Australian Government
Department of Industry, Innovation and Science

Office of the Chief Economist

Australian Innovation System Report

2015

WWW.INDUSTRY.GOV.AU/INNOVATIONREPORT

Australian Innovation System Report

Further information

Mr Roger Smith
Innovation Research
Department of Industry, Innovation and Science
GPO Box 9839
Canberra ACT 2601
+61 2 6213 7352
Email: InnovationReport@industry.gov.au

Project Team

Mr Andrew Lalor (Project Sponsor)
Dr Luke Hendrickson (Senior Editor)
Mr Roger Smith (Project Manager/Editor)
Dr Mahmoud Alinejad
Dr Antonio Balaguer
Mr Stan Bucifal
Ms Francy Bulic
Mr Paul Drake
Dr Samira Hassan
Ms Stacey Wilkinson
Dr Katherine Barnes
Ms Laura Jones

Acknowledgements

The Department wishes to acknowledge the contributions of Diane Braskic, David Hansell, David Taylor, Francesca Beddie, David Thomson, Rifat Majumder and Professor Per Davidsson as well as the contributions from the authors of feature articles and businesses, universities and research organisations that provided valuable information for case studies. The report also benefited from valuable comments by various other staff members.

Referencing

ISSN: 978-1-925092-61-5

Images

Provided by contributors and Shutterstock.

Disclaimer

The views expressed in this report are those of the author(s) and do not necessarily reflect those of the Australian Government or the Department of Industry, Innovation and Science.

For more information on Office of the Chief Economist research papers please access the Department's website at: www.industry.gov.au/OCE

Brisbane Australia, Aeypix / Shutterstock.com

Foreword

Massive trucks, their trays heavily laden with iron ore or coal, reflect our previous association with the source of our economic growth. Now it is more likely to be the brilliant chemist who has found a new process to extract minerals more efficiently and her business partner who can see the commercial application.

It will be innovation-led growth, driven by entrepreneurial and disruptive actions that will sustain our role as one of the world's leading economies in the years to come. It was Joseph Schumpeter, the prophet of innovation, who first drew attention to the role of the entrepreneur in driving economic growth and job creation. The entrepreneur is the "the agent of innovation … the pivot on which everything turns".

Innovative entrepreneurs embrace change and disruption. They create new products and business models and leave an imprint across the economy as they do so. This year's Australian Innovation System Report, the sixth in the series, adopts the theme of innovative entrepreneurship.

Disruption is all around us in our hyper-connected and globalised world; where radical change to established ways of doing business is relentless and economies are being transformed at remarkable speed.

While rapid, large scale change can represent a threat, it can also present opportunity. A better understanding of innovation and its complex workings offers a better chance of harnessing Schumpeter's gale of creative destruction to Australia's advantage. More granular and integrated data has made more penetrating analysis possible. The new Expanded Analytical Business Longitudinal Database (EABLD) has enriched our knowledge of firms in our economy. It contains a range of integrated firm-level information for the period 2001–02 to 2012–13 and includes the full population of firms for each year.

Using the EABLD and other sources in this report, we have drawn on new research that examines how innovative entrepreneurs create change as they grow their ventures. Using new data, we examine how start-ups behave differently to more mature businesses. We discuss the wide variety of factors that facilitate this entrepreneurial growth, such as the role of clusters and geography, collaboration with universities, corporate culture and access to specialised forms of finance.

Our series of case studies of innovative Australian companies and the entrepreneurs that brought them to fruition furthers our knowledge of how innovation works in the real world.

Governments can't conjure up entrepreneurs. But they can set the conditions under which entrepreneurs flourish. That means looking at whether the right arrangements are in place to finance new businesses, encourage commercialisation of new ideas, and support research and development. It also means removing the market barriers that favour incumbents and prevent innovative entrepreneurs from challenging entrenched firms on the basis of their new product offerings.

Mark Cully
Chief Economist
Department of Industry, Innovation and Science
November 2015

Contents

Adelaide Australia, Aeypix / Shutterstock.com

Executive Summary

Entrepreneurs mobilise ideas, people and resources to act on business opportunities. Their activities – wreaking disruption and creative destruction – can affect the economy in ways which lead to employment growth, new products and services, as well as different ways of doing things.

By finding new ways of creating, delivering and capturing value, visionary entrepreneurs are important game-changers who defy old business models, rewrite the rules, and define new traditions in their industries. This is essential for Australia in the post mining boom economy where economic progress will increasingly depend on new sources of growth to maintain and improve our standard of living.

The 2015 Australian Innovation System Report explores the entrepreneurship dimension of the innovation system.

The sixth Australian Innovation System Report explores innovation through the lens of entrepreneurship. It brings together analysis of the new Expanded Analytical Business Longitudinal Database (EABLD) and customised data outputs from the ABS Business Characteristics Survey; case studies of innovative Australian companies and entrepreneurs; and feature articles by innovation academics to highlight the entrepreneurship dimension of the Australian innovation system.

This report takes a systems approach to show how the components of the national innovation ecosystem interact. We monitor and assess the performance of the Australian Innovation System over time and in comparison to other nations.

Innovative entrepreneurship refers to activity where innovative SMEs intersect with young and high-growth business. The potential of future innovators to disrupt established market shares in the Australian economy is immense.

Australia is distinct in terms of its high share of small businesses (less than 50 employees) that are start-ups (up to two years). By world standards the level of business start-up activity in Australia is high, driven primarily by a desire to exploit new business opportunities rather than by economic necessity and this shapes the mindset, behaviour and culture of Australian entrepreneurs.

Australia's high rate of start-up activity is at the heart of our employment growth.

Looking at the very earliest stages of business start-up, the Global Entrepreneurship Monitor study estimated Australia's total entrepreneurial activity at 13.1 per cent of the adult population in 2014. This places us amongst the highest of developed economies. This reinforces other data which shows Australia's rate of business entry is one of the highest in the OECD.

Innovative entrepreneurs act as agents of change, creating opportunities for themselves and others. Between 2006 and 2011, the activity of start-ups (firms

two years old or younger) added 1.44 million full-time-equivalent (FTE) jobs to the Australian economy, whereas all other firms shed more than 400,000 FTE jobs. The bulk of this employment growth is driven by a relatively small number of high-growth-orientated start-ups: from 2006 to 2011 just 3.2 per cent of all micro start-ups (less than 10 employees) accounted for 77 per cent of gross job creation by surviving micro-start-ups. These businesses more than compensate for the job destruction of exiting micro-start-ups. They are found in all sectors of the economy.

Factors within the control of the firm, such as investment in innovation, are driving the growth of these highly dynamic Australian start-ups. For example micro businesses that undertake research and development (R&D) are significantly more likely to exhibit higher growth in sales and profitability than similar-sized businesses that do not invest in R&D.

Australia's high start-up rate is a positive indicator of entrepreneurship and, given their potential to contribute to growth, it is of concern that the proportion of start-ups is declining. In 2006, it is estimated that there were 152,000 start-ups representing about 19 per cent of firms. In 2011, however, that number had dropped to 132,000, representing 16 per cent of firms. This decline is apparent across a number of OECD countries and is also reflected in Australia's falling start-up share of total employment and the share of start-ups in gross job creation.

Innovative entrepreneurship is inherently connected to the concept of business age since it involves establishing new and novel business entities, operations or market relationships. In addition to contributing to employment growth, younger businesses are also more likely to report increases in annual sales, profitability, productivity and product range.

While older businesses have higher levels of productivity, younger businesses are more likely to report productivity growth.

As businesses age, they tend to report declines or stagnation in these variables. While older Australian firms usually have higher absolute levels of productivity, new firms are driving productivity growth and innovation. Start-ups aged one year or less are slightly more likely to introduce new or significantly improved goods or services than older firms, and when they do so, their innovations are more likely to be new to their industry rather than just to the firm.

Start-up firms worldwide are also typically the pioneers of business model innovation—innovation that involves changes in multiple components in a business model simultaneously, oftentimes with changes in the entire system. They are more likely than older businesses to use research and scientific, IT professional and marketing skills in their core activities.

These types of skills are the most appropriate for developing the firm's initial product range. On the other hand, more mature firms are more likely to use skills needed for operational efficiency, such as engineering, IT support, trades, plant and machinery, business management and finance.

In the context of business model innovation, 'newness' is an advantage, underpinning superior sales performance, gross operating profit, employment

and value added. Being less constrained by rigid organisation structures, established routines, and lengthy decision-making processes often found in existing organisations, new ventures are swifter in spotting new market trends, more responsive to changes in customer needs, and more efficient in coming up with novel solutions.

The innovation system has an inherent tendency toward geographical clustering. The benefits of clustering extend beyond the economies of scale associated with shared access to infrastructure, skilled labour and other resources. Proximity between firms, universities and research institutions builds trust and cooperation. These help to reduce transaction costs and encourage the exchange of ideas.

Geography matters and regional innovative entrepreneurship is enhanced by the presence of research organisations.

New business entries, patterns of R&D expenditure, and trademark and patent applications provide useful proxy measures of entrepreneurial activity. Our analysis of the geographic patterns of business entries suggests that innovative entrepreneurship in Australia tends to be concentrated in the major metropolitan areas, with Sydney and Melbourne having the highest rate of entries per capita.

In terms of R&D expenditure in a given region, we found a correlation with other innovation proxies such as patents and trademarks. In particular, for every 1 per cent increase in R&D expenditure, a 0.35 per cent increase was estimated in the number of patent applications and a 0.40 per cent increase in the number of trademark applications filed. Additionally, every 1 per cent increase in business entries was correlated with a 2.3 per cent increase in expenditure on R&D. These results confirm the importance of R&D expenditure to knowledge and business creation.

The presence of research organisations in a region further enhances its capacity for innovative entrepreneurship. This is especially the case where Cooperative Research Centres or Centres of Excellence are present. The positive impact of research institutions being in the same region applies in particular to new business entries in Professional, Scientific and Technical Services. This industry, along with the Financial and Insurance Services industry, has high numbers of new business entries and high levels of business expenditure on R&D. Professional services may be a catalyst for innovative entrepreneurship in the Australian economy.

Notable impediments to innovative entrepreneurship include access to specific purpose finance and access to the right skills.

Australian entrepreneurs rely on a variety of funding sources to support their new business ventures. A majority of young SMEs do not seek external finance as their major source of funding but instead draw on their savings, credit cards and other personal credit facilities.

Equity finance is particularly important for knowledge- and technology-intensive start-ups, especially in the early stage. Yet, equity finance success rates are considerably lower than those for debt finance.

National innovation systems also rely on venture capital. Unlike in the United States, Israel and many other countries, Australian venture capital investment has not bounced back to levels reached before the global financial crisis. While Australia is performing slightly above the OECD median for later-stage investment,

early-stage investments at 0.007 per cent of GDP are just half the OECD median. Venture funds in Australia also tend to be narrowly focused in the information technology and life science sectors.

Many of the other influential indicators associated with entrepreneurship paint a favourable picture of framework conditions for entrepreneurship in Australia. For instance, the World Bank ranks Australia as tenth in the world on ease of doing business and seventh on starting a business.

But if high growth innovative start-ups are to thrive more is required than just good framework conditions. In particular, the report finds that Australia would benefit from more diversity in models for equity funding of entrepreneurship.

Innovation-driven entrepreneurship is not a spontaneous outcome of sound framework conditions; policy has an important role to play.

The greatest barrier to innovation for all young SMEs aged up to four years remains lack of access to additional funds. There is an associated need for better data to improve understanding of equity funding markets and of the financing needs of innovative entrepreneurs.

Another major barrier to innovation affecting SMEs is the lack of skilled people. Finally, Australian businesses of all sizes have room to improve on collaboration. Only 16 per cent of Australian businesses have a high performance innovation culture. Australian corporate culture needs to overcome an inward-looking tendency and pay more attention to the role of geographical proximity and clusters in nurturing a fertile eco-system for innovative entrepreneurs to emerge.

Entrepreneurship is sometimes seen as a spontaneous phenomenon where entrepreneurs are driven more by enthusiasm and energy than by knowledge, experience and opportunities. International experience shows that where entrepreneurship has been an important force of economic transformation, that entrepreneurship activity has been innovation and knowledge-driven.

The report provides data and analysis that describes innovative entrepreneurship in Australia and suggests a role for policy in developing the entrepreneurial ecosystem. The policy question is about how to increase the small number of start-ups that have dramatic positive impacts on the economy. What conditions and support are needed to facilitate the formation and growth of these types of start-ups?

The EABLD presents new insights into how successful innovative entrepreneurs achieve their growth. The EABLD can also help to understand to what extent these firms rely on available skills, funding, government programmes and other resources available in the innovation system. The Department of Industry, Innovation and Science has an ambitious plan to continue using the EABLD to build further evidence for better and more targeted innovation policy.

Australia would benefit from more targeted support for the innovative entrepreneurial ecosystem.

INTRODUCTION

QUT Gardens Point Brisbane Australia

1. Introduction

Innovation is the core driver of business competitiveness and productivity. It supports economic growth, exports and job creation.

The sixth Australian Innovation System Report explores innovation through the lens of innovative entrepreneurship

The terms of trade boom has come to an end. To continue to prosper, Australia must find new sources of wealth. As an advanced economy, we expect that further advances in national competitiveness and economic growth, including employment growth, will come primarily through innovation. Innovation is the core driver of business competitiveness and productivity. It supports economic growth, exports and job creation. Facilitating innovation involves enabling disruptive technologies and globalisation to access more opportunities for new products, new industries and new markets.

Since 2010, the Australian Innovation System Report has benchmarked our innovation system against previous performance and against comparable OECD and select Asian countries. Each report uses quantitative and qualitative approaches to demonstrate the value of innovation to the firm and to society.

This report, the sixth in the series, explores innovation through the lens of innovative entrepreneurship. Using data and case studies of innovative Australian companies, we describe the capacity of innovative entrepreneurship to generate growth in the Australian economy.

The Innovation System reports use an internationally agreed definition of innovation:

> *Innovation is the implementation of a new or significantly improved product (good or service), process, new marketing method or a new organisational method in business practices, workplace organisation or external relations.*[1]

1 OECD (2005) *Oslo Manual: Guidelines for collecting and interpreting innovation data*, 3rd edition, OECD and European Commission

Innovation is a complex phenomenon, and much of what promotes the innovation capacity of an economy is hidden from national accounting. But there is increasing recognition of the importance of innovation to economic resilience and competitiveness, and to sustainable social, economic and environmental progress.

This report adopts a 'systems' approach to innovation. Without understanding how the components of the national innovation ecosystem interact, we cannot properly identify the causes and implications of innovation. This approach advances our knowledge of how Australia can optimise its potential for productivity gains and sustainable economic growth.

We define an innovation system in this way:

> *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. The 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.*[2]

The first element, *networks*, can include geographic clusters of economic activity, business associations and supply chains. The second element, *innovation activities*, can include training, research and development, venture capital investment and patenting activity. *Framework conditions* can encompass a whole range of macro-economic, cultural, educational and policy settings that play a role in nurturing innovation. For a full description of the national innovation system, see the 2011 Australian Innovation System Report.[3]

A systems approach is particularly important to a contemporary understanding of what drives innovation. One way of looking at this is to examine the network of capabilities that exist within a national innovation system. These capabilities are inputs and tools for innovation. As new capabilities — technologies, business models or processes, for example — are developed, entrepreneurs find more ways to combine them with their existing capabilities. This can lead to innovation-led growth that is more than just an accumulation of labour and capital stock.[4] Our feature article by Professor John Foster further illuminates the role of entrepreneurship in the context of a complex economic system.

In addition to firms, government and the not-for-profit sector also undertake innovation-related activities. The public sector has a central role to play in the innovation system, setting framework conditions, instilling knowledge and education networks, conducting basic and applied research and fostering certain types of innovation activities. Our feature article by Professor Mariana Mazzucato

---

2 Australian Government (2014) *Australian Innovation System Report - 2014,* Department of Industry, Canberra, p.14

3 Australian Government (2011) *Australian Innovation System Report - 2011,* Department of Innovation, Industry, Science and Research, Canberra

4 Hausmann R and Hidalgo C (2011) 'The Network Structure of Economic Output', *Journal of Economic Growth*, 16:309–42

explores this further. Innovation outcomes are often maximised where public and private interests merge. This can include collaboration in clusters and sectoral activity or where social or environmental outcomes are sought.

1.1 What is innovative entrepreneurship?

The OECD has defined innovative entrepreneurship as that sphere of activity where innovative businesses intersect with young and high-growth businesses and small and medium-sized enterprises (SMEs).[5] In academic terms, innovative entrepreneurship can also be understood as either an agency for a totally new economic activity that leads to a radical change in the marketplace, or one that draws on existing resources (ideas, technologies, organisation styles, etc.) to initiate an economic activity that is not merely a replication of what has already been done.[6]

Drawing on these definitions, in this report we define innovative entrepreneurship more broadly as any type of new business activity that significantly changes market conditions. We are also interested in how entrepreneurship interacts with and is fertilised by the broader innovation system and the unpredictability of competitive markets.[7] Throughout the report, our focus is on firms rather than individual entrepreneurs.

A new technology business that successfully designs and commercialises a new product would fit the category of innovative entrepreneurship. On the other hand, opening a restaurant at a new location in Australia would not — unless the owners also introduced a new business model, a new customer experience or delivery methods to create a new customer base.

An innovative entrepreneur may not just shift market share through technological, product or process innovation; they may actually target 'non-consumption' by convincing hitherto non-consumers to start buying a new product or service such as cheap, no-frills air travel. Or the entrepreneur might integrate novel design aspects into a product line that disrupts competitors and creates new value for consumers. What distinguishes these entrepreneurs from inventors is the former's focus on introducing innovation into the market place.

The innovative entrepreneur can also act as a catalyst within the overall innovation system. This occurs though the creation of partnerships and networks which did not previously exist within the system. One such partnership could be between researchers and producers. A new network might involve the creation of a new supply chain from entities that had been operating separately.

Innovative entrepreneurs have wrought disruption and creative destruction in existing business models across whole sectors of the global economy. Despite

5 OECD (2013) *Innovative Entrepreneurship,* Paris, Final Report, unpublished, p.4

6 Stam E (2008) *Entrepreneurship and Innovation Policy,* Jena Economic Research Papers 2008-006, Max Planck Institute of Economics

7 Sundbo J (1995) *Three paradigms in innovation theory, Science and Public Policy,* vol. 22, no. 6, Surrey, UK: Beech Tree; see also Hayek F A (1948) Economics and Knowledge, Reprinted in *Individualism and Economic Order*, Chicago: The University of Chicago Press

"Many successful entrepreneurs don't necessarily develop the IP or innovation, but they often see a different way of utilising the innovation — we all know Google was not the first search engine."
Mark Paddenburg
(Sunshine Coast Innovation Centre)

their position now at the forefront of global value creation and market capitalisation, companies like Google, Facebook or Amazon did not even exist as recently as 20 years ago.

The potential of future innovators to disrupt traditional market shares in the Australian economy and potentially threaten jobs and prosperity is immense. Innovative entrepreneurship that can disrupt business models is certainly among the factors that determine Australia's competitive edge. Internet ubiquity and the new platforms that the internet creates for delivery of business models, coupled with globalised production networks, is increasing the potential for disruption. The rise of hundreds of millions of new middle class consumers in Asia and Latin America adds to the potential customer base for new products and business models. This dynamic business environment promises great opportunities, but also disruption to businesses that are unable or unwilling to keep up.

Professor John Foster

Feature: The economics of complex systems and the role of entrepreneurship

By John Foster, Professor of Economics, University of Queensland

Over the past two decades, economists, mainly outside the mainstream of the discipline, have tried to understand the economic system in a new way. Instead of basing their analysis on the presumption that individuals and businesses continually make optimal choices in the pursuit of self-interest, complex system analysis makes a more realistic assumption: people face radical uncertainty. Thus, they cannot make optimal decisions in the manner presumed in most of mainstream economics. This is particularly problematic when decisions are made for the medium and long term.

Complex system analysis begins with a pragmatic 'networks' view of the economic system when trying to understand the behaviour of individuals, firms, industry and the whole economy. In this view, increasing connectivity (i.e. quantity and quality) within and between networks, is fundamental to achieve a growing economic system. Long term economic growth is heavily dependent upon the establishment of new networks in the economic system. For example, an entrepreneur creating new business that produces a new product has to connect with the existing finance network to get funding and to existing customer networks to sell the new product.

Thus, to understand how an economic system works it is necessary to look at the extent and strength of its connections, not just its elements (i.e. individual decision-makers). This view does not deny that individuals or businesses try to make optimal choices when they can. The important issue is the context in which these decisions take place: that is the amount of uncertainty and the degree of time irreversibility (or 'lock-in') imposed by previous decisions. Uncertainty means that optimal decisions cannot be made because people have incomplete knowledge of the future and are locked into choices from the past.

The formation and maintenance of connections creates a productive structure that enables the economic system to function and grow. But what are the most crucial connections? Clearly, it is those connections that involve difficult and risky decisions in the face of uncertainty that are the key, and these are made by entrepreneurial and innovative individuals and groups. Entrepreneurs introduce new technological, organisational and institutional rule structures that yield new processes and products. The result is either greater productivity or a greater variety of goods and services. For new entrepreneurs to succeed, they need to survive a process of competition both with each other and with existing firms.

Thus, the failure rate of entrepreneurial projects is high. Dominant firms in a market often use their power to protect their position and avoid competition but this can result in a lack of adaptive capacity and ultimate demise as new firms enter with superior processes or products. The technological, organisational or institutional rules that drive such 'creative destruction' then diffuse and generate economic growth.

For example, innovators increased the efficiency of vehicles powered by combustion engines (refinement of a set of technological rules) through the 19th century, and entrepreneurs eventually organised the manufacture of such vehicles at great risk because of the uncertainty involved and the entrenchment of horse-powered transportation systems. So the entrepreneurial failure rate was very high, but innovation diffusion, which involved incremental innovation, learning-by-doing and economies of scale and scope, largely removed the seemingly unassailable horse-powered system. This involved technological, organisational (think of Henry Ford) and institutional (think of all the rules and regulations surrounding the building and use of vehicles) innovations. The end result was entirely new network structures and increased economic complexity.

Economic growth is not just the outcome of optimal decision-making; it emerges through a process of self-organisation and competitive selection. The consequent increase in organised complexity is accompanied by industrial concentration and a rise in the power of large firms. But the presence of entrepreneurs ensures that an economic system where entry is not blocked by vested interests is always restless.

Standard economics struggles to capture these 'evolutionary' processes because it starts with the assumption that individuals and businesses make optimal choices in abstract (timeless) settings with a high degree of knowledge and computational capacity, tendencies toward a theoretical balance between supply and demand and associated time reversibility. Thus, there is little connection with actual historical experience. In complex systems economics, the starting point is history and attempts are made to identify the key network structures that exist. This enables the economist to identify the key 'meso-rules' that make the economic system function.

With regard to the process of economic evolution, the adaptive capacity of a business can vary considerably, depending on the degree of rigidity (or lock-in) in its network structure and in the number of potential connections available externally. Lack of such external connections implies a high degree of uncertainty and, thus, adaptive capacity. For example, when there is a high degree of uncertainty about policy responses to climate change, power generation companies tend not to adapt because they are uncertain where

to invest to best effect. This is exacerbated by the strong lock-in characteristics of power generation which involves plants that can operate for forty years.

When adaptive capacity is low, then only competitive selection is operative — entrepreneurship and self-organisation cannot gain much expression and the industry is characterised by defensive strategies such as lobbying government to introduce protections. When adaptive capacity is high, existing organisations can alter the meso-rule structure under which they operate and there is scope for innovation, entrepreneurship and plans to invest in new processes and products.

So how might such a perspective on economics help us to understand better where the Australian economy is placed and what the future holds? Complex system economics suggests quite strongly that forecasting is a dubious activity and this is borne out in any assessment of the success of forecasting agencies in the past and, of course, most dramatically in the case of the Global Financial Crisis. Entrepreneurship is very hard to incorporate in conventional economic analysis but it clearly plays a pivotal role when we view the economy as a complex, networked system. It is entrepreneurs who forge new links in existing networks and form new networks that yield new products and processes. Entrepreneurs forge the technological, organisational and institutional rules that, when widely adopted, become the key 'economic' meso-rules.

It is essential that policy-makers understand the pivotal role of entrepreneurship and how meso-rules are formed over time. This involves a great deal of historical investigation in understanding how structural change operates in particular contexts. Complex systems methodologies, such as agent-based modelling, can then be used to develop possible future scenarios that might result from policy initiatives applied in different conditions. This 'history-friendly' methodology can be of great value in policy-making. The complex systems perspective also suggests to policy-makers that a diverse range of entrepreneurial projects should be supported, with an expectation that only a minority will succeed. In other words, given any policy goal, an 'innovation experiment' should be conducted, rather than trying to 'pick winners'.

1.2 *Why is innovation important?*

The qualitative and quantitative data in the Australian Innovation System Reports produced since 2010, in conjunction with the available academic literature, demonstrate a causal link between innovation and performance measures like productivity. The OECD estimates that as much as 50 per cent of economic growth in its member countries can be accounted for by innovation activity.[8]

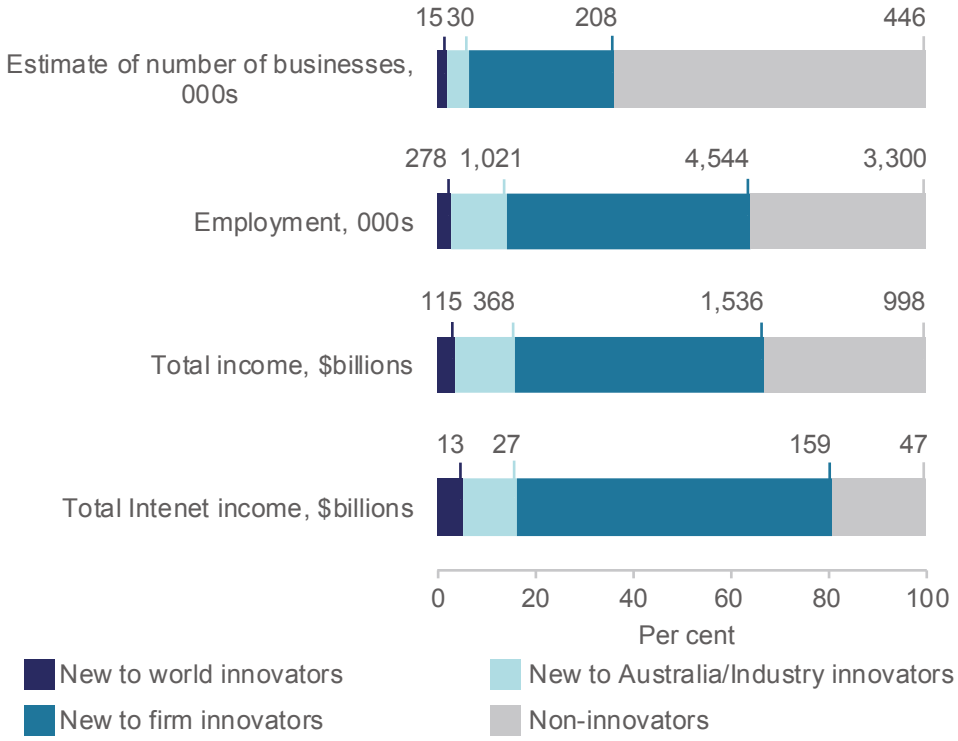
8 OECD (2015) *OECD Innovation Strategy 2015 – An agenda for policy action,* OECD Publishing, Paris, p.4

At the aggregate level, innovation leads to a more productive allocation of resources throughout the economy. Based on the concept of 'creative destruction' developed by Schumpeter,[9] innovative cutting-edge firms (and their business models) enter markets and disrupt them forcing less productive models out.

Figure 1.1 illustrates the impact of innovating businesses on an economy-wide basis. Innovating businesses have a disproportionate share of the Australian economy's total income, internet income and employment compared to firms that do not innovate. Although innovating firms accounted for only 36.6 per centof businesses in 2012–13,[10] they accounted for over 60 per cent of employment and sales in the whole economy. Businesses with a higher degree of innovation novelty (for instance, new-to-world or new-to-industry innovators) have an even greater impact.[11]

"We are not interested in investing in just another industry; we want to invest in something that is a different model that brings disruption, that brings true innovation, and that prompts people to think, talk and act".
Alberto Chang-Rajii
(Future Solar Technologies)

Figure 1.1: Total estimated number of employing businesses and their contribution to employment and income, by innovation status and degree of novelty, 2012–13



Note: Labels indicate totals for each category.

