer-facing companies such as REA Limited or Carsales.com Limited, for example, whose businesses are largely online, are naturally more likely to have an advanced digital footprint compared with companies in the industrial or mining sectors.

Next, the companies were clustered using machine learning into distinct 'tech tribes', or groups of companies which had a similar digital footprint based on their usage of over 1,000 online services and technologies. While no two companies use the exact same set of technologies or 'tech stack', each of the tribes had some distinguishing 'signature' features — such as whether the companies host their own website using their own server or whether they used cloud hosting.

New tech means greater returns

We found the 'tech tribes' distinguished by use of more contemporary technologies outperformed the market in total shareholder return, while those using older technologies were found to perform below the index benchmark.

This analysis has identified an important correlation between the digital maturity of companies and their performance. It is assumed that the signal about the digital footprint of a company reflects several factors such as corporate strategy and management capability to leverage emerging digital platforms, as well as contextual variables relating to market

dynamics of their industry sector and the age of a company.

With the success of this initial pilot project, Data61 decided to experiment with a similar approach to see whether analysing digital signals could be used to predict which of the 300,000+ small, private companies in Australia are more likely to become high-growth enterprises.

Identifying Australia's Joeys

Previous research in Australia and overseas has shown that a small number of high-growth firms are responsible for a disproportionate share of new net job creation.^{3, 4} These high-growth firms have been called the 'vital 6 per cent' and also Gazelles for their speed, youth and agility.

In this project, we name Australian high-growth firms Joeys — young, high-growth firms who are likely to provide the best opportunities for students to intern and also, once graduated, find future employment. We define Joeys as small to medium-sized companies from all industries and from all around Australia that have grown their employee headcount by over 20 per cent per annum over the past two years.

Early identification of Joeys has the potential to create a more efficient marketplace for digital talent in Australia but also for others, including suppliers, partners and investors. By discovering and promoting Australia's most promising and innovative high-growth companies of the future, ultimately we hope to help accelerate the transformation and growth of the Australian economy.

Many of the smartest companies in the world are now using unconventional data signals to discover and rank companies. Two of the world's top-ten hedge funds, Two Sigma (New York) and Winton Capital (London), both use a data-centric approach, accessing trillions of data points from many data sources to inform their highly successful investment strategies. Winton Capital was not founded by a business school graduate but by a first-class honours student who studied Physics at Cambridge University. Its quantitative approach to investment has led to spectacular success. Starting with \$1.6 million in 1997, it now holds over \$25 billion under management.

Finding the Joeys

In order to identify Australia's Joeys, we used machine learning on a small sample of companies whose digital footprint and employment growth rates are known. We identified the digital technologies used that were statistically significant in relation to company employment growth. Based on this analysis, the next step was to identify a larger cohort of companies that could qualify as Joeys, using only knowledge of their digital footprint.

We collected data on a sample of 563 Australian companies from a representative sample of industries with between 11 and 200 staff and known headcount growth rates from LinkedIn over the two years to March 2017. For each of these companies, we created a database of 1,500 online services and technologies used on the main website of each of these companies, as noted by the global web analytics service [BuiltWith](#). We examined each technology individually to explore the possibility of a correlation between any given technology and headcount growth. For each technology, we separated companies into two separate groups: companies that used a technology and companies that did not. We also only examined technologies that were used by more than 20 per cent of the sample (100 companies) to ensure the growth rates of the companies in each sample followed a normal distribution.

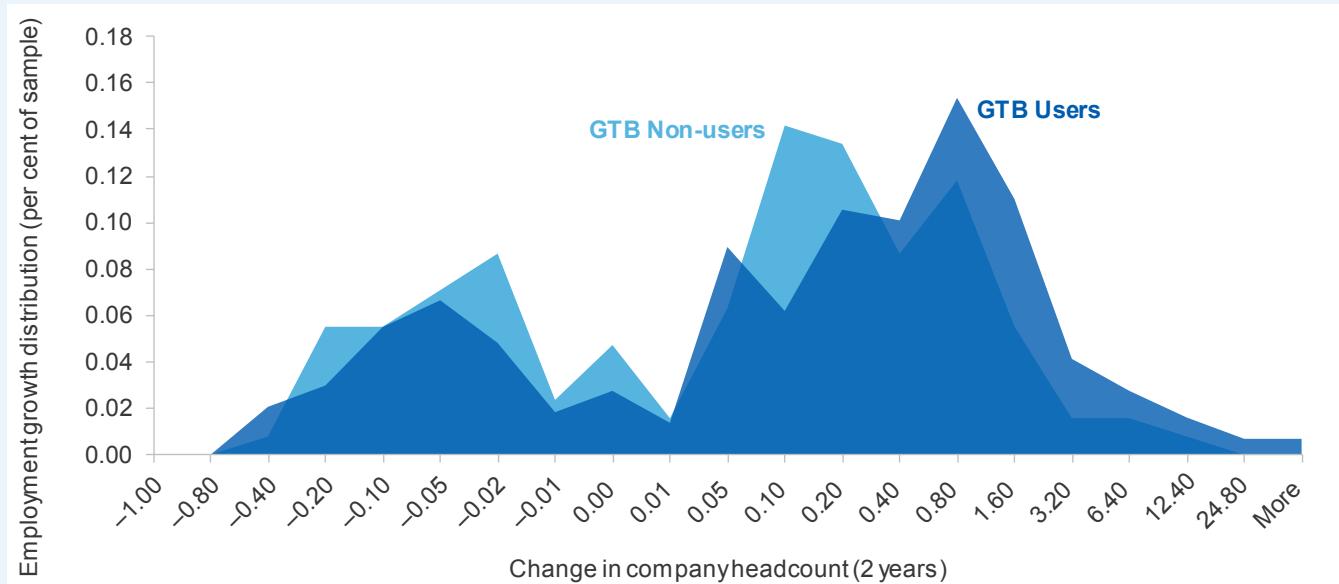
Using a two-tailed T-test, we examined the difference in the growth trends of two groups: users and non-users. The T-tests revealed that there were 20 features which showed a statistically significant difference between the distribution of companies (using a 95 per cent confidence interval), revealing a statistically different distribution among users and non-users of the technologies — 11 of these features had an association with a distribution of companies with higher employment growth and we have labelled these the Growth Technology Basket (see results below).

Table 4.1: Growth Technology Basket, 2017

Feature	P-value	Median growth per cent (without feature)	Median growth per cent (with feature)	Difference in median growth (Users to non-users) percentage points
Google Apps for Business	0.00	10	41	31
Sitelinks Search Box	0.00	10	30	20
Yoast SEO Premium	0.01	10.5	30	19.5
Wordpress Plugins	0.00	10	27	17
Yoast WordPress SEO Plugin	0.03	11	27	16
Yoast Plugins	0.03	11	26.5	15.5
Live Writer Support	0.00	10	25.5	15.5
jQuery Form	0.02	13	25	12
WordPress	0.00	9	23	14
Really Simple Discovery	0.00	10	23	13
Twemoji	0.00	10	23	13
jQuery Masonry	0.05	13	19	6
Device Pixel Ratio	0.01	10	17	7
Total Growth Technology Basket		8	16	8

Notes: Due to the range of the growths spanning from small losses to very large growths we chose to consider the median instead of the mean to better reflect the range in the distribution of each group. Overall, companies which used growth technologies showed an 8 per cent higher median headcount growth when compared with companies which didn't use these technologies.

Figure 4.3: Growth Technology Basket: technology users vs non-users



Source: Data61 (2017)

Next steps

This work illustrates a clear link between a company's digital footprint and its employment growth. In turn, companies likely to be higher-growth companies can be distinguished from their peers through comparison of their digital footprints.

We are now fine tuning to establish a more comprehensive and scalable method to identify Australian companies predicted by the machine learning algorithms to have higher growth than their peers, filtered by state, industry and age. This will include updating the Growth Technology Basket, based on time series data to allow for changes in its composition, as well as investigating access to more accurate information about the employment growth of a small sample of private companies for training the machine learning algorithms.

Based on this work, CSIRO Data61 aims to identify and launch a list of Australian Joeys (Joey 500) that has the potential to create improved and more timely insight about Australia's innovation ecosystem. It will also be available as an online resource to improve services such as Rabit as well as other new and emerging investment, collaboration and education initiatives.

Further work will investigate applying this approach to explore how digital footprints can help identify growth companies measured in other dimensions such as exports, innovation and revenue growth.

4.3 Type of innovation matters for firm growth

Econometric analysis suggests firm growth is related to particular types of innovation, rather than innovation activity in general (see Methodology box 4.1).

Across all firms, and after controlling for all other factors, innovation in goods and services increased firm growth by an average of 3.3 percentage points. Similarly, innovation in marketing increased turnover growth by around 4 percentage points.^(w) However, organisational/managerial and operational process innovations did not appear to have an independent impact on turnover growth (Figure 4.4).

The growth benefits from goods and services innovation are magnified for Turnover HGFs. The analysis suggests that undertaking goods and services innovation increased the turnover growth rate of HGFs by around 7.4 percentage points, more than double the impact for all firms. In other words, some of the firms in scope became Turnover HGF as a direct result of undertaking goods and services innovation. There is also tenuous evidence that Turnover HGFs may benefit from organisational/managerial innovation (Figure 4.7).^(x)

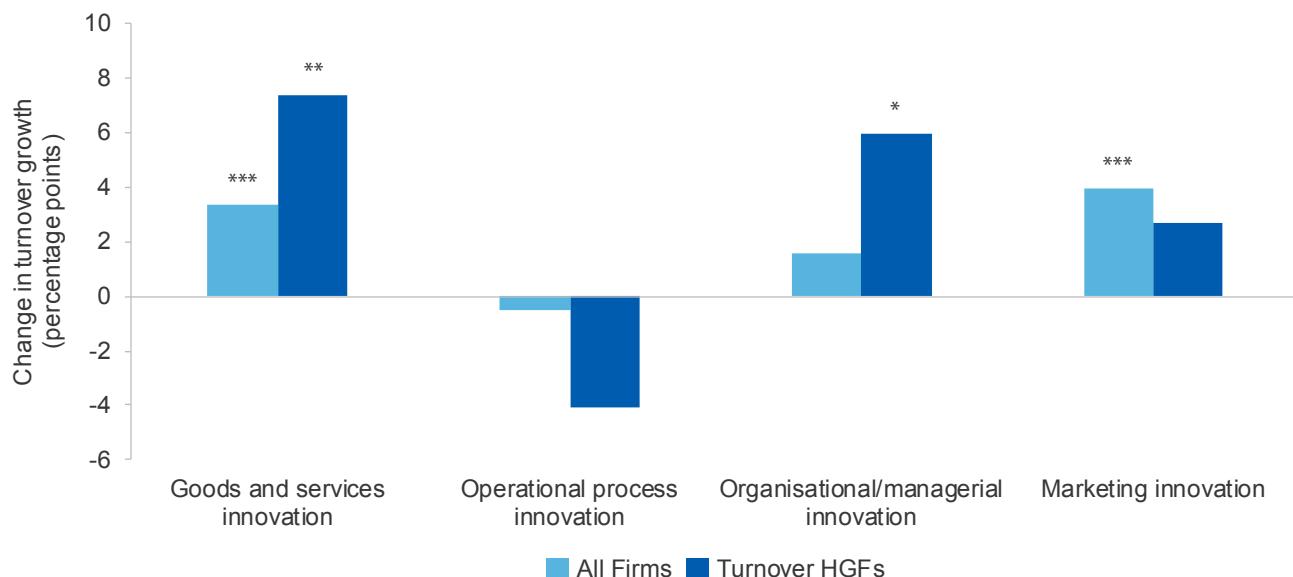
However, Turnover HGFs do not seem to derive any benefit from marketing innovation once all other factors were taken into account. And similar to the average firm, operational process innovation does not have a statistically significant impact on HGFs (Figure 4.7).^(y)

(w) These are calculated across all firms in the sample (BCS data for both HGFs and non-HGFs pooled over 2002–2013, see Box 2.3)

(x) Significant only at the 10 per cent level

(y) Further research should be undertaken to see if the various types of innovation impact industries differently

Figure 4.4: Impact on turnover from undertaking different types of innovation, by turnover growth category, 2005–06 to 2012–13



Notes: *** p<0.01, ** p<0.05, * p<0.1.

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

Methodology 4.1: Econometric analysis

The analysis presented in this chapter is based on a study by Majeed et al. (2017), which looks at the impact of innovation and business focus on firm growth using data covering 2005 to 2013.

The study examines causal relationships using econometrics based on the BCS and BERD components of BLADE. The econometric analysis starts by using Ordinary Least Squares (OLS), which seeks to explain the causal link between the control variables and dependent variables. In the regressions the study controlled for different types of innovation, firm strategy, skills, business age, size, industry division, and macroeconomic effects. To account for any growth rate autocorrelation or other omitted variables, lagged growth rates were included in the regressions (similar to Coad and Rao, 2008).

OLS can suffer from time-invariant omitted variable bias, including innate ability of the firm. To control for this, panel data techniques such as Fixed Effects were used.

Reverse causality remains one important concern, where innovation can impact firm growth but concurrently firm growth can impact the ability to undertake innovation. This study and the literature deal with this by lagging the variables or using lagged variables as instruments. The idea being that the current turnover growth will not affect the past innovations that have already been undertaken — for detail see Coad and Rao (2008) and Majeed et. al. (2017).^{5,6}

Separate estimations were carried out using a sample of all firms and a sample with only HGFs. HGFs have much higher growth compared to the average for the whole population. As such, this high-growth rate will be reflected by a level shift. Including a constant in the regression means that level shift will be captured by the constant. The coefficients of the innovation and business focus variable still capture marginal effects.

Various robustness measures were undertaken and the most conservative results are presented.

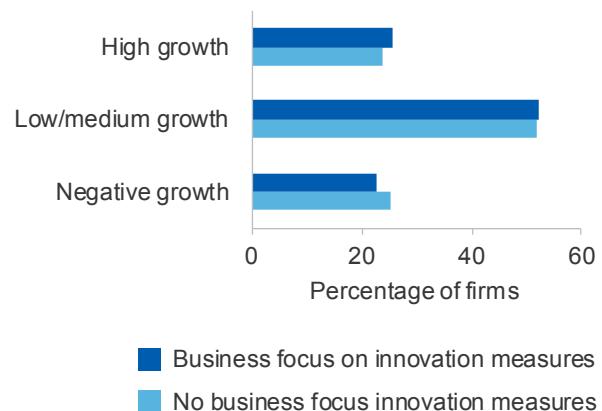
4.4 Business strategy impacts firm growth

Many firms that pursue innovation in a deliberate and systematic fashion will put in place ways of explicitly measuring and tracking their own innovation performance, which can then inform business planning. Firms that take into account innovation measures when assessing their business performance are more common among high-growth and low/medium-growth firms, compared to firms that do not. For negative-growth firms, the opposite is observed, suggesting a positive relationship between strategic focus on business innovation performance and firm growth (Figure 4.5).

Across all firms, those that focussed on innovation performance increased their turnover growth rate by an average of 4 percentage points. The increase in turnover growth rate from focusing on innovation performance is even more pronounced for Turnover HGFs, with an average increase of 9.7 percentage points (Figure 4.6).

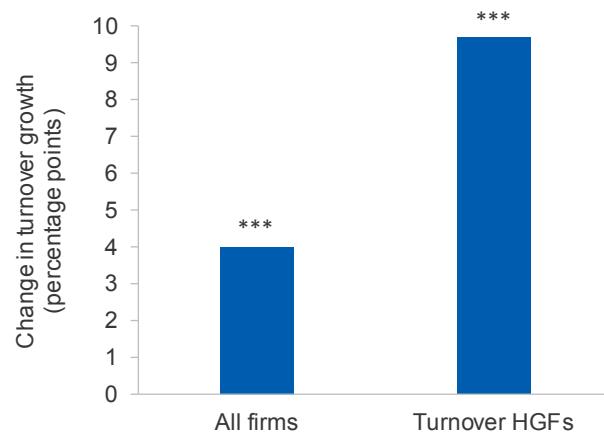
The positive impact of business focus on innovation may be linked to management capability, as specific business strategies are typically determined by managers and entrepreneurs. More capable managers and entrepreneurs may be more likely to proactively measure and assess the innovation performance of their firm. In this case, managers and entrepreneurs may be more capable than others in finding innovative ways to increase firm turnover.

Figure 4.5: Business assessment of performance included a focus on innovation measures, by turnover growth category, 2005–06 to 2012–13



Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

Figure 4.6: Impact of business focus on innovation measures, by turnover growth category, 2005–06 to 2012–13



Notes: *** p<0.01

Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.



Case Study: Redbubble

UTS Business School

Abasi Latcham

*Department of Industry, Innovation
and Science*



Redbubble was founded by Martin Hosking, Paul Vanzella and Peter Styles in Melbourne in 2006.

The core concept always centred on the internet and print-on-demand, but quickly evolved beyond the basic idea of printing customers' photos onto mugs or t-shirts. Now, Redbubble links over 400,000 independent visual artists with customers who can use those artists' designs on everyday products.

How Redbubble works

Artists upload designs to Redbubble's website, where customers select their favourite design and choose their product. The customer's order is then sent to a network of third-party fulfillers, one of whom will print the design onto the customer's chosen product (such as wall art, apparel, stationery, housewares or electronic accessories), and ship to the customer. Redbubble has created a three-sided marketplace by facilitating the exchange between the seller (the artist), the producer (the fulfiller) and the customer.

In 2006–07 the founders developed the initial concept and the website, raised seed funding, recruited a core team, and launched the firm.

Redbubble began trading in 2007 and grew rapidly to become one of the largest Australia-based consumer technology companies. Since 2009, its revenue has increased by more than 40 times (an annual average growth rate of 69 per cent) and the number of employees has grown by more than 15 times. By June 2016, Redbubble had channelled over \$55 million to independent artists, and in the 2015–16 financial year alone reached over two million buyers. The company has won many awards for its concept, website and growth, making the BRW Fast 100 list in 2012 and 2014, and more recently, the 2016 Goods Growth Company of the Year.

In these early days, the founders' personal networks provided vital access to advice, talent and capital. Martin Hosking, the current CEO, was a consultant with McKinsey and an experienced leader of emerging high-tech firms, particularly those entering overseas markets and going through the process of scaling and raising capital.

Learning from the start

Learning from early feedback caused Redbubble's business model to evolve, driving changes in strategy, tactics and operations, but affirming the core concepts. Redbubble has maintained a clear long-term focus with a strategy that is reviewed and updated every six months at group and corporate levels, rather than a long-term business plan. Strategy reviews are informed by analyses of market dynamics, website and marketing effectiveness, and indicators of customer satisfaction.

In 2007, orders were shipped from the first Australian and American suppliers, and in 2010 the first European supplier joined the network. In 2011, Redbubble opened an outfit in San Francisco. In 2015, \$15.5 million was raised from institutional investors. In 2016, Redbubble raised \$12 million of pre-IPO funding, and later that year the company listed on the ASX, raising a further \$30 million.

Sustainable relationships with creatives

Although the founders of Redbubble saw the market opportunity, they also sought a sustainable relationship with their artists. As Martin reflects, "Bringing more creativity into the world was a mission we all shared".

Redbubble enables artists to select how their work is used and at what price, while removing the logistical overhead by organising online marketing, payment processing and fulfilment. There are now 12 suppliers in 18 locations, close to their customers. In

2015–16 the US accounted for about 60 per cent of sales, Europe about 25 per cent and Australia less than 10 per cent.

Value for artists and customers

Creating value for artists and for customers through an internet platform became Redbubble's defining insight. It was clear to the founders that the potential market was large and growing, and that Redbubble needed to be "born global" says Martin. Redbubble's website started in English, but German, French and Spanish-language sites launched in 2016. This multilingualism reflects the international nature of Redbubble's artists, the majority of whom live in North America, Europe and Australia.

A global niche

Like many firms that sustain high-growth, Redbubble focusses on a specific niche. But Redbubble's niche is global, and is a multibillion-dollar market. Its innovative business model has enabled it to use the internet to mitigate the tyranny of distance and reach customers all around the world.

"We have an unrelenting focus on our niche, we have actually got narrower in our focus over time and will not allow ourselves to be distracted. This has meant forgoing opportunities for growth in the local market and adhering rigorously to our vision," says Martin.

Organic growth

Redbubble is reliant on increasing demand for de-branded, made-to-order creative products enabled by print-on-demand technology. Growth has been largely organic; suppliers and customers learn what is possible and more artists join. As more artists join, Redbubble's critical mass builds, attracting more customers and more sales, in turn attracting more artists. This example of network effects increases returns and entrenches Redbubble's competitiveness.

Most growth is because of existing users introducing new users, and from free searches, aided by Google and Facebook. The market grows as more customers become comfortable buying online and value the convenience and range of choice available. Redbubble's product range has grown steadily, to over 50 products.

Responding to change

Redbubble responds rapidly to changes in the market and technology. In the beginning, management didn't realise just how widely creative

content could be used on products — but the development of print-on-demand, cut/print/sew and sublimation printing technologies has presented significant opportunities for the company.

Realising these opportunities required Redbubble to work with its supplier network and negotiate operating agreements to ensure consistent quality and customer service.

Growth without losing flexibility

Aligning individual and company motivations and approaches is easier in a small firm. As Redbubble grew, management found that the scope for individual autonomy shrank, and new approaches were needed to standardise procedures without losing flexibility.

"The transition from start-up to sustained growth was challenging; having an experienced Chief Operating Officer and Board was important for steering the firm through this phase. We learned that the flexibility that is vital for entrepreneurial firms has to be supplemented by routines and systems, particularly in operational planning and human resource management," says Martin.

As part of a change process that has taken three years, Redbubble has reorganised around decision groups with high levels of accountability. For example, responsibility for developing the European websites is delegated to a cross-functional decision group drawing expertise from Europe, the US and Australia.

Real passion and meaningful purpose

Looking back on the Redbubble journey since 2006, Martin reflects on why Redbubble exists, the value it creates and for whom.

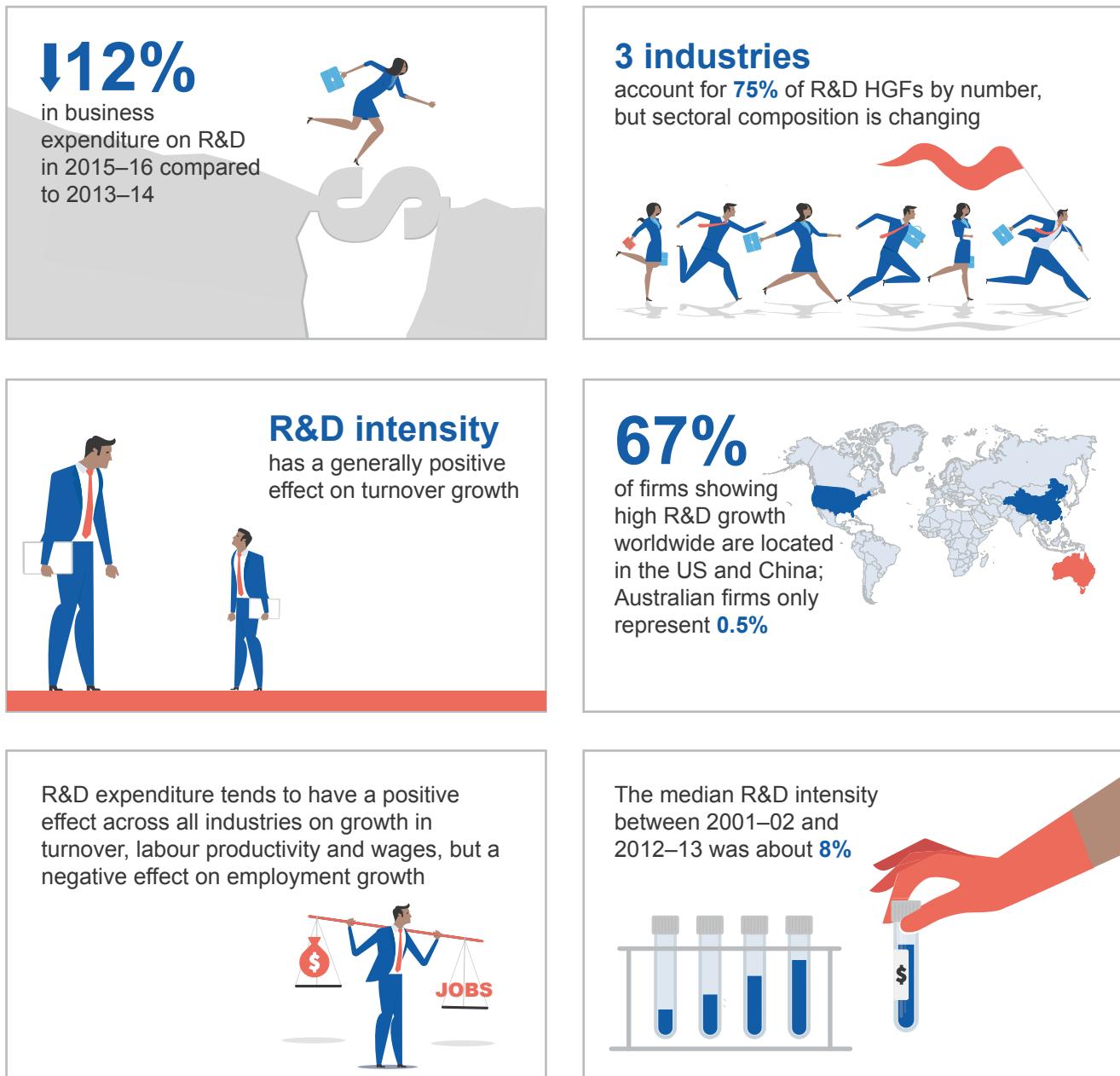
"How are we benefitting customers? And is the benefit we provide much better than the alternatives? The biggest threat in both strategy and marketing is to lose sight of the customer and to try and frame everything from the company's point of view."

"You need to be driven by a genuine passion for what you are doing (and this cannot just be money). There will not be a single hard moment but many hard moments. Each of these will challenge you to surrender or continue forward. You will only continue forward if the passion is real and the purpose meaningful. Further, you will need others to share the journey with you. A shared passion is all that will both get you and keep you together."

Chapter 5

In this chapter, attention turns to the role and growth of business R&D. The HGF concept is typically applied to firm performance measures such as turnover, employment or productivity. However, the concept can also be extended to R&D growth, which may signal a growing commitment by firms to pursue new to market innovation.

Growth in business R&D activity



Sources (left to right): 1) ABS (2017) Research and Experimental Development, Businesses, Australia, 2015–16, cat. no. 8104.0; 2) Department of Industry, Innovation and Science (2001–2011) Programme data for the R&D Tax Concession; 3) ABS (2017) Business Longitudinal Analysis Data Environment (BLADE), Analysis by Department of Industry, Innovation and Science; 4) European Commission (2016) The 2016 EU Industrial R&D Investment Scoreboard, <http://iri.jrc.ec.europa.eu/scoreboard16.html>, accessed 22 May 2017; 5–6) ABS (2017) Business Longitudinal Analysis Data Environment (BLADE), Analysis by Department of Industry, Innovation and Science



KEY POINTS

- Australian businesses spent \$16.7 billion on R&D in 2015–16 compared to \$18.9 billion in 2013–14, a decrease of 12 per cent in current prices.
- Australia's BERD investment grew strongly — from a relatively low base — in the 1990s and 2000s. But the BERD-to-GDP ratio has declined sharply from its peak in 2008–09. The ratio of gross expenditure on R&D (GERD) to GDP followed a similar growth pattern and has also declined since 2008–09.
- In 2014–15, R&D HGFs comprised 15 per cent overall of total industry R&D, down from 33 per cent in 2004–05.
- Three industries account for 75 per cent of R&D high-growth firms by number, but their composition has changed since 2004–05 when Manufacturing contributed over half the HGFs.
- By 2014–15 high R&D growth was much more evenly distributed across the leading industries. R&D high-growth firms are dominated by mature firms and SMEs.
- R&D expenditure tends to have a positive effect across all industries on growth in turnover, labour productivity and wages, but a negative effect on employment growth. These effects have become more pronounced over time.
- Globally, the growth in BERD is highly concentrated in a small number of corporations in just three or four key industries. In terms of investment in BERD, few Australian firms are significant players on the world stage.

Definition 5.1: R&D and R&D HGFs

R&D involves the creative and systematic work undertaken in order to increase the stock of knowledge — including knowledge of humankind, culture and society — and to devise new applications of available knowledge.¹ R&D is conducted in all sectors of the economy (business, higher education, government and not-for-profit), but sectors differ in the balance of their R&D activity between basic research and applied or experimental kinds of R&D.

R&D HGFs are all firms undertaking R&D which achieve at least 20 per cent compound average annualised growth in R&D expenditure over a three-year period. R&D HGF proportions are calculated for all firms undertaking R&D which have five employees or more.

5.1 R&D plays an important role in the innovation system

R&D is a key input to innovation, particularly in the development of new products and technologies. The importance of R&D varies by industry. For many service industries, a substantial part of firms' innovation effort does not rely on R&D.² Given that service industries jointly contribute more than 60 per cent of Australia's national output, the importance of R&D to Australia's innovation performance is likely to be different from other economies with different industrial structures.³

In those industries where R&D is important to innovation, R&D serves a dual function for the firm:

- the new knowledge generated by R&D is an input to the firm's innovation
- it enhances the firm's ability to assimilate and exploit existing information, which builds its 'absorptive capacity'. Absorptive capacity is important as it supports the learning that underpins future R&D efforts.⁴

Business expenditure on R&D (BERD) measures the effort and resources that the business sector devotes to R&D activity.

Historically, advanced economies such as the US, Switzerland and Germany had some of the highest BERD to GERD ratios, with roughly 70 per cent of GERD performed by business enterprise in 1981. By 2015, the countries with R&D investment most driven by BERD were Israel (85 per cent), Japan (78 per cent), Taiwan (78 per cent), Korea (78 per cent) and China (77 per cent).⁵

The share of R&D undertaken by business in Australia is well below that of the leading countries. When Australian business R&D data was collected for the first time in 1981, business expenditure

on R&D was only 25 per cent of GERD while government and higher education R&D comprised the majority of GERD.⁶ However, by 2008–09, Australia's BERD/GERD ratio peaked at 61 per cent before retreating to 53 per cent in 2015–16.⁷ GERD also grew strongly during this period, with the ratio of GERD to GDP increasing from 1.48 per cent in 2000–01 to a peak of 2.25 per cent in 2008–09, then falling to 1.88 per cent in 2015–16. As a result, Australia's ratio fell further below the OECD average of 2.38 per cent and below that of China (which has risen to 2.07 per cent), and its ranking on this indicator fell to 19th among the 35 OECD countries.

While Australia's BERD/GDP ratio has been declining since 2008–09, a small proportion of firms — R&D high-growth firms — accounted for a disproportionate share of BERD (see Section 5.7). Evidence shown in the *Australian Innovation System Report 2015* suggests firms that performed R&D were more likely to be employment, turnover or profit 'gazelles'.^(z) The association is especially clear for gazelles by turnover and profit growth.⁸

5.2 R&D intensity has a positive effect on turnover growth

Firms with high turnover growth appear to be better able to capitalise on R&D expenditure (Figure 5.1).^(aa) Firms at the 90th percentile of the turnover growth distribution benefit by increasing their R&D intensity (i.e. R&D expenditure divided by total turnover) about 13 times more than the median firm. There is evidence that firms at the lower end of the turnover growth distribution experience a negative impact on turnover from increasing R&D intensity.^(ab) On average, R&D intensity is positively related to turnover growth.^(ac)

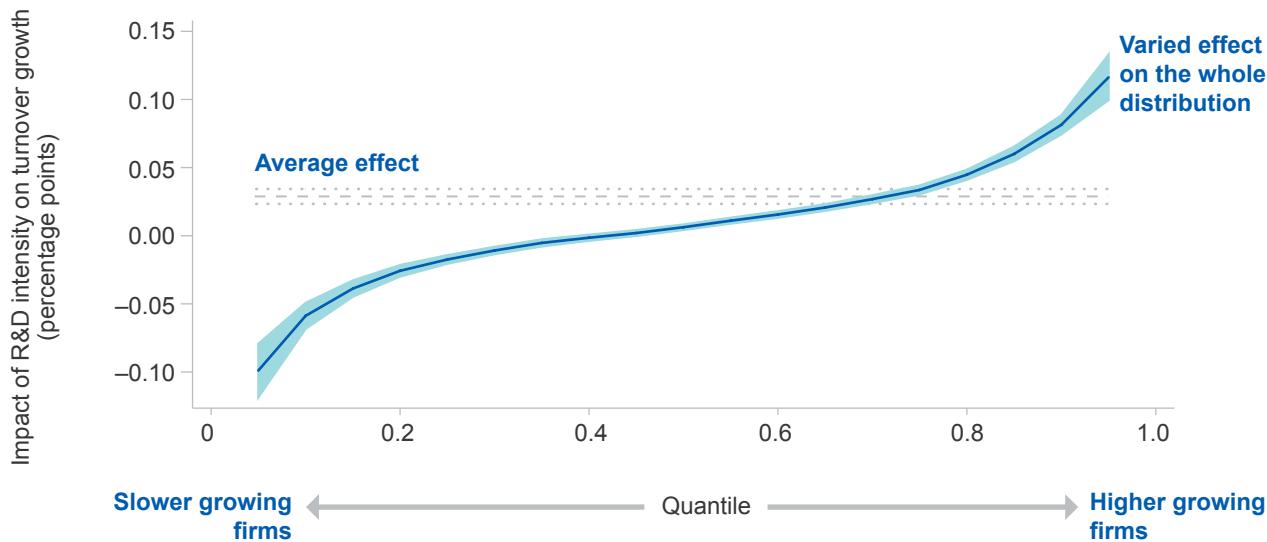
(z) See the Glossary for the definition of a 'gazelle'.

(aa) Quantile regression analysis was performed to examine the impact on high-growth firms of R&D intensity (the control variable). We considered a one-year gap between R&D intensity and turnover growth but the model was also tested for two and three year gaps without significant change in the results.

(ab) These results are similar to those found for the UK by Coad and Rao (2008).

(ac) These results are based on the most conservative estimates that we obtained through econometrics.

Figure 5.1: Impact of R&D intensity on turnover growth by quantile, 2001–02 to 2012–13.



Note: Results based on quantile regressions (Majeed (forthcoming))

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

Box 5.3: Analysis of the impact of R&D intensity on firm growth

This study examined the impact of R&D intensity (as measured by R&D expenditure divided by turnover) on firm turnover growth. The dataset used for this research is based on the ABS Business Expenditure on Research and Development data in BLADE. Before 2011–12, the data covered all businesses that spent \$100,000 or more on intramural R&D. From 2011–12, the R&D survey was based on a random sample of businesses stratified by industry and R&D expenditure. The data set covered the period 2001–02 to 2012–13. To remove the volatility associated with small firms, the data focussed on firms with five or more employees.

The study is based on econometric analysis using quantile regression and panel data techniques.