Source: Australian Bureau of Statistics (ABS) *Business Characteristics Survey: Customised Report*

9 Schumpeter, JA (1942) *Capitalism, socialism and democracy* (2nd ed.), Impact Books, Floyd, Virginia

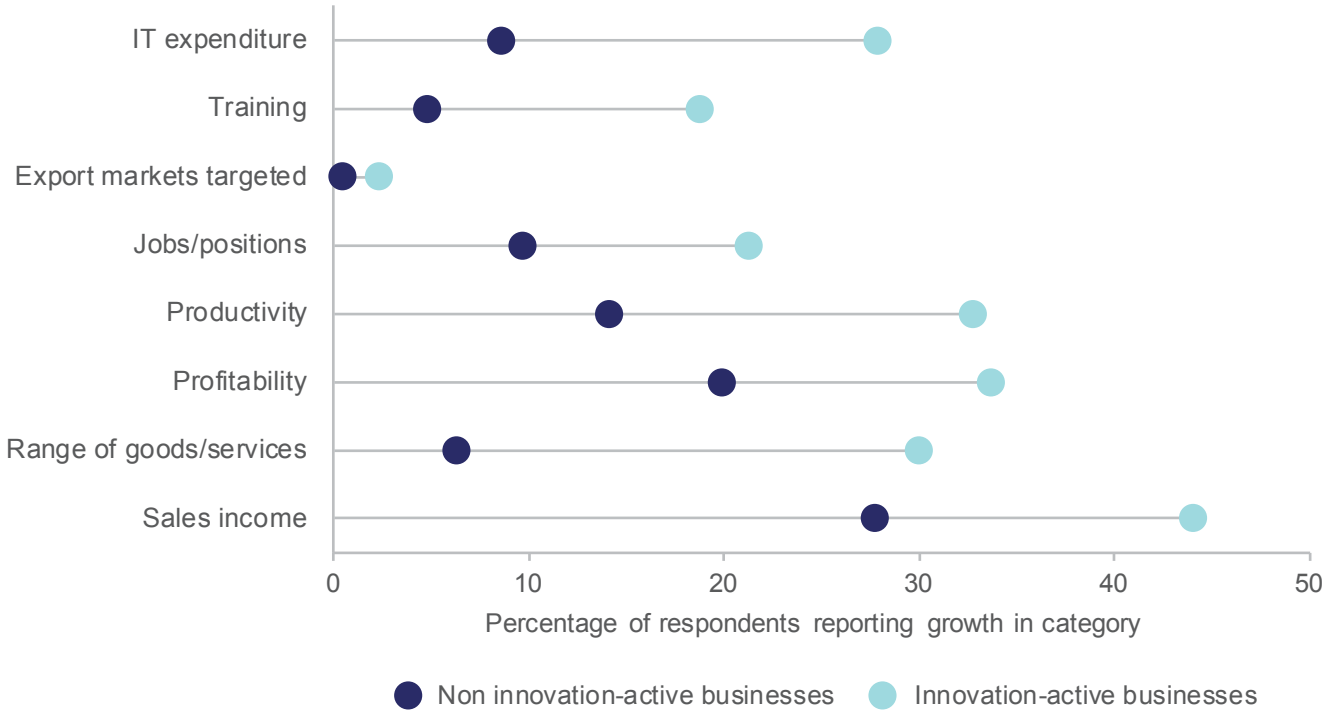
10 This figure only includes businesses that actually implemented innovation in 2012–13. Accounting for businesses with innovation in development or abandoned brings this figure to 42.2 per cent of businesses: ABS (2014) *Innovation in Australian Business 2012–13* cat. no. 8158.0

11 There is a strong size and frequency effect as larger firms are more likely to be innovating in any one year.

Stark differences between innovating and non-innovating businesses are also apparent from the firm performance data shown at Figure 1.2. Compared to businesses that do not innovate, innovative businesses report that they are:

- around 60 per cent more likely to report increases in income from sales and increased profitability
- four times more likely to increase the number of export markets targeted
- about twice as likely to increase productivity and employment
- around three times more likley to report increases in investment in training and IT expenditure
- around five times more likely to increase the range of goods and services offered.

Figure 1.2: Increases in business performance and activities compared to previous year, by innovation status, 2012–13



Source: ABS (2014) *Selected characteristics of Australian businesses, 2012–13*, cat. no.8167.0

Case study: QUT Business school[12]

It is sometimes said that entrepreneurs are born — not made. However, Queensland University of Technology (QUT) Business School Dean Professor Rowena Barrett — whose teaching methods are helping to nurture the next generation of Australian entrepreneurs — does not agree.

Entrepreneurship is one of the main streams in the school's MBA program and is increasingly being incorporated into other subjects. According to Associate Professor Paul Steffens, entrepreneurship is a broad concept and can include "any activity that makes a difference in the marketplace. This includes even an imitative business model if it changes the competitive environment of a market. It can also include social entrepreneurship or intrapreneurship (entrepreneurship within the company)".

So how does QUT approach its mission of instilling the concepts and practices of innovative entrepreneurship into its students? Dr Steffens explains that entrepreneurship education is essentially about two elements. It is about equipping students with the skills needed to develop and grow a new business venture. But just as importantly, it is about moulding the right setting for entrepreneurship to thrive. This latter element involves creating the right cultural setting for ideas — the genesis of entrepreneurship — to germinate in the context of a globalised and connected business environment. It is about teaching students how to translate what they are really passionate about into making a difference in the marketplace.

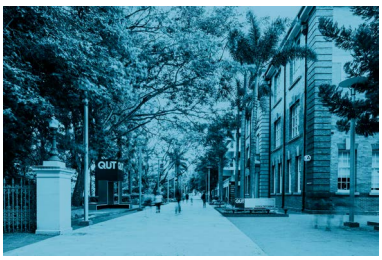
In other words, it is about opening minds to possibilities and then teaching the skills that facilitate putting those ideas into practice. A value proposition is the starting point, but it is also about how to deliver that value to the market and to capture its value.

According to QUT Postdoctoral Research Fellow Julienne Senyard, the study of management and entrepreneurship is different now to the 1980s or 1990s. "The platforms are different and there are improved cultural attitudes now to entrepreneurship and innovation. Customers are more technologically aware. They seek innovation to be built into the products they buy".

There are many aspects that make up effective entrepreneurship in Australia. "Entrepreneurship is about finding the right synergy between a market opportunity and the capabilities and passion of the entrepreneur(s)", says Dr Steffens.

Professor Barrett believes that the future for entrepreneurship in Australia is bright. Government has a role to play, she believes, in nurturing the right enabling environment for entrepreneurship to flourish, including regulatory reform.

QUT Business School



QUT Campus View

QUT Gardens Point Brisbane

12 Based on an interview conducted on 23 April 2015.

1.3 What are the trends in Australia's innovation over time?

One of the first studies of Australia's innovation system, in 1993, noted Australia's 'low levels of science and technology expenditure, a high level of government involvement in financing and undertaking research, a low level of private sector research and development and exceptionally high dependence on foreign technology'.[13] However, this situation has since improved somewhat.

Australia's gross expenditure on R&D (GERD) as a percentage of GDP grew from 1.48 per cent in 2000 to 2.12 per cent in 2013, but its OECD ranking only increased from 16th to 14th, as other countries also increased their R&D intensities.

The percentage of GERD performed by the government sector fell from 32 per cent in 1990 to 11.2 per cent in 2013. As a result, the Australian government sector's prominence in performing R&D also fell compared with other OECD countries during this period from 10th to 16th.

Despite these decreases, government still plays a critical role in financing the innovation system, through the funding of research organisations such as universities, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Defence Science and Technology Organisation. Total Australian Government support for science, research and innovation has grown in nominal value from $4.2 billion in 2000–01 to $10.1 billion in 2013–14, an increase of 140 per cent. However, the share of government funding to government research agencies has fallen from 35 per cent in 1990–91 to 19.4 per cent in 2013–14. The business enterprise sector has been the major beneficiary of this redirection, with its share of Australian Government support increasing over this period from 18.6 per cent to 32.1 per cent, the majority of this coming through a five-fold growth in the value of the tax incentive for business R&D.

Australian business expenditure on R&D (BERD) was 0.71 per cent of GDP in 2000 (0.51 per cent in 1990), ranked 17th in the OECD and was 218 per cent below the OECD top five countries average at the time. However, BERD grew strongly in Australia from the mid-1990s with the BERD/GDP ratio increasing to 1.19 per cent in 2013. This is still below the OCED average of 1.58 per cent (ranked 15th in the OECD). The gap from the top five performing countries has narrowed, but remains considerable.

This increase in BERD has made for a more important role for business in Australia's innovation system compared to its historical trend. The percentage of GERD performed by the business sector has increased from 40.2 per cent in 1990 to 56.3 per cent in 2013, although it is still below the OECD average of 68.1 per cent.

As noted in previous Australian Innovation System Reports, the proportion of innovation-active businesses in Australia oscillates each year and this has been

13 Gregory RG (1993) *The Australian Innovation System*, in Nelson, RR (ed.) National Innovation Systems, Oxford University Press, Melbourne, p. 324

true across all four types of innovation. The proportion of businesses introducing goods or services innovation hardly changed from 19.3 per cent in 2005 to 20.0 per cent in 2012–13, and the proportion introducing organisational innovation was also relatively unchanged over this period. The most notable change has been the increase in the proportion of businesses introducing marketing innovation, which from its 2005 value of 14.3 per cent rose to 18.8 per cent in 2012–13. There was a corresponding trend away from process innovation, which was introduced by 20.8 per cent of Australian businesses in 2005 but fell to 16.9 per cent in 2012–13.

"I think that the really lasting benefits come from business model innovation rather than from product innovation"
Brendan Swifte (Geofabrics)

Studies of innovation have shown the importance of collaboration to the effectiveness of its economic benefits, although data collection of business collaboration only began in 2005–06. While the percentage of innovation–active SMEs collaborating on innovation increased from 17 per cent in 2006–07 to 20 per cent in 2012–13 and that of large firms from 22 per cent to 32.3 per cent, Australia ranked 24th and 29th respectively on these measures in 2009, the most recent OECD international comparison available.

Australia's innovation and economic performance of the past decade has been dominated by the mining sector, which has high levels of BERD intensity and has exploited its comparative advantage to generate enormous growth in investment, output and exports.

According to the OECD, the level of skills attainment in an economy enables it to capitalise on innovation which, as part of a knowledge economy, is a conduit towards improved economic growth and productivity.[14] In the 15 years to 2014, there was a 5.4 percentage point increase in the proportion of the working age population in Australia holding a bachelor degree and a 3.8 percentage point increase in the proportion holding a post-graduate degree. At the same time, attainment of diplomas and advanced diplomas increased 1.4 percentage points, while attainment of Certificates III/IV actually declined by 3.4 percentage points.[15] The stronger growth in higher level qualifications reflects increased demand for greater skills and the demands of an innovation-led economy.

According to the Global Innovation Index 2015, the evidence suggests Australia is less efficient than similarly developed countries in transforming innovation inputs into outputs. Innovative entrepreneurs as agents for transforming these innovation inputs into new viable business models are therefore central to realising Australia's innovation potential. New research on the impact of innovative entrepreneurship on the Australian economy, particularly with respect to employment generation, is discussed in Chapter 3.

A comprehensive Innovation Database measuring Australia's performance is found at Appendix A.

Australian rates of entrepreneurship are examined in more detail at 2.1.

14 OECD (2011) *Skills for Innovation and Research,* OECD Publishing, Paris

15 Australian Bureau of Statistics (2014) *Education and Work in Australia,* 1999, 2004, 2009, 2014 (cat. no. 6227.0)

1.4 Structure of this report

The report is structured as follows:

Chapter 2 examines international trends in entrepreneurship and how Australia compares. We also analyse the importance of business age to a wide variety of business performance characteristics, including employment growth, sales, profitability, productivity, product range, innovation, collaboration and skills. The age of a business, particularly its initial creation by entrepreneurs, is found to be highly correlated with growth and innovation, reinforcing the importance of innovative entrepreneurship to business dynamism.

Chapter 3 further analyses the impact of entrepreneurship on the national innovation system and the Australian economy by focusing on its impact on employment growth. It reports findings from new research showing the important role of young SMEs in generating jobs growth (and jobs destruction) in Australia. It also finds that small businesses performing R&D are more likely to report large increases in sales and profitability.

Chapter 4 maps geographic patterns of business entry and links this to the distribution of patents, trademarks and R&D expenditure around Australia. It finds that patenting and trademarking activity is concentrated in Australia's major cities, that it is often correlated with higher rates of business entries and that the presence of research organisations may stimulate innovation in a region.

Finally, Chapter 5 examines some systemic issues for innovative entrepreneurship, including barriers to innovation and whether Australia has a 'culture' of innovative entrepreneurship. We find that access to various forms of finance is a key issue for entrepreneurs. Innovation active start-ups are particularly reliant on equity finance. The limited scale and scope of venture capital, in particular, may be hindering these start-ups in reaching their full potential.

1.5 A note on methodology

Where possible, the concepts, definitions and methodology used in this report are based on the Innovation Metrics Framework Report[16] and the concept of an innovation system described above. Data in this report is current as of September 2015.

The reader should note that a variety of definitions of business size and age (micro, start-ups, young, mature etc) are used in the sources for data analysed in this report. Because of this, the report cannot use a single consistent definition of business size and age. Instead, the relevant definitions are provided in relation to specific data sources as they appear in this report.

This report is based on a series of research papers published at: http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Pages/Australian-Innovation-System.aspx. These reports are:

16 Australian Government (2010) *Australian Innovation Metrics: consolidated report,* Department of Innovation, Industry, Science and Research, Canberra

- The Employment Dynamics of Australian Entrepreneurship
- Financing Innovative Entrepreneurship
- Business Age and Performance
- Australian Geography of Innovative Entrepreneurship

As part of a systems approach to measuring innovation, international comparisons for each indicator are presented where possible. Country comparisons are made because policy mixes can be quite different. Country comparisons help us to think about which activities work best in different frameworks, and how networks and cultures affect innovation.

This report also makes extensive use of the following new databases:

1. Expanded Analytical Business Longitudinal Database (EABLD)
2. National Innovation Map
3. Innovation Insights.

Each of these datasets uses its own methodologies and each indicator has its limitations. This report does not provide complete analysis of the pros and cons of each methodology. It is recommended that the reader refer to the source for metadata and more comprehensive discussion of methodology.

The report includes a series of case studies of innovative Australian companies and business schools highlighting how different entrepreneurs approach innovation, opportunities and strategies in their respective markets. We also incorporate various feature articles by leading thinkers in Australia and overseas on the subject of innovative entrepreneurship. The views expressed by these writers are theirs alone and do not necessarily reflect the views of the Department of Industry, Innovation and Science or the Australian Government.

Box 1.1: The Expanded Analytical Business Longitudinal Database 2001–02 to 2012–13

The Expanded Analytical Business Longitudinal Database (EABLD) is a statistical data integration project with the Australian Bureau of Statistics (ABS) as the Integrating Authority. The development of the EABLD was funded by the Department of Industry, Innovation and Science.

The EABLD is a series of integrated, linked longitudinal datasets that cover the period 2001–02 to 2012–13. It contains a range of firm-level information based on the Business Register and includes the population of firms for each year. The EABLD uses the ABS statistical unit as the firm-level unit. Large/complex firms are included. It includes business-level data from administrative sources (predominantly Australian Taxation Office (ATO)) and a range of ABS surveys (including the Business Characteristics Survey, the Business R&D survey and the Economic Activity Survey). The use of Business Activity Statement data (sourced from the ATO) provides a basic set of financial information for all businesses.

Because the EABLD has been created retrospectively, not all information about firm entries, exits and restructures is available. Various methods have been developed to ensure a longitudinal perspective. The ABS found ways to map the various tax reporting structures to the ABS units model. This is essential to facilitate the linking of directly collected ABS data into the EABLD.

Using the ABS statistical unit structure enables the EABLD to reflect the industry composition which forms part of ABS economic statistics. The EABLD allows for policy evaluation, research and analysis, and the production of statistical outputs for a variety of firm performance measures. As primary linking is undertaken using the Australian Business Number (ABN), other administrative data also containing ABN can be linked to the EABLD.

More information on the EABLD and how to access it can be found here.[17]

Box 1.2: National Innovation Map

The National Innovation Map is a Department of Industry, Innovation and Science initiative to help understand innovative activity in Australia's regions. In an interactive visualisation for every statistical region in Australia, the map shows, details of: (a) new business creation; (b) expenditure on research and development; (c) patenting activity; and (d) trademarking activity.

It brings together data from the Australian Bureau of Statistics, IP Australia and the Department of Industry, Innovation and Science. The map allows users to examine innovation activity and tailor the information they are seeking, by selecting:

17 http://www.abs.gov.au/ausstats/abs@.nsf/mf/8171.0?OpenDocument

- a state, territory or suburb
- an indicator (e.g. new business entries, patents, research and development expenditure or trademarks)
- a year (data is available for dates between 2008 and 2014).

This tool presents information that can inform individuals choosing to locate their business in an innovation hotspot. It also raises interesting questions, such as why similar regions perform so differently. This issue is discussed in more depth at Chapter 4.

More information on the National Innovation Map and how to access it can be found here.[18]

Box 1.3: Innovation Insights Database

The Australian Innovation System report relies on data from many sources, including the Organisation for Economic Cooperation and Development (OECD), the Australian Bureau of Statistics, the World Economic Forum, and the Global Entrepreneurship Research Association. Additionally, data straddles a number of topics, including general economic indicators, education, science and research and patents. In response, the Department of Industry, Innovation and Science has developed the Innovation Insights Database, which compiles these diverse sets of indicators from various countries in one place. The data allows readers to see how Australia has performed on innovation since 1990 (where available) against all countries in the OECD for which there is data plus Singapore, China and Taiwan (where available). This data can be used to facilitate a better understanding of innovation and to build a strong evidence base for policy-makers, academics and others interested in the Australian innovation system.

The key tables of the Innovation Insights Database are published at Appendix A and updates to the tables will be publically released here. [19]

Feature: The entrepreneurial state

By Mariana Mazzucato, RM Phillips Professor in the Economics of Innovation, Science Policy Research Unit (SPRU), University of Sussex and author of 'The Entrepreneurial State: debunking public vs. private sector myths'

Countries around the world are seeking smart innovation-led growth. At the same time, there is rising concern that this growth needs to be both more inclusive and sustainable than in the past. Achieving these outcomes requires rethinking the role of both government and public policy in relation to the economy; funding not just the rate of innovation, but

Professor Mariana Mazzucato

18 http://www.industry.gov.au/Office-of-the-Chief-Economist/Pages/National-Innovation-Map.html

19 http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Pages/Australian-Innovation-System.aspx

also envisioning its *direction*. Such an approach challenges our very notion of economic progress and the need for this to speak to wider social considerations than simply economic growth itself.

It requires a new justification of government intervention that goes beyond the usual one of fixing market failures. It means ensuring that our policymakers and their institutions have the ability and confidence to shape and create markets and for a more 'inclusive' notion of growth to more fairly distribute both risks and rewards.

Modern capitalism faces a number of great societal challenges, including climate change, youth unemployment, obesity, ageing and rising inequality. As the European Commission's 2020 strategy demonstrates, to give one example, these challenges have created a new agenda for innovation and growth policy that requires policymakers to 'think big' about what kinds of technologies and socio-economic policies can fulfil visionary ambitions to make growth more smart, inclusive and sustainable.

Although such challenges are not strictly technological — for they also require behavioural and systemic changes — they have much to learn from those mission-oriented feats that led human beings to putting a man on the moon, or to those that led to the emergence of new general-purpose technologies, ranging from the internet and wireless technology to biotechnology and nanotechnology.

Achieving such missions required companies that were willing and able to make long term investments and a confident entrepreneurial state. An entrepreneurial state is one that is able and willing to invest in capital intensive areas of extreme uncertainty, courageously envisioning the *direction* of change across public agencies and departments which the private sector fears to tackle. Such a state must welcome, rather than fear, the high risk and uncertainty across the entire innovation cycle from research to commercialisation to business model and the experimentation processes required for organisational learning along the way. Most importantly, an entrepreneurial state must think big in terms of the scale of the challenges it seeks to address, the innovations needed and the shift in direction aspired to.

Finding ways for governments to do this is not just about throwing public money at different activities or sectors. It requires a new economic framework that can justify the role of the public sector in directing change; forming the right institutional structures that can foster and adapt to change in a dynamic way. This framework needs to be based on an understanding and justification of the potential catalytic role of government, its ability to transform landscapes, create, shape and disrupt markets and not just fix them. Such an approach requires new indicators through which to evaluate public investments. It implies a very different approach to the organisation of government, and to the distribution of risks and rewards that emerge from the collective effort towards smart innovation-led growth.

Beyond a market failure approach to innovation policy

Market failure theory justifies public intervention in the economy only if it is geared towards fixing situations in which markets fail to efficiently allocate resources. This approach suggests that governments intervene only to fix or compensate for markets by investing

in areas with 'public goods' characteristics (such as basic research, or drugs with little market potential) and by devising market mechanisms to internalise external costs (such as greenhouse gas pollution) or external benefits (such as herd immunity).

While market failure theory provides interesting insights, it is at best useful for describing a *steady state* scenario in which public policy aims to put patches on existing trajectories provided by markets. It is less useful when policy is needed to dynamically create and shape new markets — to transform markets. This means it is problematic for addressing innovation and societal challenges because it cannot explain the kinds of transformative, catalytic, mission-oriented public investments. It is such mission-oriented investments that coordinate public and private initiatives, build new networks and drive the entire techno-economic process, which resulted in the creation of entirely new markets (eg. the Internet, nanotech, biotech, cleantech and so on).

There are four opportunities for changing the current innovation policy discourse, currently hampered by the limitations in market failure theory, which continue to guide policymaking today. These relate to directionality; evaluation; organisation; risks and rewards.

(1) Choosing Directions. First, Market Failure Theory assumes that the state only fixes problems, with the 'market' setting the actual direction. In actuality, periods of transformative change have been deeply steered on both the supply side and the demand side by visionary policy making. As I show in my book 'The Entrepreneurial State: debunking public vs. private sector myths', every technology that makes the iPhone 'smart' (internet, GPS, touch-screen display and SIRI) was directly publicly funded. Government not only funded the actual technologies (such as mainframes, the internet, wind and solar power, and fuel cells), but also created a network of decentralised public and private actors, provided early-stage funding to companies that risk-averse private finance would not, and devised special tax credits that favoured some activities more than others. Even in Australia, by one estimate, five of the country's top 10 patents, had their origins in the public sector or had significant public sector support.[20] These facts seem to point to a different analytical problem facing policymakers: not whether the right role is to intervene or to stand back, but understanding how particular directions and routes can be chosen, and determining how to mobilise resources in those directions.

By ignoring this fact, we allow directions to be set without much debate. Shale gas, which was fully funded by the US government, is a case in point, considering the negative impact that the technology (fracking) required to produce it has on natural environments.

The importance of such a debate is absent in traditional economic policies, which aim to correct markets and assume that once the sources of the failure have been addressed, market forces will efficiently direct the economy to a path of growth and development. Yet, markets are 'blind' and the direction of change provided by markets often represents suboptimal outcomes from a societal point of view. This is why, in addressing *societal challenges*, governments have had to lead the process and provide the direction towards new 'techno-economic paradigms', which do not come about spontaneously out of market forces. In the mass production revolution and the IT revolution, governments made direct

20 Lloyd M (2015) 'Our top 10 patents prove it can be done', *Australian Financial Review*, 10 July 2015

mission-oriented investments in the technologies that enabled these revolutions to emerge, and formulated bold policies that allowed them to be fully deployed throughout the economy.

(2) Evaluating market making. The second opportunity is to address the limitations that market failure theory has in its ability to measure its transformational impact by developing more dynamic and less static evaluation metrics. Market failure theory has developed concrete indicators and methods to evaluate government investments. These stem from the framework itself, usually through a cost-benefit analysis that estimates whether the benefits of public intervention compensate for the costs associated both with the market failure and the implementation of the policy (including 'government failures').

There is a mismatch, however, between the intrinsically *dynamic character* of economic development and the static tools used to evaluate policy; the diagnostic tools and evaluation approach based on market failure theory involves identifying the sources of market failure and targeting policy interventions on their correction. This entails *ex-ante* considerations about administrative and fiscal requirements and the political-economic consequences of intervention.

Such an exercise usually consists of a number of steps. Prior to any action taken, there will be a cost-benefit analysis that weighs up the costs of the failure, the (private and social) benefits that flow from addressing it, the costs and risks of government failure and an identification of sources of market failures and of second-best policy tools to address them. This process then informs a diagnosis of the best "principal–agent" structure that avoids governmental *capture* by private interests (insulation/autonomy) and that forces private agents to do what the principal (government) wants. And, after changes have been implemented, there will be an evaluation of the outcomes of the intervention set against any quantifiable predictions made in relation to the likely outcomes of the intervention.

This is a limited toolbox. The nature of policy intervention and investment involved in addressing societal challenges are intrinsically dynamic and this approach represents a static exercise of evaluation. By not allowing for the possibility that government can transform and create new landscapes that did not exist before, the ability to measure such impact has been limited or non-existent, with economists often resorting to a pseudoanalysis of the public sector as if it were an inefficient private sector.

This is evident not only in the area of innovation, but also for public services. This then leads to accusations of government 'crowding out' businesses, which implies that those areas that government moves into could have been areas for business investment. Such accusations are at best defended through a 'crowding in' argument, which rests on showing how government investments create a larger pie of national output that can be shared between private and public investors, including savings to both. However, this defence does not capture the fact that the goal of public investments should be to not only 'kickstart' the economy but to choose directions that, as Keynes wrote, *"do those things which at present are not done at all"*. By not having *indicators* for such transformative action, the market failure toolbox limits governments' ability to know when it is simply operating in existing spaces or making new things happen that would not have happened anyway. This often leads to investments that are too narrow or directed within the confines of the

boundaries set by incumbent business capability practices, regulatory environments or the prevailing set of technologies.

(3) Organisational change. The third opportunity presented by the weakness of market failure theory relates to the organisation of the state; currently market failure theory neglects the role that fear of failure has in limiting the capacity public sector *institutions* have to innovate themselves, through a process of learning, experimentation and self-discovery. At its most extreme, market failure theory calls for the state to intervene as little as possible in the economy, in a way that minimises the risk of 'government failure' (for example, crowding out, cronyism and corruption). This view requires a structure that insulates the public sector from the private sector (to avoid issues such as agency capture) and has resulted in a trend of 'outsourcing' that often rids government of the knowledge capacities and capabilities (for example, around IT or research) that are necessary for managing change. Studies have examined the influence of outsourcing on the ability of public institutions to attract top-level talent with the relevant knowledge and skills to manage transformative mission-oriented policies. Without such talent and expertise it will difficult for the state to coordinate and provide direction to private actors when formulating and implementing policies that address societal challenges.

Indeed, there seems to be a self-fulfilling prophecy whereby the less 'big thinking' occurs in government, the less talent/expertise the public sector is able to attract, the less well it performs and the less 'big thinking' it is allowed to do. In order to promote transformation of the economy, by shaping and creating technologies, sectors and markets, the state must organise itself so that it has the intelligence (policy capacity) to think, to be ambitious and formulate bold policies. This does not mean it will always succeed. Indeed, the underlying uncertainty of the innovation process means that the state will often fail. But if the emphasis is on the *process of policy making* that can allow the public sector to envision and manage transformational change, then it is essential to understand the appropriate structures of public organisations, how to allow them to become 'learning' organisations, that welcome rather than fear the trial and error process underlying innovation.

(4) Risks and Rewards. The final opportunity a new framework should address is how to ensure a fairer distribution of both risks and rewards from the innovation process, developing more symbiotic private-public partnerships. Market failure theory has little to say about cases where the state is the *lead investor and risk taker* in capitalist economies through 'mission-oriented' investments and policies. Having a vision of which way to drive an economy requires direct and indirect investment in particular areas, not just creating the conditions for change. This requires crucial choices to be made, the fruits of which will create some winners, but also many losers. Indeed, precisely because venture capital has become increasingly short-termist, with emphasis on an exit in three to seven years (while innovation can sometimes take 15-20 years), publicly funded seed early stage finance has become increasingly important (such as SBIR funds in the US), as have also guaranteed loans for innovative high-risk projects. For example, the Obama administration recently provided large guaranteed loans to two green-tech companies, Solyndra ($500 million) and Tesla Motors ($465 million). While the latter is often glorified as a success story, the former failed miserably and became the latest example, used widely by both economists and the

more popular treatment in the media, of government being unable to 'pick winners'. Indeed, the taxpayer picked up the bill, and complained.

This highlights the need to build a theoretical framework that can help the public sector understand its choices across a broad 'portfolio'- offsetting the inherent risks of innovation by diversifying its investments to enable the rewards of the successes to cover the losses of the many, inevitable, failures - and how to therefore socialise not only the risks of those investments but also the rewards. In building a portfolio, it is crucial to make sure that the assumptions regarding the distribution of returns, as well as their measurement, are driven by a real understanding of the fundamental uncertainty that drives the innovation process, and the broad nature of social returns. The risk-reward question comes down to whether a government deserves to retain a direct share of the profits generated from the growth that it fosters.

Is it right that US taxpayers shouldered the Solyndra loss, yet made nothing from the Tesla profits? Or, put another way, are taxes currently bringing back enough returns to government budgets to fund high-risk investments that will probably fail? It is well known that companies that benefit greatly from government investments have been successful in avoiding tax: Google, whose algorithm was funded by the National Science Foundation, has been criticised for such avoidance, as have also Apple and Amazon and a host of 'new economy' companies. But even if they were not avoiding tax, *tax* rates, such as that on capital gains, have been falling due to the misguided narrative that it is a narrow set of agents who are the real innovators, wealth creators and risk takers. It is indeed this same narrative that has justified the increasing financialisation of the private sector, with many large companies in IT, energy and pharmaceuticals spending more of their returns on share buybacks than on research and development, a dynamic which William Lazonick[21] has shown to hurt 'sustainable' and 'smart' growth. Only when this limited and biased wealth creation narrative is debunked, can we begin to build more symbiotic innovation eco-systems that can ensure future funding by both public and private actors.

New framework, new questions

The economy of 2030 — and beyond — requires an Entrepreneurial State, to boldly look ahead and set the direction of change rather than timidly creating the conditions and levelling the playing field, allowing markets to set directions for us.

The solutions derived from market failure theory (downsizing the state apparatus, promoting market-based mechanisms to counter market failures, insulating public agencies from the private sector, etc.) might hold for steady state situations, but not for the situations in which public policy is required to embrace disruption and create new markets, such as those witnessed through the technological and socio-economic missions of the past. They are not fit for purpose.