Quantile regression can be used to characterise the entire conditional distribution of a dependent variable (in this case, turnover growth), given a set of independent variables. Quantile regression allows the study of how R&D intensity affects turnover growth, and is robust to outliers. Regressions were based on a total of 29,673 observations and 7,030 businesses.

All the standard control variables in the literature, including size, age, industry effects and time effects were used in the regressions.⁹ Panel data techniques including Fixed Effects were used to test for robustness. These included Fixed Effects which controlled for the firm's capability.¹⁰

Further, for this analysis, high R&D intensity firms are those that have R&D intensity above the median value (which is 7.9). Conversely, low R&D firms are those with an R&D intensity lower than the median value.

There are several plausible explanations for the large variation in the effect of R&D intensity on turnover growth:

- Coad and Rao (2008) suggest that firms that innovate and fail may be commercially worse off than firms that do not innovate at all.¹¹
- R&D intensive firms are susceptible to imitation of their innovative products or processes from rival firms.¹² These imitations can reduce potential growth in turnover and market share for the firm undertaking R&D.
- Low or negative turnover growth may be expected where firms are attempting to capture market share or their research is yet to be commercialised. For example, biomedical and pharmaceutical firms may be focussed on clinical trials to establish whether a new product/technology has commercial potential. A similar effect may occur for firms in mineral exploration which are likely to be bought out by large mining firms.¹³
- Evolutionary economics suggests that while firms innovate and spend on R&D to improve their profits, only a few of these firms are ultimately successful.¹⁴ This selection process happens in a competitive environment where more successful firms grow at the expense of the less successful ones. There is no optimal amount of R&D that guarantees firm growth or even survival.

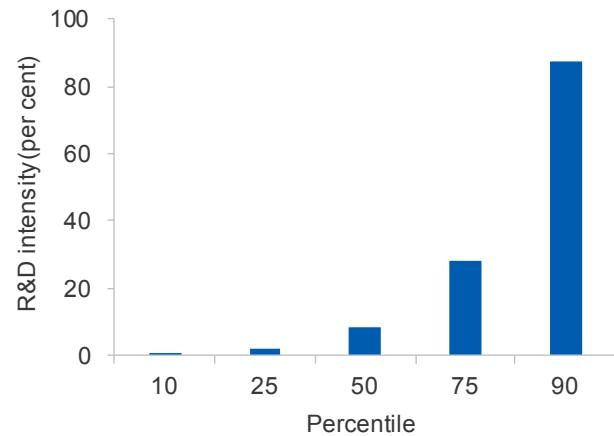
5.3 R&D intensive firms had higher returns

In general, firms with high R&D intensity have a higher return from R&D expenditure compared to low R&D intensity firms. There is a wide variation in R&D intensity among firms undertaking R&D. During 2001–02 to 2012–13, the median R&D-active firm spent about 8 per cent of its turnover on R&D expenditure and the distribution of R&D spending was skewed to the left (Figure 5.2). The bottom 10 per cent of the firms spent less than 0.5 per cent of their turnover on R&D expenditure, while the top 10 per cent of the firms spent more than 87 per cent of their turnover on R&D expenditure.

The impact on turnover growth was larger for high R&D intensity firms compared to low R&D firms (Figure 5.3). These results are based on two different methods of econometrics — Ordinary Least Squares

and Fixed Effects (see Methodology 4.1). Results based on these methods show that the impact of R&D on turnover growth for high R&D intensity firms is between 5.9 to 7.3 times higher than for low R&D intensity firms.

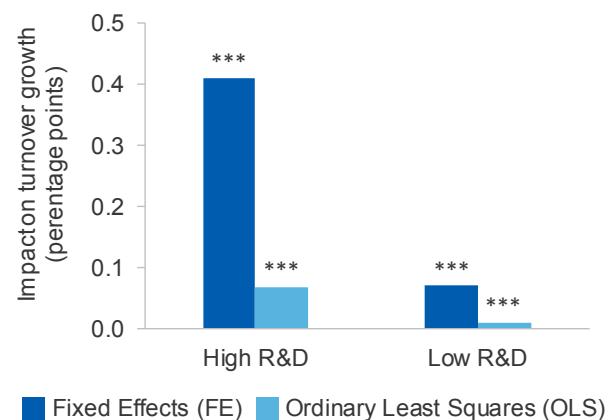
Figure 5.2: Distribution of R&D intensity of all firms, 2001–02 to 2012–13



Notes: Firms in the BERD data within BLADE.
See Methodology Box 2.1

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Data analysis commissioned by the Department of Industry, Innovation and Science.

Figure 5.3: Impact on turnover growth of high and low R&D intensity, analysis by fixed effects and ordinary least squares, 2001–02 to 2012–13



Notes: High R&D intensity firms are those that have R&D intensity above the median value (which is 7.9). Conversely, low R&D firms are those with intensity lower than the median value.

*** means that the values are greater than zero at the 1 per cent significance level.

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

5.4 R&D activity and its impact on firm growth

Overall, R&D activity appears to have an important impact on firm performance. Analysis of four indicators of growth (turnover, employment, labour productivity and wages) for a cohort of 2008–09 firms after one, three and five years revealed noticeable differences between R&D-active firms (defined here as those registered for the R&D Tax Concession) compared to all firms.^(ad)

R&D-active firms had substantially increased growth in turnover and wages compared to all firms (Figure 5.4). Growth in the turnover, labour productivity and wages of R&D firms was more pronounced over time, demonstrating the relatively long-term impact of R&D. Employment growth for R&D firms had a larger decrease after five years compared to all firms.

In Manufacturing, compared to all firms, R&D-active firms in the 2008–09 cohort:

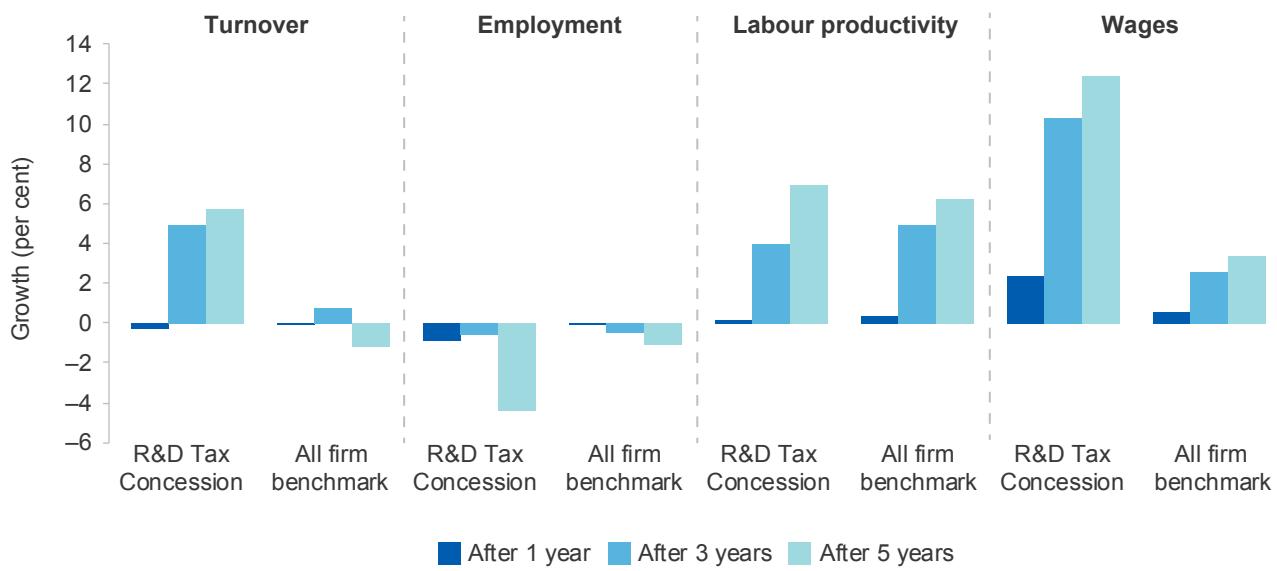
- had higher labour productivity growth after five years, with only marginal differences in turnover and wages growth (Figure 5.5)
- had a larger decline in employment growth after the first year, but after three and five years this difference reduced.

In Professional, Scientific and Technical Services (PSTS), despite an initial negative turnover growth after one year, R&D firms in the 2008–09 cohort:

- had higher turnover after three and five years compared to all firms (Figure 5.6)
- had a larger decline in employment growth after three and five years compared to all firms, despite similar trends in wages growth.

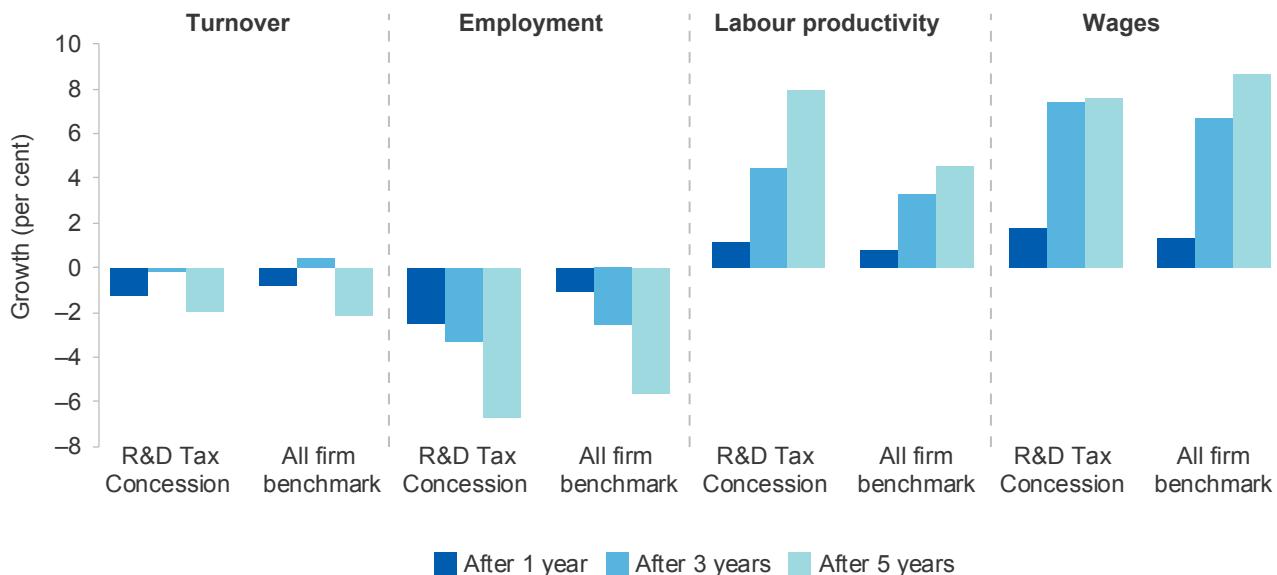
(ad) The benchmarks shown in Figures 5.3, 5.4 and 5.5 were created for comparative purposes, but they are not perfect counterfactuals.

Figure 5.4: Firm performance growth of R&D-active firms and all firms benchmark, 2008–09 cohort



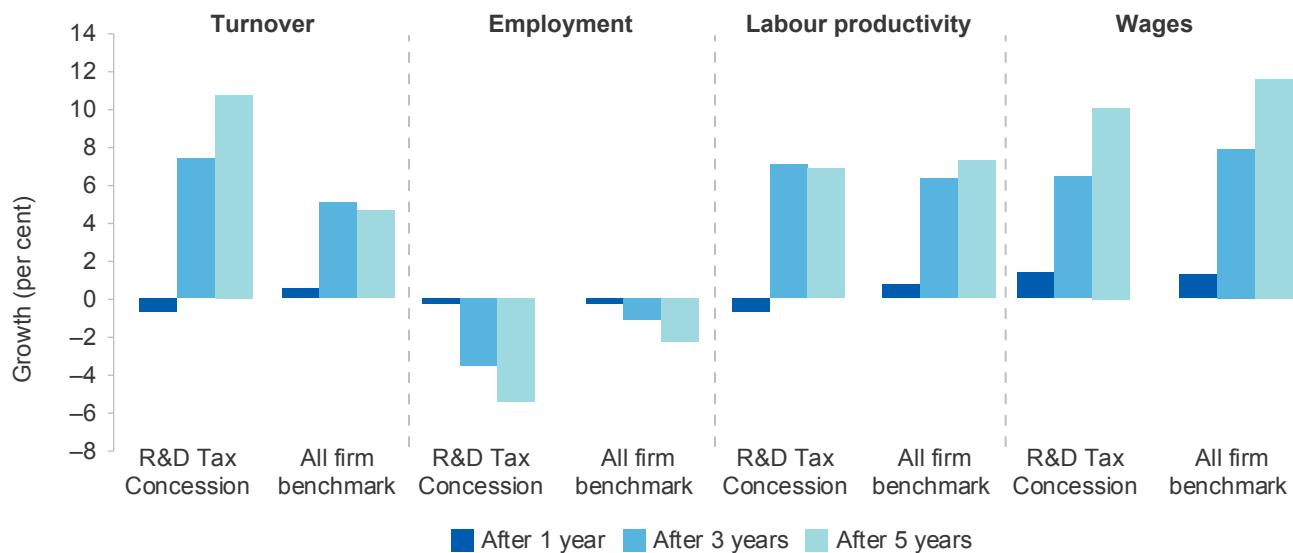
Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE), ABS calculations.

Figure 5.5: Firm performance growth of Manufacturing R&D-active firms and all Manufacturing firms benchmark, 2008–09 cohort



Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE), ABS calculations.

Figure 5.6: Firm performance growth of PSTS R&D-active firms and all PSTS firms benchmark, 2008–09 cohort



Notes: Median values are used.

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). ABS calculations.

5.5 Trends in R&D high-growth firms

In the last decade, the business sector has become a more substantial contributor to Australia's national R&D effort (Methodology 5.1). BERD tripled between 2000–01 (\$5 billion in current prices) and 2007–08 (\$15 billion), with the ratio of BERD to GDP increasing from 0.7 per cent to 1.3 per cent. However, after peaking in 2008–09 at 1.4 per cent, the BERD to GDP ratio has since fallen sharply to 1 per cent (\$16.7 billion) in 2015–16.¹⁵

During the upsurge in BERD in the previous decade, growth by R&D HGFs in the first half of the 2000s occurred at roughly the same pace as total R&D growth across the economy. As business R&D expenditure took off, the absolute number of R&D HGFs grew rapidly and the share of R&D HGFs in total R&D firms increased to a peak of 38.4 per cent in 2005–06. This declined markedly during the GFC, but recovered by 2010–11 to 29.7 per cent. By 2014–15, however, the share of R&D HGFs in total R&D had declined again to 15.1 per cent.^(ae)

(ae) Department of Industry, Innovation and Science programme data for the R&D Tax Concession (2001 to 2011) and the R&D Tax Incentive (2013 to 2015).

Methodology 5.1: R&D tax registration data

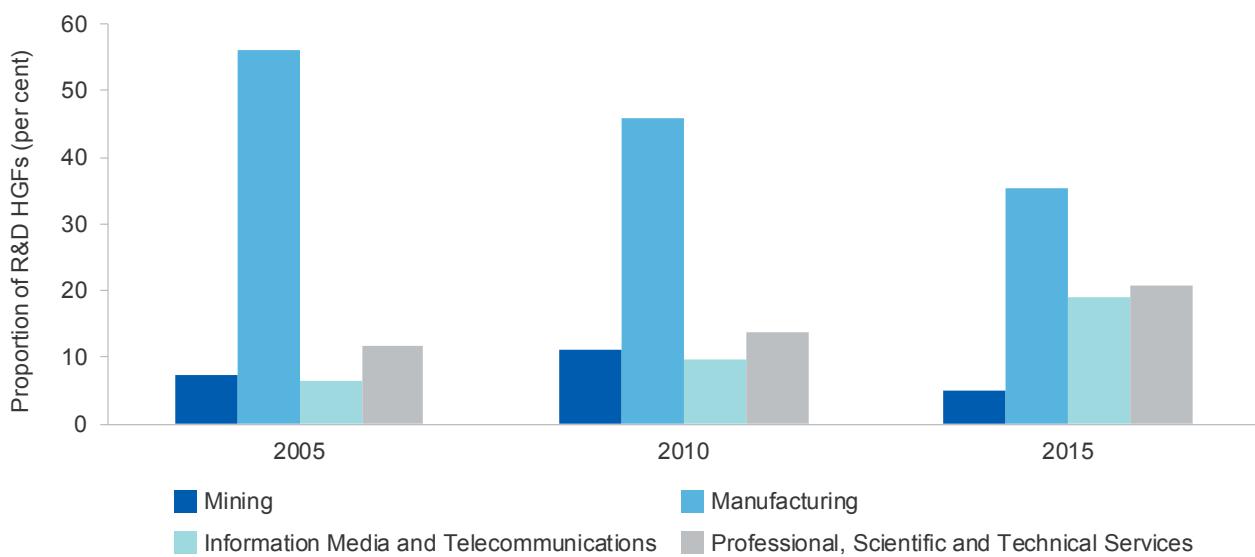
The analysis of Australian R&D trends in this chapter uses the R&D tax registration data from the R&D Tax Concession programme (before 2011) and the R&D Tax Incentive programme (after 2011).

This data set represents a virtual census of R&D business activity, with around 15,500 firms currently registered in the programme. Historically, there has been a close correspondence between total business R&D expenditure from the registration data and business expenditure on R&D data collected by the ABS.

Manufacturing leads R&D HGFs, but sectoral composition is changing

In recent years, there has been a clear compositional shift of R&D HGFs, moving from Manufacturing towards Professional, Scientific and Technical Services (PSTS), and Information Media and Telecommunications (IMT). These three industries accounted for 75 per cent of all R&D HGFs in 2015. However, the share of Manufacturing R&D HGFs declined from 56 per cent in 2004–05 to 35 per cent in 2014–15. On the other hand, PSTS and IMT have grown to each account for around 20 per cent of R&D HGFs in 2014–15 (Figure 5.7).

Figure 5.7: R&D HGF proportions in top four industries, 2005, 2010 and 2015



Notes: Years refer to financial years: thus, 2005 represents 2004–05, 2010 represents 2009–10 and 2015 represents 2014–15.

Source: Department of Industry, Innovation and Science programme data for the R&D Tax Concession (2001 to 2011) and the R&D Tax Incentive (2013 to 2015).

Share of R&D HGF expenditure decreasing

The level of R&D expenditure by R&D HGFs grew strongly during the first half of the 2000s. R&D expenditure by R&D HGFs grew from \$2.1 billion in 2003–04 to \$4.1 billion in 2006–07 before the GFC set growth back, with pre-crisis levels of expenditure reached again in 2009–10. However, more recently, R&D HGFs have been a much less significant contributor to Australian industry's total R&D. In 2014–15, R&D HGFs comprised 15 per cent overall of total industry R&D, down from 33 per cent in 2004–05.

While R&D expenditure in Manufacturing continued to grow during the last decade, the share of expenditure by Manufacturing R&D HGFs has fallen. Manufacturing's R&D expenditure grew from \$1 billion in 2003–04 to \$5.3 billion in 2014–15. However expenditure by Manufacturing R&D HGFs dropped from 30 per cent in 2003–04 to 11 per cent in 2014–15.

R&D expenditure by Mining R&D HGFs doubled between 2005 and 2010, making it the leading

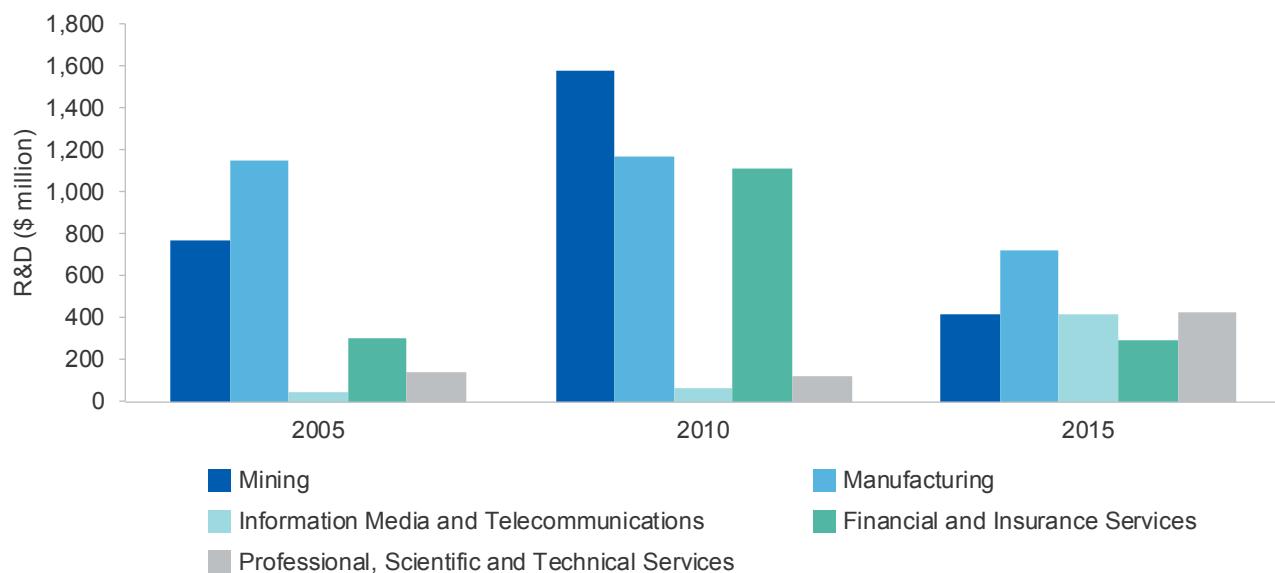
industry for R&D expenditure (\$1.6 billion). However, R&D HGFs in Mining's total R&D spending fell to \$418 million by 2015, contributing just 15 per cent of Mining's total R&D expenditure (Figure 5.8).

There has been a clear structural shift in the industry composition of R&D HGFs' expenditure. With the passing of the mining investment boom, Manufacturing has returned to its former position as the highest R&D spending industry, and is the leading HGF industry.

In 2003–04, Manufacturing contributed 48 per cent of R&D HGFs' expenditure; but by 2014–15 this dropped to 25 per cent. Mining's contribution increased from 24 per cent in 2004–05 to 32 per cent in 2009–10, but by 2014–15 it made up just 16 per cent of R&D HGFs.

Increased contributions have come from Professional, Scientific and Technical Services (PSTS, 14 per cent in 2014–15), Information, Media and Telecommunications (IMT, 14 per cent) and Financial and Insurance Services (FIS, 12 per cent). These changes show the Australian economy is diversifying and shifting towards industries using human capital more intensively.

Figure 5.8: Real R&D expenditure by R&D HGFs in top five industries, 2005, 2010 and 2015



Notes: Years refer to financial years, so 2005 represents 2004–05, 2010 represents 2009–10 and 2015 represents 2014–15.
R&D is in real 2010 values (deflated by the ABS's Production Price Index).

Source: Department of Industry, Innovation and Science programme data for the R&D Tax Concession (2001 to 2011) and the R&D Tax Incentive (2013 to 2015).

Most R&D HGFs were older

The majority of R&D high-growth firms are aged five years or more and the share of older firms over five years old, at 93 per cent in 2014–15, is the same as in 2004–05. This contrasts with the findings for HGFs by turnover which found that firm age negatively impacts on growth, with Turnover HGFs on average two years younger than non-HGFs (see Section 2.3).

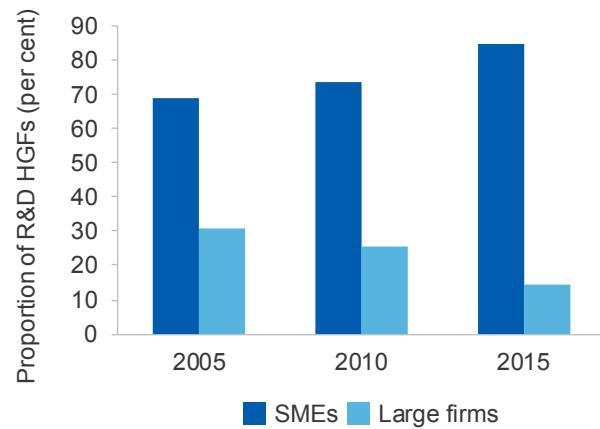
The overrepresentation of older firms among R&D HGFs may in part reflect that R&D relies on cumulative learning and the building up of knowledge and capabilities in the firm. The definition of HGFs as firms that have experienced three consecutive years of growth precludes very young firms. Young firms may initially face borrowing constraints which would limit their ability to spend on R&D.

Most R&D HGFs were SMEs

Most R&D HGFs were SMEs rather than large firms. The proportion of R&D HGFs that were SMEs steadily increased, from 69 per cent in 2005 to 85 per cent in 2015. This was commensurate with the ratio of SMEs in firms registered under the R&D Tax Incentive programme (Figure 5.9).

The growth in R&D HGFs that are SMEs is likely attributable in part to changes in policy. In 2011 the R&D Tax Incentive was introduced, replacing the previous R&D Tax Concession and providing increased incentives for SMEs to perform R&D. SMEs now receive an after-tax benefit of at least 13.5 cents in the dollar (and some as high as 43.5 cents in the dollar) for eligible R&D investments, compared to 7.5 cents in the dollar under the R&D Tax Concession.

Figure 5.9: R&D HGF proportions by firm size, 2005, 2010 and 2015



Notes: Years refer to financial years: thus, 2005 represents 2004–05, 2010 represents 2009–10 and 2015 represents 2014–15.

Source: Department of Industry, Innovation and Science programme data for the R&D Tax Concession (2001 to 2011) and the R&D Tax Incentive (2013 to 2015).

5.6 Global R&D trends

In the 1990s, R&D was considered one of the less mobile economic activities in the international business supply chain.¹⁶ R&D operations were thought to be too integral to the firm's performance to be separated from a company's headquarters. But more recent analysis shows that multinational corporations are now relocating R&D activities to fast-growing, emerging economies such as China and India.¹⁷

Globally, R&D is dominated by a small cadre of firms, especially multinational companies. In 2012 the top 2,000 companies accounted for around 90 per cent of the total business R&D expenditure of OECD countries plus Argentina, China, Romania, the Russian Federation, Singapore, South Africa, and Taiwan.¹⁸

The phenomenon of R&D growth at the firm level is also highly concentrated. Analysis of the top 2,500 R&D performing firms collected by the European Commission shows the United States and China dominate R&D HGFs by number (Figure 5.10). Sixty-seven per cent of all R&D HGFs are concentrated in these two countries (41 per cent in the US and 26 per cent in China).

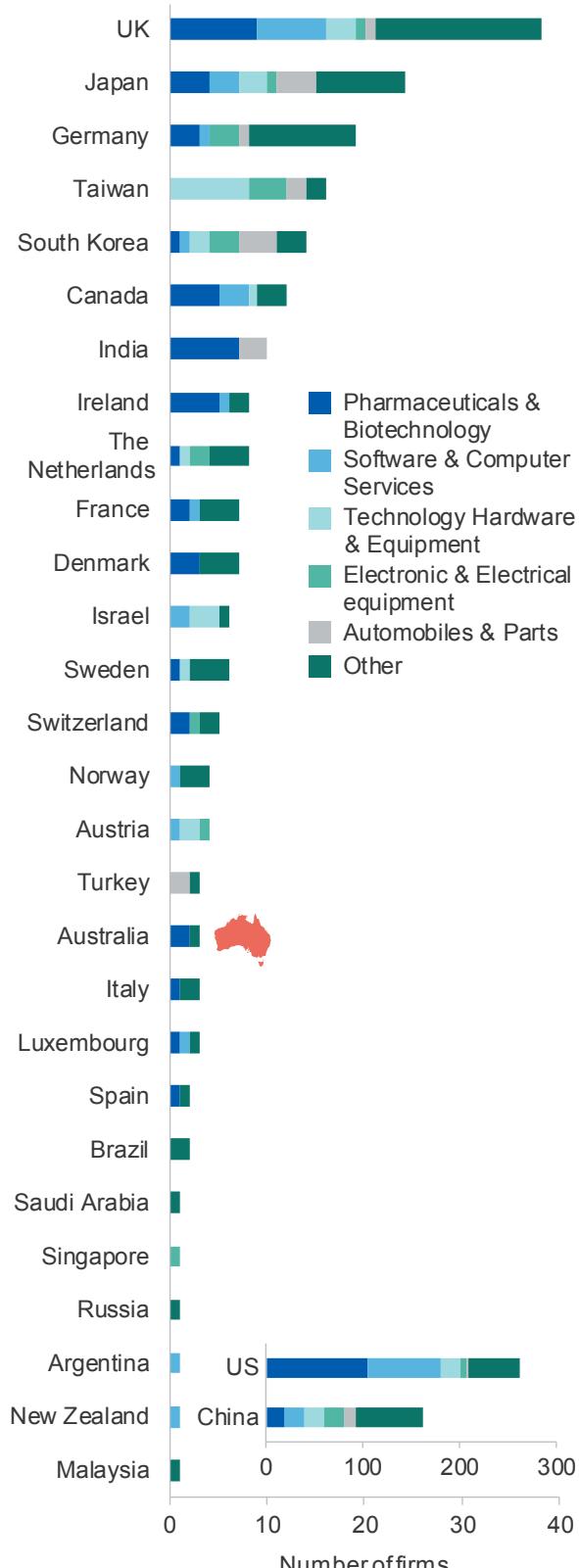
By industry, R&D HGFs were predominantly found in:

- Pharmaceuticals/Biotechnology (27 per cent)
- Software/Computer Services (19 per cent)
- Technology Hardware (10 per cent)
- Electronics (7 per cent).

Most of the R&D high-growth firms shown in the EU dataset have significant expenditures in R&D, with an average of \$412 million (and a median of \$90 million).

Medium-sized, newly industrialised economies like Taiwan and South Korea show a number of domestic firms leading their R&D growth. In contrast to the US, most of the R&D HGFs in these countries are in technology, especially electronics. China's R&D spending pattern is more diversified, including companies in Chemicals, Automobiles and Construction. It appears these countries are not relying on multinational corporations to invest in R&D; domestic firms see R&D as a critical factor for competitiveness and are investing themselves.

Figure 5.10: Top 2,500 global R&D HGF performers, by selected industry, 2015



Note: Number of firms recording 20 per cent or higher annual growth in R&D for three consecutive years to 2015.

Source: *The 2016 EU Industrial R&D Investment Scoreboard*, <http://iri.jrc.ec.europa.eu/scoreboard16.html>, accessed 22 May 2017.



Feature Article: Australia's venture capital and private equity market

Yasser El-Ansary

Chief Executive

Australian Private Equity & Venture Capital Association Limited

Over the last few years, the Australian innovation landscape has changed dramatically — start-ups, incubators, and accelerators have emerged across the country. Savvy investors are increasingly seeing the commercial value of new technologies buoyed by the success of local companies like Atlassian, Canva and Hatchtech. At the same time, innovation has been widely recognised as central to Australia's future prosperity.

While much of the focus has been on the burgeoning start-up sector, a vital part of the national economy has remained somewhat misunderstood: the role of high-growth companies in driving an enduring value-creating economic transition.

Graduating from a start-up

These companies are neither two-person operations with bright-eyed founders hoping to gain a slice of a market, nor big businesses looking to pivot and adapt in the face of technology-driven disruption.

Rather, these companies — 'scale-ups' — are businesses that have graduated from the initial start-up phase with a proven product and market opportunity and now need further funding and expertise to hire staff, drive sales and invest in R&D.

Typically, these scale-ups require a capital injection of \$5 million to \$20 million to finance their critical expansion stage and realise their potential.

As Australia transitions away from its traditional reliance on natural resources, the success of these high-growth companies will be critical to the nation's success. Currently, seven out of Australia's top ten goods and services exports come from minerals, energy or agriculture.¹⁹ This must broaden if Australia is to succeed in the 21st century.

Investing in high growth

The majority of private equity (PE) and venture capital (VC) investment is directed towards small and medium-sized enterprises (SMEs) and high-growth companies, which often struggle to attract financing from traditional lenders, and may lack the experience or networks to accelerate their expansion and capitalise on opportunities in domestic and global markets.

Over the financial years (FY) 2013 to 2016, the average PE investment in a company was \$41.5 million, concentrated in small and mid-market companies, while the average VC investment (\$3.4 million) was focussed on early stage companies.²⁰ PE and VC funds regularly meet critical funding and experience gaps, providing crucial support at varying stages of a company's life cycle.

Industry data shows that start-ups and SMEs are currently witnessing a wave of investment across all industries, with venture capital "dry powder" at an all-time high.

PE fundraising in FY2016 was \$2.55 billion, down slightly from the previous year. However the total was higher than the combined PE fundraising recorded in FY2014 and FY2015. This capital is currently being deployed into mainly Australian businesses, and will continue to be over the coming years.²¹

The benefits of such investment for Australia are clear. Deloitte Access Economics analysis shows the average workforce for a PE-backed company grew from 378 to 1,636 FTE jobs over a five-year period, representing an annual compound growth rate of 27.6 per cent.²² These results are the dividend of the innovation and transformational change brought about through PE investment.

While PE has steadily increased its footprint in Australia since its emergence around 25 years ago, over recent times the VC sector has also come of age, with AVCAL's June 2017 report, The Venture Capital Effect, highlighting progress. For example, in FY2016, \$568 million was raised by VCs, more than tripling the amount raised in 2013. This momentum has been carried into FY2017, with conservative estimates suggesting that more than \$1 billion has been raised.²³

This boost in fundraising has partly been driven by improved VC returns in recent years, along with renewed investor appetite from large Australian superannuation funds for exposure to cutting-edge technology.

While this resurgence is welcome, there remains great potential to grow the VC sector much further, with Australia's market remaining less than half the size of the OECD+ average.²⁴

Of course, critical to the ongoing growth of the sector, and the broader economy, will be the scaling-up of promising Australian companies into world leaders.

The success of SafetyCulture

An example of what Australian businesses can achieve is VC-backed technology company, SafetyCulture. Aimed at tackling workplace safety, the iAuditor app has had over one million downloads and is the most used checklist inspection app in the world. Launched just five years ago, crucial to the rapid growth of the company was an investment of capital and expertise from Blackbird Ventures which helped the firm to bring on a team and open an office in Townsville in just eight weeks. Today, Blackbird, and other investors, including VCs from Silicon Valley, have helped Safety Culture to open new offices in San Francisco, Kansas City, and Manchester, employing over 120 people.²⁵

Hatchtech matches innovation and commercialisation

Hatchtech, an Australian pharmaceutical company, developed an innovative product tackling the age-old scourge of head lice. Stemming from University of Melbourne research, and backed by local VC firms (Uniseed, GBS Ventures, One Ventures and Blue Sky Ventures), Hatchtech developed an innovative treatment which tackled the dual problems of both head lice and their eggs, providing the company with a competitive differentiator in the market. Actively developed over ten years, Hatchtech signed an A\$279m commercialisation agreement with Dr Reddy's Laboratories in September 2015.²⁶

Potentially significant for the health of children worldwide, Hatchtech demonstrates the opportunity for the university and VC sectors to partner on the commercialisation of world-leading research.