If Australia is to fully achieve its potential, its government will need a dynamic approach not just to address problems as they emerge, but to perceive and act on opportunities in advance of competitors and in advance of the market. The role of government in engaging with the historical challenges of Australia's geographic isolation and the need to achieve

21 Lazonick W (2014) 'Profits without prosperity', *Harvard Business Review*, Sept 2014

economic independence can be seen right through its history from the early development of the merino wool industry to the establishment of steelworks in Newcastle and the Commonwealth Serum Laboratories during the First World War. Similarly the iconic nation-building symbols of post-World War Two reconstruction like the Snowy Hydro Scheme, mass migration from Europe to build future industries and the establishment of the CSIRO to meet Australia's particular industrial and scientific challenges were all publicly conceived and realised projects to confront Australia's emerging challenges and to realise its full potential.

It is not about prescribing specific technologies, but providing directions of change which firms can then experiment around. As my colleague in the Science Policy Research Unit at the University of Sussex, Professor Andy Stirling has put it: *"The more demanding the innovation challenges like poverty, ill health or environmental damage, the greater becomes the importance of effective policy. This is not a question of 'picking winners' — an uncertainty-shrouded dilemma, which is anyhow equally shared between public, private and third sectors. Instead, it is about engaging widely across society, in order to build the most fruitful conditions for deciding what 'winning' even means".*

It is of course important not to romanticize the State's capacity. The State can leverage a massive national social network of knowledge and business acumen. Government spending is around 26 per cent of GDP in Australia. This number by itself means little. What is more relevant is the way in which investments are directed through a variety of institutions, which also enable learning (eg from mistakes), and evaluated through accountability measures which account for the objectives beyond the static 'market failure' framework.

This requires understanding the State as neither a 'meddler' nor a simple 'facilitator' of economic growth. It is a key partner of the private sector — and often a more daring one, willing to take the risks that business won't. The State cannot and should not bow down easily to interest groups who approach it to seek handouts, rents and unnecessary privileges like tax cuts. It should seek instead for those interest groups to work dynamically with it, doing things they would not have done anyway, and setting a direction of change. Today such change could be driven by the mission for '*green* innovation-led growth'. In the same way that putting a man on the moon required many sectors to interact, the green direction being debated today also requires all sectors to change. As Carlota Perez has emphasised, green is not only about wind, solar and biofuels but also about new engines, new maintenance systems, new batteries, new business models, new collaborative sharing economies, and new ways of thinking about product obsolescence and a circular, resource efficient economy.

But this requires investment and all the evidence shows that the kind of patient, long-term finance required comes from state investment. Australia need not follow some of its OECD counterparts in following a straight-jacketed focus on austerity and a politically inspired, but economically illiterate, drive to run continual budget surpluses If we want to see real long-term growth in 2030, we need to understand the state's critical role in creating and shaping the new markets of tomorrow. The successful economies of 2030 are already making that investment today. And to make sure economic growth is smart (innovation led) and inclusive concrete structures must be in place to share not only the risks but also the rewards.

ENTREPRENEURSHIP AND BUSINESS AGE

Melbourne city skyline

2. Entrepreneurship and business age

In contrast to a relatively modest performance on indexes of innovation and competitiveness, Australia has some of the highest rates of entrepreneurship among developed economies.

This chapter focuses on how Australia compares internationally on a a number of influential measures of entrepreneurship

In Chapter 1, we introduced the concept of innovative entrepreneurship and discussed Australia's performance over time on a number of innovation indicators. In this chapter, we start by focusing more specifically on how Australia compares internationally on a number of influential measures of entrepreneurship. In contrast to a relatively modest performance on indexes of innovation and competitiveness, Australia has some of the highest rates of entrepreneurship among developed economies.

Entrepreneurship is inherently connected to the issue of business age. The remainder of the chapter therefore draws on recent departmental research using the Australian Bureau of Statistics (ABS) Business Characteristics Survey. This research examines Australian businesses at different ages to determine whether younger firms — established by entrepreneurs — behave differently in terms of expansions in various indicators.

Younger businesses in Australia are found to often perform differently from older firms and to grow faster. This is consistent with international research.[22] New Australian SMEs are no exception to the growing international evidence of the importance of start-ups in generating business dynamism and growth. From the survey data, we consider how business age is correlated with performance in terms of employment and sales growth, profitability and productivity. We then consider impacts on product range, innovation, export capability, collaboration and skills.

22 Evans DS (1987) 'The relationship between firm growth, size and age: Estimates for 100 manufacturing industries', *The Journal of Industrial Economics*, 35 (4): 567-581; Haltiwanger J, Jarmin R & Miranda J (2010) *Who creates jobs? Small vs. large vs. young?*, Working Paper 16300, National Bureau of Economic Research, Cambridge, Massachusetts

"Entrepreneurship is about finding the right synergy between a market opportunity and the capabilities and passion of the entrepreneur(s)"
Paul Steffens
(QUT Business School)

The chapter therefore frames the age dynamic as being one of young, flexible, innovative firms driving employment and productivity growth. It is important not to overlook also the fact that viable opportunities to start a firm are created (in part) by innovation. In the broad sense this reorientates our perspective back to the capacity of individuals, researchers and potential entrepreneurs to generate and commercialise innovations through business creation.

A feature article by Paul Steffens supports the chapter's exposition of the role of business start-up activity in national economic development.

2.1 *International indicators of entrepreneurship — how Australia compares*

Measuring entrepreneurship and its economic and social effects is often difficult due to the inherent uncertainties and complexities in entrepreneurial activities. A range of national and international research organisations collect qualitative and quantitative data to measure entrepreneurship in both potential (attitudes, culture, institutions) and realised (business creation, survival, growth, etc.) terms.

The measurement of entrepreneurial activity for analytical purposes has evolved from relying on self-employment as the predominant indicator to more sophisticated indicators. Today, statistics measuring entrepreneurial performance are mainly of two types: those that focus on individuals (the entrepreneurs) and those that focus on businesses (the enterprises).[23] There are also qualitative indicators, such as the entrepreneur's attitudes and intentions, which could play a significant role in business success. Social attitudes, political practices, economic policies and the legal system also play a role in creating an environment conducive to entrepreneurship — in particular in relation to supporting creativity and risk-taking and starting new businesses.[24] The cultural framework for innovative entrepreneurship is dealt with in Section 5.2.

The Global Entrepreneurship Monitor (GEM), a not-for-profit academic research consortium, is a comprehensive study for mapping and measuring entrepreneurship activity worldwide. GEM data collection has included national adult population surveys, personal interviews with national experts and standardised economic data from national and international sources. It seeks to measure the different levels of national entrepreneurship activity, with key indicators such as statistics on start-ups and young firms, and venture capital and angel investment.

One GEM measure is 'Total early-stage Entrepreneurial Activity' (TEA). This includes individuals in the process of starting a venture and those running a new business less than three-and-a-half years old as a percentage of the working

23 OECD and Eurostat (2014) *In-depth review of entrepreneurship statistics*, United Nations Economic and Social Council, Economic Commission for Europe, Conference of European Statisticians, Sixty-second plenary session, Paris, 9-11 April 2014

24 Wood F Q (2011) *Entrepreneurship in Australia: the missing links, A report prepared for the US Studies Centre*, September 2011 http://ussc.edu.au/s/media/docs/publications/Wood_ussc_report_Sept_2011.pdf

age population (18–64 years old).[25] The TEA divides entrepreneurship into two categories: 'improvement- or opportunity-driven' as opposed to 'necessity-driven'. It finds that most entrepreneurship in advanced economies, including Australia, is improvement-driven.

The Department of Industry, Innovation and Science sponsored an analysis of Australian GEM data conducted by Queensland University of Technology. GEM measures Australia's TEA rate at 13.1 per cent in 2014, the fourth highest among developed economies — comparable to the United States (13.8 per cent) and Canada (13 per cent).[26] Australia also has the third highest female TEA rate among developed countries at 10.3 per cent. Similar to other developed countries, only around 18 per cent of Australian entrepreneurs start new business activity due to 'necessities', such as unemployment or the absence of other economic opportunities.[27]

The OECD's *Entrepreneurship at a Glance 2015* notes Australia's above average performance in start-up creation despite the fact that self-employment rates are lower than before the global financial crisis.[28]

According to the ABS, Australia's actual new firm entry rate (i.e. the number of new firms as a percentage of total firms operating) declined from 17.4 per cent in 2003–04 to just 11.2 per cent in 2012–13. However, the latest ABS figures for 2013–14 indicate a rise to 13.7 per cent. The business exit rate also decreased from 14.0 per cent in 2012–13 to 12.7 per cent in 2013–14. Half of the businesses that started operating in 2010–11 were still operating in June 2014. There was a total of 2,100,162 actively trading businesses in Australia in June 2014.[29]

Many of the other influential indicators associated with entrepreneurship paint a favourable picture of framework conditions for entrepreneurship in Australia. For instance, the World Bank ranks Australia as tenth in the world on ease of doing business and seventh on starting a business.[30]

Australia also has advantages in the efficiency of its financial system as well as strengths in health and primary education and higher education and training. These favourable conditions help to support an advantageous eco-system for entrepreneurs to emerge. Based on the World Economic Forum's Global Competitiveness Report, Australia was ranked third in the world for soundness of

25 Singer S, Amorós JE, Arreola DM and Global Entrepreneurship Research Association (2015) *Global Entrepreneurship Monitor 2014 Global Report*, Babson College, Universidad del Desarrollo, Universiti Tun Abdul Razak, Tecnológico de Monterrey, p.24

26 *Ibid,* p.84

27 Steffens P and Hechavarria, D (2015) *Global Entrepreneurship Monitor (GEM) 2014 Australian National Report for the Department of Industry and Science*, The Australian Centre for Entrepreneurship Research, Queensland University of Technology, Brisbane, pp.2, 31-32

28 OCED (2015) *Entrepreneurship at a Glance 2015,* OECD Publishing, Paris, pp.16, 20

29 ABS (2015) *Counts of Australian Businesses, including Entries and Exits*, Jun 2010 to 2014, cat. no. 8165.0

30 World Bank (2015) *Doing Business, World Bank Group* http://www.doingbusiness.org/rankings

banks and fourth for protection of legal rights. In fact, the World Economic Forum ranked Australia as high as seventh in the world in 2015–16 in terms of its overall financial market development.[31]

The World Economic Forum ranked Australia relatively poorly by the standards of developed countries in terms of business sophistication. By this metric, Australia ranked 27th in the world and well below the OECD average. This indicator examines factors such as the state of cluster development, local supplier quality and quantity, nature of competitive advantage, value chain breadth, control of international distribution and production process sophistication.[32] Similarly, the Global Innovation Index 2015 ranks Australia just 23rd in the world for business sophistication.[33]

In today's globalised world, international connectedness is an increasingly important success factor. On the DHL global connectedness measure, Australia is ranked just 32nd in the world in 2014 — one place behind New Zealand.[34]

Such factors may impact on Australia's performance in translating favourable rates of entrepreneurship and conditions for business entry into actual business innovation.

2.2 *Business age and growth*

Innovative entrepreneurship is inherently connected to the concept of business age since it involves establishing new and novel business entities, operations or market relationships. Consistent with Schumpeter's theory of 'creative destruction', these new entities disrupt older business models and drive the competitive reallocation of resources to more productive uses in the economy. Entrepreneurs are the economic actors that bring new businesses to fruition and take many new products to market. Measures of their performance and growth may differ from older firms.

Criscuolo *et al.* found that across 18 countries examined over a decade (2001–11), younger SMEs (i.e. less than five years old) consistently made a greater contribution to jobs growth than their contribution to total employment would imply.[35] Decker *et al.* estimated that a relatively small number of high-growth start-ups compensate for the entrant firms that fail or do not expand.[36] These conclusions also apply in Australia. As we note in Chapter 3 innovation may be a key endogenous (i.e. within-firm) factor explaining these employment dynamics.

---

31 World Economic Forum (2015) *The Global Competitiveness Report 2015 – 2016*, pp.100-101

32 *Ibid*

33 Cornell University, INSEAD & WIPO (2015) *The Global Innovation Index 2015: Effective Innovation Policies for Development*, Fontainebleau, Ithaca and Geneva, p.167

34 Ghemawat P and Altman S (2014) *Global Connectedness Index 2014: Analysing global flows and their power to increase prosperity*, DHL

35 Criscuolo C, Gal PN and Menon C (2014) *The Dynamics of Employment Growth: New Evidence from 18 Countries*, OECD Science, Technology and Industry Policy Papers, No. 14, OECD Publishing, Paris

36 Decker R, Haltiwanger J, Jarmin R, and Miranda J (2014) 'The Role of Entrepreneurship in US Job Creation and Economic Dynamism', *Journal of Economic Perspectives*, 28(3): 3-24

Based on the international literature, the growth potential of start-ups also extends beyond employment to other variables, such as sales, productivity, profitability and product innovation. The Department of Industry, Innovation and Science therefore commissioned customised data from the Australian Bureau of Statistics (ABS) Business Characteristics Survey to test whether these theories about the superior growth performance of younger businesses apply in Australia.[37] The data cover a wide variety of business metrics which are then referenced to business age and size.

Table 2.1 illustrates the proportion of Australian SMEs reporting increases and declines in employment and sales in 2012–13. It shows that the younger the business age category the greater the proportion of SMEs reporting an increase in employment and in sales. When asked about a decline in jobs or positions over the previous year, a reverse trend is observed. The older the business age category, the greater the likelihood of reporting a decrease in employment and sales over the previous year. As firms age, they are also more likely to be stable in any given year.

The proportion of young SMEs reporting an increase in sales income is more than double the proportion reporting an increase in jobs or positions. This indicates that sales growth is more easily achieved than employment growth.

Table 2.1: SME employment and sales performance over previous year by business age, 2012–13 (businesses with less than 200 employers)

	Employment growth			*Sales growth*		
Firm age	*Increase in jobs/positions (per cent)*	*Stayed the same (per cent)*	*Decrease in jobs/positions (per cent)*	*Increase in sales income(per cent)*	*Stayed the same (per cent)*	*Decrease in sales income (per cent)*
1–4 years	21.8	51.0	13.8	45.7	18.0	24.2
5–9 years	17.4	57.9	15.2	35.8	21.6	37.4
10 years plus	11.7	62.0	16.9	32.2	23.6	39.9

Source: Australian Bureau of Statistics (ABS) *Business Characteristics Survey: Customised Report*, Table 6

These findings make intuitive sense. SMEs that have survived into their second year of operation may have done so because they introduced a new business model, product or service or a superior method of marketing an existing product. Alternatively, the entrepreneur may have chosen a sector or geographic location that facilitates not just survival beyond the first year, but also rapid expansion in employment and sales. Firms that have less successful business models may already have dropped out by the end of the first year. The fact that they mature, however, does not lead to constant increases in growth.

37 Smith R and Hendrickson L (2015) *Business Age and Performance in Australia*, Department of Industry, Innovation and Science, Office of the Chief Economist, Canberra (forthcoming)

Similar trends also apply to profitability and productivity (Table 2.2). As Australian SMEs age, they are less likely to report increases in both of these variables and increasingly likely to report declines over the previous year. In the earlier years, as with employment and sales, Australian businesses are more likely to report superior growth.

These findings are particularly apparent with respect to changes in productivity. Young businesses (one to four years) are around three times more likely to report an increase in productivity than a decrease. But by the time they are 10 years old, they are more likely to report a fall in productivity than an increase. These trends are observable at all firm size cohorts, but are most clear for smaller firms of fewer than five employees (figures not shown here).

Table 2.2: Profitability and productivity performance over previous year by business age, 2012–13 (businesses with less than 200 employees)

Firm age	*Increase in profitability (per cent)*	*Decrease in profitability (per cent)*	*Increase in productivity (per cent)*	*Decrease in productivity (per cent)*
1–4 years	33.4	29.5	31.5	10.8
5–9 years	28.7	37.3	23.8	18.2
10 years plus	23.5	43.1	19.3	20.3

Source: Australian Bureau of Statistics (ABS) *Business Characteristics Survey: Customised Report*, Table 6

The findings on the relationship between age and productivity growth are also consistent with the existing international literature. Studies have indicated that new business entrants tend to have a lower than average productivity level for the industry in question. Productivity increases at a faster rate for those younger firms that survive and the rate of increase subsequently declines as the firm ages.[38] This may be attributable to the higher learning rates needed at initial stages of business development to catch up with or exceed average industry productivity levels. In an Australian study, Nguyen and Hansell 2014 found that productivity growth peaked in the second year of operation.[39] Beyond 10 years, age ceases to affect productivity growth.[40]

In relation to profitability, Loderer and Waelchli found that the return on assets and the profitability of a sample of American firms in the period from 1976 to 2009 declined as the firms aged. They postulated that this was due to increased

38 Coad A, Segarra A and Teruel M (2013) 'Like milk or wine: Does firm performance improve with age?', *Structural Change and Economic Dynamics*, 24: 173-189; Matteo R (2014), 'Firm age and performance: A literature review', in Vrontis T, Weber Y & Tsoukatos, E (eds), *The Future of Entrepreneurship*, 7th EuroMed Conference of the EuroMed Academy of Business, September 18-19, 2014 pp.1326-1336

39 Nguyen T and Hansell D (2014) *Firm Dynamics and Productivity Growth in Australian Manufacturing and Business Services*, Australian Bureau of Statistics, Canberra (ABS cat no. 1351.0.55.052), p.14

40 De Kok J, Fris P and Brouwer P (2006) 'On the relationship between firm age and productivity growth', *Scales Research Reports* H 200617

rigidities in the business and failure to retain key innovative people or their ideas. Innovations were only fully exploited in the initial stages of investment, with returns on investment declining as the company aged.[41] Coad *et al.* also found, based on Swedish data, that sales growth is faster in the early years of a firm's life.[42]

That many struggling older firms do actually survive may be, according to Loderer *et al.* because they make unattractive takeover partners.[43]

In this way, a model of firm dynamism emerges whereby firms develop a variety of growth trajectories. Some exit, some grow quickly due to productivity improvements, while others may survive and mature but not expand rapidly.

"It's all about leveraging the energy and the commitment and the needs of others to make things happen".
Sarah Pearson (Canberra Innovation Network)

2.3 *Business age, product range and internationalisation*

Another indication of business performance and growth is the range of goods and services that the firm offers to consumers. An increase in the range offered is indicative of expansion. This expanded range may encompass products that are totally new to the industry/market or they may just be new to the firm. An expanded product range may indicate business dynamism as it would potentially diversify the firm's sources of income from sales and may indicate buoyant demand conditions in the firm's market.

It may also indicate a response to changing market conditions. This suggests dynamism on the part of the business owner or entrepreneur and/or the market itself. The business itself may benefit from this expanded product range through economies of scope; that is, reductions in the average cost per unit associated with increasing the scale of production from fewer product types.

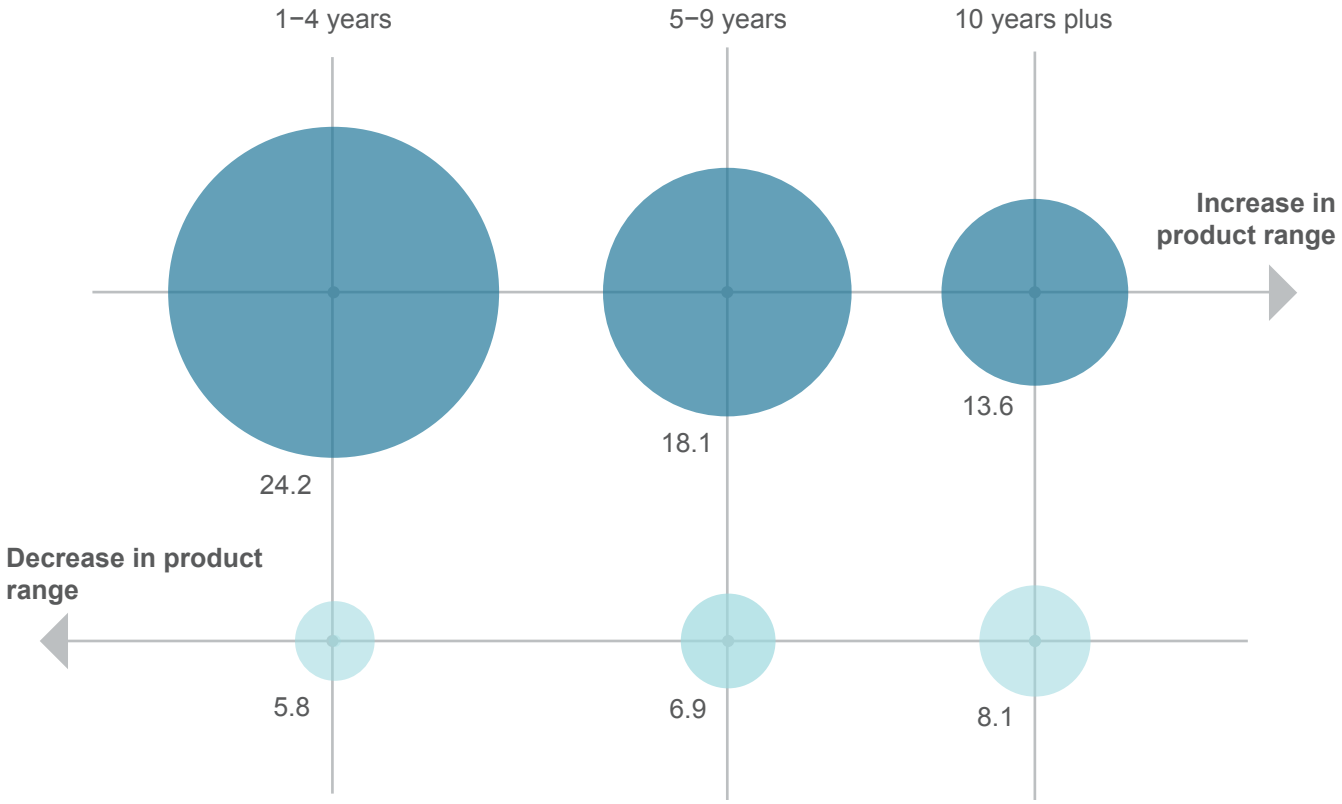
Figure 2.1 illustrates how it is younger SMEs in Australia that are more likely to increase the range of goods and services they offer to customers.

41 Loderer C and Waelchli U (2011) 'Firm age and performance', Available at SSRN: http://ssrn.com/abstract=1342248 or http://dx.doi.org/10.2139/ssrn.1342248

42 Coad A, Daunfeldt S-O and Halvarsson D (2015) 'Firm growth and growth persistence by age', Available at SSRN: http://ssrn.com/abstract=2616759 or http://dx.doi.org/10.2139/ssrn.2616759

43 Loderer C, Neusser K and Waelchli U (2011) 'Firm age and survival', Available at SSRN 1430408

Figure 2.1: Percentage of SMEs that increased or decreased the range of goods and services offered over previous year, 2012–13



Source: Australian Bureau of Statistics (ABS) *Business Characteristics Survey: Customised Report*, Table 6

With respect to the impact of business age on export and internationalisation strategies, the international literature tends to stress the risks to firm survival should exporting activity take place too early in the life of the business, when resources and capabilities are not adequately developed.[44]

Carr *et al.* nevertheless found, based on a longitudinal US sample, that there was no higher likelihood of failure consequent upon internationalisation for younger firms. On the contrary, younger firms were more likely to experience short-term sales growth following internationalisation than older firms — possibly, the authors argued, because their youth made them more flexible and better able to realign resources and capabilities to match their internationalisation strategies.[45] Similarly, Naldi and Davidsson found that knowledge acquisition from overseas expansion can materialise in the form of new goods and services and that this so-called 'entrepreneurial growth' from such expansion is greater in younger firms. [46]

44 Sapienza HJ, Autio E, George G and Zahra S (2006) 'A capabilities perspective on the effects of early internationalization on firm survival and growth', *Academy of Management Review* 31(4): 914–933

45 Carr JC, Haggard KS, Hmieleski KM and Zahra S (2010) 'A study of the moderating effects of firm age at internationalization on firm survival and short-term growth', *Strategic Entrepreneurship Journal* 4:183–192

46 Naldi L and Davidsson P (2014) 'Entrepreneurial growth: The role of international knowledge acquisition as moderated by firm age', *Journal of Business Venturing,* 29(5): 687–703

Examination of the customised ABS dataset reveals that the proportion of Australian businesses deriving income from exports in 2012–13 was greatest for businesses 10 years and older (8.8 per cent for SMEs and 28.1 per cent for businesses with 200 or more employees). Although firms appear to defer exporting until they have developed sufficient scale and capabilities, there were still 7.9 per cent of SMEs aged under one year that were exporting in 2012–13. The phenomenon of the 'born global' company therefore does seem to exist in Australia in some instances. Furthermore, consistent with trends elsewhere, there may be greater pay-offs to younger businesses that decide to embark on export activity, although the evidence has yet to be tested in the Australian context.

2.4 *Business age and innovation*

Investment in innovation may be one endogenous (within-firm) factor driving the superior growth of Australian start-ups. The ABS dataset allows the investigation of innovation by firm age not previously conducted with national statistics in Australia.

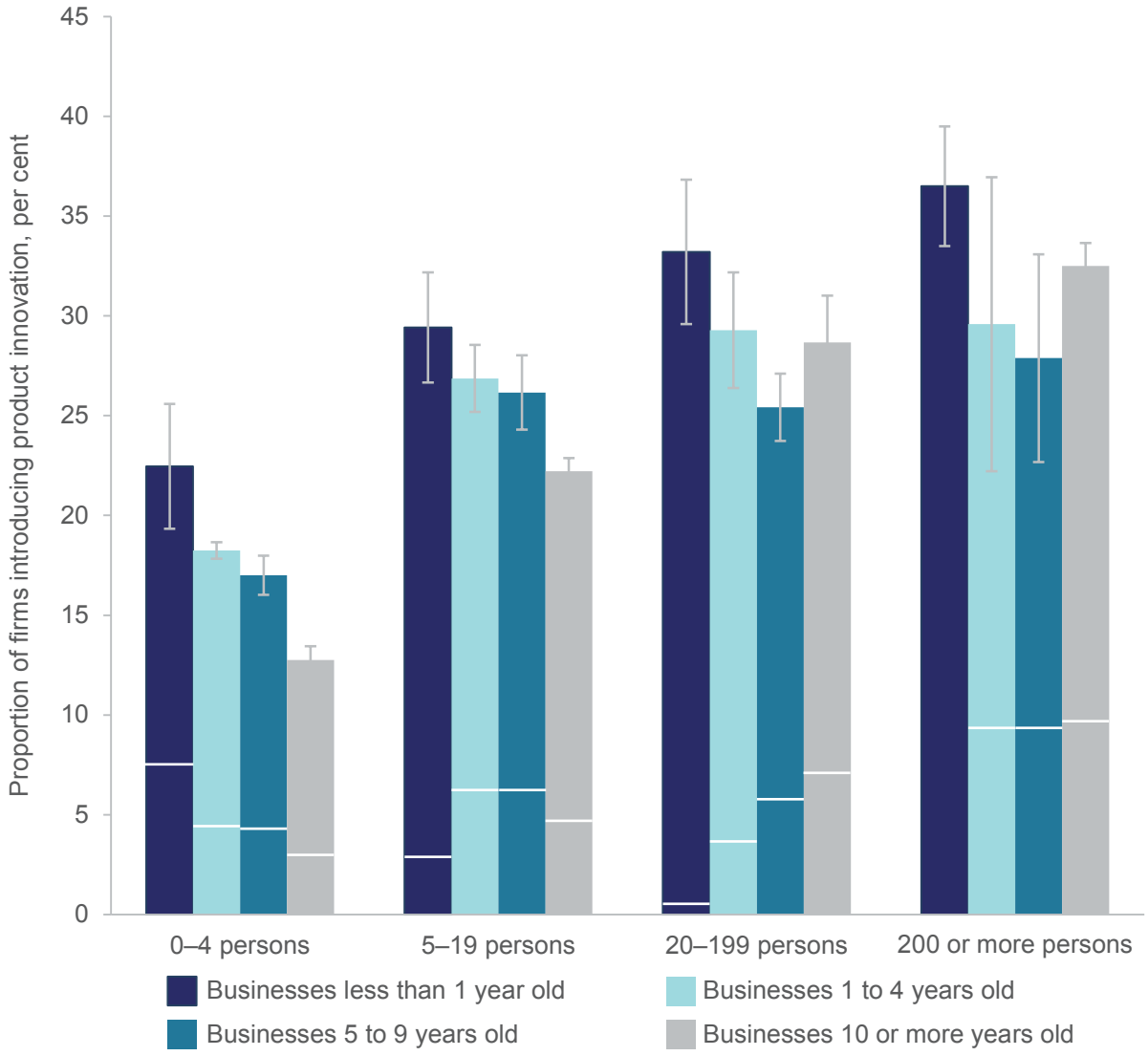
SMEs in their first year of operation are overall more likely than older firms to introduce new or significantly improved goods and/or services. In 2012–13, nearly one quarter (24.1 per cent) of Australian businesses aged under one year (with 0-199 employees) invested in such new products. This declined to 19 per cent for mature SMEs aged 10 years or more.

Once these figures are broken down further by firm size, it becomes apparent that this trend is most observable in small (less than 20 employees) rather than medium-sized or large businesses (Figure 2.2). Nevertheless, across all size categories, start-ups aged less than one year are most likely to introduce new or significantly improved goods or services.

Start-ups are not just more likely to innovate, but in the case of businesses with under five employees and under one year of age, they tend to exhibit a higher degree of novelty in their innovation. They are more likely to introduce 'new-to-market' innovation and less likely to introduce innovation that is 'new-to-the-firm' only.

Around one-fifth (21.3 per cent) of the product innovation by entrant SMEs aged under one year in 2012–13 was 'new-to-the-industry'. But for firms over 12 months old, this degree of novelty represents less than 10 per cent. For older firms, their goods and services innovation is far more likely to be 'new-to-the-firm' only, such as modifications or adoptions of innovations created by other businesses.