Vaxxas transforms vaccine delivery

Similarly, Vaxxas — arising from University of Queensland research — has developed a unique Nanopatch vaccine delivery solution which promises to transform the way in which medicine is administered worldwide. Recognised in 2015 as one of just 24 World Economic Forum Technology Pioneers, Vaxxas has benefited from investment and advice from investors including OneVentures and Brandon Capital, who are helping to guide the company towards a clinically proven, marketable product.²⁷

Supporting scale-ups supports our economy

While Safety Culture, Hatchtech and Vaxxas each showcase the potential of Australian innovators, there remain too many high-growth companies which are missing out on the capital and expertise they need.

Currently, a lack of VC funding opportunities at this vital scale-up stage pushes many abroad, and in some cases, to the brink of existence. Making sure these scale-ups receive support has economy-wide implications, including for Australia's ability to drive future productivity and employment growth.

Over FY2011 to FY2016, only 25 per cent of Australian VC-backed companies received later/expansion stage funding, down from 29 per cent of companies in FY2007-11.²⁸ This can be contrasted with Europe and the US where around 45 per cent of all VC deals take place in that stage.

So why does this matter? Because scale-ups lie at the heart of future employment growth, and Australia's ability to successfully transition to a more competitive economy that can continue to grow its footprint in the global marketplace.

Australian Government research shows that start-ups (aged 0–2 years) were the largest contributor to job creation in Australia representing 90 per cent of net positive job creation over recent years (2004 to 2011), despite the Global Financial Crisis.²⁹ These companies created more than 1.2 million jobs in that period, contributing \$164 billion to the Australian economy.

Australia must learn from its overseas counterparts if we are to compete with, and eventually surpass other comparable developed markets. In November 2015, research from Stanford University and the University of British Columbia highlighted the contribution of VC to the US economy, particularly in funding innovative companies. In 2014, VC-backed companies accounted for 44 per cent of the total R&D spending of US public companies, despite only representing 17 per cent of them by number, and 21 per cent by market capitalisation.³⁰

Indeed, three of the five largest US public companies by market capitalisation — Apple, Google, and Microsoft — all received most of their early external financing from VC. The employment dividend of such investment is clear: since 1974, 25 per cent of net job growth for publicly listed US corporations came from VC-backed companies.³¹

If we can ensure that Australian high-growth companies receive the support they need, there is every reason to believe we can achieve similar results and thrive in the new economy.

Chapter 6

This chapter explores some of the policy considerations that might be relevant to pursuing innovation-led growth. Creating the general conditions conducive to innovation-led growth invariably involves an ongoing focus on skills and capabilities, competition and regulation, and access to finance suited to various stages of innovation.

Digital innovation is also increasingly important. Beyond this, some countries have started to experiment with policies aimed at HGFs directly, notwithstanding the numerous challenges involved.

Policy considerations for innovation-led growth

Despite their large contributions, it is difficult to target HGFs with policy tools

Policy should target enhancing **framework conditions**

There is a positive association between levels of **competition and innovation**

Access to risk capital and skills mismatches are constraints on the innovation activity of Australian firms

150% in foreign direct investment into Australia in 2016 compared to 2015

Income generated over the internet in 2015–16 was in excess of **\$320 billion**, up from **\$144 billion** 5 years earlier

Sources (left to right): 1–2) no source; 3) ABS (2017) Selected Characteristics of Australian Businesses, 2015–16, cat. no. 8167.0; 4) ABS (2017) Selected Characteristics of Australian Businesses, 2015–16, cat. no. 8167.0; OECD (2016) Skills Matter: Further Results from the Survey of Adult Skills, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264258051-en>; 5) OECD (2017) FDI flows (indicator), 2017, viewed 29 October 2017, <https://data.oecd.org/fdi/fdflows.html>; 6) ABS (2017) Selected Characteristics of Australian Businesses, 2015–16, cat. no. 8167.0.



KEY POINTS

- Policymakers may find HGFs to be an attractive target due to their potential to create jobs and income growth. However, the effectiveness of international policies directed at HGFs remains to be seen.
- Irrespective of any policies specific to HGFs, underlying policy should continue to focus on creating a macroeconomic environment conducive to innovation and growth by improving framework conditions.
- Increasing the depth, breadth and relevance of skills available, particularly to small firms, could strengthen Australia's ability to capitalise on future challenges through innovation.
- Australia has a strong regulatory environment, however there are opportunities for further reform. Maintaining relevant competition policy can encourage levels of competition that promote innovation.
- Improving access to finance, particularly for innovation-active SMEs, would further support the growth of innovative and disruptive firms.
- Australia's successful adoption of digital technology is likely to be fundamental in boosting productivity growth and maintaining global competitiveness. Policy settings and increasing the availability of skills will be ever important in this area.

6.1 Policy settings to enhance innovation

Targeting high-growth firms

Given the disproportionate economic contribution of HGFs, policy makers are understandably attracted to these firms as a potential means of supporting job creation and income growth. Some countries have been experimenting with targeted policy support for HGFs. France, for example, has been operating several support measures aimed at HGFs, with an estimated 62 per cent of the country's HGFs accessing state support.¹ Other notable examples include Germany's High-Tech Start-up Fund and the Swiss CTI Start-up programme. The USA and UK have also introduced such policies.

To date, however, there is scant evidence to show that targeting HGFs has had a significant impact on economic performance, and some of the

programmes have been discontinued, such as the UK Growth Accelerator programme.² The feature article *Innovation and High-Growth Firms* (Section 6.5) discusses the challenges involved in targeting HGFs. Concerns have been raised in several international studies regarding such policy measures, pointing to issues such as:^{3, 4, 5}

- difficulties in predicting which firms will grow^{6, 7}
- the lack of persistence of exceptional firm growth⁸
- the lack of an economic rationale for intervention⁹
- employment growth attributable to HGFs may occur outside of the home country where the firm is legally registered¹⁰
- the failure of many HGFs to exhibit other desirable characteristics, such as profitability or sound financial position¹¹

The experimental research of CSIRO's Data61 into ways of identifying Australian companies on high-growth employment trajectories is described in Section 4.2.

Framework conditions and complementary measures

The extent to which firms might pursue growth through innovation depends on a range of factors, the most obvious of which relate to the quality of the business environment in which firms operate. The targeted policy support for HGFs mentioned above is invariably introduced as complementary policy to the ongoing efforts across developed economies to improve general framework conditions. These ongoing reforms cover broad areas such as competition, regulation, intellectual property arrangements, skills and management capabilities, or access to finance.

Sound framework conditions are necessary but not sufficient for achieving innovation-led growth. Complementary measures can help unlock the benefits of innovation, especially where they aim to address specific market failures such as those related to coordination problems or innovation spillovers. For example, supporting the development of innovation ecosystems (around specific technologies) or clusters (around certain geographical locations) may assist by facilitating collaboration between firms and research institutions so that they may identify and address issues of common interest.

However, regardless of their particular design or scope, complementary measures should be based on a sound economic rationale that sets out the case for why policy action may be warranted. The case for policy action should be supported by evidence and, where possible, supplemented with an analysis of the expected net social benefit the measure is intended to deliver.

6.2 Skills and capabilities

Building skills and management capabilities

Innovation-led growth requires a well-functioning education and training system, a skilled workforce, and capable management. Australia is performing relatively well in terms of generating knowledge but not so well in making the best use of skills or translating knowledge into commercial innovations.

Australia is recognised globally for its high-quality research and knowledge creation. Despite having only 0.3 per cent of the world's population, Australia contributed to almost 4 per cent of world research publications in 2016.¹² Australia has the third highest number of researchers in the government and higher education sector per thousand workers out of OECD+ countries.¹³ Australia also had relatively high levels of higher degrees by research graduates, with 11.7 doctorate holders per thousand people in the working-age population.¹⁴

Australian innovation-active businesses report high usage in all skill types, however lack of access to skills was often cited by businesses as a barrier to innovation in 2014–15.¹⁵ Innovation and Science Australia's 2016 Performance Review of the Australian Innovation, Science and Research System (*ISR System Review*) also found a mismatch between industry demand and skills in the workforce. Australia's Vocational, Education and Training (VET) sector was recognised as an underused resource, with challenges identified in ensuring VET training packages remained relevant to industry needs.¹⁶

Ongoing skills gaps in management and leadership capabilities were reported by Australian firms in the *ISR System Review* and the current supply of information and communication technology (ICT) graduates does not appear to meet industry needs.¹⁷ A recent OECD survey of adult skills also identified that skill mismatch was comparatively high in Australia, ranking 5th highest out of 29 OECD countries. (af),¹⁸ Recently published data of Management and Organisational Capabilities of Australian Business by the ABS shows sharp differences between large and small firms in the levels of management capability.¹⁹

(af) Skill mismatch arises when workers have an educational attainment that is higher or lower than that required by their job.

STEM skills underpin new-to-market product innovation

To enable firms to pursue innovation-led growth, it is important that the education system generates the kinds of skills required to drive new-to-market innovation in goods and services. In Chapter 1 it was noted that Australian firms tend to have less focus on new-to-market innovations, precisely the kind that have a higher degree of novelty and therefore more economic value. Chapter 4 presented evidence that innovation in goods and services is related to firm growth.

Science, technology, engineering and mathematics (STEM) skills play an important role in enabling firms to pursue new-to-market innovation in goods and services, especially for innovations that are new to the world. New-to-market international innovators (Definition 1.3) are:

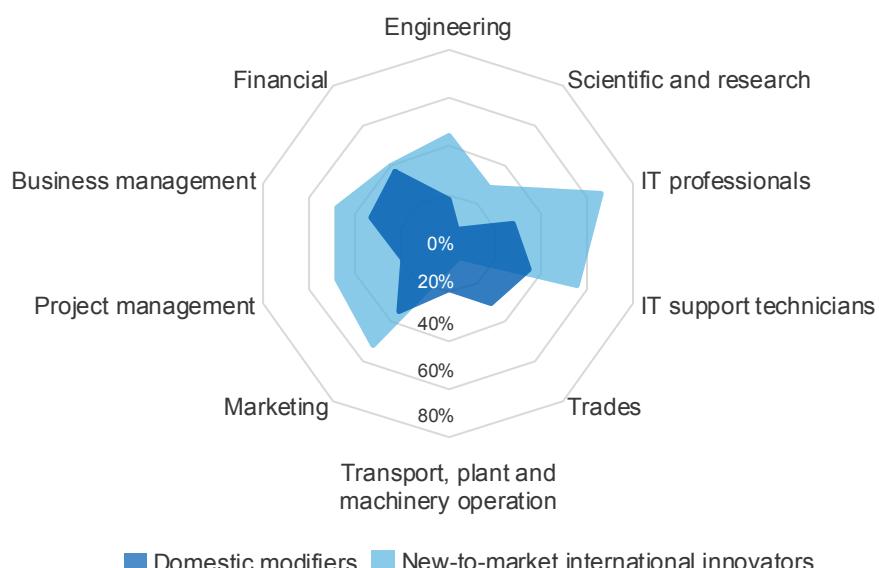
- more than twice as likely to use engineering skills and professional IT skills than domestic modifiers
- four times more likely to use scientific and research skills, than domestic modifiers

- more likely to use project management, business and marketing skills than domestic modifiers
- three times less likely to use trades skills than domestic modifiers of existing innovations (Figure 6.1).

STEM skills are relevant not only for new-to-market innovation but also for the absorptive capacity of firms — their ability to recognise the value of new, external information, assimilate it and apply it to commercial ends. Prior knowledge of the most recent scientific and technological developments in a given field is a determinant of a firm's ability to innovate through exploiting external knowledge.²⁰

An education in STEM also develops a range of generic and specialised skills and strategic thinking that enables individuals to identify and grasp opportunities. These capabilities — including deep knowledge of subject, creativity, problem-solving, critical thinking and communication skills — are essential in an increasingly wide range of occupations.

Figure 6.1: Skills used by new-to-market international innovators and domestic modifiers, 2014–15



Note: The axes show the proportion of businesses reporting the use of skills.

Source: ABS (2016) Data analysis commissioned by the Department of Industry, Innovation and Science.

6.3 Competition and regulation

Competition can drive innovation

Competition is a key driver of innovation and arguably one of the most important conditions for innovation-led growth.²¹ A joint study by the ABS and the Productivity Commission suggests firms appear more likely to innovate if they face stronger competition.²² Firms may innovate to increase their profit margins or improve their offering. As the number of competitors in a given market increases so does the proportion of innovation-active businesses (Figure 6.2).

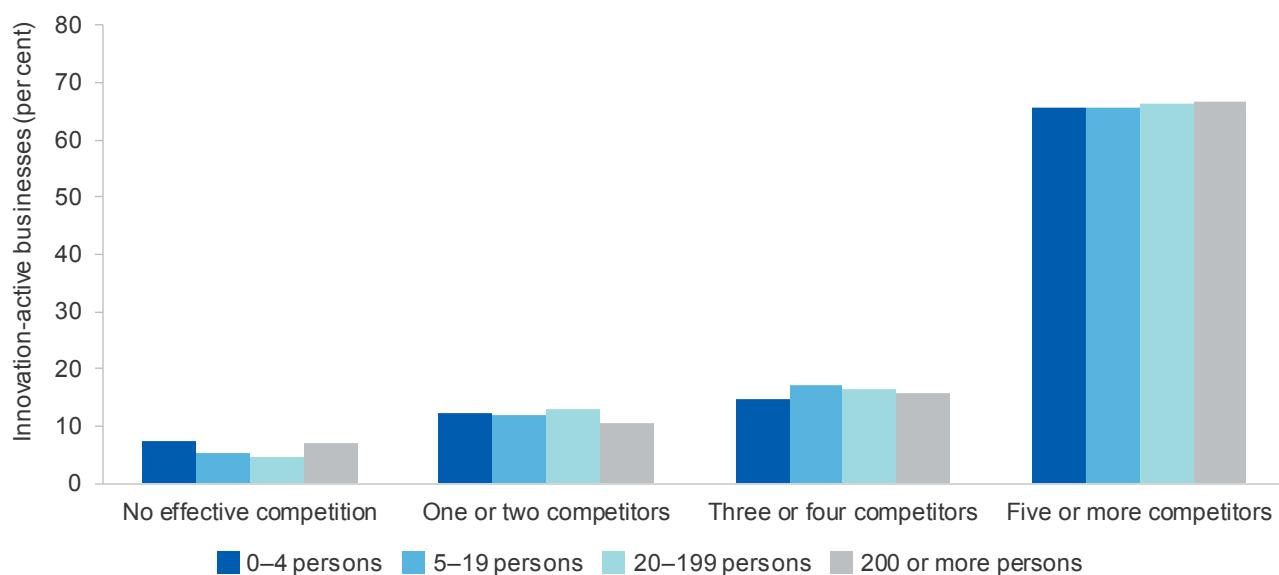
Competitors can be a direct source of ideas for innovation. In 2014–15, around 28 per cent of innovation-active businesses cited competitors as a source of ideas, led by Information, Media and Telecommunications and Accommodation and Food Services, which reported this source in the highest proportions (Figure 6.3). Interestingly, less than 20 per cent of innovation-active Manufacturing businesses consider competitors to be a source of ideas for innovation, despite being a highly trade-exposed sector and subject to strong levels of competition.

The OECD *Economic Survey of Australia 2017* concluded that progress in structural reform in recent decades has considerably improved policy settings for the Australian business environment. However, Australia's competitive advantage in these areas is being eroded as other countries improve their framework conditions.²³ To boost innovative capacity and business productivity, it was recommended that, among other things, Australia continues to follow through on the recommendations of the Competition Policy Review.²⁴

The Productivity Commission has recently put forward a broad suite of recommendations aimed at improving the factors and influences that may affect Australia's economic performance.²⁵ With regard to competition reform as it relates specifically to innovation, the Productivity Commission suggests the following:

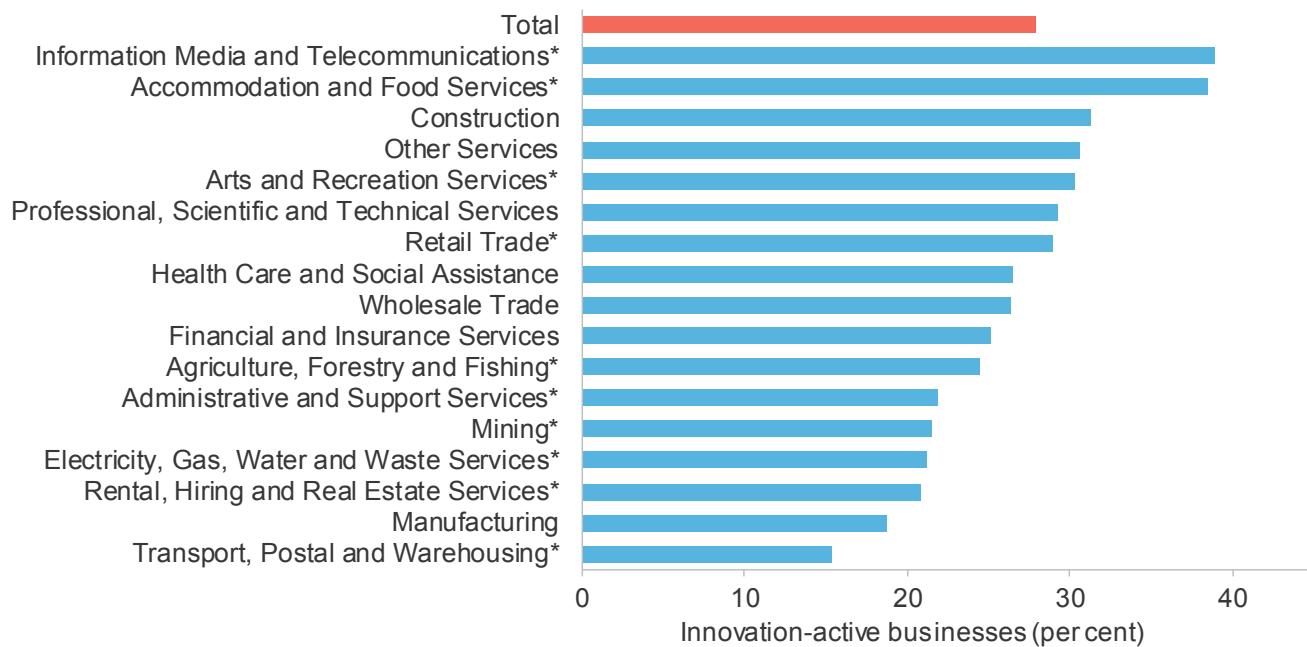
- revitalising competition policy with respect to the digital economy
- removing the competition law exemption for intellectual property
- improving access to, and the availability of, data
- making sure that firms can operate in an environment of intellectual license.

Figure 6.2: Effect of competition on innovation-active businesses, by firm size (FTE), 2015–16



Source: ABS (2017) *Selected Characteristics of Australian Businesses, 2015–16*, cat. no. 8167.0.

Figure 6.3: Innovation-active businesses that used competitors from the same industry as a source of ideas for innovation, 2014–15



Notes: The asterisks (*) denote standard errors in the range between 10 to 25 per cent.

Source: ABS (2016) *Innovation in Australian Business, 2014–15*, cat. no. 8158.0

Australia's regulatory environment supports innovation

The *ISR System Review* assessed Australia's regulatory environment as generally supportive of innovation and its broader outcomes.²⁶ Australia performs well above OECD averages for indicators of federal regulatory policy and governance.²⁷ It ranks 8th of 127 economies for regulatory quality and 13th of 189 economies for ease of doing business.^{28, 29} Australia also ranks highly in terms of the soundness of its banks, legal rights and corporate finance; it has one of the world's most efficient stock markets and some of the strongest financial and banking regulations and competition legislation.³⁰

Product Market Regulation (PMR) is the degree to which policies promote or inhibit competition in areas of the product market where competition is viable.

Australia has a respectable overall PMR score (1.3), just below the OECD average (1.5) in 2013.³¹ Other PMR indicators reveal Australia has low initial costs associated with creating a new business, but once created, businesses have to negotiate higher levels of business regulation compared to other OECD countries.³²

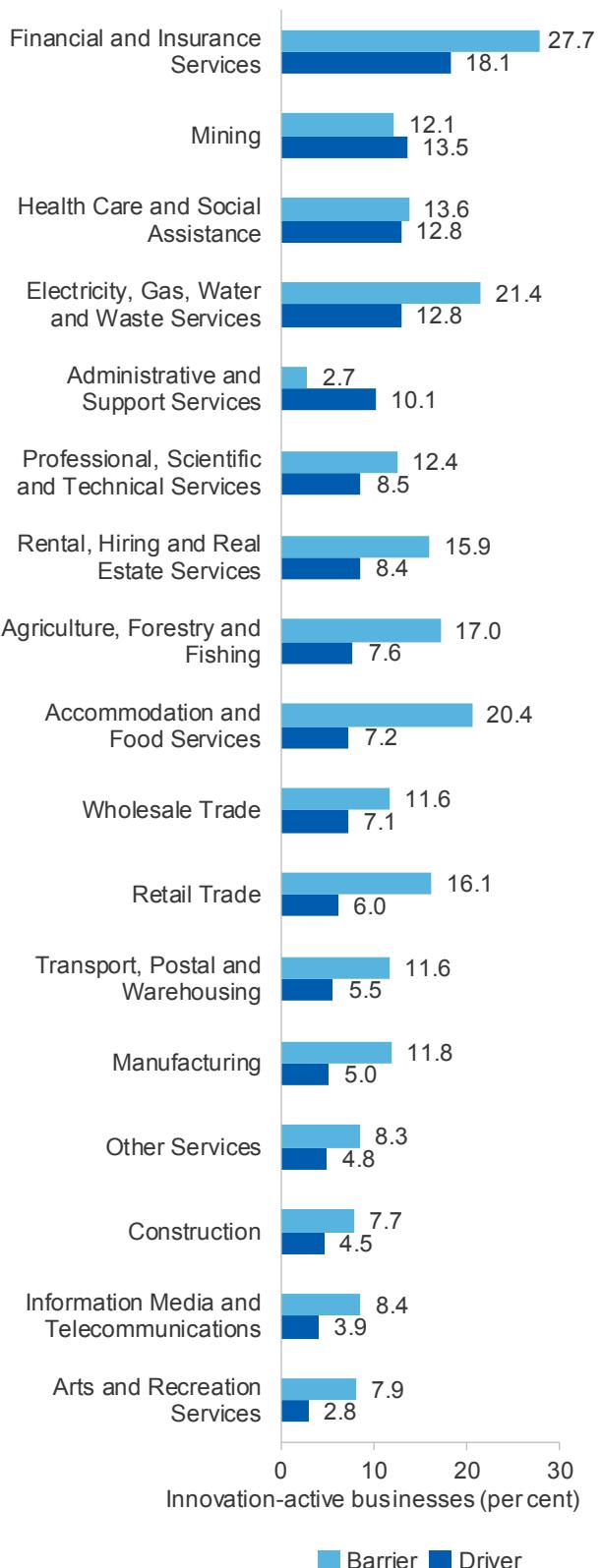
Rather than being a major barrier, Australia's regulatory frameworks are generally seen as essential to consumer and environmental protection, providing a form of assurance behind exported products which rely on reputational capital of the exporting country. Government regulation or compliance was the sixth of nine barriers to innovation identified by innovation-active businesses in 2015–16, behind lack of access to additional funds or skills, cost of development or implementation, and uncertain demand for new goods or services.³³

Regulation is both a barrier and a driver for innovation

Regulations can have both positive and negative effects on the innovation activities of firms. In 2014–15, around 7.5 per cent of innovation-active businesses reported pursuing innovation in response to government regulations or initiatives. At the same time, Government regulation and compliance was identified by 12.7 per cent of innovation-active businesses as a barrier to their attempts at innovation. Financial and Insurance Services was the industry with the highest proportion of innovation-active businesses reporting regulation affected their innovation efforts, both positively and negatively (Figure 6.4).

Frequent regulatory changes can stifle innovation activity and investment by introducing uncertainty to business planning, increasing the costs of development or undermining the viability of entire ventures. Regulatory stability can encourage and incentivise innovation by setting clear quality, environmental and ethical standards, providing confidence to consumers in both domestic and foreign markets.

Figure 6.4: Government regulations as a driver or barrier to innovation in innovation-active businesses, 2014–15



Notes: Barriers — respondents identified government regulations and compliance; Drivers — innovative activity was in response to government regulations or initiatives.

Source: ABS (2016) *Innovation in Australian Business, 2014–15*, cat. no. 8158.0

Further regulatory reform could boost innovation

While regulation is not seen as a major barrier to innovation by Australian firms, some areas could be improved. The *ISR System Review* identified a number of areas for regulatory improvement, some of which include improving intellectual property arrangements, strengthening insolvency laws, and reforming planning and zoning regulations.³⁴ Reform is underway in many of the identified areas, through the National Innovation and Science Agenda and other initiatives.

6.4 Finance

Risk capital access

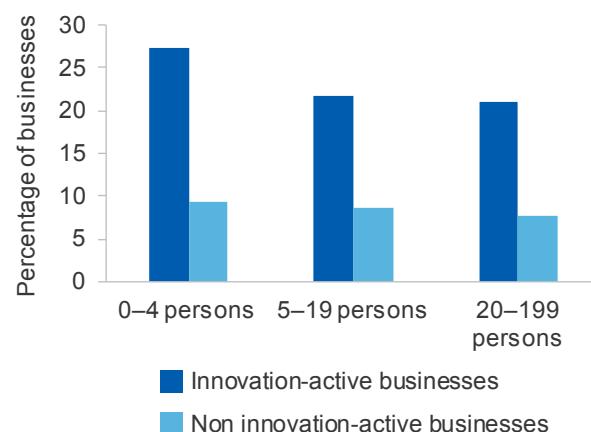
At the SME end of the business size spectrum, access to risk capital appears to be a major hurdle for innovative Australian businesses. In 2015–16, between 21 and 27 per cent of innovation-active SMEs reported lack of additional funds as a barrier to innovation (Figure 6.5). The *ISR System Review* also found that while financial markets generally function well, access to risk capital is a constraint for Australian businesses.³⁵

A relatively large proportion of Australian SMEs do not seek external finance, and those firms that do so are more likely to seek debt finance, rather than equity finance. In 2015–16, only 12 per cent of micro-businesses, 19 per cent of small businesses and 24 per cent of medium-sized enterprises sought debt or equity finance (Figure 6.6). Of these, around 94 per cent sought debt finance and only around 24 per cent sought equity finance. The rate of success for debt finance acquisition was in the range of 88–95 per cent. For equity finance, however, the success rate ranged between 50–53 per cent.³⁶

The types of finance sought by SMEs can have implications for their future growth and are heavily influenced by the risk profile and collateral available within the business. Recent research has found that “debt financing appears to be ill-suited for newer, innovative and fast-growing companies, with a higher-risk return profile”.³⁷ A lack of funds for the higher-risk early stages of innovation may impose significant limitations on the growth potential of innovative and disruptive firms in Australia.

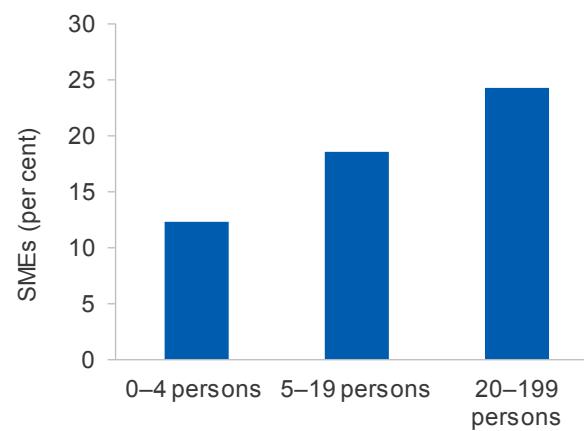
Furthermore, the interest rate disparity between loans to SMEs and to large firms has remained high ever since its increase during the GFC. This is likely underpinned by SMEs’ share of total outstanding loans, which increased by 4.6 percentage points between 2007 and 2015. While the average interest rate charged to Australian SMEs declined by 2.4 percentage points between 2007 and 2015, it is still high compared to most other OECD countries.³⁸

Figure 6.5: SMEs identifying ‘lack of access to additional funds’ as a barrier to innovation, 2015–16



Source: ABS (2017) *Characteristics of Australian Business, 2015–16*, cat. no. 8167.0.

Figure 6.6: SMEs that sought debt or equity finance, by business size, 2015–16



Source: ABS (2017) *Characteristics of Australian Business, 2015–16*, cat. no. 8167.0.



Case Study: Nautitech

Nautitech



Nautitech has undergone many ups and downs since being founded in 2001, and at one point came close to failure.

The company was founded by two engineers to develop equipment for the marine and mining markets. After a few years it was split when they decided to go in different directions. Retaining the name but focusing on the mining industry, Nautitech today designs, develops, manufactures and installs specialised mining equipment. Its customers are extractive mining companies and multinational mining equipment manufacturers.

Growth and crisis

Nautitech has had two periods of high-growth (2010–12 and 2014–16) separated by a deep crisis.

In the early years, the company remained small with a narrow product range. The founders' knowledge of the market and technology guided the company's

strategy and led product development. Growth was slow, and decision-making, management and administration systems remained largely informal.

The mining boom brought rapid change — sharply growing demand with little pressure on prices. Over the three years from 2010, revenue tripled and the number of employees increased by more than five times, to 33.

However, the rapid growth during the mining boom masked a deeper issue. The inadequacy of the company's largely informal approaches to product design and quality control became evident as complaints and product returns increased. Nautitech's reputation and sales declined, followed closely by staff morale — putting out the fires created by these issues absorbed their energy.

The emphasis on the design and manufacture of devices during the first phase of rapid growth caused the company to underestimate the need for stronger management systems. This focus led to missing an important change in the market, namely that mining companies were increasingly seeking lifetime product support services, rather than only hardware. Other competitors noticed this change earlier and, as a result, captured Nautitech's market share. Nautitech failed to recognise the need for both management and business model innovation.

Survival strategy

In 2011, the CEO began to address the quality issues by contracting Alex Lester, then an independent consultant, to advise on systems for on-time delivery, cost reduction and continuous improvement.

But by then the mining boom was coming to an end. The price of coal dropped by more than 50 per cent, mines closed and investment almost stopped. Sales dissipated — Nautitech's revenue declined by over 30 per cent each year for two years. And at this low point, Nautitech's CEO and co-founder died suddenly — the firm's survival was in doubt. Despite the risks and challenges, the remaining owner, Aga Blana, decided to back the survival strategy proposed by Alex and reinvest in the company. Alex was appointed general manager and set about addressing the firm's strategic, managerial, technical and marketing shortcomings.

Nautitech's new survival strategy, which also became a foundation for renewed growth, had four elements.

"We had to re-engage with our final customers and build a reputation for integrity," says Alex.

"While we had good relationships with the suppliers of equipment on which our devices were installed, we hadn't invested in building close links with the users of that equipment, the final customers".

For this, it was essential to focus on the value proposition for the final user, in addition to product engineering and integration.

Continuous improvement

Systematic learning tools and processes were introduced to identify the problem causes and develop continuous improvement.

"We formed improvement teams to implement LEAN and Six Sigma quality management tools. Previously, the causes of product failures, the sources of costs, or how our designs reflected the priorities of customers was just not known," Alex explains.

Now confident of the reliability of their new products, and with clear information on production costs for each product, Nautitech could lower margins and win market share. This was the beginning of a resurgence and the second period of fast growth.

New growth but old wounds

The stress of the downturn had left a mark — morale suffered through the years of turmoil and poor product performance.

"Our sales team were reluctant to even go out and face our customers," says Alex.

To build a more inclusive team culture, revenue-sharing incentives and a bonus system were introduced, seniority privileges such as car spaces were removed, and career paths to management were clarified. The management assured staff there would be no redundancies. Some, who felt that their status was threatened or their benefits had been reduced, resisted these culture-change initiatives. Some left.

As the benefits of these changes began to show, and growth began to pick up, the firm could attract talent and deepen management and engineering capability.

"They were attracted by our success," explains Alex.

"Word got around that it was a great place to work, with challenging and stimulating innovation projects".

Growth in 2014–15 exceeded 30 per cent.

Innovation initiatives

Nautitech launched three innovation initiatives.

1. Business model innovation

Refocusing the value proposition on the needs of the final customer led Nautitech to provide ongoing support for the installation, maintenance and improvement of its devices.

This required building a direct relationship with users rather than relying on equipment producers to install and market the devices. As the firm evolves beyond focusing on product design and manufacturing, Nautitech will likely require further business model improvements, involving greater innovation in software and the capacity to contribute to the performance of overall mining operations.

2. Management innovation

The Six Sigma, LEAN and Continuous Improvement methodologies were adapted and introduced across all functional areas, including product development, production and marketing. These management innovations were embedded in a values-based approach to corporate culture.

"We aimed to rebuild the firm on a foundation of integrity: high-integrity relationships with customers, employees involved in decision-making and hiring new staff based on character and integrity more than skills," says Alex.

3. Solutions focus

The third improvement involved developing new products and a culture of disciplined innovation based on defined processes and focussed on customer priorities.

Institutionalising a culture of innovation linked with the changes to Nautitech's business model led the company to focus increasingly on customer solutions, rather than just on products. When developing new products, Nautitech now collaborates with a coal miner (Glencore), a mining equipment firm (Komatsu Mining) and two research organisations (CSIRO and the University of Technology Sydney), and is discussing further collaboration with other research groups.

Increasing automation in mining is driving a need for a wider range of sensors and a greater

capacity to link, collect, integrate and interpret diverse data streams — which translates into market opportunities for Nautitech.

Using a modified stage-gate innovation approach,^(ag) Nautitech's portfolio of new products is reviewed every two weeks, and the time to market has been more than halved. Alex adds: "We also work with external engineering groups for aspects of new product development where they can be faster or cheaper than an in-house team for that work".

Ongoing evolution

As opportunities are likely to decline in the underground coal industry in Australia, Nautitech recognises it must invest in developing new products, markets, relationships and capabilities. It must continue to evolve from a product company to a solutions provider, with the systems and culture to support this.

"We have started trials in hard rock underground mines in South Africa and Poland, and won our first sales in South Africa. Exports to other markets and acquisitions are now on our radar," says Alex.

(ag) A Stage-Gate system is a conceptual and operational road map for moving a new-product project from idea to launch. Stage-Gate divides the innovation effort into distinct stages separated by management decision gates (gatekeeping).

Venture capital investment is low in Australia

Venture capital (VC) investments depend on considerable information sharing between venture capitalists, entrepreneurs, and others in the innovation ecosystem, such as bankers, fund managers, advisors and technology specialists. It's estimated this type of activity generates significant positive knowledge spillovers to other firms.³⁹ The role of venture capital in funding Australia's high-growth firms is described in the feature article titled *Australia's venture capital and private equity market* in Section 5.6.