Figure 2.2: Businesses undertaking product (goods and service) innovation, by innovation novelty, firm age, by employment size, 2008–09 to 2012–13



Notes: Values are annual averages ± standard errors. Lower columns represent the proportion of businesses introducing new to market goods and services. The standard errors calculated and shown in the charts are average of yearly means to show year on year variation of a mean, and not within year variation in the population.

Source: Australian Bureau of Statistics (ABS) *Business Characteristics Survey: Customised Report*, Table 12

When other types of innovation are examined, the picture of the innovative start-up becomes less distinct. With respect to new or significantly improved operational processes, such as in logistics or distribution, businesses of under one year were actually the least likely to innovate.

There is very little distinction based on age in terms of the proportion of businesses introducing new or significantly improved organisational or managerial processes, such as knowledge management or managing relations with external entities. Around one in five SMEs invested in this type of innovation at all firm ages.

Younger businesses were slightly more likely to introduce new or significantly improved marketing methods. This could include innovations in design and packaging, pricing, media promotion or placement. As many as 20.3 per cent and 21.5 per cent respectively of businesses aged zero to one year and one to four years participated in this type of innovation in 2012–13. This fell to just 16.0 per cent for businesses five to nine years before rising slightly to 18.5 per cent for SMEs aged 10 years or over.

These figures suggest that many new business entries often start out in the market with a new or improved product to entice customers away from the existing competition and gain initial market share. It is consistent with the notion of the innovative entrepreneur being prepared to experiment and to innovate with a new idea.

Higher rates of product innovation among younger SMEs may be one driver behind their higher rates of growth with respect to employment, sales, productivity, profitability and product range. The innovation literature offers evidence of the impact of product innovation (in contrast to process innovation) on job generation.[47]

The lesser likelihood of operational innovation as opposed to product innovation for start-ups is consistent with the theory that firms are more likely to focus on improving production only once the initial product has been developed, launched and tested in the market. Start-up innovations are about developing a value proposition and delivering it to the market. Therefore younger businesses may be more likely to allocate their scarce resources to developing the product and considering how to deliver and market it. Operational improvements come later. At the same time, organisational or managerial innovation does not seem to be strongly mediated by firm age.

Perhaps due to their initial lack of experience in or knowledge of market conditions, businesses aged less than one year were the least likely to report any barrier to innovation among each of the four age categories. This increased likelihood to report barriers to innovation as they age is particularly apparent for medium and large sized businesses.

47 Edquist C, Hommen L, and McKelvey M (2001) *Innovation and Employment: Process versus Product Innovation*, UK: Edward Elgar Publishing, Cheltenham

"The time you get to maximise a price premium on a new product is so short these days, unless it is a really disruptive product"
Brendan Swifte (Geofabrics)

However, consistent with the literature,[48] when it comes specifically to lack of access to additional funds as a barrier to innovation, the customised ABS dataset shows the youngest category of businesses (zero to one year) was most likely to report lack of access to additional funds (averaged for the period 2006–07 to 2012–13) as a barrier to innovation at various firm sizes.

These findings are broadly consistent with much of the international literature. Huergo and Jaumandreu, for instance, found that the probability of product innovation generally declines with business age and that new entrants demonstrate the highest probability of innovation. Exiting firms are also least likely to have introduced process innovations.[49]

In relation to how introducing 'new-to-the-firm' innovation affects firms at different ages, Kotha *et al.* found that older firms benefited in terms of increased quantity of output, whereas younger businesses experienced a higher impact of their innovation due to more flexible structures and processes that enable them to better exploit new approaches.[50]

Start-up and entrepreneurship rates also matter for innovation. According to an analysis of the Comprehensive Australian Study of Entrepreneurial Emergence (CAUSEE) in 2007–11, the vast majority of new ventures (up to four years old) subjectively reported that they offered some degree of innovation in some aspect of their business — whether in respect of the product, the process, market selection, or marketing approach. Close to 75 per cent of new ventures reported some degree of product or service novelty, and over 40 per cent reported that they target markets neglected by other businesses.[51] The innovativeness of start-ups varies by industry, with manufacturing start-ups standing out as the most innovative. Health/education/social services, retailing, and consumer services are also among the more innovative industries, while construction and agriculture score low on innovation.[52]

In addition, more than 20 per cent of firm founders surveyed reported their venture as being 'high-tech' and/or based on new technologies and/or giving R&D a central role, with the reported proportions markedly higher for nascent firms being set up.[53]

48 See, for instance, Pellegrino G (2015) *Barriers to innovation: Can firm age help lower them?,* Barcelona Institute of Economics (IEB) Working Paper 2015-03

49 Huergo E and Jaumandreu J (2004) 'How does probability of innovation change with firm age?', *Small Business Economics* 22 (3-4): 193-207

50 Kotha R, Zheng Y, and George G (2011) 'Entry into new niches: the effects of firm age and the expansion of technological capabilities on innovative output and impact', *Strategic Management Journal*, 32(9): 1011-1024

51 Davidsson P and Gordon S (2013), *Innovation and Change in New Ventures, Business Creation in Australia,* Research Paper #3, Queensland University of Technology, Brisbane, p.4

52 *Ibid,* p.6

53 *Ibid*, p.12

The CAUSEE data presents a positive picture of the degree of novelty and innovation injected into the Australian economy by emerging new businesses. The authors of the study conclude that, in the limited international comparisons undertaken, the innovativeness of Australian start-ups is high rather than low.[54]

2.5 *Business age and collaboration*

Collaboration is an important means for businesses to gain an advantage in the marketplace, by developing capabilities, transferring skills, sharing risks and resources, and innovating to maximise performance outcomes. We examine the extent to which SMEs in Australia had collaborative arrangements in place in 2012–13 by reference to business age. This could include joint buying, joint production, joint marketing or distribution, joint R&D activities or an integrated supply chain

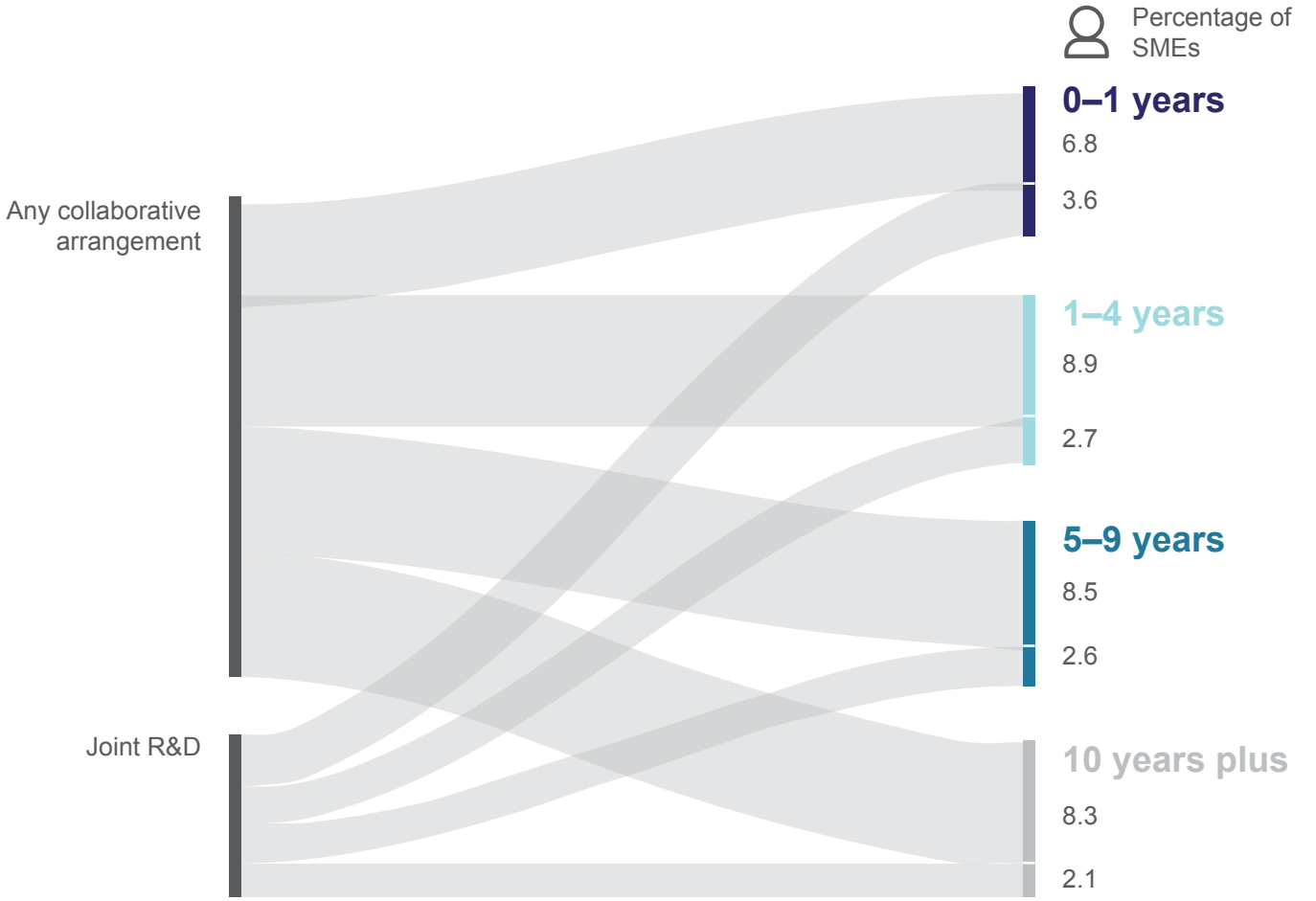
Such collaborative arrangements are, in fact, relatively rare in Australia.[55] Similar to some of the above indicators of innovation, the likelihood of having a collaborative arrangement in place peaks at age one to four years at 9 per cent and then falls away slightly for older businesses (Figure 2.3).

Some 3.6 per cent of SMEs aged 0–1 years had joint R&D arrangements in place. This proportion becomes even smaller as SMEs age. This may again illustrate the higher likelihood of product innovation (and more novel product innovation) for start-ups which in this case may be facilitated by having collaborative R&D arrangements in place.

54 *Ibid, p.21*

55 As noted in previous issues of the Australian Innovation System Report, Australia has relatively low levels of collaboration between industry and researchers. Australian SMEs were ranked 24th out of 31 OECD countries in 2008–10 for collaboration on innovation. Large firms ranked 29th: Australian Government (2014), *Australian Innovation System Report 2014*, Department of Industry, Canberra, p.7

Figure 2.3: SME collaborative arrangements, 2012–13



Source: Australian Bureau of Statistics *(ABS) Business Characteristics Survey: Customised Report*, Table 10

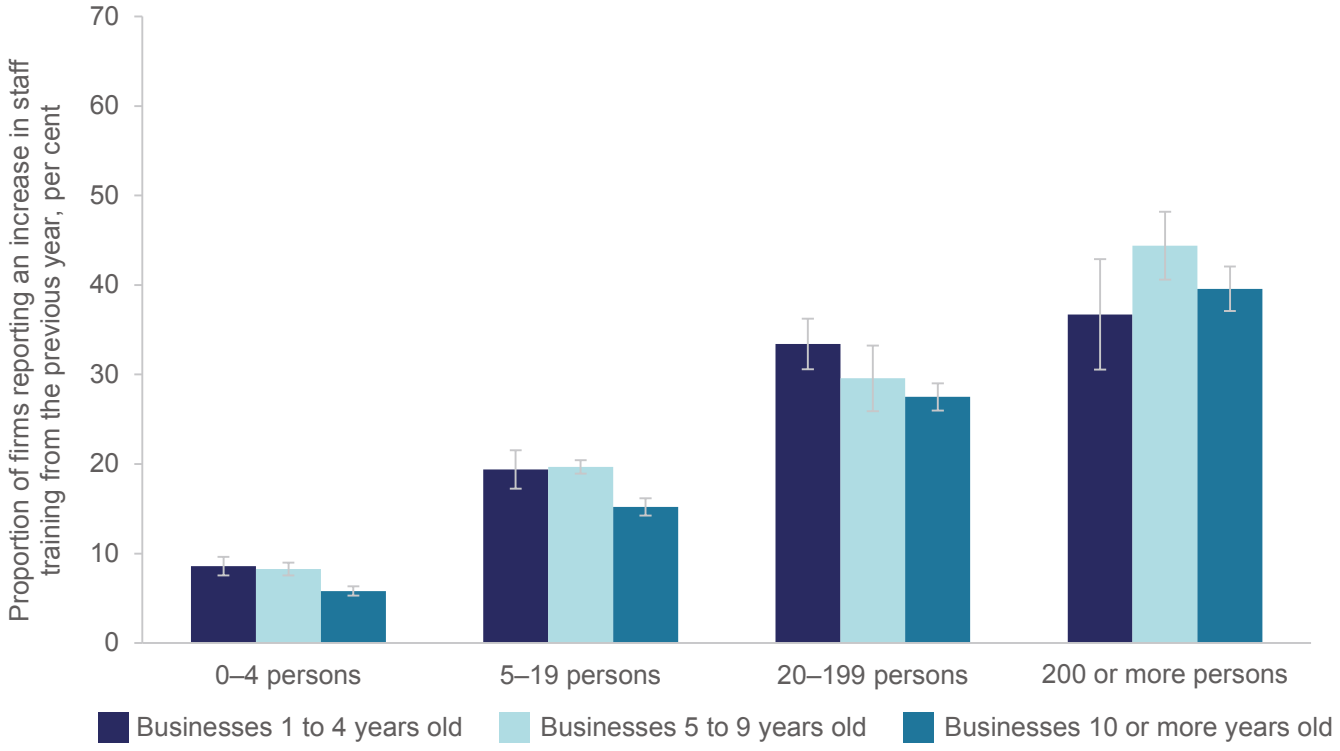
2.6 *Business age and skills*

Does business age matter for the skills that a business needs? There is at least some indication that firm entry plays a disproportionately important role in demand for certain core skills.

As shown in Figure 2.4, for SMEs the younger the business the more likely it is to report an increase in structured or formal training for its workforce as compared to the previous year. This trend is not apparent for larger businesses.

Where all three SME sizes are combined, in 2012–13, as many as 14.7 per cent of SMEs aged one to four years reported an increase in the amount of structured or formal training that they offered to employees. This fell to 12.3 per cent for firms aged five to nine years and just 8.9 per cent for firms aged 10 years plus.

Figure 2.4: Proportion of businesses that reported increases in structured/formal training compared to the previous year, 2012–13



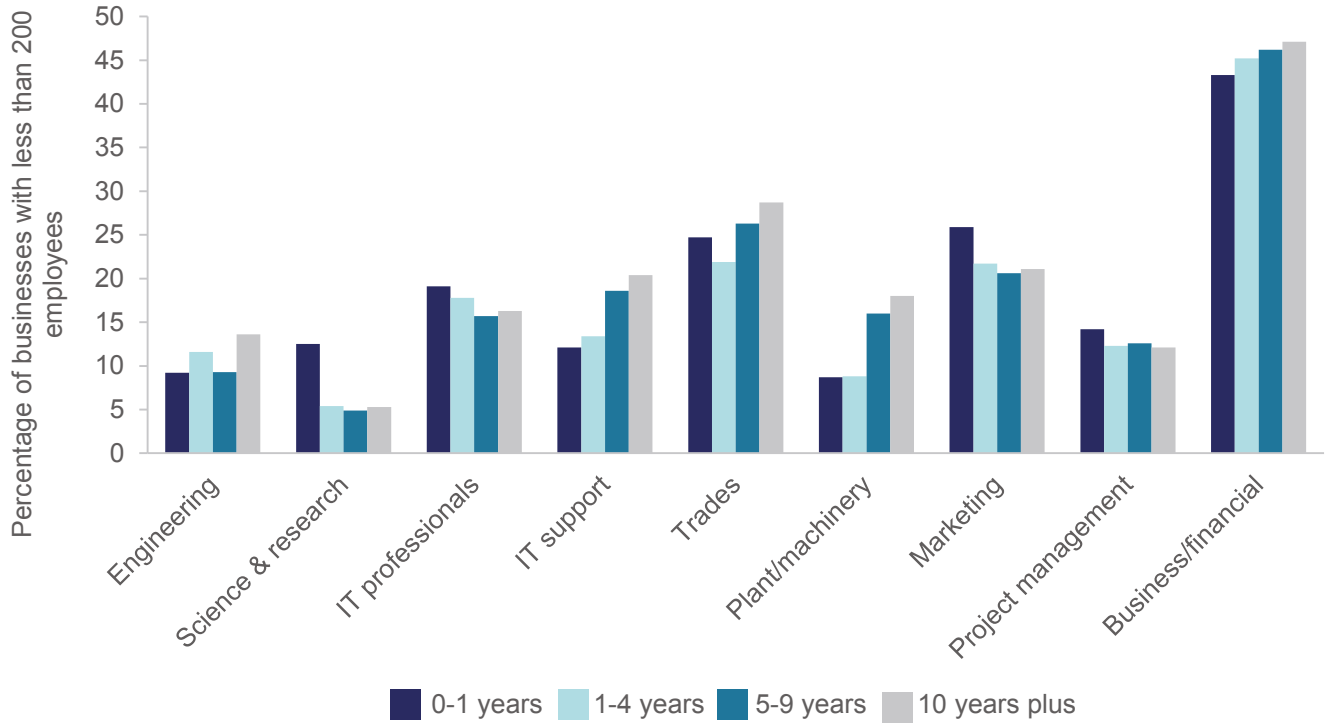
Notes: Values are annual averages ± standard errors. The standard errors calculated and shown in the charts are the average of yearly means to show year on year variation of a mean, and not within year variation in the population.

Source: Australian Bureau of Statistics (ABS) Business Characteristics Survey:Customised Report, Table6

Business age is also a variable at play with respect to the type of skills that businesses use. We have previously noted the disproportionate role played by start-ups and younger businesses in terms of business growth, innovation and dynamism. This is borne out also in terms of the skills used by younger firms. As shown in Figure 2.5, younger SMEs are more likely to use research and scientific skills and slightly more likely to use IT professional and marketing skills. When all three SME sizes are combined, start-up SMEs were more than twice as likely to report using science and research skills in 2012–13 as compared to older businesses. These types of skills are the most appropriate for developing the firm's initial product range.

On the other hand, more mature SMEs were more likely to use skills needed for operational efficiency, such as engineering, IT support, trades, plant and machinery, business management and finance.

Figure 2.5: Skills used in core activities, 2012–13



Source: Australian Bureau of Statistics (ABS) Business Characteristics Survey: Customised Report, Table 20

Feature: Grassroots entrepreneurship and innovation — Business start-up in Australia

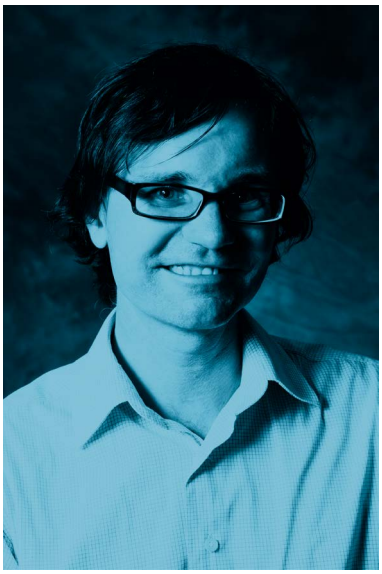
By Dr Paul Steffens, Deputy Director, Australian Centre for Entrepreneurship Research (ACE) and Associate Professor, School of Management, QUT Business School

This article provides a broad picture of business start-up activity and its level of innovativeness in Australia. This sector of the economy is of critical importance for economic development as young SMEs are an important engine of job creation. In Australia, like other OECD countries, young SMEs less than five years old contribute a much larger share of job creation (41 per cent) than either their share of the stock of jobs (19 per cent) or job destruction (24 per cent) (see Chapter 3).[56]

By world standards the level of business start-up activity in Australia is high. Looking at the very earliest stages of business start-up, the Global Entrepreneurship Monitor (GEM) study estimated Australia's total entrepreneurial activity (TEA) at 13.1 per cent of the adult population in 2014. This places us amongst the highest of developed economies. This concurs with other data which shows Australia's rate of business entry is one of the highest in the OECD.

Australians also appear relatively effective at starting businesses. A large longitudinal study of business start-up attempts, CAUSEE,[57] and a US counterpart (PSED II),[58] reveals Australian entrepreneurs are about twice as likely on average to get a business operational than those in the US (31 per cent vs 12 per cent after one year or 30 per cent vs 16 per cent after three years). This picture is supported by GEM data that reveals while Australia has a similar TEA to the US, we have a lower percentage of the population engaged in the process of starting a business and a higher percentage who have recently started a business.

So business start-up activity appears to be alive and well in Australia. But what about the quality of these start-ups? How innovative are they, and how much do they grow?



Dr Paul Steffens

56 Hendrickson L, Bucifal S, Balaguer A and Hansell D (2015) *The Employment Dynamics of Australian Entrepreneurship*, Department of Industry, Innovation and Science, Office of the Chief Economist, Canberra; Criscuolo C, Gal PN & Menon C (2014) *The Dynamics of Employment Growth: New Evidence from 18 Countries*, OECD Science, Technology and Industry Policy Papers, No. 14, OECD Publishing, Paris

57 Davidsson P, Steffens P and Gordon S (2011) *Comprehensive Australian Study of Entrepreneurial Emergence (CAUSEE): design, data collection and descriptive results*, Handbook of research on new venture creation, 216-250. See: https://www.qut.edu.au/research/research-projects/the-comprehensive-australian-study-of-entrepreneurial-emergence-causee

58 Reynolds P and Curtin R (2008) Business creation in the United States: Panel study of entrepreneurial dynamics II initial assessment, *Foundations and Trends in Entrepreneurship*, 4 (3), 155-307. See: http://www.psed.isr.umich.edu/psed/home

First, it must be emphasised that the broad population of business start-ups are dominated by a 'modest majority' that do not aspire to grow particularly large, nor do they. The CAUSEE study reveals that after three years, the median revenues of the 30 per cent of start-ups that became operational is only $60,000, only 35 per cent regularly employ any staff, and the median of those that do is only between 1-2 staff. However, this is not to say that start-up firm growth is poor in Australia. These figures are almost identical to international studies such as PSED (Panel Study of Entrepreneurial Dynamics) II.

In fact, overall the innovativeness of the average business start-up in Australia appears to be, if anything, relatively high by world standards. GEM indicates that Australia outperforms most other developed economies on indicators that represent the quality and economic impact of early-stage businesses. For example, in Australia, 5.7 per cent of adults report they are starting businesses selling products or services that no or few other businesses sell. This compares favourably to the developed economies average (3.8 per cent) or benchmarks like the UK (3.6 per cent), however falls a little behind that of the USA (6.8 per cent). Similar patterns are true for growth aspirations, the number of opportunity-driven start-ups and other indicators of innovativeness. This overall positive picture concurs with data from CAUSEE and PSED studies where, for example, Australia's start-ups are more likely to be engaged in R&D or new technologies.[59]

Other evidence suggests that Australia's small firms are also relatively innovative. Surveys indicate Australia compares well in terms of the self-reported innovativeness of its SMEs, ranked 7th of 32 OECD countries.[60] Australia similarly ranks highly amongst developed economies for what GEM calls employee entrepreneurial activity in established firms, ranked 3rd among 29 developed economies.

So, it appears that start-up activity in Australia is high by world standards and that, while these efforts are modest on average, they are reasonably innovative by international comparisons. Yet what about Australia's performance when it comes to the very high growth firms, such as the so-called gazelles?

Here reliable international comparisons of just how many start-ups exhibit high or sustained growth have been lacking. Studies based on representative samples of firms reveal just how rare these firms are, and hence we are left with only a tiny number of very high growth firms which may not be representative of the population of high growth firms. For example, in the CAUSEE sample only seven per cent of operational firms, or just two per cent of start-up attempts, had revenues over $1 million after three years. But these figures were stronger than recorded in the US counterpart PSED II (three per cent of operational firms, or one per cent of the start-up attempts).

Alternatively, after three years only a tiny proportion of firms in Australia had achieved medium size status by employing more than 20 people (0.8 per cent of operational firms or 0.2 per cent of those start-up attempts). This is the one area where the US counterparts performed better (four per cent of operational firms, or just over one per cent of start-up

59 Davidsson P, Steffens P, Gordon S and Reynolds P (2008) *ACE research briefing paper 006: Anatomy of New Business Activity in Australia: Some Early Observations from the CAUSEE Project* Queensland University of Technology, Brisbane

60 OECD (2014) *Entrepreneurship at a Glance 2014*, OECD Publishing. http://dx.doi.org/10.1787/entrepreneur_aag-2014-en

attempts). This new data and international comparisons will be crucial to pinpoint areas of comparative strengths and weaknesses of our start-up sector.

Australia's rate of business entry is one of the highest in the OECD.
Credit: 360b / Shutterstock.com

THE IMPACT OF INNOVATIVE ENTREPRENEURSHIP ON EMPLOYMENT

Federation Square, Melbourne

3.The impact of innovative entrepreneurship on employment

Australia has one of the highest proportions of start-ups and young firms among small businesses in the OECD.

This chapter explores the impact of firm age on employment

In Chapter 2, we examined the impact of business age on a wide variety of business performance metrics. In this chapter, we explore in more depth the specific impact that firm age has on employment and therefore the opportunities that innovative entrepreneurship offers for economic renewal and growth.

This chapter draws on a departmental research paper[61] that explores the dynamics of employment and productivity growth of all Australian firms using a newly created Expanded Analytical Business Longitudinal Database (EABLD) (see Box 1.1). The study examines the contribution of young businesses, particularly start-ups, to net job creation in the Australian economy between 2001–02 and 2011–12.

Australia has one of the highest proportions of start-ups and young firms among small businesses in the OECD. As is the case in many other advanced economies, we show that start-ups and young businesses contribute disproportionately to job creation in Australia. However, it is only a relatively small percentage of very high growth businesses that make up the bulk of this contribution.

Turning to other ways that innovative entrepreneurship impacts the Australian economy, research shows that businesses that perform R&D are more likely to record high growth in sales and profitability.

61 Hendrickson L, Bucifal S, Balaguer A and Hansell D (2015) *The Employment Dynamics of Australian Entrepreneurship*, Department of Industry, Innovation and Science, Office of the Chief Economist, Canberra

A feature article and three case studies support our study of the disruptive potential of innovative entrepreneurship in this chapter. Dr Fei Qin from the London School of Economics and Political Science discusses entrepreneurship as a vehicle for dynamism and change. Fishburners shows how a co-working space can enhance creativity through collaboration between individuals who thrive on innovation and challenge. Future Solar Technologies demonstrate the disruptive potential springing from research collaboration and a global orientation. A case study on UTS Business School examines cutting edge approaches to teaching entrepreneurship in Australia.

3.1 *Australia has a relatively high (but declining) proportion of young businesses*

The overwhelming majority of Australian businesses are small, although most employment is concentrated in medium to large size firms. Large businesses (250 employees plus)[62] represent only 0.3 per cent of all Australian firms, but account for some 40 per cent of employment. This is broadly comparable to countries like France, the United Kingdom, the United States and Canada.[63]

Australia is distinct in terms of its high share of small businesses (less than 50 employees) that are start-ups (up to two years old). Australia had the second highest proportion (behind Brazil) of small businesses that are either start-ups or start-ups/young (up to five years) over the 2001–11 period. More than half (54 per cent) of Australian small businesses are aged under five years. The nearest comparable OECD country is Spain at 46 per cent.

When broken down by sector, Australia also had the second highest share of start-ups (during the 2001-11 period) behind Brazil in both manufacturing at 24 per cent and in services at 33 per cent. Japan had the lowest proportion of start-ups overall and among manufacturing firms, while Finland had the lowest start-up share in services.

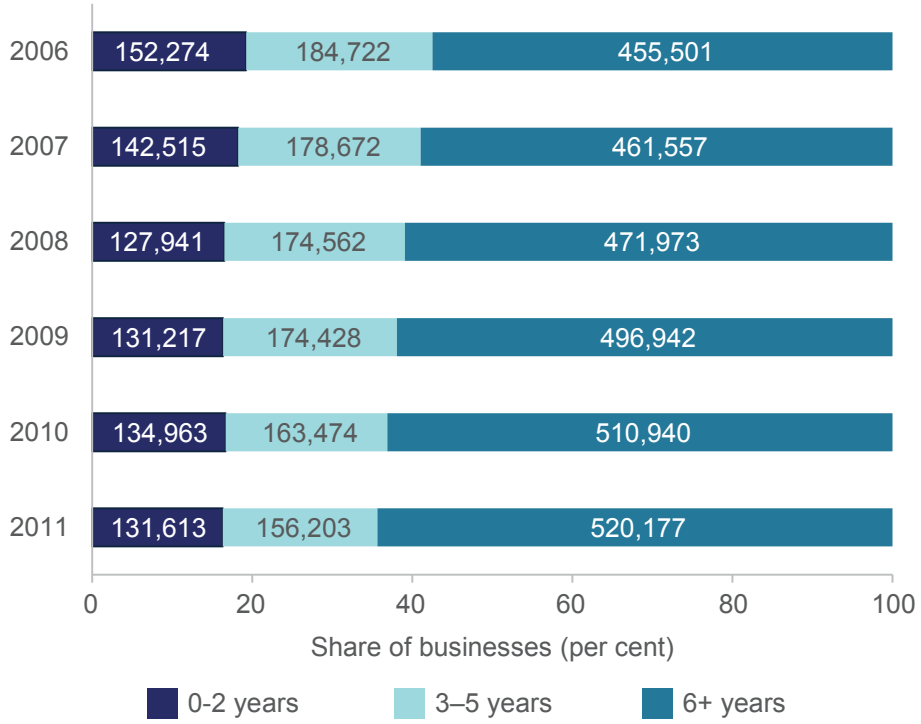
This high start-up rate is a positive indicator of entrepreneurship in Australia, but Hendrickson *et al.* observe, as do other analysts,[64] that start-up rates (proportion of start-ups to the total number of businesses) have been declining since the period 2004–06.[65] This decline is apparent across a number of OECD countries [66]and is also reflected in Australia's falling start-up share of total employment and the share of start-ups in gross job creation.[67]

It is useful to view a complete breakdown of Australian employing SMEs (1–199 employees) by business age. Figure 3.1 confirms the absolute decline in the

62 Using an OECD definition to support international comparison.
63 Hendrickson *et al.* (2015) *op cit.,* p.5
64 Talimanidis D (2014) *Where have all the entrepreneurs gone? Australia's falling business entry rate*, Institute of Public Affairs, Melbourne
65 Averaged across the 3-year periods of 2001–03, 2004–06, 2007–09 and 2010–11
66 Researchers note that the decline in business dynamism in the United States over the last 30 years is observed across all 50 states: Hathaway I and Litan R (2014), *Declining business dynamism in the United States: A look at states and metros*, Brookings Institute, Washington DC.
67 Hendrickson *et al.* (2015) *op cit.,* p.6

number of start-ups (up to two years) and start-ups/young businesses (up to five years old) in Australia since 2006. The proportion of businesses aged under five years declined from 43 per cent in 2006 to 36 per cent in 2011. Theproportion of SMEs that were start-ups declined from 19 per cent to 16 per cent over the same period even though the total number of SMEs has been growing. This matters for job creation.

Figure 3.1: Age composition of small to medium sized businesses, 2006–2011, per cent of SMEs



Notes: The graph shows the number of firms by different age groups in the total number of small and medium firms (1–199 employees) in Australia. The units in the bars are the total number of businesses in each age category. Young firms are 0–5 years and mature firms are 6+ years Start-ups are defined as a subset of young firms that are 0–2 years of age.
Data is for all sectors of the economy excluding government and non-employing firms.

Source: ABS (2015) *Expanded Analytical Business Longitudinal Database 2001–02 to 2012–13*

Dr Fei Qin

Feature: The role of entrepreneurship as a vehicle for dynamism and change

By Dr Fei Qin, London School of Economics and Political Science

Entrepreneurship as a concept has multiple connotations. Depending on the sources of the definition, it could encompass a wide range of economic activities from self-employment and new venture creation to corporate venturing. Researchers have also distinguished between replicative entrepreneurship and innovative entrepreneurship, need-based entrepreneurship and opportunity-based entrepreneurship. In the 2014 Global Entrepreneurship Monitor survey, Australia ranks fourth in terms of total early stage entrepreneurial activities (TEA) among all the 29 innovation-driven economies covered by the report, next to Qatar, Trinidad and Tobago, and the United States. When entrepreneurship has almost become a buzz word in business today, a question becomes important in understanding the nature and impact of various types of entrepreneurship — what kind of entrepreneurship is more relevant to economic growth, or has the potential to shape tomorrow's business paradigm?

Ever since Austrian economist Joseph Schumpeter first linked entrepreneurship with innovation, entrepreneurship has been widely recognised as a key driver for 'creative destruction', the revolutionary and discontinuous changes that break the static mode of the economy and lead to shifts in business cycles and long-term economic development. While in modern history new firms have always come into being, the role of entrepreneurship has never been as central as today when business transactions and economic activities are increasingly complex, dynamic, and globally integrated. During the post-industrial revolution era, when standardisation and mass production gave rise to the dominance of large organisations, new ventures, albeit always serving as an important source of economic growth, did not occupy the centre stage of the economic landscape. The values of entrepreneurial organisations have mostly been heralded for employment generation and commercialisation of new inventions. This is all changing with the rise of the knowledge and digital economy, where entrepreneurs and the organisations they create are uniquely positioned to exploit new opportunities, adopt new production methods and technologies, and reshape competition by penetrating new markets.

This article highlights two emergent trends of entrepreneurship that have enabled entrepreneurial organisations to generate unprecedented and profound impacts on the ways that production and business transactions are carried out. These are a) increasing engagement in business model innovation and b) the emergence and proliferation of global start-ups.

Traditionally entrepreneurship has been closely associated with technological or product innovation; nowadays from Alibaba.com to Uber, start-up companies worldwide are playing a pioneering role in business model innovation —innovation that involves changes in multiple components in a business model simultaneously, oftentimes with changes in the entire system. Through devising new ways of creating, delivering, and capturing values, visionary entrepreneurs have become important game-changers who defy old

business models, rewrite the rules, and define new traditions in their industries. With the development of internet and mobile technology that opens up new and easily accessible distribution channels, the core of business competition has increasingly shifted towards providing unique solutions catered to varying and fast-changing customer needs, which is often enabled by new value propositions coupled with a novel combination of resources.

While successful business innovations in well established companies are rare in general, new ventures have made impressive achievements in spearheading business model innovation. For instance, a new wave of disruptive business model innovation based on the concept of the 'sharing economy' is exemplified by the success of start-up companies such as Airbnb and Uber whose business models centre around building a platform connecting people and resources rather than directly offering products or services. Conventional management theories argue that new ventures face unique challenges from simply being new to the game, i.e. the 'liability of newness'. However, when it comes to business model innovation, 'newness' becomes an advantage rather than a liability. Being less constrained by rigid organisation structures, established routines, and lengthy decision-making processes often found in existing organisations, new ventures are swifter in spotting new market trends, more responsive to changes in customer needs, and more efficient in coming up with novel solutions.

Another important new trend in entrepreneurship concerns the rise of the so-called 'born globals' or 'international new ventures' — start-ups that have operations in multiple countries from or near inception. Such new venture creation activities are not bounded by geographic locations. The past decade has seen entrepreneurial initiatives mushroom in the transnational space. In the past, companies usually became established in the home market first and then entered the international markets step by step. Thus only big, mighty, and resource-abundant companies can go global. This standard internationalisation trajectory has been transformed by a new generation of ventures that compete on the global stage from the outset. Although new and small, these fledgling start-ups operate across multiple geographies, draw from both local and global resources, and sell to the world market. The successful international launch of new ventures can be found in many sectors, ranging from high tech to consumer goods and processed food. The entry of this flock of new players is fundamentally transforming the competitive landscape of global business that was traditionally dominated by big multinational companies.

It is worth noting that behind global start-ups are entrepreneurs with strong international orientation and a global mindset. Oftentimes these organisations are created and led by migrants who are equipped with international experience and multicultural backgrounds, with deep knowledge of both domestic institutions and foreign markets. Australia boasts a highly skilled migrant population that also creates a vast reservoir of entrepreneurial talent. This talent pool can be an invaluable asset to the country's global competitiveness, providing the potential to become a major hub of global start-up companies.

In short, among a wide variety of entrepreneurial activities, special attention could be paid to the above-mentioned two types — entrepreneurial organisations engaging in business model innovation and international new ventures — that could constitute important sources of dynamism and changes in the future global business arena.

3.2 *Start-ups drive employment growth*

While innovative entrepreneurship can disrupt competitive markets, it also has the potential to nurture business dynamism and economic growth. Like many OECD countries, Australia is in the midst of an economic transition. Australia's situation is different in that it is not so much seeking recovery from a downturn as searching for new sources of growth to balance the relative decline in resources sector investment.[68] The role of the entrepreneur is central to this process.

Productivity differences between firms have a large impact on their survival and growth.[69] Both productivity and profitability are closely linked to business dynamism in the form of firm entry, exit, stagnation and growth — all encompassed in the Schumpeterian concept of creative destruction. One estimate is that as much as 74 per cent of aggregate productivity growth may be derived from the reallocation of employment to innovating businesses through both entry and exit dynamics (21 per cent) and growth through the capture of new market share (53 per cent).[70]

These dynamics are driven by the decisions of individual entrepreneurs and managers who determine investment in and deployment of firm capabilities, such as hiring skilled labour, investing in plant and equipment, and acquiring new know-how. Until now, our capacity to understand these firm dynamics and their impact has been limited by a lack of data enabling researchers to link firm-level change in employment and production to national trends. The EABLD now allows this linkage in Australia.

Hendrickson *et al.* estimate that, over the period 2006 to 2011, 1.04 million full time equivalent (FTE) jobs were added to the Australian economy. However, once this FTE job creation is broken down year-by-year and for different categories of firm age, the data shows that younger businesses, particularly start-ups (up to two years old), contribute disproportionately to generating jobs in the Australian economy. Start-up businesses added approximately 1.44 million jobs to the economy whereas older businesses (three years old or more) shed just over 400,000 net jobs over the same period (Figure 3.2).

The data also illustrate the importance of start-ups to job creation, both in periods of economic downturn like the global financial crisis (GFC) and more buoyant conditions when the Australian economy was not shedding net jobs overall.

---

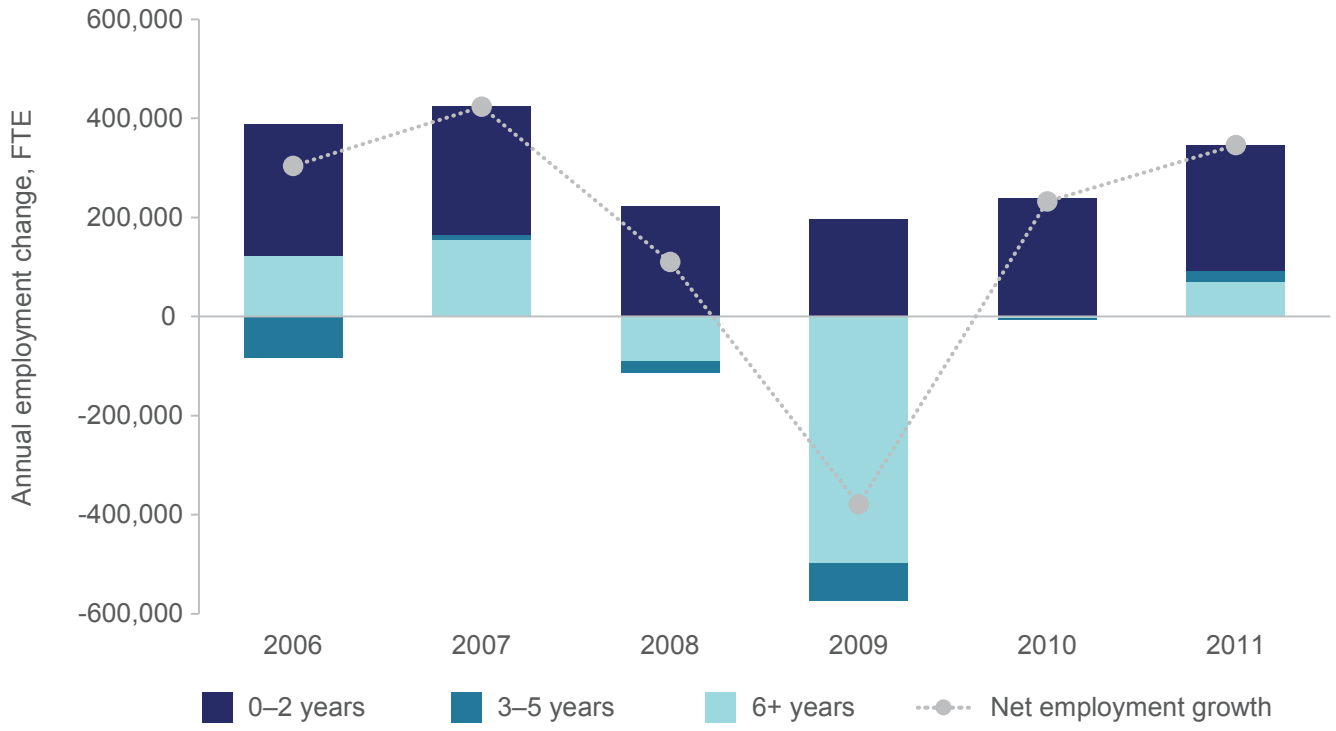
68 For instance, resources investment was expected to decline from around 7 per cent of Australia's GDP at the height of the boom to about 2–3 per cent of GDP over the longer term: Gruen D and Wilcox R (2014) *After the resources investment boom: Seamless transition or dog days?*, Speech to the Australian Conference of Economist, Hobart, 3 July 2014

69 Syverson C (2011) 'What determines productivity?', *Journal of Economic Literature* 49(2): 326–65

70 Lentz R and Mortensen DT (2008) 'An empirical model of growth through product innovation', *Econometrica* 76(6): 1317–73

In the GFC year of 2009, it was mature businesses aged over five years that contributed most of the net job loss; start-ups still made a net positive contribution to employment. Net employment loss during this period was driven by downsizing rather than exit of firms.[71]

Figure 3.2: Net employment growth by business age, 2006–2011



Notes: Employment is measured in Full Time Equivalents. Results are for all non-government sectors and exclude non-employing firms. Young firms are aged 0–5 years and mature firms are 6+ years. Start-ups are defined as a subset of young firms that are 0–2 years of age.

Source: ABS (2015) Expanded Analytical Business Longitudinal Database 2001–02 to 2012–13

Australia had one of the highest average annual employment growth rates (at 2.9 per cent) in the OECD between 2001 and 2008. Disaggregating this rate by business age shows that the unweighted net employment growth rate of surviving young businesses (aged up to five years) was 12.2 per cent over the period from 2001 to 2011. By contrast, the unweighted net employment growth rate of mature businesses (six years or older) was significantly lower at 1.4 per cent over the same period. The net growth gap between these young, surviving and mature businesses is one of the highest in the OECD.[72]

71 Hendrickson *et al.* (2015) *op cit.,* p.8
72 *ibid,* pp.10–11

3.3 *Many indicators of start-up performance have declined since the global financial crisis*

Australia has relatively high net job creation compared to other OECD countries, which range between one per cent and five per cent. During the global financial crisis, there was a general decline in the performance of Australian start-ups, although Australia still compares relatively favourably to many other OECD countries (see Table 3.1).

Data on net job creation by entrants that survive at least three years shows that for every 100 jobs in Australia in any given year, on average start-ups will add 5 jobs within the following three years. Net job creation by surviving entrants relative to total employment peaked at 6.3 per cent in 2004 and declined to 3.6 per cent by 2008. Similarly, Table 3.1 shows that the start-up rate was close to 20 start-ups per 1,000 employees at the beginning of the reference period in 2003, but has since fallen back sharply to 11.5 per cent in 2012. Australia has a mid-range start-up ratio compared with other OECD countries which range between three and 23 start-ups per 1,000 employees. Of the sectors covered in the analysis, the data shows that start-up rates are low in manufacturing and high in selected service sectors of the economy.

Three-year survival rates were steady between 2003 and 2008 at around 60 per cent, but dipped for the 2009 cohort to 55.7 per cent (Table 3.1). The three-year survival rate of Australian start-ups is moderate to low compared with other OECD countries which range from about 55 per cent to over 70 per cent.

Most businesses that survive three years either grow marginally or retain their staff numbers at entry levels. A ratio of final to initial employment above 100 per cent shows post-entry growth (see the final column of Table 3.1). Average post-entry growth of start-ups that survive three years was 114.6 per cent over the reference period. Australia's average post-entry growth has been declining over the period measured, with a notable fall during the global financial crisis, and a return to moderate net employment growth for firms entering the economy in 2009. Australia's average post-entry growth rate is low compared to most other OECD countries examined to date (ranging from 110 per cent to 240 per cent).

Table 3.1: Indicators of start-up job creation in Australia, 2003-2012

Entry cohort	*Net job creation by surviving entrants relative to total employment*	*Start-ups per thousand employees*	*Start-up survival rate, proportion of firms surviving after three years (per cent)*	*Average start-up employment size at entry*	*Average post-entry growth, ratio of final to intial employment (per cent)*
2003	5.8	18.9	59.2	2.7	141.1
2004	6.3	18.8	59.4	3.3	129.3
2005	5.6	16.4	60.1	3.6	118.3
2006	5.3	15.7	59.5	3.6	118.3
2007	4.1	15.4	59.8	3.6	98.0
2008	3.6	13.7	59.4	3.8	89.5
2009	3.9	12.2	55.7	3.9	107.4
2010	-	15.6		-	-
2011	-	15.2		-	-
2011	-	11.5		-	-
Mean	4.9	15.3	59.0	3.5	114.6

Notes: These data are for manufacturing, construction, and non-financial business services. For the purposes of OECD comparisons, headcount measures are used rather than Full Time Equivalents. Some indicators are not available beyond 2009 because the third year survival and growth data is not yet available in the database.

Source: ABS (2015) *Expanded Analytical Business Longitudinal Database 2001–02 to 2012–13*

3.4 *A small number of high growth micro start-ups drive the bulk of net job creation*

The dynamics of employment creation in Australia are more complex than first appear from this data. Most micro-start-ups do not survive to five years and even fewer grow. So where does the employment growth come from? Given that larger start-ups may be the result of merger and acquisition activity, examination of micro-start-ups (new firms with fewer than 10 employees) may yield a more accurate representation of *de novo* entrepreneurship.

When examining the performance of these micro start-ups in Australia, Hendrickson *et al*. found that a very small fraction of the surviving micro-sized start-ups are responsible for most of the job creation by all micro-start-ups over a five-year period. Although representing only 3.2 per cent of all micro-start-ups, they accounted for 77 per cent of gross job creation by surviving micro-start-ups over the five year period examined (2006-11). This result is very similar to results for other OECD countries (generally less than 5 per cent). For most sectors of the economy, these businesses grow dramatically to more than compensate for the job destruction of exiting micro-start-ups.

Not surprisingly, these businesses also exhibited superior sales, gross operating profit, employment and value added performance compared with surviving micro-start-ups that were stable or grew marginally over the same period. Despite these

high performance results, the high growth micro-start-ups did not experience as rapid productivity growth as other surviving micro start-ups. This trend was similar across all industries and micro-start-up cohorts observed.

This result at first glance suggests a trade-off between growth and productivity. Lower productivity growth may be explained by strategic decisions of start-up management and leadership. Owner/managers may be hiring new staff and investing in physical and intangible capital with the expectation of future returns. This would temporarily suppress revenue-based labour productivity. Future research needs to track these firms over their lifecycle to assess when these firms achieve their 'maximum' productivity performance.

Fishburners co-working space

Case study: Fishburners Co-working Space[73]

Not all entrepreneurship needs to be driven by the profit motive. Many of the most innovative organisations start with a desire to create synergies, mutual benefit and social change.

Drawing on this philosophy, Fishburners General Manager Murray Hurps describes his enterprise as a "not-for-profit whose single goal is to create the maximum number of viable start-ups". They achieve this by "inspiring start-ups to launch, attracting them to our community, supporting them to viability, and collaborating with anyone that can assist with our goal".

Now Australia's largest start-up co-working space, Fishburners was established just four years ago. It is located in the heart of Sydney's start-up and creative industries precinct of Ultimo and counts Optus, Google, News Corp, PwC, Xero, Dropbox and BigAir as among its corporate sponsors. Fishburners is home to over 135 start-ups, and has assisted the likes of GoCatch, Orion VM, DesignCrowd and 99 Dresses to get started.

The sharing economy goes to the heart of what Fishburners is about. Its philosophy is based on the idea that creativity is enhanced through collaboration among a community of individuals who thrive on innovation and challenge. Part of this comes through exploiting the diverse skill sets that come together through a co-occupied working space.

Fisburners describes its most important feature as the 200+ entrepreneurs based in the building. They share skills, contacts and motivation, and as a whole, create a watering hole to attract investors, media and government.

Fishburners has also built the most popular venue for start-up events in Australia, with over 500 visitors passing through their two event spaces each week. All events are hosted free of charge, and support is given through promotion, catering and cleaning.

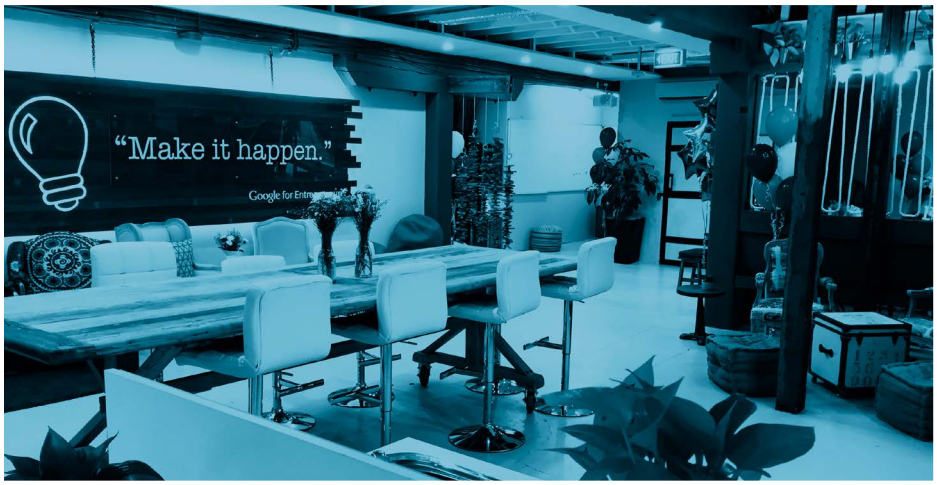
Tenants get much more than just a desk and contracted services. They get valuable advice and mentoring as they progress. Fishburners has also created a community of start-ups that leverage off each other to learn and grow. The more advanced start-ups assist entrepreneurs who are at the initial stage of developing their value proposition and building

73 Interview conducted 23 April 2014 and follow-up discussions in June 2015

their business. There is a vast of array of skills — from technical IT to management, cost structures and fund-raising — that living in a collaborative, vibrant community can help instil. Fishburners positions itself as a 'how to' hub for entrepreneurs in the internet age.

According to Murray: "A desk is wonderful, but at Fishburners the real value comes from what you can produce at that desk that you couldn't elsewhere, and the surface area for luck that comes from our scale." A primary challenge they face is commercial space: "We started in Ultimo because it was cheap, but demand has driven prices up above CBD levels, and made it difficult to find large spaces for continued expansion."

The American concept of the 'B' corporation (that has social and/or environmental as well as business objectives) may not be legislated yet here in Australia. But social enterprises like Fishburners demonstrate that the idea is alive and well in Australia. It is already creating waves and gaining momentum at the cutting edge of the start-up community.



The Fishburners ideas space

Wraparound wall for serious brainstorming

3.5 *A variety of factors may be driving start-up high growth and performance*

What framework conditions are facilitating the superior employment performance of younger firms generally, and of these truly high-growth micro start-ups in particular? How does this link in with Australia's national innovation system?

At first glance, the findings confirm Australia's position as an open economy with healthy levels of entrepreneurship and creative destruction compared with other OECD countries. It is consistent with other reports that show Australia has relatively high entrepreneurial intentions, a high rate of firm creation and low regulatory barriers to entrepreneurship.[74]

The declining start-up activity, although consistent with other OECD countries, is a matter of concern. While the global financial crisis may explain some of the decline, there may be other factors at play.

One important endogenous management-related dimension is the role of learning, innovation investment and risk-taking in differentiating start-up growth performance (R&D investment is discussed in detail in section 3.6 below). High growth start-ups are likely to develop a sustained and unique market advantage early, which may come from the introduction of new or significantly improved goods, services and methods for organising production.[75] These innovative firms are able to leverage productivity advantages faster and displace less productive competitors more quickly.

Another endogenous dimension to consider is growth orientation. Anecdotally, many entrepreneurs may be more interested in lifestyle advantages rather than maximising growth and profits. They may therefore keep their costs and re-investment low and focus on being efficient and profitable. This is a viable and successful strategy for many start-ups.

The extent to which companies embrace digital platforms for their revenue streams is another factor to consider as a driver of business growth. Australian innovative micro-entrepreneurs lead the country in e-commerce. Almost forty percent of innovative micro businesses (less than five employees) received more than 50 per cent of their income via online sales (Figure 3.3). The value of this income was $15.3 billion in 2013–14 — an increase of 130 per cent since 2007–08.

Innovative micro firms (less than five employees) are also leaders in the use of wireless technology but are less likely to have a web or social media presence than large innovative businesses.[76]

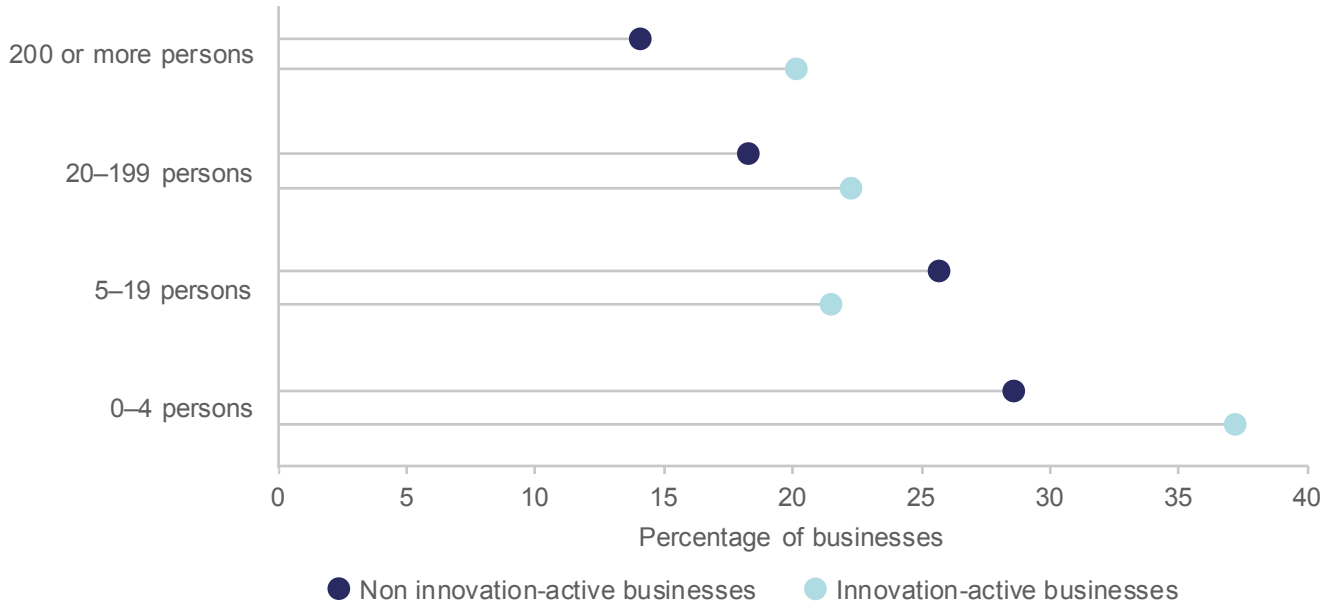
---

74 Steffens P and Hechavarria D (2015) *Global Entrepreneurship Monitor (GEM): 2014 Australia*, Report for Department of Industry and Science. Australian Centre for Entrepreneurship Research, Queensland University of Technology, Brisbane

75 Fagerberg JE (2013) *Innovation: A new guide*, TIK Working Papers on Innovation Studies, No. 20131119; Davidsson P, Steffens P & Fitzsimmons J (2013) Growing profitable or growing from profits: putting the horse in front of the cart? in, *New perspectives on firm growth*, (Davidsson P & Wiklund P, Eds) Edward Elgar, Cheltenham, UK

76 ABS (2014) *Selected characteristics of Australian business, 2012–13*, cat. no. 8167.0

Figure 3.3: Percentage of businesses where internet income represents more than 50 per cent of total income, 2013-14, by business size, by innovation status



Source: ABS (2014) *Selected characteristics of Australian businesses, 2013-14,* cat. no. 8167.0

Criscuolo *et al.*[77] highlight the importance of exogenous (outside-firm) factors such as bankruptcy laws and the availability of finance that may constrain growth. Although Australia ranks relatively highly in terms of framework conditions over the period of this analysis, there are some indications that declining high risk equity financing may be hampering the creation and growth of innovative firms. Although not critical for most start-ups, high risk equity financing plays a crucial role for the three per cent of start-ups that are driving net employment growth. Venture capital and other formal sources of finance for start-ups might be more supportive if the pool of funds were greater and if funds were more readily available across sectors of the economy beyond ICT and life sciences. These issues are examined in more detail at Chapter 5.

"Past failure as an entrepreneur is a good thing as experience is the best teacher … The best innovation often comes from life experience"
Craig Davis (Griffin Accelerator)

77 Criscuolo C, Gal PN and Menon C (2014) *The Dynamics of Employment Growth: New Evidence from 18 Countries*, OECD Industry Policy Papers, No. 14, OECD Publishing, Paris

University of Technology Sydney

UTS campus

Case study: University of Technology Sydney (UTS)

"In today's economy, you're either going to be the disruptor or the disrupted. We want to show students how to be on the winning side of that equation".

Associate Professor James Hutchin, Associate Dean, Business Practice and External Engagement, UTS

This disruptive potential of innovative entrepreneurship is essentially the rationale for the University of Technology Sydney's (UTS) latest offering for budding entrepreneurs. UTS Business School's Master of Business Administration in Entrepreneurship (MBAe) is an intensive one year course designed especially for entrepreneurs and innovators. It examines the wealth-creating potential of innovative entrepreneurship and takes a fresh approach to understanding what can make modern Australian entrepreneurs more successful. The course consists of three discrete Graduate Certificates in commercialisation, entrepreneurship and new venture funding. Students can take just one or two of these or they can take all three to end up with an MBA in Entrepreneurship.

UTS Business School Dean Roy Green explains: "Entrepreneurship and innovation underpins the strategic direction of UTS. Recognising our unique geographic position where Sydney's entrepreneurial, creative and business worlds meet, the MBAe was a natural progression from the work we were already doing in this area".

The course does not just teach entrepreneurship in an academic sense. UTS offers students the opportunity to immerse themselves in an entrepreneurial environment by working on live projects. Students can develop, test and launch their own business ideas in collaboration with other aspiring entrepreneurs and innovators. Time-poor entrepreneurs often are not able to dedicate to a full time course unless there is flexibility to structure their studies around actually implementing what they are passionate about. In that sense, UTS offers a practical approach to entrepreneurship that incorporates skills like perfecting your sales pitch to investors, getting your business plan to venture capital grade and learning to distinguish yourself from the competition.