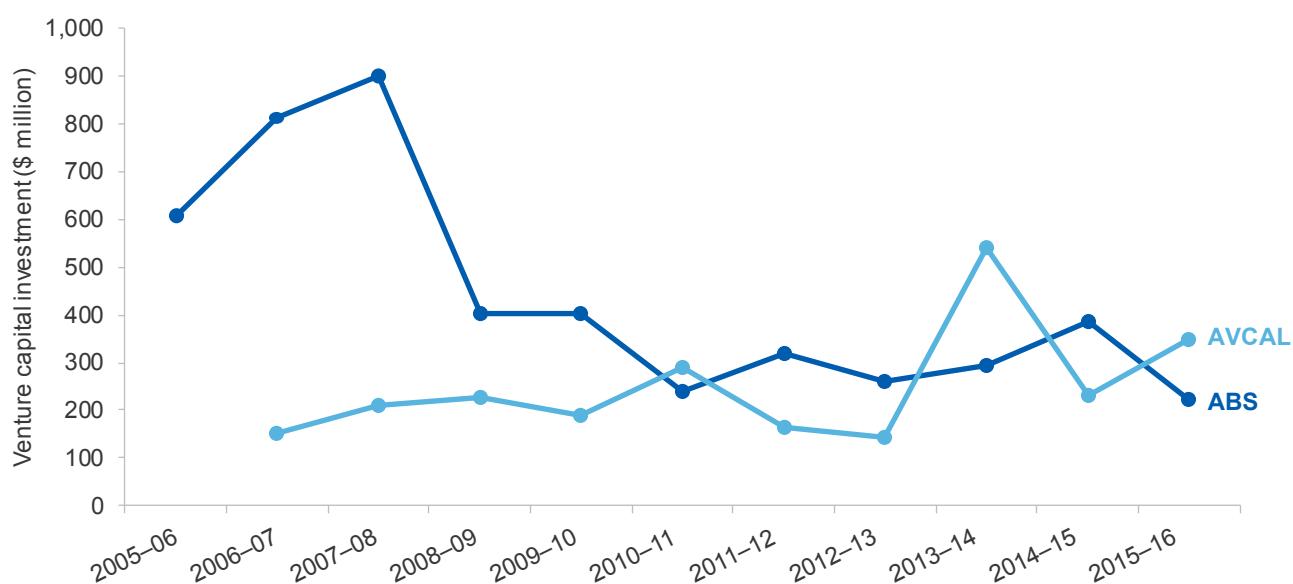
The GFC caused a prolonged slump in Australia's VC market, but there are some signs the number of investment deals is starting to recover, as the number of pre-seed, seed and start-up investments has been increasing since 2013–14.

Annual VC investment data from ABS shows volatile swings in recent years, growing from \$295 million in 2013–14 to \$383 million in 2014–15 before falling to \$223 million in 2015–16 (Figure 6.7). This data, however, pre-dates implementation of some

of the NISA changes, including the Biomedical Translation Fund and the changes to Early Stage Venture Capital Limited Partnerships (ESVCLPs) that may significantly increase VC funding.⁴⁰ In contrast, AVCAL reports that in 2015–16 there was a record 48 per cent increase in VC investment from \$233 million in 2014–15 to \$346 million in 2015–16.⁴¹ The difference in these two data sources stems from different scopes and definitions of venture capital in their respective surveys (for example, the ABS survey, which is a census of all investment vehicles active in Australia, omits investments by non-resident funds in Australian investee companies. On the other hand, AVCAL's survey does not include the pre-seed stage of investment).

Based on ABS data, investment from the venture capital sector in Australia continues to rank well below other OECD countries, at 0.013 per cent of Australia's GDP, less than half of the 0.054 per cent OECD average (Figure 6.8). Research by the Office of the Chief Economist found that the largest share of venture capital investment goes not to young start-ups but to more mature firms aged five years or older.⁴²

Figure 6.7: Venture capital investment in Australia, 2005–06 to 2015–16



Source: ABS (2017) *Venture Capital and Later Stage Private Equity, Australia, 2015–16*, cat. no. 5678.0.

Figure 6.8: Venture capital investment as a percentage of GDP, 2016



Notes: 2014 data is used for Israel and Japan.

Source: OECD (2017) *Entrepreneurship at a Glance 2017*.

Informal investment is strong

Informal investment is strong in Australia, with the prevalence of business angels at 4.1 per cent of the population in 2016.^{(ah), 43} This equates to about 0.6 million informal investors financing entrepreneurial ventures in Australia. This is comparable to the US at 4.2 per cent and above the 3.4 per cent average for developed economies. However, at just over \$75,000, the average amount invested in Australia is well above that of both the US (\$21,000) and the developed country average (\$48,000).

Foreign direct investment is growing

Foreign direct investment (FDI) and foreign ownership in companies are associated with higher degrees of innovation novelty and are more likely to achieve new-to-world innovation than businesses 100 per cent domestically owned.⁴⁴ After large falls in 2014 and 2015, FDI inflows increased by 150 per cent in 2016 to \$64.8 billion, ranking Australia 4th in the OECD, up from 10th in 2015.⁴⁵ A large portion (\$18 billion) of this investment was directed to the mining sector which accounts for 39 per cent of Australia's total FDI stock, but in recent years foreign investment has increasingly flowed into service industries.⁴⁶

(ah) A business angel is an individual who uses his own funds to contribute capital for the development of a business. Business angels are typically wealthy individuals aiming to help entrepreneurs and small business start-ups succeed.

6.5 Digital economy

Digital innovation is increasingly important

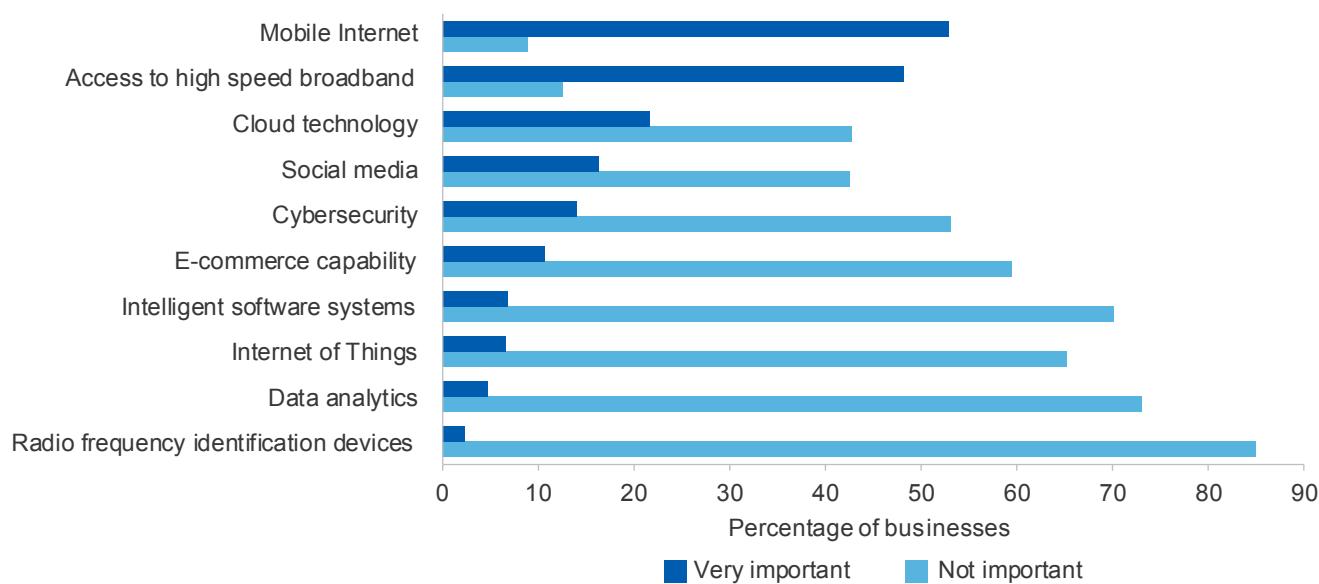
Adoption and use of ICT can lead to improved innovation performance and productivity growth.⁴⁷ The use of digital technologies can drive innovation by reducing transaction costs, enhancing communication, and further enabling the diffusion of ideas within and between organisations. Firms using data-driven innovation have raised productivity faster than non-users by approximately 5–10 per cent, according to the OECD.⁴⁸ Digital technologies can also have positive spillover effects within and across industries.

In Australia, businesses seem to be embracing digital technology. Income generated over the internet in 2015–16 was more than \$320 billion, up from \$144 billion five years earlier. In 2015–16, more than half of Australian businesses placed orders via the internet, almost 40 per cent had a social media presence, and 30 per cent used paid cloud computing services.⁴⁹

By international standards, however, there are elements of the digital economy where Australia is lagging behind other developed countries. Australia's investment in ICT as a percentage of GDP in 2015 was just over 2 per cent, below the OECD average of 2.3 per cent, putting Australia at 18th out of 32 OECD countries.⁵⁰ Similarly, Australia is typically below the OECD average for BERD in the ICT sector as a percentage of GDP, despite it being almost a third of Australia's total BERD. Investment in Australia's digital economy is incredibly important, especially as some estimate that digital technology can be expected to add between \$140 and \$250 billion to Australia's GDP by 2025.⁵¹

Regarding specific technologies, mobile internet and access to high speed broadband are considered to be most important among Australian businesses (Figure 6.9). Some industries are more predisposed to pursuing specific technologies (e.g. data analytics and intelligent software systems are most important for Mining). There is still considerable scope for a broader adoption of emerging technologies, such as the Internet of Things (IoT), data analytics, or intelligent software systems, which have been identified to be among the most promising in their potential contribution to productivity growth.⁵²

Figure 6.9: Importance of digital technologies, by technology, 2015–16



Notes: 'Importance' adapted from survey responses to the extent of digital technology importance.

Source: ABS (2017) *Business Use of Information Technology, 2015–16*, cat. no. 8129.0.

Evidence suggests that investment in digital technologies alone is not enough to drive innovation and productivity growth.⁵³ Effective use of ICTs depends on complementary investment in management capability and knowledge-based capital, in particular, firm-specific skills, and organisational change, including new business processes and business models.^{54, 55}

Australian businesses, however, do not seem to be investing in management capability to enable effective use of digital technologies. In 2015–16, more than 70 per cent of Australian businesses indicated that they had not implemented any management practices for the use of ICT and/or the internet. Similarly, business investment in new ICTs is low, with only 8.1 per cent of businesses investing in new digital technologies, and 11 per cent upgrading their cybersecurity, in 2015–16.⁵⁶

Policy and regulatory settings

Framework conditions have an important part to play in encouraging the uptake of digital technologies. Policy and regulatory settings to stimulate digital innovation may include, for instance:⁵⁷

- improving conditions for digital innovation by encouraging ICT diffusion, supporting innovation networks or expanding access to finance
- stimulating the creation of data analytics capacity, for example by investing in technologies and training
- facilitation of organisational change within/among firms, such as by encouraging teleworking and teleconferencing.

Looking into the state of digital disruption in Australia, the Productivity Commission recently found that “some regulations and regulatory approaches are explicitly preventing the development and efficient adoption of [digital] technologies”.⁵⁸ The findings were wide-reaching, but provide some guidance on areas that Australia’s framework conditions — as far as they relate to digital innovation — can improve. Looking internationally, the OECD’s *Digital Economy Outlook 2017* places Australia at or better than the OECD average, “suggesting that framework conditions in Australia are more favourable to the creation of innovative start-ups, new business models and new services enabled by digital technologies”.⁵⁹



Feature Article: Innovation and high-growth firms

Alex Coad

CENTRUM Católica Graduate Business School; Pontificia Universidad Católica del Perú, Lima, Peru

Jose Manuel Leceta

Former Director of the European Institute of Innovation and Technology (EIT); Currently Director General of Red.es, Madrid, Spain

High-growth firms (HGFs) have generated a lot of excitement in recent years, because of their potential to make a huge contribution to job creation, productivity growth, and economic development.

Many studies, focusing on OECD countries, have shown that 4 per cent of firms, or perhaps fewer, create about 50 per cent of the jobs.

HGFs can also play an important role in the emergence of new innovative industries, such as Microsoft, Intel and Amazon in the sectors of ICT and internet retailing.

Last but not least, HGFs can be a formidable driving force in an innovation system to re-energize mature sectors.

HGFs are in all sectors

The prototypical ‘Schumpeterian’ entrepreneur is a charismatic individual who brings to market a

new innovative business idea, and who generates sufficient interest from stakeholders and wider society that the firm experiences fast growth. Indeed, some entrepreneurship scholars write that entrepreneurship is innovative and high-growth by definition (which, if true, means that it becomes tautological and meaningless to inquire into the contribution of entrepreneurship to innovation and growth).

The evidence suggests, however, that HGFs are not more common in high-tech sectors — HGFs are found in all sectors, and in fact they appear to be relatively under-represented in high-tech manufacturing sectors. Nevertheless, it may be that HGFs are relatively high-tech when compared to their peers within their low-tech sectors. For example, IKEA revolutionised the generally low-tech furniture industry.

HGFs are a problematic target for policy

HGFs have therefore attracted lots of interest from investors keen to make a handsome return, as well as from policymakers keen to repeat the success stories of recent years.

HGFs are a problematic target, however, for two main reasons.

First, it is overall quite difficult to predict which firms will grow fast. There are a few variables that help predict which firms will, on average, have faster growth rates. Young firms, for example, tend to have higher average growth rates, especially in the first few years immediately after entry. Smaller firms generally grow faster than larger firms, although there are many large firms that become

HGFs. Questionnaire-based evidence shows that a founder's stated desire to grow is sometimes (but not always) associated with subsequent growth of the firm. Other variables relating to the entrepreneurs (such as education and experience of the founding entrepreneurs) or the firm (such as legal form, financial performance or previous growth) or environment (such as geographical region or sectoral affiliation) can be shown to have an effect, although the effect is so small that, overall, scholars have suggested that firm growth is best approximated by a random statistical process. And if growth is random and unpredictable, this makes it difficult for policy to directly target HGFs.

Second, and relatedly, there is remarkably little persistence in rapid growth. Even if a firm grows fast in one year, it is unlikely to repeat this performance in the next year. Repeated fast growth events do happen — just as it does happen that a lucky dice player might roll three sixes in a row. However, repeated fast growth is rare, and difficult to predict. Scholars have written about HGFs as “one-hit wonders.” Hence, by the time you have found an HGF, you have probably already missed the action, because HGFs are unlikely to continue growing into the future.

The challenges of supporting HGFs

The difficulties of predicting which firms will become HGFs, and the lack of persistence in high-growth episodes, mean that it is difficult to target or support HGFs.

Some variables, such as young age, or being incorporated or having a patent, improve the probability of high-growth to some extent, and so these firms can be kept in the portfolio of potential HGFs. Old small firms run by solo-entrepreneurs are unlikely to become HGFs, so these firms can be dropped from the portfolio. A broad-based portfolio investment approach needs to be followed, however, because picking out an individual firm as a future HGF is prohibitively difficult — for investors as well as for policymakers. The evidence also shows that boosting the raw number of business start-ups will not increase the number of HGFs, because there seems to be a trade-off between quantity and quality of new firms.

Removing barriers to growth

Policymakers have also sought a ‘detour’, a less direct approach, to remove the contextual barriers that might be hindering (potential) HGFs. Removing barriers to growth seems to be a no-regret policy.

Questionnaire evidence has highlighted a number of barriers to growth. HGFs often face difficulties in finding skilled employees. HGFs sometimes face problems with bureaucracy as well, although it should be remembered that bureaucratic procedures are supposed to be in place for good reasons (i.e. to foster public interests and the common good). Potential HGFs might have problems in finding sufficient financial resources to realize their entrepreneurial visions, but it should also be noted that many entrepreneurial visions turn out to be mistakes, and they should not all be funded. HGFs might also complain about facing too much competition, which of course does not imply that the optimal policy response would be to reduce competition. Finally, another consideration is that encouraging firms to grow excessively fast might actually push them into financial problems (where the costs of growth outweigh the incoming cash flow) and ultimately into bankruptcy.

HGFs as part of a multi-faceted ecosystem

We argue that HGFs do indeed play an important role in shaping and activating an innovation system from the bottom-up — but that they participate in a multifaceted ecosystem that includes many partners and stakeholders.

HGFs play an important role, but they are not a sufficient ingredient for economic success per se — an innovation system requires other agents too, such as removing barriers to facilitate growth.

Furthermore, given that HGFs interact with many stakeholders, and require the assistance of many agents (such as providers of finance, a skilled workforce, an entrepreneurial culture, and suppliers, clients, and collaboration partners) as well as supportive values and attitudes (such as an entrepreneurial culture, ‘born-global’ ambitions, mobility of resources, and the alignment of incentives), policy should focus on the broader ecosystem, rather than chasing in vain after elusive unicorns.

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Glossary



Absorptive capacity

Absorptive capacity is a business's ability to identify, acquire, transform and exploit knowledge that is external to the business. Measures such as research and development expenditure, number of researchers in the business and survey methods are used to measure absorptive capacity.

Business angel

A business angel is an individual who uses their own funds to contribute capital to the development of a business. They are typically wealthy individuals aiming to help entrepreneurs and small-business start-ups succeed.

Business expenditure on R&D (BERD)

R&D expenditure undertaken by the industry sector only.

Business size

According to the Australian Bureau of Statistics:

- Large businesses are considered those employing 200 or more persons
- Medium-sized enterprises are those employing 20 to fewer than 200 persons
- Small businesses are those employing between 5 and 19 persons
- Micro-businesses are those employing fewer than 5 people
- Non-employed businesses are those run by their owners.

Small to medium-sized enterprises (SMEs) are defined as businesses that employ 1 to fewer than 200 persons.

The OECD defines SMEs as businesses which employ fewer than 250 employees, while the United States considers SMEs to include businesses with fewer than 500 employees.

Business Characteristics Survey (BCS)

The BCS is an annual survey and the vehicle for the ABS' Integrated Business Characteristics Strategy. The strategy is designed to integrate the collection and quality assurance of data required for input into both the ABS' Business Longitudinal Database and the production of point in time estimates for: use of information technology; innovation; and, a broad range of other non-financial characteristics.