Throughout all the subjects there is a commitment to 'reality driven rigour' in learning methodologies. This is accomplished by having students work on a real start-up.

In relation to the broad range of skills that can be incorporated into a course of this nature, Mark Collis, Entrepreneur and Founder of PlaceAR (a real world location discovery app) explains: "There's been a kind of a predominance of technology focus. But there's so much more to being an entrepreneur and being a start-up than just the technology. For instance, there is the business modelling, the go-to-market strategy, the branding, and the user experience".

3.6 *Businesses that perform R&D are more likely to record high growth in sales and profitability*

Investment in research and development (R&D) is an important endogenous factor to the performance of high growth SMEs — whether start-ups or more established businesses.

The importance of R&D to economic growth and the performance of firms is well recognised.[78] Economic literature has focused strongly on the crucial role of corporate R&D in large organisations, technology-based businesses and science-based start-ups.[79] Less attention has been paid to the impact of R&D on average Australian firms, particularly SMEs. We have undertaken to fill this gap.

ABS data indicates that gazelle firms[80] (by sales) spent an average of $3.2 million per annum on R&D in the period 2006–11. Small gazelles (less than 10 employees), although having a lower average R&D expenditure, $595,000 in the same period, showed a much faster rate of growth of R&D expenditure almost doubling their average annual R&D expenditure from $392,000 in 2005-06 to $751,00 in 2010–11.

The OECD's Frascati Manual defines research and R&D as activities that 'comprise creative work undertaken on a systematic basis in order 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'. We assessed the relationship between R&D activity and fast growing businesses. A large panel of non-R&D performing businesses was used as a control group. Growth was measured in three output variables: sales growth, employment growth and profitability growth.

Table 3.2 illustrates the proportion of Australian businesses that were gazelle firms by these three indicators of growth — sales, employment and profitability — breaking them down into R&D performing and non-R&D performing businesses, as well as by firm size. The data shows that the likelihood of being a gazelle firm is higher for R&D performing businesses. This is particularly significant in the case of sales and profitability.

78 Freeman C (1977) 'Economics of Research and Development', in E. Spiegel-Rosing and D. de Solla Price (eds), *Science Policy Studies in Perspective,* London, Sage Publications, pp. 223–275

79 Pavitt K and Patell P (1999) *Global Corporations and National Systems of Innovation. In Innovation Policy in the Global Economy*, Archibugi, D, Howells J and Michie J (Eds). University of Cambridge Press, Cambridge, UK

80 We adopted the OECD's definition of 'gazelle firms' as those that exhibit an average 20 per cent growth per annum over three years against these variables: Peterson RP and Ahmad N (2011) *High Growth Enterprises and Gazelles*, Preliminary and sensitivity analysis, OECD, Paris

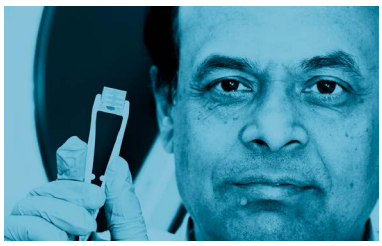
Table 3.2: Proportion of businesses that have increased sales, employment or profitability by 20 per cent over the previous year

	Sales (per cent)	*Employment (per cent)*	*Profitability (per cent)*
R&D performers			
0–9 employees	34	17	89
>10 employees	29	23	80
Non-R&D performers			
0–9 employees	27	17	81
>10 employees	24	22	74

Notes: Average values in the period 2006-2011 are presented

Source: ABS (2015) Customised report based on the *Business Characteristics Survey* data commissioned by the Department of Industry, Innovation and Science.

Future Solar Technologies



Solar cell (Future Solar Technologies)

Case study: Future Solar Technologies

There is no single formula for ensuring that a new venture is both lucrative and transformational. However, Chilean venture capitalist Alberto Chang-Rajii (president and founder of the Grupo Arcano) believes he has found one in Future Solar Technologies and is prepared to invest in its disruptive potential.

Many of the elements that attracted a globally-oriented investor such as Grupo Arcano are not particularly surprising. Firstly, new and emerging technology is a key draw card. In the case of Future Solar, it is about pushing the boundaries through Organic-Perovskite tandem solar cells and the potential this has to radically reduce the cost of solar energy by as much as 20 to 30 per cent. ”This new technology we are using makes the solar plates very thin and very light”, explains researcher Ashraf Uddin, Associate Professor, School of Photovoltaic & Renewable Energy Engineering at UNSW Australia.

In partnering with the University of New South Wales (UNSW) over the next three years, Future Solar Technologies will have exclusive licensing arrangements for intellectual property under UNSW Innovation’s Easy Access IP model. Daniel Gronowski (Business Development Manager, UNSW Innovations, UNSW’s Technology Transfer and Innovation office) explains: “We have plenty of untapped intellectual property … Grupo Arcano was very happy to come along and set up a research program which would run for a few years, and then they would have a technology that could be produced commercially”.

Secondly, there are many innovations that drive the frontiers of technological innovation and yet fail to build new markets. A new venture can lead the pack if it truly inspires. The ability to inspire customers usually requires a social impact — something that can change lives financially or socially. Alberto puts it eloquently: “We are not interested in investing in just another industry; we want to invest in something that is a different model, that brings disruption, that brings true innovation, and that prompts people to think, talk and act”.

Thirdly, networks and institutions like universities and chambers of commerce can create the scaffolding needed to bring innovators, practical business people, professionals and

financiers together. In Alberto's case, it was the Australia-Chile Chamber of Commerce and Austrade's networks that enabled him to seek out potential in another part of the world.

Finally, and perhaps most importantly, a global orientation can put together the pieces of the jigsaw puzzle. It is this orientation that enables Grupo Arcano to identify attractive resources around the world and to know how they fit together to create value for customers. Alberto explains: "Basically I would say we operate each investment at a global level … In every country, in every market, in every sector, and in every industry, there are different rules of the game. So then, it is impossible for anyone to master them all".

With its potential to dramatically reduce the costs of renewable energy, Future Solar brings together many of these elements in a fascinating blend. Cost reductions are attractive in developed economies. But in the developing countries of Africa, it may not just save consumers money. It could transform lives by allowing entry level access to power for some of the world's poorest communities. Not only this. The capacity to produce UV generation can help eradicate the Ebola virus in susceptible communities. It is this global vision and the ability to identify truly transformative applications that excites the team at Future Solar and its investors.

Are there any other secrets to identifying a successful business? According to Alberto, it is about the people: "I have never looked only at the business plan as a serious measure for decision making. I look at people. If the proposal looks interesting, the most important thing is the character of the people I am going to work with. In the case of Future Solar, I decided that I was going to invest after going through the paperwork and meeting the people once. Because I was comfortable with the people and the team".

The capacity of the Australian innovation system to produce truly breakthrough technology is sometimes questioned. In the case of Future Solar, it took the research capacity of a leading university and the vision of a Latin American entrepreneur to see how Australian technology in renewables has the potential to transform lives around the world.

Future Solar Technologies and UNSW teams: Jorge Hurtado (Future Solar Technologies), Dr Ashraf Uddin (UNSW), Alberto Chang-Rajii (Future Solar Technologies), Anne Miller (Future Solar Technologies), Daniel Gronowski (UNSW)

"The team is the heart and soul of it".
Craig Davis
(Griffin Accelerator)

THE GEOGRAPHY OF INNOVATIVE ENTREPRENEURSHIP

Regional centres like this one near Brisbane, Queensland can be thriving places of innovation

4.The geography of innovative entrepreneurship

Innovative entrepreneurship is mostly concentrated in large metropolitan centres. The presence of research organisations in a region has a positive impact on business creation in the same region, especially in professional services.

This chapter is based on the departmental research paper *Australian Geography of Innovative Entrepreneurship* and the associated National Innovation Map

We have seen in Chapters 2 and 3 some of the impacts of entrepreneurial activity on the Australian economy and its relevance to dynamism and growth. Consistent with the systems approach that we adopt in this report, this chapter explores the geography of innovative entrepreneurship in Australia.

The chapter is based on the departmental research paper *Australian Geography of Innovative Entrepreneurship*[81] and the associated National Innovation Map at www.industry.gov.au/innovationreport. The map visually displays all business entries, R&D expenditure and patent and trademark applications by SA3 regions of Australia.[82] This interactive online tool also informs the analysis in this chapter. The data used covers the period 2009 to 2014, during which over 53,000 patents and over 235,000 trademarks were applied for or granted by businesses across Australia and over 1.7 million businesses were created.

Analysis in this chapter reveals that innovative entrepreneurship is mostly concentrated in larger metropolitan centres, although there are pockets of concentrated innovative entrepreneurship in some regions of New South Wales and Queensland. We consider geographic patterns of patent and trademark activity and regional distribution of new business entities. We find that the presence of research organisations in a region has a positive impact on business creation in the same region, especially in professional services.

81 Hassan S, Bucifal S, Drake P and Hendrickson L (2015) *Australian Geography of Innovative Entrepreneurship*, Research Paper 3/2015, Department of Industry, Innovation and Science, Office of the Chief Economist, Canberra

82 SA3 regions provide a standardised regional breakup of Australia that clusters areas with similar regional characteristics. The population in each SA3 region is between 30,000 and 130,000 persons.

A feature article by Anton Kriz explores the Central Coast of NSW as an innovative region. A case study of Geofabrics Australasia demonstrates the importance of clusters or communities of knowledge, while another examines the role of the Innovation Centre Sunshine Coast in boosting innovative entrepreneurship in the area.

4.1 Proximity supports innovation

The innovation economy has an inherent tendency towards geographical clustering.[83] The study of economic geography shows that proximity to areas of dense economic activity and natural resource endowments may have a significant impact on productivity both within and across countries.[84] Proximity induces stronger competition between firms. This in turn encourages innovation and resource efficiency.[85] In addition, access to larger consumer and supplier markets helps firms achieve increasing returns to scale. These economies of scale are also driven by greater access to a large pool of workers, localised knowledge spillovers and public infrastructure.

The benefits of clustering extend beyond just economies of scale associated with shared access to infrastructure, skilled labour and other resources. Clustering of related firms and associated institutions in a particular field builds trust and cooperation. These help to reduce transaction costs and encourage the exchange of ideas.[86] Clustered firms often become more competitive due to their accumulation of intangible capital assets, mostly through research and development, education, training, innovation and networking activities. Intellectual property (IP) and brand equity are examples of intangible capital assets.

By establishing where business entrepreneurship and innovation intersect geographically, we can begin to understand where and how clusters of innovative entrepreneurship form.[87] Cluster formation is most effective when it involves complementary actors in the innovation process beyond businesses. In this regard, universities and other research organisations perform a vital role in the diffusion of knowledge that is valuable to the region. They act as a focus for localised experimentation, learning and innovation.[88]

---

83 Rothwell J, Lobo, J, Strumsky, D and Muro, M (2013) *Patenting Prosperity: Invention and Economic Performance in the United States and its Metropolitan Areas*, Brookings Institution

84 OECD (2007) *The contribution of economic geography to GDP per capita*, Organisation for Economic Co-operation and Development, Paris ECO/CPE/WP1(2007)12

85 Soames L, Brunker D and Talgaswatta T (2011) *Competition, innovation and productivity in Australian businesses,* Productivity Commission and Australian Bureau of Statistics, joint research paper

86 Enright MJ and Roberts BH (2001) Regional Clustering in Australia, *Australian Journal of Management*, 26, Special Issue, pp. 65–85

87 Rothwell J *et al.* (2013) *op cit.*

88 Rodrigues-Pose A and Comptour F (2012) 'Do Clusters Generate Greater Innovation and Growth? An Analysis of European Regions', *The Professional Geographer*, 64(2), pp. 211–231

Feature: The Central Coast as an innovative region

By Dr Anton Kriz, Senior Lecturer in Innovation Management, The University of Newcastle

Dr Anton Kriz

The Central Coast in New South Wales is positioned between Sydney to the south and Newcastle to the north. The Darkinjung people provide a rich cultural and spiritual tradition for the region. Their ancient art adds subtle reminders to the natural geography and hilly kaleidoscope. Broken Bay and the meandering Hawkesbury add to the lagoons bordering some of the best surf beaches in Australia, making beautiful waterways a feature. Mangrove Mountain is an amazing food bowl to the west, well worth the drive *en route* to the Hunter Valley. Jared Diamond in *Guns, Germs and Steel* showcased the Fertile Crescents of the globe. The Central Coast's latitude, longitude and natural habitat fit naturally into such a paradigm. This is why the Central Coast is a key holiday destination and weekender for Sydneysiders, and home for many well-to-do business people.

Although the ABS and others now recognise the Central Coast (population over 330,000) as a region, the area still struggles with identity. The addition of the Central Coast Mariners has been an advance in brand awareness for the region. Ask a soccer or sports fan now about the Central Coast of NSW and many would highlight "It's where the Mariners come from." Gosford LGA (Local Government Area, incorporating Gosford, Erina, West and East Gosford, The Peninsula, Avoca Beach and Terrigal) is the main city of the region. Like other regions, the Central Coast has a complex topography and built landscape with many sub-regions and villages. Erina retail and commercial precincts have seen sizeable shifts in activity. Gosford is now only starting to regain some of its historical central significance. A sizeable precinct has also developed in West Gosford. This emergence has largely been self-perpetuating. Terrigal's boutique shops and restaurants are a pleasant surprise for visitors. Avoca Beach has a village atmosphere with local cinema and rock fishing platform. The Peninsula in the south has notable areas like Ettalong, Woy Woy, Pearl Beach and Patonga.

The socio-economic aspects of the Central Coast area vary considerably. Wyong LGA includes resorts like Magenta Shores and Kooindah Waters, as well as landmarks like Norah Head and its lighthouse. Dooralong and Yarramalong are picturesque areas within the Wyong River catchment. The late Bryce Courtney was one of the more famous residents. Wyong and Gosford Councils have cooperated on areas like water management but the regional boundaries still create significant controversy and suggestions for a merger are common. A united regional voice and common approach to planning and policy is definitely important. A regional economic development and employment strategy (REDES) has been used to overcome some of the issues. Certainly, from a political and economic perspective it appears that ranking as the 9th biggest urban region in Australia has significant value.

The Central Coast is classified as peripheral and peri-urban with over 33,000 commuters travelling in and out of the region every day. Previous policies of the Federal Government around Enterprise Connect and the Innovative Regions Centre have had an important impact on the Coast. This led to the formation of Innov8Central and was instrumental in building an industry cluster called Central Coast Manufacturing Connect (CCMC).

Innov8Central and CCMC have encouraged innovation and collaboration among business, industry and various stakeholders. The Coasts Sessions CD featuring new and established artists has been one of the spinoffs. Natalie Imbruglia, Gina Jeffreys and up-and-coming talent were featured. An annual Innovation Summit and biannual Economic Breakfast are other outcomes. The Central Coast now has an annual business awards night built around a strong chamber network. There are over 21,000 registered businesses, many of which are micro, within the region. Construction (4,700 registered businesses) provides a substantive share. Professional, scientific and technical services ranks second with 2,600 such businesses. Health care and social assistance has fewer businesses but is the biggest industry employer. Larger businesses include well-known food processors, such as Sanitarium Health and Wellbeing, Mars, McCains, Chickadee and Cordina.

Gosford LGA has over 177,000 residents. The National Innovation Map highlights that Gosford had 1,616 new business entries in 2014 (91.2 per 10,000 inhabitants) with 71 patents applications (4.0 per 10,000 inhabitants). There were 1,660 business exits in the same period. The patent results are positive compared to many other regions around Sydney. Standouts, as may be expected, are Inner Sydney (533), Baulkham Hills (112), Chatswood (147) and Ryde (195). The patents for Gosford have been relatively stable, averaging around 62 over the last decade. What underlies such activity remains speculative. Manufacturing in the Gosford LGA has been quite resilient but somewhat scattered. Somersby has attracted many manufacturers. Somersby Industrial Park has just had a $10 million dollar upgrade announced. Some companies like Taylors Manufacturing Solutions were attracted to the area because of proximity to Sydney, available land and skilled labour. Companies like Borg Manufacturing (melamine panels) and Sulo (waste disposal) are prominent companies in the Park. Baltimore Aircoil (cooling systems) has been another innovative success story. One of the bigger investors in the region has been the family-owned Gibbens Group. Gibbens Industries manufacture all types of springs. They have now branched out and are doing well in areas like property development. West Gosford is growing considerably as a result.

Companies like North Construction are prominent in the Gosford LGA and have become known for smart process innovations around HR. North Construction hires regularly from The University of Newcastle (UoN) and has important programs for testing out potential recruits. UoN is arguably the strongest regional university in Australia, with excellent capabilities in engineering and medicine. Interestingly, such research strengths have yet to transform UoN's local Central Coast campus which remains predominantly a teaching facility. Gosford LGA had 192 registered trademarks (10.8 per 10,000 inhabitants) in 2014. The reasonable trademark results for Gosford highlight the regional importance of professional services, IT systems and finance. Ultraserve, Blink Mobile, Fortunity, Loyal IT, Kelly Partners and Treehouse are notable examples. Strengthening R&D capacity in the Central Coast is seen as key to accelerating growth. Centres of Excellence and Cooperative Research Centres have quantifiable benefits to such regions (levels of patenting and trademarking three and a half times higher than the national average). There are some excellent schools in the Central Coast area, suggesting the human capital inputs are available. Gosford Selective is one of the State's best, with local Catholic schools achieving well above average results, particularly in lower socio-economic areas. Gosford additionally has been a beneficiary of an early roll out of the National Broadband Network (NBN). The CBD is well connected

to Sydney by rail and road and now through broadband. Amenities, location and lifestyle advantages necessary for Richard Florida's creative class are either in the region or close by.

The Wyong LGA in the north has a population of approximately 162,000 people and is most likely to be the region's high growth area. Available land and initiatives like the Warnervale Town Centre are important attractors. Consequently there were 1,278 new business start-ups in the Wyong area in 2014. The number of business exits was 1,057. Twenty one patent applications in 2014 means this area is underperforming by comparison with Gosford. Over the last year it has made 28 patent applications on average. Although not dramatic, the reduction in patent activity is a concern. One of the most successful businesses in Wyong has been Sanitarium. Mars is also located in the Wyong LGA, as is Tuggerah Business Park. The Mariners have established a Centre of Excellence within the LGA. Westfield Tuggerah is the major shopping centre in the area. Mingara Recreational Club is one of the most successful registered clubs in NSW and they add to the advantages of the region.

Wyong LGA recorded 120 trademark applications in 2014. Inner Sydney produced 3,000 as a stark comparison. Trademark activity in Wyong LGA is reasonably consistent. The average over the last decade is around 115. The Henry Kendall Group has developed Nexus Smart Hub and this should help stimulate such activity. A key element of the Hub is to draw some commuters off the road and rail network. Many of these occupants are professionals with high level skills. They have the capacity to help start-ups and add considerable value to occupants. Warnervale Business Park includes Primo Small Goods Distributions Centre and Woolworths Distribution Centre, adding to the array of distribution and logistics providers including Linfox Food Services Distribution. Companies like TrendPak have also been success stories in the Wyong LGA. Wyong LGA and Council are keen to develop infrastructure, with plans to upgrade the airport for freight flights. The Council is also keen to attract another university to the region.

Overall both Gosford and Wyong have plenty of scope to improve their business activity and innovation outcomes. As identified, the business community has been compensating for what is lacking in research institutional support. The foundations appear substantive but change requires common purpose and leadership. This remains a challenge for a region united around a common brand but functioning as two LGAs.

4.2 Geographic patterns of innovative entrepreneurship

Hassan *et al.* [89] examine the intersection of innovation-related activity on the one hand and firm creation in Australia on the other, mapping the extent to which these activities are geographically clustered. When population-adjusted innovation and entrepreneurship activities are examined geographically within Australia, they reveal that during the period 2008–14 these activities tended to be concentrated in the major metropolitan areas of Australia, Sydney in particular.

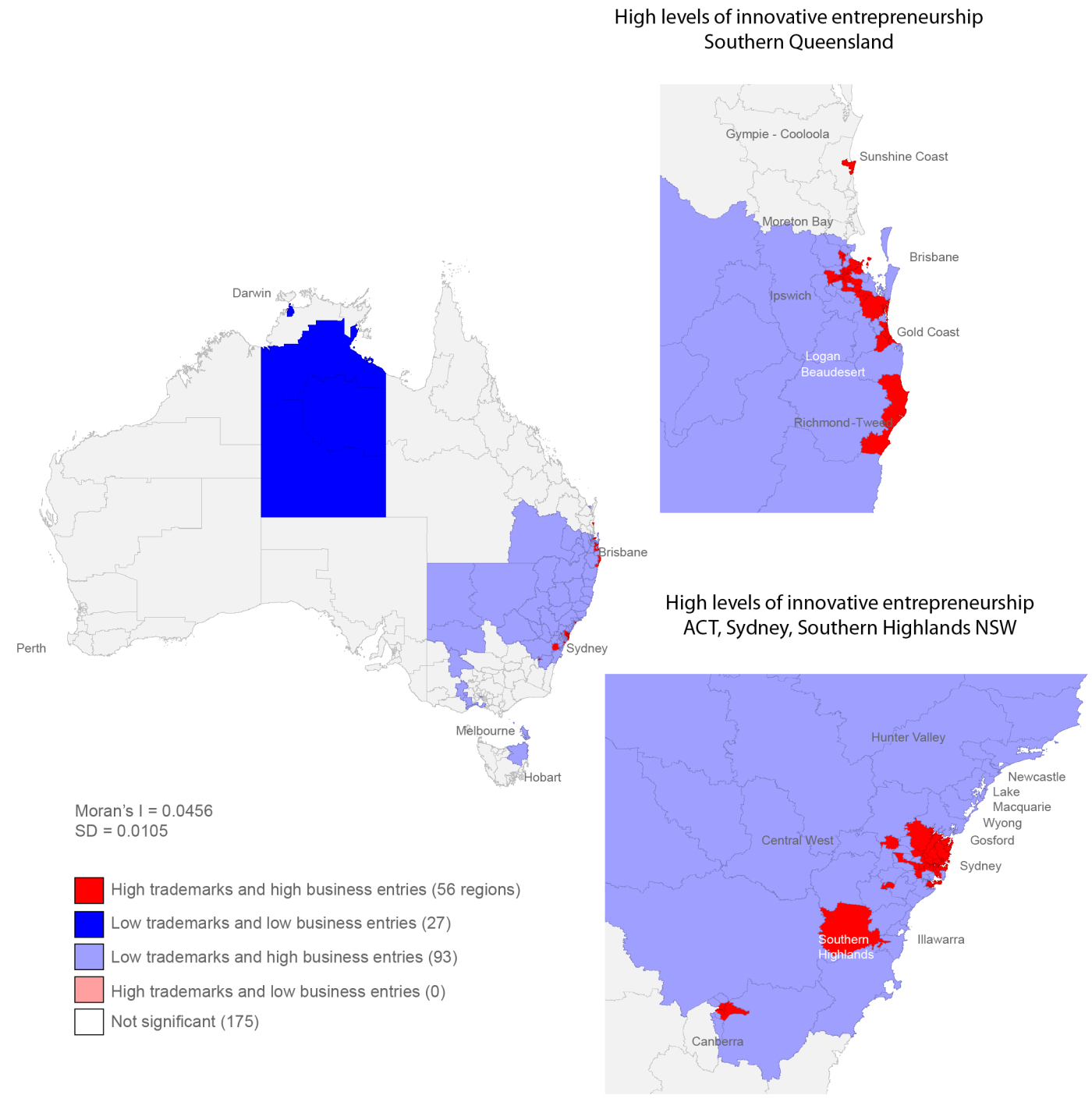
89 Hassan S *et al.* (2015) *op cit.*

The paper also shows the presence of some important regional areas of innovative entrepreneurship in parts of Queensland and New South Wales. The authors find a correlation between the presence of research institutions with innovation activity (revealed in the form of patents and trademarks)[90] which in turn is linked to the generation of new businesses, especially in Professional, Scientific and Technical Services. The areas with high concentrations of both trademarks and business entries around Sydney, Brisbane, Gold Coast, Sunshine Coast and Richmond Tweed are shown in Figure 4.1.

The Gold Coast has a high concentration of trademarks and business entries

90 It should be noted that there are limitations in using patents and trademarks as indicators of regional innovation. This includes the fact that the innovation could have happened at a location other than where patent holder resides and the fact that patents do not necessarily equal products. Nevertheless there are few other indicators that provide a superior indication of innovation.

Figure 4.1 Spatial autocorrelation analysis with average trademark applications per 10,000 inhabitants and average business entries per 10, 000 inhabitants



Notes: Positive *Moran's I* denotes an overall presence of clusters where high numbers of trademarks and business entries overlapped. Correlation between data counts attributed to spatial regions were determined at a statistical significance level of 95 per cent or more i.e. there was less than 5 per cent probability that data counts associated with spatial regions shown in any of the four comparative overlaps above (high trademark - high business entries; high trademark - low business entries; low trademark - high business entries; and low trademark - low business entries) were occurring at random.

Source: Australian Bureau of Statistics (2015) *Counts of Australian Businesses 2008–2015,* cat. no. 8165.0 (data cube: Excel spreadsheet), (data available on request) and Intellectual Property Government Open Data 2015 (IP Australia)

4.2.1 Trademarking and patenting activity is concentrated in the major cities

Trademarks serve to reinforce businesses' IP strategies and can be considered as an indicator of innovation performance. Trademarks are arguably a broader proxy for innovation than patents in that they also indicate non-technological innovation, such as innovation in business models, marketing and organisational innovation.[91]

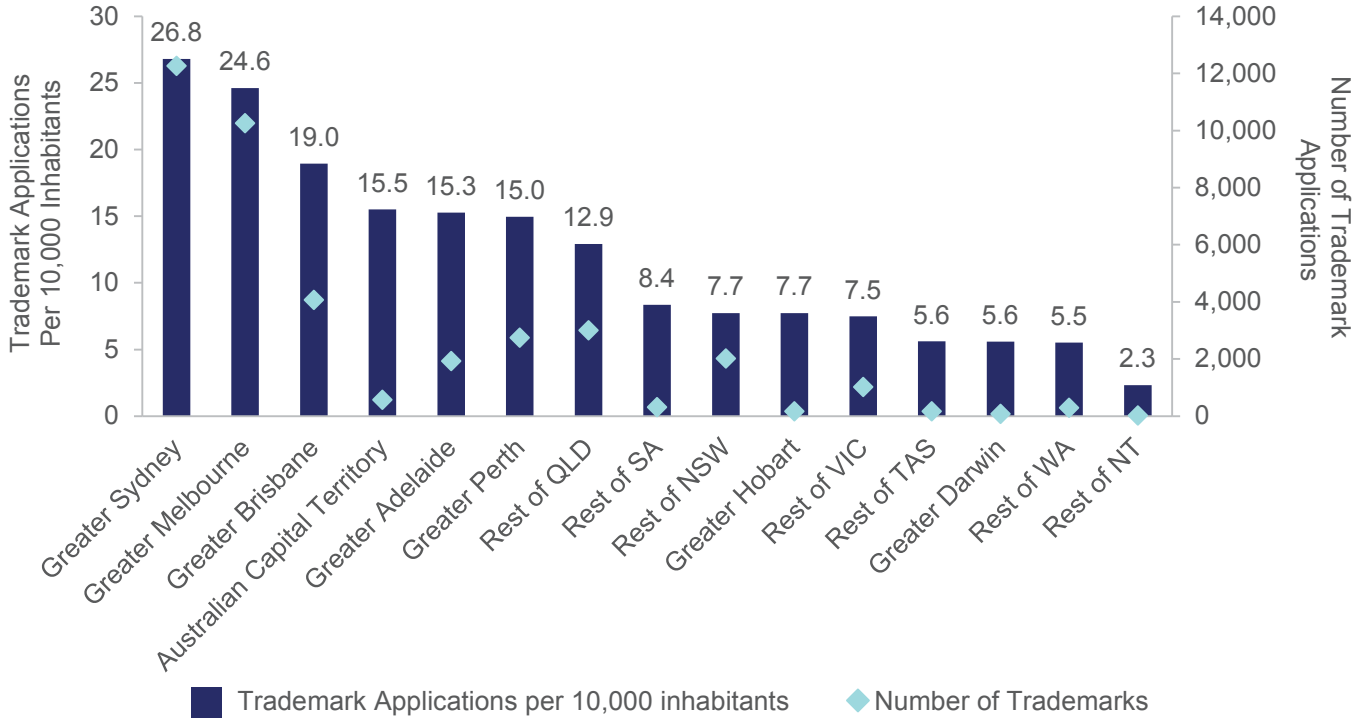
The average annual rate of trademark applications per 10,000 inhabitants from 2008 to 2014 set out in Figure 4.2. It shows the highest density of trademark applications is found in Sydney, Melbourne and most other mainland capitals. Among regions outside the mainland state capitals, Queensland (outside Brisbane) has the highest rate of trademark applications.

Patents are a form of intellectual property conferring an exclusive and legally enforceable right to exploit the value of an invention. Like trademarks, they are an important proxy indicator of innovation activity. The trends for patenting are similar to those for trademarks.[92]

91 Flikkema M, De Man A and Castaldi C (2014), 'Are Trademark Counts a Valid Indicator of Innovation? Results of an In-Depth Study of New Benelux Trademarks Filed by SMEs', *Industry and Innovation*, 21(4), pp. 310–331.