A key part of the BCS is a detailed set of questions on business innovation asked every second year. This is why some business innovation data presented in this report is only available every second year. The detailed survey includes questions on drivers, sources of ideas and collaboration for innovation.

Business Longitudinal Analytical Data Environment (BLADE)

The ABS' BLADE is a series of integrated, linked longitudinal datasets over the period 2001-02 to 2013-14. It is based on retrospectively reconciling the different reporting structures in ATO and ABS data to facilitate linking survey and administrative data for businesses.

The survey data used here is from two sources: the Business Characteristics Survey, and the Business Expenditure on Research and Development. The administrative data is sourced from the Australian Taxation Office and includes Business Activity Statements and Pay-As-You-Go. Demographic information, such as business age or industry classification, are also derived by a combination of data from the ABS Business Register and historical ATO reporting patterns.

Business economy

The OECD defines the business economy according to the International Standard Industrial Classification of all economy activities Revision 4. It effectively includes all non-public sector businesses. It comprises Mining and quarrying, Manufacturing, Electricity, gas, steam and air conditioning supply, Water supply, sewerage, waste management and remediation activities, Construction and Services, Wholesale and retail trade, repair of motor vehicles and motorcycles, Transportation and storage, Accommodation and food service activities, Information and communication, Financial and insurance activities, Real estate activities, Professional, scientific and technical activities, and Administrative and support service activities. For this report, it excludes holding companies.

Capital expenditure

Capital expenditure, or Capex, are funds used by a company to acquire or upgrade physical assets such as property, industrial buildings or equipment. It is often used to undertake new projects or investments by the business.

Collaboration

Collaboration amounts to interactions both among organisations and between organisations and their surroundings. Systems approaches often highlight linkages as the most vital area for promoting innovation activity. These interactions can consist of informal contacts and information flows, or more formal collaboration on innovation projects. They include adjustments in the value chain, such as closer relationships with suppliers or users, or research on market demand or on the potential uses for technologies.

Businesses may have close relationships with other businesses within an industry cluster, global supply or production chain or be part of looser networks. They may draw on published work from public research institutions or work directly with them on collaborative projects. The lowest level of links between businesses is when a business draws on information belonging to another business that is openly available and that does not require the purchase of technology or intellectual property rights, or interaction with the source.

Linkage may also involve acquisition of knowledge and technology through procurement of external knowledge and/or purchase of capital goods and services (machinery, equipment and software) which have knowledge and technology embodied them. The benefits of linkages will depend on how well knowledge is shared throughout the enterprise and channelled into the development of new products, processes and other innovations.

Competitiveness

The competitiveness of trade-exposed businesses is defined as their ability to succeed in international competition against leading international competitors. For businesses that are non-trade exposed, competitiveness is defined by their ability to be as efficient and effective as global leaders in their industry.

Competitive advantage

Competitive advantage is the value a business can create for its buyers that exceeds the business's cost of creating it. Value is what buyers are willing to pay, and superior value stems from offering either lower prices than competitors for equivalent benefits or providing unique benefits that more than offset a higher price.

Creative destruction

Creative destruction refers to the continual process by which new product and process innovations replace, or 'destroy' outdated ones. The term was coined by Joseph Schumpeter in the early 1940s.

Diminishing returns

Diminishing returns is the reduction in the marginal output associated with a single input to the production process as the quantity of this input is increased, holding other factors of production (such as labour or capital) constant. This law explains why innovation and human capital are such significant contributors to productivity growth, as unlike other production inputs, such as labour, land and capital, they tend not to exhibit diminishing returns.

E-commerce

E-commerce relates to the purchase or sale of goods or services, or the transmission of funds or data, via the Internet.

Endogeneity

In econometrics, an endogeneity problem occurs when an explanatory variable is correlated with the error term, which causes the estimates of the regression coefficients to be biased. Endogeneity can happen due to various reasons including measurement error, selection bias, omitted variables and reverse causality.

Entrepreneurship

Entrepreneurship has been typically referred to as a creative, risky and innovative idea, activity or process that is converted into new products, processes and organisational forms which enhance economic development and growth. Despite definitional differences it is generally agreed that entrepreneurship is both a driving force of and a challenge for young start-ups that lack funds, human capital and relevant experience.

Entrepreneurial business

'Entrepreneurial businesses' are new businesses that are not subsidiaries or spin-offs from existing businesses and are not in the financial investment or superannuation industries.

Export and import of goods and services

Exports of goods and services consist of sales, barter, or gifts or grants, of goods and services from resident to non-residents, while imports consist of purchases, barter, or receipts of gifts or grants, of goods and services by residents from non-residents. International transactions in services differ in many respects from those in goods. The production and the delivery of a service is usually a single operation carried out by agreement between producer and consumer, which requires some prior contact between them.

Goods cover general merchandise, goods for processing, repairs on goods, goods procured in ports by carriers, and nonmonetary gold. By general balance of payments principles, change of ownership is the principle determining the coverage and time of recording of international transactions in goods. Exports and imports of goods are recorded at market values at points of uniform valuation, that is, the customs frontiers of exporting economies.

Framework conditions

The efficacy of an innovation system often hinges upon the quality of framework conditions, namely the capacity to ensure an innovation-friendly environment. This is shaped not only by R&D but also by the interplay of factors which enable knowledge to be converted into new products, processes and organisational forms which in turn enhances economic development and growth. Framework conditions encompass the quality and reach of governance in a country, an effective banking and financial system, an honest and functioning judiciary, and working educational and health systems.

Full-time equivalent (FTE)

Full-time equivalent (FTE) is a measure of the total level of staff resources used by firms. The FTE of a full-time staff member is equal to 1.0. The calculation of FTE for part-time staff is based on the proportion of time worked, compared to that worked by full-time staff performing similar duties. While FTE includes full-time and part-time workers, it does not include contractors.

Gazelle

The term 'gazelle' used in this report relates to firms up to 5 years of age with at least 10 employees that exhibit average annualised growth (e.g. in turnover or employment) of at least 20 per cent per annum, over a three-year period.

Gibrat's Law

Developed by Robert Gibrat in 1931, Gibrat's law states that firm growth rates occur independent of size. It is the first attempt to explain in stochastic terms the systematically skewed pattern of the distribution of firms' size within an industry.

Global Financial Crisis (GFC)

The economic downturn of 2007-08. It was a global phenomenon of economic difficulty experienced by markets and consumers. The downturn was caused by a multitude of complex economic factors including unnecessary risk-taking by the financial sector, macroeconomic conditions and speculative behaviour.

Gross Domestic Product (GDP)

GDP can be defined according to three different methods:

- output based definition: Gross domestic product is an aggregate measure of production equal to the sum of the gross values added of all resident institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs). The sum of the final uses of goods and services (all uses except intermediate consumption) measured in purchasers' prices, less the value of imports of goods and services, or the sum of primary incomes distributed by resident producer units
- expenditure based definition: Expenditure-based gross domestic product is total final expenditures at purchasers' prices (including the f.o.b. value of exports of goods and services), less the f.o.b. value of imports of goods and services
- income based definition: Income-based gross domestic product is compensation of employees, plus taxes less subsidies on production and imports, plus gross mixed income, plus gross operating surplus

Industry sector

For indicators for which internationally comparable data exists, the industries have been defined in accordance with the International Standard Industrial Classification of All Economic Activities (ISIC), Rev.3.

For national data, industries are defined according to the 2006 Australian and New Zealand Standard Industrial Classification (ANZSIC).

Gross expenditure on R&D (GERD)

Gross expenditure of R&D represents the total expenditure devoted to R&D by the business, government, private non-profit and higher education sectors.

High-growth firms (HGFs)

For this document, we have followed the OECD definition of high-growth firm, but have also adopted alternate measures to better capture Australia's growth dynamics. Definitions of all measures used are as follows:

■ OECD Employment HGF

The OECD defines an Employment HGF as a firm with at least 10 employees at the start of the period that has achieved over 20 per cent average annualised growth in the number of full-time equivalent employees over a 3-year period.

■ OECD Turnover HGF

The OECD defines a Turnover HGF as a firm with at least 10 employees at the start of the period that has achieved over 20 per cent average annualised growth in turnover over a 3-year period.

■ Employment HGFs

To capture a better picture of Australian firms' growth dynamics, this report uses a modified version of the OECD definition of Employment HGFs. This comprises firms with at least five employees which achieve at least 20 per cent average annualised growth in the number of FTE employees over the three-year measurement period. See Section 2.1 for further details.

■ Turnover HGFs

To capture a better picture of Australian firms' growth dynamics, this report uses a modified version of the OECD definition of Turnover HGFs. This definition comprises all employing firms that achieve at least 20 per cent average annualised growth in turnover over the three-year measurement period. See Section 2.1 for further details.

■ R&D HGFs

R&D HGFs are all firms undertaking R&D which achieve at least 20 per cent compound average annualised growth in R&D expenditure over a three-year period. R&D HGF proportions are calculated for all firms undertaking R&D which have five employees or more. See Section 5.4 for further details.

Higher education expenditure on R&D (HERD)

R&D undertaken by universities and other research institutions.

Human capital

Human capital relates to the skills, knowledge, and experience of an individual, viewed in terms of their value to a firm or country and is a measure of the economic value of an employee's skill set.

Innovation

Innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

Innovation activity

Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Some innovation activities are themselves innovative; others are not novel activities but are necessary for the implementation of innovations. Innovation activities also include R&D that is not directly related to the development of a specific innovation.

Innovative firm

An innovative firm is one that has implemented an innovation during the period under review.

Innovation-active businesses

An innovation-active business is one that has undertaken any innovative activity, irrespective of whether the innovation was introduced, still in development or abandoned during the reference period. Four types of innovation are distinguished: product innovations, process innovations, marketing innovations and organisational innovations.

■ Product innovation

A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user-friendliness or other functional characteristics.

■ Process innovation

A process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.

■ Marketing innovation

A marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

■ Organisational innovation

An organisational innovation is the implementation of a new organisational method in the business's business practices, workplace organisation or external relations.

Innovation system

In this document, an innovation system is defined as an open network of organisations both interacting with each other and operating within framework conditions that regulate their activities and interactions. Three components of the innovation system: networks; innovation activities; and framework conditions, collectively function to produce and diffuse innovations that have, in aggregate, economic, social and/or environmental value.

Intellectual property rights

Clear intellectual property rights are vital for improving incentives to innovate in some industries, particularly in high-technology sectors where R&D plays a central role in innovation. Laws and regulations are part of the framework in which businesses operate. Well-designed regulations and standards can provide a strong signal to support and guide innovative activities. They affect access to information, property rights, tax and administrative burdens (in particular for small businesses). Some enterprises may even avoid some types of highly complex links if they have concerns about the loss of intellectual property. A number of methods are used for protection of intellectual property:

- patents
- registration of design
- trademarks
- copyrights
- confidentiality agreements and trade secrecy
- secrecy that is not covered by legal agreements
- complexity of product design
- lead time advantage over competitors.

Innovator and adaptor types

- New to market international innovators. These firms have introduced a product innovation (good or service) that is new to international markets and have developed new products or processes in-house or in collaboration with others.
- New to market domestic innovators. These firms introduced one or more product innovations that are new to domestic markets only. These innovations were developed in-house or in collaboration with others.
- International modifiers. These firms introduced one or more products already available on international markets. These innovations were developed in-house or in collaboration with others.
- Domestic modifiers. These firms have introduced one or more products that exist already on international or domestic markets. These innovations were developed in-house or in collaboration with others.
- Adapters. These firms introduced one or more products that already exist internationally, but unlike domestic modifiers, adapters do not develop products in-house but acquire innovations from others without making modifications to them.
- Businesses with ongoing or abandoned innovation. These businesses have undertaken innovation projects or activities that have either been abandoned or have not yet been finalised.

National Innovation System

An innovation system is an open network of organisations both interacting with each other and operating within framework conditions that regulate their activities and interactions. Three components of the innovation system: networks; innovation activities; and framework conditions, collectively function to produce and diffuse innovations that have, in aggregate, economic, social and/or environmental value.

New-to-market innovation

New to the market innovations include innovations that were any of the following:

- new to the world
- new to Australia but not new to the world
- new to the industry within Australia, but not new to Australia or the world.

For more information, see novelty.

Management Capability

Management capability relates to how effective a firm's management is. It is thought to be a critical contributor to firm growth. In theory, competent managers can endorse firm growth by promoting a better utilisation of firm resources.

Novelty

All innovations must contain a degree of novelty. Three concepts of the degree of novelty of innovations are: new to the business, new to the market and new to the world.

New to the business innovation

The minimum entry level for an innovation is that it must be new to the business. A product, process, marketing or organisational method may already have been implemented by other businesses, but if it is new to a given business, then it is an innovation to that business.

New to market innovation

Innovations are new to the market when the business is the first to introduce the innovation on its market. The market is simply defined as the business and its competitors and it can include a geographic region or product line.

New to the world innovation

An innovation is new to the world when the business is the first to introduce the innovation for all markets and industries, domestic and international. New to the world therefore implies a qualitatively greater degree of novelty than new to the market.

Organisation for Economic Co-operation and Development (OECD)

A group of countries working towards common problems of increasing economic growth, welfare and social problems. The list is comprised of Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

OECD Frascati Manual

The Frascati Manual is a manual that provides guidelines for collecting and reporting data on Research and Experimental Development.

OECD Oslo Manual

The Oslo Manual is a manual that provides guidelines for collecting and interpreting innovation data.

Ordinary Least Squares (OLS)

ordinary least squares is a method for estimating the unknown parameters in a linear regression model, with the goal of minimising the sum of the squares of the differences between the observed responses in the given dataset and those predicted by a linear function of a set of explanatory variables.

Panel Data

The term 'panel data', relates to data which comprise observations of multiple variables observed over multiple periods of time, such as a survey completed by the same individuals or firms over several years.

Productivity

Productivity is the ratio of outputs to inputs. It can be measured at the level of the firm, industry or the whole economy. There are a number of ways to measure productivity. Labour productivity is where the only input being considered is labour costs. Multifactor productivity uses labour and capital costs and Total factor productivity uses capital, labour, energy, material and services costs as inputs. Productivity growth occurs when growth in industry outputs exceeds growth in inputs.

Product market regulation (PMR)

Product market regulation is the degree to which policies promote or inhibit competition in areas of the product market where competition is viable.

P-value and statistical significance

The P-value is that it is the probability or likelihood of an event occurring at random if the Null Hypothesis is true. So, the lower the P-value the more likely that there is a 'real' effect, or the result will be statistically significant. The Null Hypothesis is the hypothesis of no effect or association.

Real value

Real values are also known as constant values or inflation adjusted values. The real value is the nominal value adjusted for inflation. Real values are obtained by removing the effect of price level changes from the nominal value of time-series data. Values that are adjusted for inflation enable comparison of quantities over time.

Research and Development (R&D)

Research and experimental development (R&D) comprise creative work undertaken on a systematic basis to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

The term R&D covers three activities: basic research, applied research and experimental development. Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. Applied research is also original investigation undertaken to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

R&D Intensity

At a country level, R&D intensity is defined as R&D expenditure expressed as a percentage of GDP on a national scale. At a firm level, R&D intensity is defined as R&D expenditure expressed as a percentage of firm turnover.

R&D Tax Concession

The R&D Tax Concession was a tax concession available to all firms that incurred R&D expenditures exceeding \$20,000. It was jointly administered by the ATO and AusIndustry until 2011 when it was superseded by the R&D Tax Incentive programme. It captures virtually all business R&D activity undertaken up to 2011.

R&D Tax Incentive

The R&D Tax incentive is a tax incentive introduced in 2011 that is available to all incorporated companies who have incurred at least \$20 000 worth of R&D expenditures. It captures virtually all business R&D activity undertaken since 2011.

Researchers

Researchers are defined as professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, as well as in the management of these projects.

Risk capital

Money explicitly available for investment into a high-risk business or security.

Schumpeterian growth

Schumpeterian growth theory features quality-improving innovations that displace previous technologies, and are motivated by prospective monopoly rents. It predicts that a higher rate of growth should be associated with a higher rate of business entry and exit, and that exit can enhance productivity growth.

Spillover

The situation in which the costs of producing or the benefits of consuming a good spill over onto those who are not producing or consuming it. Spillover effects are also known as externalities.

Science, technology, engineering and mathematics (STEM)

Research or qualifications that are based on science, technology, engineering and mathematics.

Trademarks

Trademarks are the outcome of establishing recognisable designations and symbols for goods and services, as well as businesses' identities. They play a crucial role in the process of marketing innovations, being instrumental in differentiating the attributes of goods and services in the marketplace. Trademark data is considered a useful complementary measure of innovation activity in business compared with patents because of its broader applicability to service industries.

Value added

The amount by which the value of an article is increased at each stage of its production, exclusive of initial costs. In national accounts, value added is often obtained by deducting intermediate consumption from gross output.

Venture capital

Venture capital is defined as high-risk private equity capital for typically new, innovative or fast growing unlisted companies. A venture capital investment is usually a short to medium-term investment with a divestment strategy with the intended return on investment mainly in the form of capital gains (rather than long-term investment involving regular income streams).

The following describes various stages at which a venture capital vehicle may make investments:

earlier stages (includes pre-seed, seed, start-up or early): products are in development, testing or pilot production. Investee companies may not be fully operational and may not yet be generating revenue

expansion (includes early expansion, expansion or late expansion): developed products are in the market and the investee company has significant revenue growth and may be approaching, or at, profitable operating levels

later stages (includes turnaround, late, buy-out or sale): a mature investee company that may require financing for turnarounds (because of flat or declining revenue), consolidation and selling of the business.

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