92 Hassan *et al.* (2015) *op cit.*, Figure 2.2, pp. 8–9

Figure 4.2: Annual trademark applications per 10,000 inhabitants at Greater Capital City Statistical Area (GCCSA) level averaged over the period 2008–2014



Source: Australian Bureau of Statistics (2011) *Population by Age and Sex, Regions of Australia*, 2011, cat. no. 3235.0, (data cube: Excel spreadsheet), viewed 8th May 2015, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3235.02011, Intellectual Property Government Open Data (2015), viewed 1st May 2015, https://data.gov.au/dataset/intellectual-property-government-open-data

4.2.2 Geographic patterns of R&D expenditure are correlated to patents and trademark generation

Using R&D Tax Incentive programme data,[93] Hassan *et al.* estimated the median annual R&D expenditures between 2008–09 and 2012–13 for each Greater Capital City Statistical Area. In absolute dollar terms, median R&D expenditures were highest in Greater Perth ($27.5m), Greater Sydney ($25.2m), Greater Melbourne ($24.5m), and to a lesser extent in the Greater Brisbane area ($15.0m).

Hassan *et al.*[94] also found, based on an analysis by SA3 region of the correlation between R&D expenditure and IP innovation proxies, that overall, for every 1 per cent increase in R&D expenditure, a 0.35 per cent increase was observed in the number of patent applications and a 0.40 per cent increase in the number of trademark applications filed (Table 4.1). These results confirm the importance of R&D expenditure to knowledge creation. The same authors found that every 1 per cent increase in the number of business entries was correlated with a 2.3 per cent increase in expenditure on R&D.

93 The analysis presented here is based on data for the firms that have registered for the R&D Tax Incentive and does not include R&D performing firms that may not be claiming this tax offset. Firms may register for the tax offset if their claim is more than $20,000.

94 Hassan *et al.* (2015) *op cit.*, p. 6

Table 4.1: Effects of expenditures in R&D on patent and trademark application counts; and business entries, per 10,000 inhabitants

Models	*Coeff. between estimators*	*Constant*	*R^2 (overall)*
ln (Patents) = β ln(R&D Expenditure)	0.350 (0.019)***	-3.953	0.396
ln (Trademarks) = β ln(R&D Expenditure)	0.403 (0.023)***	-3.366	0.434
ln (R&D Expenditure) = β ln(Business Entries)	2.332 (0.205)***	2.925	0.248

Notes: *** Significant at 0.1 per cent level. R&D expenditure was obtained for financial years ending in June 2009 till June 2013; patent and trademark applications were obtained for years 2008 to 2014; and average business entries were obtained for 2008–09 to 2013–14. Log-linear regression on time-series panel data was carried out, as described in Hassan et al. (2015), Appendix A.

Source: Intellectual Property Government Open Data (2015), viewed 1 May, 2015, https://data.gov.au/dataset/intellectual-property-government-open-data; R&D Tax Incentive Programme, viewed 22 June, 2015; Australian Bureau of Statistics (2015) *Counts of Australian Businesses 2008–2015,* cat no. 8165.0 (data cube: Excel spreadsheet), (data available on request).

Geofabrics Australasia

Case study: Geofabrics Australasia[95]

Established in Australia by its offshore parent company in 1978, Geofabrics is the sole manufacturer of synthetic materials for geotechnical applications (used in road and railway construction, mining and resources projects, landfill and coastal engineering applications) in Australia. For Geofabrics, the end of the mining boom meant that the innovation challenge was suddenly thrust upon it. Managing Director Brendan Swifte explains: "we didn't expect the mining boom would come to its end so quickly and so steeply ... So while in 2014 we had record results, in the following year we had a record turn-around. But that is what happens when booms end."

Geofabrics is broad in the scale of its operations. It has around 200 staff across Australia and New Zealand, with factories in Albury NSW and South East Queensland. During the mining boom, the emphasis was less focused on developing new products, but rather on how to maximise demand for its existing geosynthetic products — especially in the booming markets of Western Australia and Queensland.

That direction has now changed. Innovation has become central to the company's plans for survival and growth. "We have moved from not having innovation on our agenda at all to now having it on the agenda in every monthly meeting … innovation has got to be part of our culture", says Brendan.

Innovation does not have to mean just developing new products. With the end of the resources boom, Geofabrics started to pour new products into the market. But the real appetite internally was for business model or business process innovation. Brendan has

95 Based on an interview conducted on 30 July 2015

an interesting insight on this: “I think that the really lasting benefits come from business model innovation rather than from product innovation. The time you get to maximise a price premium on a new product is so short these days, unless it is a really disruptive product”.

Clusters of knowledge and innovation can play an important part in generating business activity. Brendan emphasises the importance of clusters or communities of knowledge that his company can leverage to its advantage. Locating its head office in Melbourne means, for instance, that Geofabrics can collaborate with an industry-leading professor at Monash University, technologically-leading engineering firms in Melbourne and other industry specialists. Learnings from these local clusters can be executed nationally.

Brendan elaborates: “Those knowledge clusters are naturally formed if you are open to them…We didn’t choose our location because we are close to those sources, but rather we arrived in a certain location and everything else followed”. He is also a firm believer in the mutual benefits that flow from industry-academic collaboration: “The papers presented by academics in conferences today are generally what will be happening in our industry in the next five years”.

Finally, Brendan has a number of observations on what government can do to create a more conducive environment for Australian business post the boom: “The missing piece is a steady and stable infrastructure building programme. The lack of this means that what we could be doing this year we can’t be doing until 4–5 years from now. Steady policies in this field will give industry a sense of stability and confidence which enables it to plan and which can translate into growth…I also like the idea of industry hubs because they provide opportunities for engagement with people in industry and academia, opportunities for serendipity, and potential for disruptive innovation”.

Coastal project

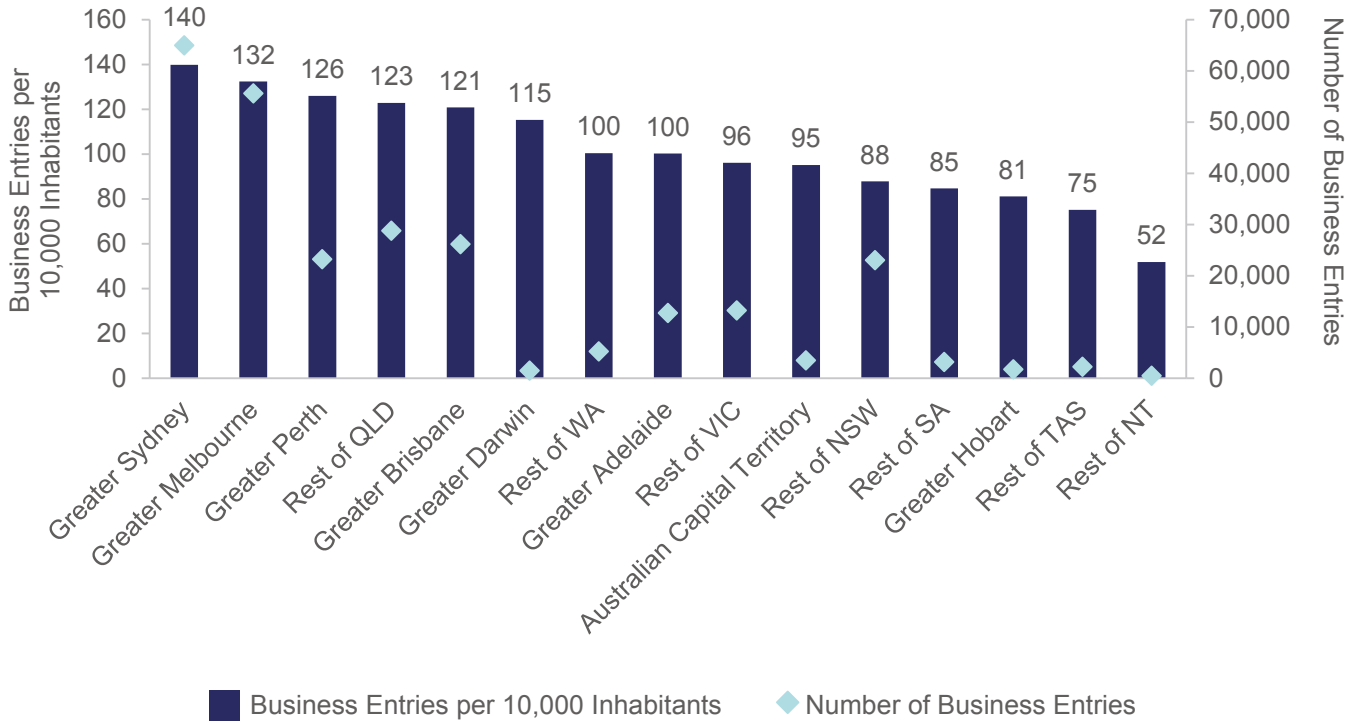
Railway projects

4.2.3 Regional distribution of new business entries

New business entries are a useful proxy measure of entrepreneurial activity. A regional distribution of annual new business entries around Australia, averaged over the years 2008–09 to 2013–14, is shown in Figure 4.3. It is also illustrated in map form in Figure 4.4. As is the case for trademarks, Sydney and Melbourne have the highest rate of entries per capita. Perth comes in third followed by regional areas of Queensland. Darwin also performs well.

Based on these figures, Hassan *et al.* observed a correlation between business entries in an SA3 region and innovation output, with patents and trademarks as the proxy measures for that activity. They found that a 1 per cent increase in the number of business entries for a region was associated with an increase in numbers of both patent applications (0.12 per cent) and trademark applications (0.21 per cent).

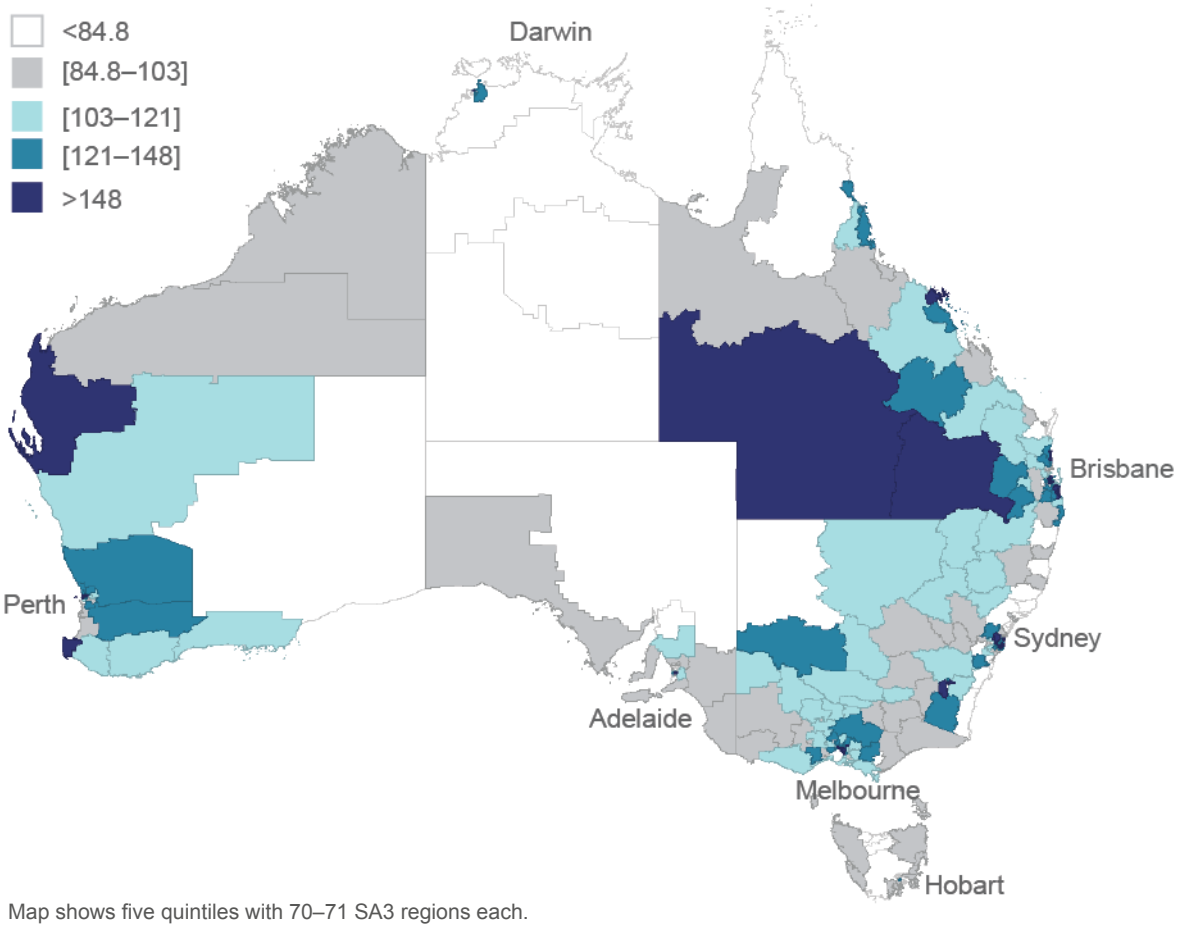
Figure 4.3: Annual business entries per 10,000 inhabitants at Greater Capital City Statistical Area (GCCSA) level averaged over the period 2009–2014



Notes: Excludes ANZIC division X

Sources: Australian Bureau of Statistics (2015) *Counts of Australian Businesses 2008-2015*, cat. no. 8165.0 (datacube: Excel spreadsheet), (data available on request), Australian Bureau of Statistics (2011) *Population by Age and Sex*, Regions of Australia, 2011, cat. no. 3235.0 (data cube: Excel spreadsheet), viewed 8th May 2015, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3235.02011

Figure 4.4: Business entries per 10,000 inhabitants, averaged 2009–2014, by SA3 regions



Notes: Map shows five quintiles with 70–71 SA3 regions each.

Source: Australian Bureau of Statistics (2015) *Counts of Australian Businesses 2008–2015*, cat. no. 8165.0 (data cube: Excel spreadsheet), (data available on request) and Department of Industry, Innovation and Science (2015) *National Innovation Map*

Overall Hassan *et al.* show that there is a significant clustering of business entries, R&D expenditure and IP generation in metropolitan Australia. There are also no regions in Australia where high IP generation does not occur in tandem with high levels of entrepreneurship (measured by business entries). Innovative entrepreneurship is typically a city phenomenon, although Hassan *et al.* also found some notable exceptions like the Sunshine Coast of Queensland and the Southern Highlands of New South Wales (see Figure 4.1).

The corridor of industries stretching from the Sunshine Coast, through Brisbane to the Gold Coast results in Queensland having a more even spread of innovative entrepreneurship than any other state in Australia. Along with the high per capita business entries in less populous central and western Queensland it might be said that Queensland is the most 'entrepreneurial' state in Australia.[96]

Hassan *et al.* identified regions where business entries are associated with patents and trademarks. Each SA3 region was assessed to determine whether its entrepreneurial activity (through business entries) and innovation activities

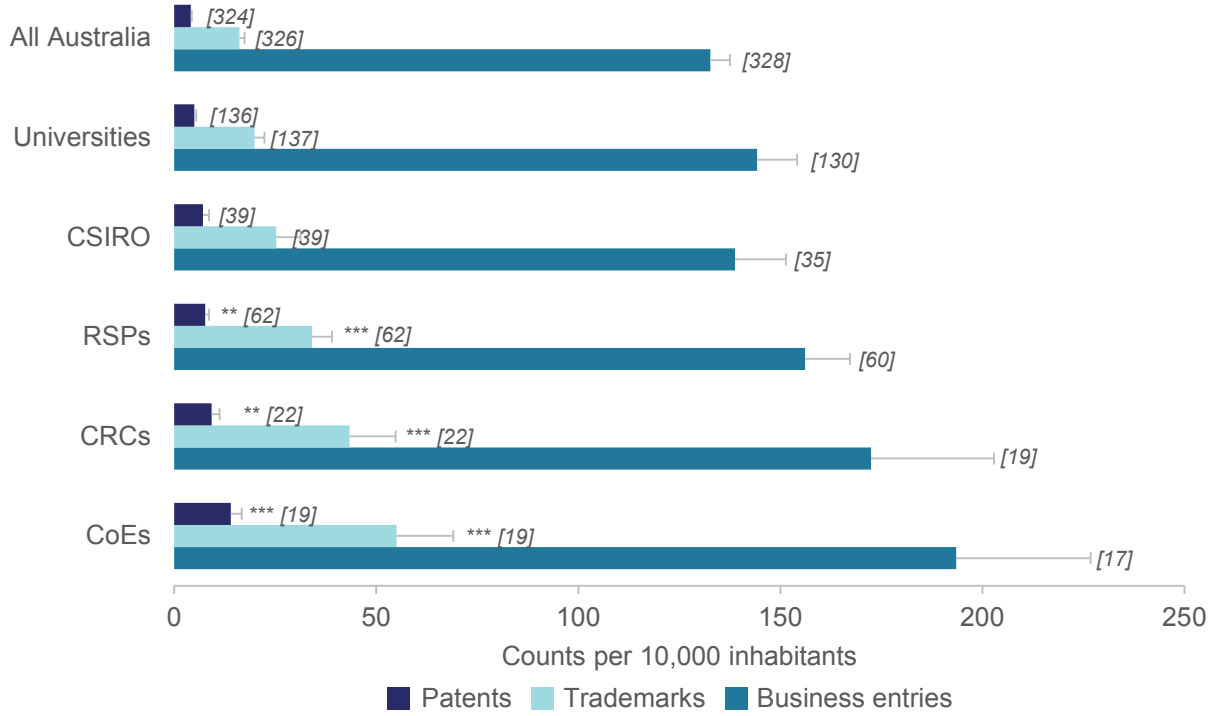
96 Hassan *et al.* (2015) *op. cit.* Table 2.3, p. 14

(through patents and trademarks) were higher than the average of its neighbouring regions. Significant correlations were found in areas around Sydney, Canberra, Brisbane, Gold Coast and Sunshine Coast.

4.2.4 Research organisations stimulate innovation

Hassan *et al* found that the presence of research institutions in a given region of Australia is correlated with a higher level of innovation activity (Figure 4.5). However, different types of research institutions have different degrees of correlation and have specific industry effects. The effects are enhanced when the research organisation also hosts specialised research centres such as Cooperative Research Centres (CRCs) funded by the Department of Industry, Innovation and Science or Centres of Excellence (CoEs) funded by the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC). The presence of these institutions in the region was found to be correlated with greater business patenting and trademarking activity, and also with a higher number of business entries.

Figure 4.5: Annual patent, trademark and business entry counts in SA3 regions with research institutions, per 10,000 inhabitants, averaged for the period 2009–2014 [number of applicable regions in brackets]



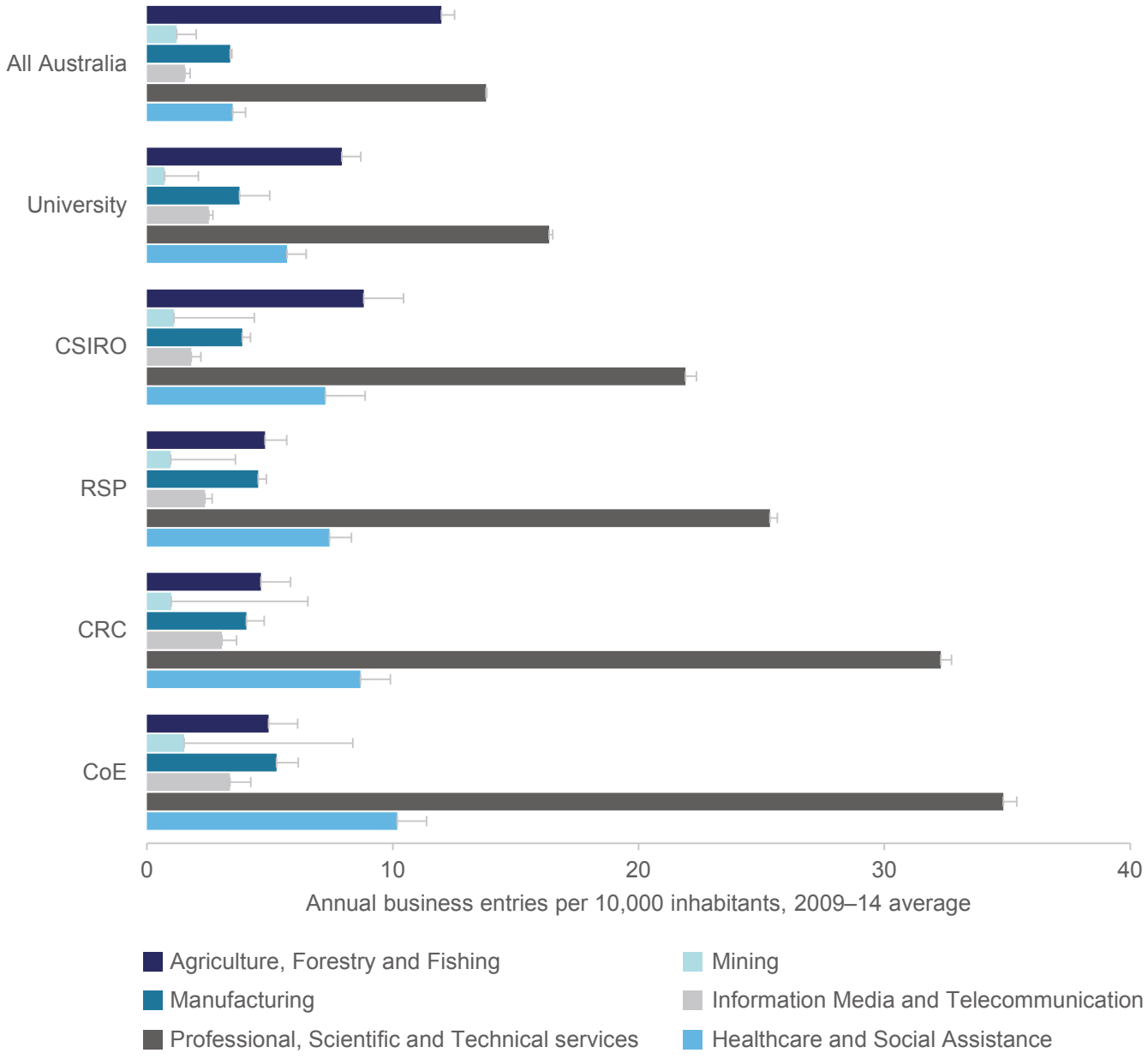
Notes: Research institutions – Universities (campus locations provided by Universities Australia), CSIRO (Commonwealth Scientific and Industrial Research Organisation), RSPs (Research Service Providers, as obtained from Business.gov.au), CRCs (Cooperative Research Centres) and CoEs (Centres of Excellence, funded by the Australian Research Council or the National Health and Medical Research Council, currently active). CoEs are often subsets of universities and CSIRO, as the latter are often host institutions. CRCs include at least one Australian higher education institution and one Australian end-user as essential participants. Mean values 2009–2014 and standard error of the mean (SEM) [for SA3 regions] shown. The asterisks denote the statistically significant change between all Australian regions and the regions with research institutions; calculated by one-way ANOVA comparison (with Tukey-Kramer multiple comparison post-hoc test).** Significant at 1 per cent level, *** Significant at 0.1 per cent level..

Sources: Australian Bureau of Statistics (2011) *Population by Age and Sex, Regions of Australia, 2011*, data cube: Excel spreadsheet, cat. no. 3235.0, viewed 8th May 2015, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3235.02011, Intellectual Property Government Open Data (2015), viewed 1st May 2015, https://data.gov.au/dataset/intellectual-property-government-open-data, Australian Bureau of Statistics (2015) Counts of Australian Businesses 2008–2015, cat. no. 8165.0 (datacube: Excel spreadsheet), (data available on request)

Figure 4.6 illustrates the impact of these same various research organisations on business entries broken down by selected industries. The data suggests that these research organisations have specific industry effects rather than stimulating a general lift in entrepreneurship.

Compared to regions across Australia as a whole, regions with a research organisation actually contain fewer new entries in Agriculture, Forestry and Fishing. There was virtually no impact on new entries in Mining or Manufacturing. Instead regions with research organisations were more likely to be correlated with the presence of new entries in Information Technology, Health Care, and Professional, Scientific and Technical Services. The impact on the latter was particularly marked, and as for all new entries, was accentuated in the case of CRCs and CoEs. Business entries within the Professional, Scientific and Technical Services industry were found to be 250 per cent higher in regions where a CoEs was present and 233 per cent higher in a region where a CRCs was present.

Figure 4.6: Annual business entries in SA3 regions with research institutions, by selected sector per 10,000 inhabitants, averaged for the period 2009–2014



Notes: Research institutions – Universities (campus locations provided by Universities Australia), CSIRO (Commonwealth Scientific and Industrial Research Organisation), RSPs (Research Service Providers, as obtained from Business.gov.au), CRCs (Cooperative Research Centres) and CoEs (Centres of Excellence, funded by the Australian Research Council or the National Health and Medical Research Council, currently active). CoEs are often subsets of universities and CSIRO, as the latter are often host institutions. CRCs include at least one Australian higher education institution and one Australian end-user as essential participants.Mean values 2009-2014 and standard error of the mean (SEM) [for SA3 regions] shown. One-way ANOVA with Tukey-Kramer Multiple comparison test between all of Australian regions and regions with research institutions was performed to test the statistical significance of deviations in the sample mean from the (All Australia) population mean. ** Significant at 1 per cent level, *** Significant at 0.1 per cent level.

Source: Australian Bureau of Statistics (2011) *Population by Age and Sex, Regions of Australia,* 2011, cat. no. 3235.0 (data cube: Excel spreadsheet), viewed 8th May 2015, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3235.02011, Intellectual Property Government Open Data (2015), viewed 1st May 2015, https://data.gov.au/dataset/intellectual-property-government-open-data, Australian Bureau of Statistics (2015) *Counts of Australian Businesses 2008–2015*, datacube: Excel spreadsheet, cat. no. 8165.0 (data available on request)

Case study: Innovation Centre Sunshine Coast[97]

It may not have the global fame of California's Silicon Valley, but the 'Silicon Coast' of South-East Queensland has quickly grown a reputation as one of the leading entrepreneurial regions of Australia, thanks in no small part to the role played by the Sunshine Coast's Innovation Centre.

The opening of the University of the Sunshine Coast (USC) in 1996 was emblematic of the region's dynamic economic growth that took off from the 1990s. But despite the surge in students and knowledge generated by the new university, most of the local talent for innovation on the Sunshine Coast was leaking to the capital cities and overseas.

The Innovation Centre Sunshine Coast Pty Ltd became operational in 2002, a key aspect of the local economic development plan. It was the shared vision of the founding Vice-Chancellor of the University of the Sunshine Coast, Professor Paul Thomas AM, and the local Mayor, Mr Don Culley who set the goal for the centre of retaining local entrepreneurial talent in the region in order to diversify the local economy and encourage new innovation. CEO Mark Paddenburg explains, "Connectivity between talent, start-up entrepreneurs and catalytic services was vital, so establishing the Innovation Centre as a company of USC based on campus was the logical choice."

In 2015, the Innovation Centre is still the place where start-up businesses and entrepreneurs on the Sunshine Coast go to gain access to an inclusive ecosystem of support that gives their fledgling ideas room to grow, and wings to fly. The Innovation Centre currently assists 36 member companies with its purpose built 1,500m^2 business incubator, dedicated Entrepreneur in Residence, a panel of 24 expert mentors, regular member events such as Pitch Competitions, Start-up Weekend, seed funding opportunities, and the chance to connect with like-minded entrepreneurs and university researchers.

With established pillars of the region's economy such as tourism, retail and construction hit hard after the GFC, the region has focused on assisting start-up and high growth companies that could grow with the right support. The Innovation Centre's activities and members' successes have contributed to Sippy Downs being recognised as an 'Innovation Hotspot' now at the heart of a knowledge precinct, effectively linking entrepreneurs to the university's talent, programmes, immersive technologies and research facilities. USC now has over 12,000 students and the broader precinct is attracting significant new investment, as demonstrated by the opening of the Ochre Health facilities in 2014 and the recent announcement that Youi Insurance will base its global headquarters there. Mark is optimistic that by leveraging from the soon-to-be-completed $2 billion Sunshine Coast Public University Hospital and Oceanside Kawana Health Precinct, the Innovation Centre can become the regional 'go to' place for entrepreneurial development of health and wellbeing-related technologies.

The Centre has played a pivotal role in boosting innovative entrepreneurship on the Sunshine Coast, having assisted with the launch of over 135 start-up companies, raising $32 million in early stage capital and creating over 530 jobs in member companies. A 2012

"A desk is wonderful, but at Fishburners the real value comes from what you can produce at that desk that you couldn't elsewhere, and the surface area for luck that comes from our scale"
Murray Hurps (Fishburners)

Innovation Centre Sunshine Coast at night

97 Based on an interview conducted on 8 May 2014

survey of over 100 of the founded companies showed 92 per cent are still trading and 88 per cent still have their headquarters on the Sunshine Coast.

Many of the Centre's founders and employees began the start-up phase of their business while studying at USC. Mark says "our members all have big, innovative plans and many are already competitive on the global stage however, like me, they also greatly value the benefits of being based on the wonderful Sunshine Coast."

The Sunshine Coast has become an attractive destination for 'lifestyle entrepreneurs' and baby boomers, people who are relocating from the major capital cities and downsizing their work commitments but still wish to apply their entrepreneurial skills, whether as mentors, angel investors or running businesses from home.

Some 70 per cent of the Centre's members are exporters, showing the broader horizons of today's successful entrepreneurs. Mark notes, "They're not coming here to service the Sunshine Coast. For them to be viable and scalable they must have a national or international customer outlook."

Mark also believes that the word 'entrepreneur' has changed and is now seen in a more positive light than five to ten years ago. According to Mark, "many successful entrepreneurs don't necessarily develop the IP or innovation, but they often see a different way of utilising the innovation, putting it into a different business model or even looking at totally different applications for that innovation – we all know Google was not the first search engine."

4.3 *The importance of professional services to innovative entrepreneurship*

Sectoral aspects of the geography of innovation are important since the benefits of clustering are often more apparent to the innovation economy and creative industries than to traditional industries.[98]

A sectoral analysis of business entries showed that the increases in Sydney, Canberra, Brisbane, Gold Coast and the Sunshine Coast were mainly attributable to the Professional, Scientific and Technical Services industry. This industry has a high propensity for generating innovations which require protection through IP rights.

Interestingly, many regions of New South Wales and southern Queensland had high rates of new businesses in the absence of patents and trademarks. This is suggestive of relatively strong entrepreneurialism in these regions, but of business

98 Boschma R (2015) 'Do spinoff dynamics or agglomeration externalities drive industry clustering? A reappraisal of Steven Klepper's work', Papers in Innovation Studies Paper no. 2015/18, Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE) Lund University, pp. 11–12. See also Rothwell J, Lobo J, Strumsky D and Muro M et al.(2013) *Patenting Prosperity: Invention and Economic Performance in the United States and its Metropolitan Areas*, Brookings Institution, p. 35

activity that is not accompanied by innovation. Many of these businesses are found in the Agriculture, Forestry and Fishing or Construction industries which do not tend to generate high levels of IP.

Figure 4.7 examines the distribution of Australia's business expenditure on R&D (BERD) from 2009 to 2014 compared with the distribution of new business entries in the same industry sectors. There is very little correlation between the industries where most new entries occur and those where investment in business R&D takes place. For instance, by far the highest proportion of BERD occurs in the Manufacturing and Mining sectors. But this is not accompanied by correspondingly high proportions of business entries in these sectors. In fact, while Manufacturing and Mining together contribute to almost half of all BERD in Australia, they contribute less than five per cent of all new business entries.

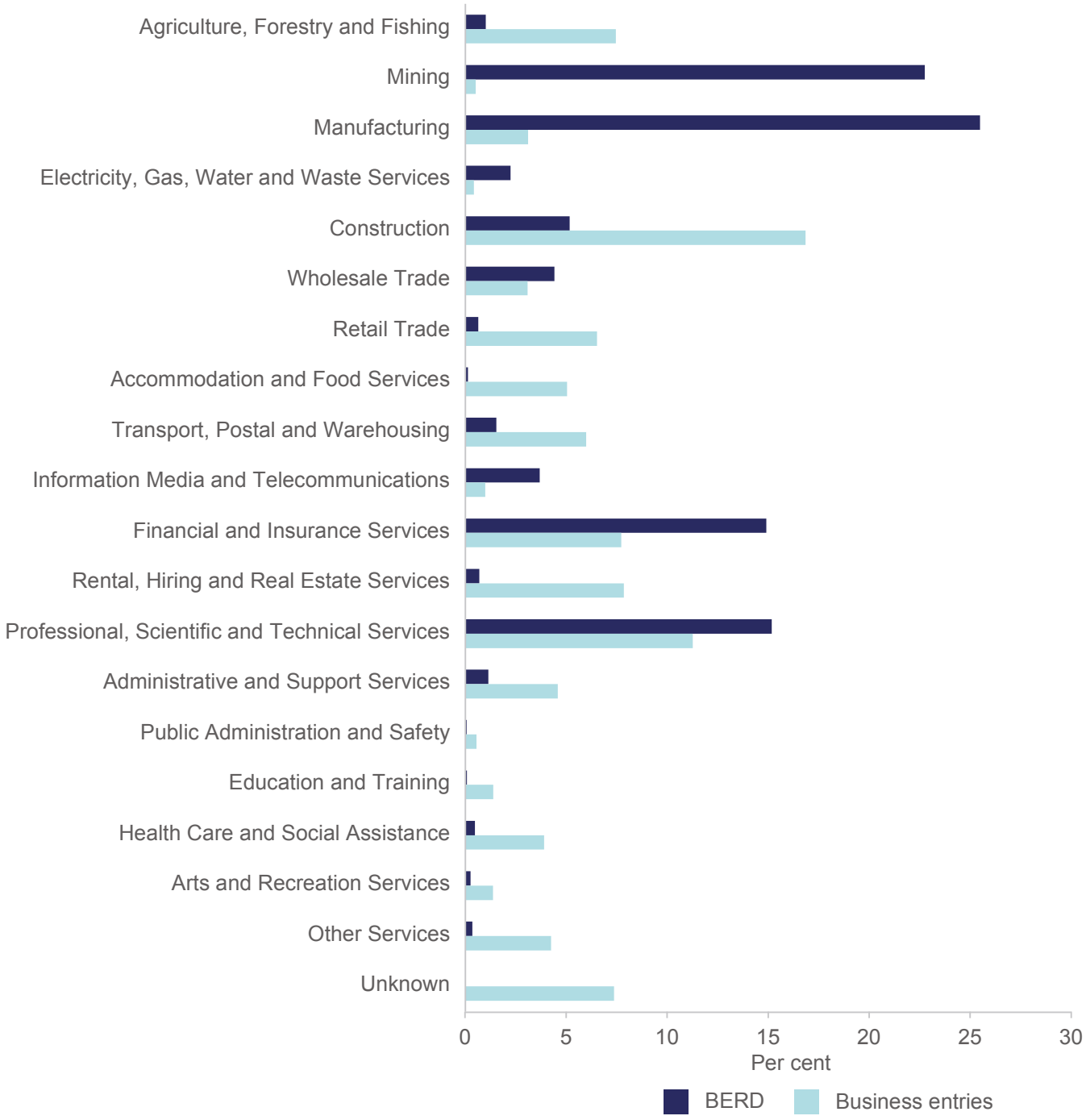
Conversely, the highest proportion of business entries was observed in Construction, but less than five per cent of national BERD occurred in this industry.[99] Other industries with a high ratio of new business entries but low BERD include Agriculture, Forestry and Fishing; Retail Trade; Accommodation and Food Services; Transport, Postal and Warehousing; Rental, Hiring and Real Estate; and Healthcare and Social Assistance. On the other hand, there is correlation between high levels of BERD in both Financial and Insurance Services and Professional Scientific and Technical Services. These industries have the highest levels of BERD outside Manufacturing and Mining and some of the highest rates of overall new business entries.

Most R&D expenditure tends to be conducted by larger more established firms, rather than new ones, and in capital intensive industries like Mining and Manufacturing. For instance, two-thirds of BERD is carried out in large companies employing 200 employees or more (which also tend to be older firms that have had more time to grow).[100] New business entries, on the other hand, tend to be concentrated in service industries where economies of scale and other barriers to entry may be less burdensome.

99 It should be noted, however, that some new construction firms may be linked to Mining and its higher levels of BERD

100 Australian Bureau of Statistics (2013) *Research and Experimental Development, Businesses, Australia, 2011–12* cat no. 8104.0, Table 2

Figure 4.7: Annual share of business expenditure on R&D (BERD) (ave. 2009–2012) and of new business entries (ave. 2009–2014), by ANZSIC industry division,



Notes: BERD data was averaged for the period 2009-2012.. Business entries were averaged for 2009-2014.

Source: Australian Bureau of Statistics (2013) *Research and Experimental Development, Businesses, Australia, 2011-12*, datacube: Excel spreadsheet, cat. no. 8104.0, Australian Bureau of Statistics (2015) *Counts of Australian Businesses 2008-2015*, cat. no. 8165.0 (datacube: Excel spreadsheet), (data available on request)

The analysis shows Professional, Scientific and Technical Services to be a key industry for innovative entrepreneurship. High business entry for this sector coincides with high R&D or high IP generation. Professional, Scientific and Technical Services is the industry with the second highest number of new entries and the fourth highest BERD levels. R&D in this sector is also less concentrated in large firms.

The importance of this industry to innovation is underpinned by the fact that it has the highest concentration of engineers and PhD graduates in the private sector[101] and one of the highest rates of new-to-market innovation.[102] Businesses seeking ideas for innovation are more likely to approach consultants in the Professional, Scientific and Technical Services industry than they are to seek ideas from research organisations. The sector is widely distributed throughout the economy with almost 20 other subdivisions consuming more than $1 billion worth of professional, scientific and technical services in 2009–10.

In this context, Professional, Scientific and Technical Services may therefore act as a transformative service industry for innovative entrepreneurship.

101 Australian Government (2014) *Australian Innovation System Report 2014*, Department of Industry, Office of the Chief Economist, Canberra, p. 129

102 *ibid.*

SYSTEMIC ISSUES FOR INNOVATIVE ENTREPRENEURSHIP

Sydney, a global start-up hub

5.Systemic issues for innovative entrepreneurship

Australia has some of the highest rates of entrepreneurship and start-up activity among developed economies in the world. Framework conditions for innovative entrepreneurship, such as skills, education and economic freedom are high.

This chapter examines some of the systemic issues needed for innovative entrepreneurship to flourish.

As we have seen, innovative entrepreneurship exists as part of a broader ecosystem. In this chapter, we discuss some of the systemic issues needed for innovative entrepreneurship to flourish.

Australia has some of the highest rates of entrepreneurship and start-up activity among developed economies in the world. Framework conditions for innovative entrepreneurship, such as skills, education and economic freedom are high. But Australian entrepreneurs seem to have difficulty in taking advantage of these favourable conditions to generate commercially viable innovative outputs. The Global Innovation Index, for instance, ranks Australia at just 30th among OECD countries for innovation efficiency (despite our world ranking of 17th overall for innovation).[103]

Based on an analysis of the Australian Bureau of Statistics (ABS) Business Characteristics Survey, this chapter examines key barriers to innovation for Australian businesses and compares these to barriers to business activity in general. We then consider two systemic issues that may enhance or impede the ability to translate favourable innovation inputs and framework conditions into output.

The first is the culture of innovation. A number of factors may facilitate not just entrepreneurship, but innovative entrepreneurship. One explanation for Australia's poor ranking in the Global Innovation Index is that a majority of firms are insufficiently outward oriented, even though they have an innovation strategy in place.

103 Cornell University, INSEAD & WIPO (2015) *The Global Innovation Index 2015: Effective Innovation Policies for Development,* Fontainebleau, Ithaca and Geneva, p.167

The second is access to finance. We present research using customised data from the ABS Business Characteristics Survey to analyse equity and debt finance conditions — particularly the extent to which a gap may exist for high risk early equity finance in Australia. We find that to nurture its innovative potential, Australia needs to attract increased levels of venture capital, especially at the early stages of the innovation cycle.

A case study of the Griffin Accelerator and a feature article on innovation at Telstra bring together key concerns of this report.

5.1 *Barriers to innovation and business activity*

We used customised Business Characteristics Survey data to examine barriers to innovation for SMEs (0–199 employees) according to whether they are start-ups (under 1 year old); young (between 1 and 4 years old); mature (between 5 and 9 years old) or old (over 10 years old). The survey asked businesses to report whether any of the listed factors (see Table 5.1) affected their ability to develop or introduce new goods, services, processes or methods.[104]

As shown in Table 5.1, the greatest barrier to innovation for all young SMEs aged up to four years remains lack of access to additional funds. Overall and depending on the reference year and age of the firm, between 18 per cent and 26 per cent of Australian SMEs cite this as a barrier to innovation. However, we see that for start-up firms aged under one year this barrier seems to be decreasing in importance. This may reflect the return to better business conditions following the effects of the global financial crisis in 2008–09.

The next most important barrier to innovation affecting SMEs is the lack of skilled people. Depending on the reference year and firm age, between 13 per cent and 23 per cent of SMEs reported lack of skills as a barrier to innovation over the six years to 2013. Closely related to finance is the consistently highly reported barrier of the cost to develop and implement innovation. Other significant reported barriers are uncertain demand for new goods or services, and government regulations and compliance.

104 The data was customised for this Report from: ABS (2014) *Innovation in Australian Business, 2012–13,* cat. no. 8158.0

Table 5.1: Selected barriers to innovation activities for start-ups and young SMEs (less than 200 employees) (per cent)

	Under 1 year			*1–4 years*		
	2008–09	*2010–11*	*2012–13*	*2008–09*	*2010–11*	*2012–13*
Lack of access to additional funds	26.0	25.6	18.1	21.3	23.7	22.5
Lack of skilled persons: in any location	13.2	22.7	14.3	17.4	18.2	17.9
Cost of development or introduction/implementation	13.6	18.3	14.2	13.9	13.6	13.5
Uncertain demand for new goods or services	11.9	13.7	9.5	14.1	12.7	15.4
Government regulations or compliance	12.5	11.6	9.2	8.7	12.1	8.7
Any of the listed barriers to innovation	41.7	49.5	33.2	41.9	46.3	47.0

Source: ABS (various) *Business Characteristics Survey*: customised report, cat no. 8158.0

Selected barriers to general business activity or performance for young SMEs (0-4 years) are set out at Table 5.2. Unlike barriers to innovation, the biggest single barrier to business activity identified by young Australian SMEs is the pressure to lower profit margins to remain competitive. This suggests that declining cost competitiveness for many young businesses is having an impact with nearly one in four young Australian SMEs reporting it as a barrier to business activity in 2012-13.

During the period of the global financial crisis (GFC) in 2008-09 and 2009-10, lack of additional funds was the top barrier to business activity for start-ups aged under one year. Nearly one in four start-ups reported it as a barrier to business activity during the GFC. But this proportion decreased to 17 per cent in 2011–12 and 13.7 per cent in 2012–13.

Depending on the reference year and firm characteristics, lack of customer demand for goods or services is generally ranked third as a barrier to business activity. Other significant reported barriers are lack of skilled persons, outstanding accounts receivable limiting cash flow and the cost of inputs.

Table 5.2: Selected barriers to general business activity or performance for start-ups and young SMEs (less than 200 employees) (per cent)

	Under 1 year					*1-4 years*				
	2008–09	*2009–10*	*2010–11*	*2011–12*	*2012–13*	*2008–09*	*2009–10*	*2010–11*	*2011–12*	*2012–13*
Lower profit margins to remain competitive	18.8	17.9	23.7	25.1	24.1	23.8	23.3	22.7	25.5	24.2
Lack of access to additional funds	24.6	23.8	22.5	17	13.7	19.1	16.5	20.1	19.4	17.9
Lack of customer demand for goods or services	18	15.4	17.2	23.5	8.8	18	17	17	20.3	17.2
Lack of skilled persons: in any location	10.1	10.4	20.4	16.4	17.8	15.4	16.9	15.1	13.6	17
Outstanding accounts receivable limiting cash flow	10.9	7.9	12.9	14.1	11	15.9	13.6	16.2	15	13.6
Cost of inputs	7.7	13.5	14	15.4	8.8	9.9	9.3	13.5	14	15.1
Any of the listed barriers to general business activities or performance	52.9	52.3	56.9	55.6	44.5	51.9	51	55.5	53.5	53.8

Source: Customised report based on: ABS (various) *Selected Characteristics of Australian Business*, cat. no. 8167.0

5.2 *A culture of innovative entrepreneurship*

"We have moved from not having innovation on our agenda at all to now having it on the agenda in every monthly meeting … Innovation has got to be part of our culture."
Brendan Swifte (Geofabrics)

As shown in Chapters 2 and 3, Australian rates of entrepreneurship are among the highest in the OECD. Framework conditions for entrepreneurship, such as ease of doing business, capital market liquidity, cost of business start-up and regulatory burden are good relative to other developed economies. An entrepreneurial culture is also important to creating optimal conditions for entrepreneurship.

A business culture that nurtures and facilitates innovative entrepreneurship is difficult to quantify, given the intangible nature of many of its inputs. Such a culture can include being open to new ideas, developing an innovation strategy (within a business), global benchmarking, capacity to collaborate and willingness to take technological or commercial risks.

According to the OECD, the entrepreneurial culture in a country is reflected in the attitude that individuals have towards entrepreneurship, the likelihood of choosing entrepreneurship as a career, ambitions to succeed and to start again after failure, or support provided to family and friends to start up a business.[105] Despite being near the top in terms of our entrepreneurship rates, on many entrepreneurial culture metrics, Australia ranks only around the OECD average or slightly below. For instance, data from the 2014 Global Entrepreneurship Monitor (GEM) show some 53.4 per cent of Australians aged 18-64 years considered entrepreneurship to be 'a good career choice' — slightly below the average for developed 'innovation-driven' economies of 55.1 per cent. This was significantly below the United States (64.7 per cent), the United Kingdom (60.3 per cent) and the Netherlands (79.1 per cent).[106]

In terms of 'fear of failure', the GEM data indicated that 39.2 per cent of Australians aged 18 to 64 years were more fearful of business failure than the average for developed economies (37.8 per cent). This is much higher than the United States (29.7 per cent) and slightly higher than the UK (36.8 per cent).

Similarly, for entrepreneurial intentions (the proportion of 18 to 64 year olds expecting to start a new business within the next three years), Australia at 10.0 per cent was also slightly below the developed economy average of 12.3 per cent. Japan (2.5 per cent) and Germany (5.9 per cent) ranked lowest on this measure. The United Kingdom also ranked low at just 6.9 per cent.[107]

As an alternative to this survey methodology, Jaruzelski et al. used the Global Innovation 1000 to benchmark corporate innovative culture against the world's best.[108] The Global Innovation 1000 is a list of publicly listed companies in the world with the highest R&D expenditures.

---

105 OECD (2015) *Entrepreneurship at a Glance 2015*, OECD Publishing, p.110

106 Singer S, Amorós JE, Arreola DM and Global Entrepreneurship Research Association (2015) *Global Entrepreneurship Monitor 2014 Global Report*, Babson College, Universidad del Desarrollo, Universiti Tun Abdul Razak, Tecnológico de Monterrey, p.78

107 *Ibid,* p.80

108 Jaruzelski B, Loehr J and Holman R (2011), *Why Culture is Key, The Global Innovation 1000*. Booz & Co. Issue 65, Winter

"There are improved cultural attitudes now to entrepreneurship and innovation. Customers are more technologically aware. They seek innovation to be built into the products they buy" Julienne Senyard (QUT Business School)

The Jaruzelski approach was adapted in the 2012 Australian Innovation System Report to quantify, using the ABS Business Characteristics Survey, the extent to which Australian businesses have a cultural bias towards innovation.[109] This adapted method combines three signals for a strong innovation culture: 1) whether a business sources ideas for innovation from users or customers; 2) the importance a business places on innovation as a measure and strategy for business performance; and 3) a tendency to network and collaborate. A business lacking all three of these components would be considered to have no innovation-oriented culture.

Using these signals, we can identify businesses as belonging to one of four categories:

1. High performance culture — innovation is part of the strategy (businesses measure their innovation performance) and businesses are outward orientated (they either collaborate or source ideas from users or customers).

2. Informal or *ad hoc* culture — innovation is not part of the strategy but the business is outward oriented.

3. Silo culture — innovation is part of the strategy but businesses are not outward oriented.

4. Little or no innovation culture — businesses in this category are not outward-oriented and innovation is not part of their strategy.

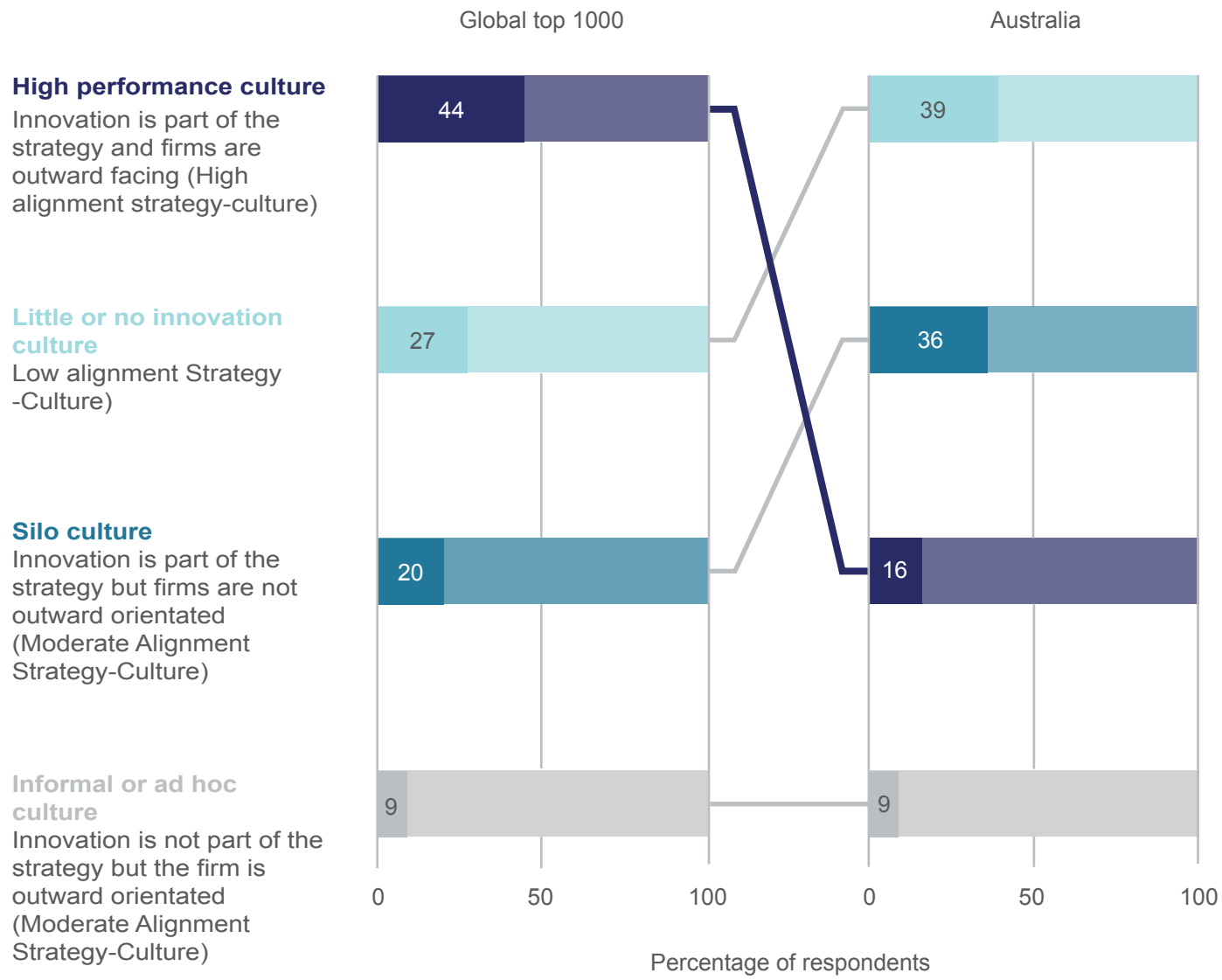
The analysis confirms that Australian businesses have room to improve to a 'high performance innovation culture'. Only 16 per cent of Australian businesses have a high performance innovation culture in contrast to 44 per cent of the Global Innovation 1000 (Figure 5.1). While this is perhaps an unfair comparison, it is a goal to strive for. The same data also show that for the year 2012–13, a large proportion of Australian businesses had a 'siloed' innovation culture (36 per cent), although even more had little or no innovation culture (39 per cent).

These findings may be one factor in helping to explain Australian businesses' relatively poor performance in developing new-to-market or new-to-world innovations when compared internationally. The 2012 Australian Innovation System Report confirmed that Australian businesses with a high performance innovation culture are more likely to financially outperform businesses with a lower degree of innovation culture.[110]

109 Australian Government (2012), A*ustralian Innovation System Report 2012*, Department of Industry, Innovation, Science, Research and Tertiary education, Canberra, pp.44–45

110 *Ibid*, p.46

Figure 5.1: Innovation culture patterns in Australian businesses contrasted with the 2011 Global Innovation 1000, 2012-13



Notes: The Global Innovation 1000 are publicly listed companies with the highest R&D expenditures. SME businesses are defined as having less than 200 employees.

Source: ABS (2014) Department of Industry special data request, adapted from Booz & Co. report, *Why Culture is Key.*

5.3 *Australian entrepreneurs rely on a variety of funding sources*

Access to finance is an important framework condition for the creation, survival and growth of innovative new ventures. Lack of finance can prevent them from investing in innovative projects, commercialising their ideas, covering working capital requirements and meeting market demand.

A majority of young SMEs do not seek external finance as their major source of finance. Instead they draw on personal savings (72 per cent for start-ups and 51 per cent for young businesses), personal credit cards (21 per cent for start-ups and 19 per cent for young businesses), other personal credit facilities (30 per cent for start-ups and 20 per cent for young businesses) and founders' personally secured bank loans (12 per cent for start-ups and 11 per cent for young firms). A higher incidence of seeking external funding is evident if the start-up firms are commenced by teams (33 per cent), are product-based (29 per cent), or are considered 'high-tech' firms (30 per cent).[111] Another data source, the Start-up Muster (the largest survey of the Australian start-up community) indicates that 19 per cent of Australia start-ups are funded by family and friends and 15 per cent by public grants. Overall, half of Australian start-ups receive $100,000 or less in total funding.[112]

Business angel investors provide financial backing for small start-ups or entrepreneurs as another component of informal finance. In Australia, the scale of angel investment is difficult to measure due to their less organised and dispersed nature and because angel investors are generally only active at the very early stages of business development. However, an Australian analysis of the 2014 Global Entrepreneurship Monitor found that these funds can be significant. As much as 4.4 per cent of the adult population in Australia were informal (angel) investors in the sense that they had helped finance entrepreneurial ventures. This is similar to the United States level of 4.3 per cent and well above the average for developed countries of 3.2 per cent. The average investment noted in this analysis was $43,500.[113]

While debt financing by financial institutions plays the most significant role after personal savings in small firm formation, equity finance is also an important source of finance particularly for technology- or knowledge-intensive businesses.[114] Muller and Zimmermann's (2009) study of 6,000 German SMEs showed that companies with high R&D intensity, such as high-tech firms, need more equity

111 Davidsson P, Gordon S R. and Steffens P R (2012) 'Early stage start-ups: evidence from the Comprehensive Australian Study of Entrepreneurial Emergence (CAUSEE)', in *Australian Small Business : Key Statistics and Analysis* [2012 ed.], Commonwealth of Australia, Canberra, pp.13–15

112 Startup Muster: https://www.startupmuster.com/

113 Steffens P and Hechavarria, D (2015) *Global Entrepreneurship Monitor (GEM) 2014 Australian National Report for the Department of Industry and Science*, The Australian Centre for Entrepreneurship Research, Queensland University of Technology, Brisbane, p. 43

114 The World Bank (2008) *Finance for All? Policies and Pitfalls in Expanding Access*, A World Bank Policy Research Report, The World Bank, Washington D.C

capital and are more dependent on a functioning market for external equity.[115] Companies backed by equity-based venture capital are also more likely to invest in R&D.[116]

Venture capital is an important component of a national innovation system. By providing finance and other backing, it can spur entrepreneurship and support skills development, helping to turn novel ideas into innovative outputs.[117] Equity-based investors, including venture capitalists and angel investors, also provide early entrepreneurs with much needed mentoring and advice on matters such as governance, management and networking.

In a recent inquiry into firm creation in Australia, the Productivity Commission (2015) reviewed access to finance for new businesses. The draft report showed that many new businesses do not require external financing; that innovation-active businesses are more likely to identify access to finance as a barrier to innovation; and that personal finance is the dominant source of finance for micro and small start-up firms. The Productivity Commission concluded that equity finance was not a major issue for Australian entrepreneurship.[118]

A recent financial inquiry published by the Australian Treasury found that new SMEs have more difficulty than large businesses in accessing bank loans. Financial institutions often judge the business concepts and technologies of innovative start-ups to be unviable investments because they are not yet generating revenue and often have predominantly intangible assets.[119] An OECD study on entrepreneurship finance suggests this wariness is compounded by innovative start-ups' need for significant upfront investment in technology and knowledge acquisition that has no promise of short-term return.[120]

5.4 *Demand for debt and equity finance is greater for start-ups than older businesses*

To further investigate the likelihood of businesses of different ages, sizes and innovation status to seek and obtain external (debt and/or equity) finance, the Department of Industry, Innovation and Science undertook an analysis of customised ABS data. This was published as a research paper, *Financing Innovative Entrepreneurship*.[121] The analysis found that, in common with many other OECD countries, a majority of SMEs in Australia do not seek external debt

115 Müller E and Zimmermann (2009) 'The importance of equity finance for R&D activity', *Small Business Economics* 33: 303–318

116 Da Rin M and Penas M F (2015) *Venture capital and innovation strategies*, (CentER Discussion Paper; Vol. 2015028), Tilburg: Finance

117 The Treasury (2012) *Review of Venture Capital and Entrepreneurial Skills – Final Report, a report for the Australian Government*, prepared by the Treasury and the Department of Industry, Innovation, Science, Research and Tertiary Education

118 Productivity Commission (2015) *Business Set-up, Transfer and Closure*, Draft Report, Canberra

119 The Treasury (2014) *Financial System Inquiry Interim Report*, 15 July, Canberra http://fsi.gov.au/files/2014/07/FSI_Report_Final_Reduced20140715.pdf

120 OECD (2015) *New Approaches to SME and entrepreneurship finance: Broadening the range of instruments—Final Synthesis Report*, Working Party on SMEs and Entrepreneurship (WPSMEE)

121 Alinejad M, Balaguer A and Hendrickson L (2015) *Financing Innovative Entrepreneurship*, Department of Industry, Innovation and Science, Office of the Chief Economist, Canberra

or equity financing in a given year. The proportion of new SMEs seeking debt or equity finance between 2006–07 and 2012–13 averaged only around 20–25 per cent per year.[122]

Figure 5.2 illustrates the proportion of SMEs seeking and obtaining debt (Panel A) and equity (Panel B) finance by both size and age in a given year averaged over the period 2006–07 to 2012–13. The lower columns indicate the proportion of businesses that were successful in obtaining finance.

The figure shows that demand and supply for debt finance is substantially greater than for equity finance. But there are some clear differences based on business size and age. In general, larger and younger businesses are more likely to seek both forms of finance. SMEs with five to 199 employees are more likely to seek and obtain both debt and equity finance than their micro counterparts of under five employees.

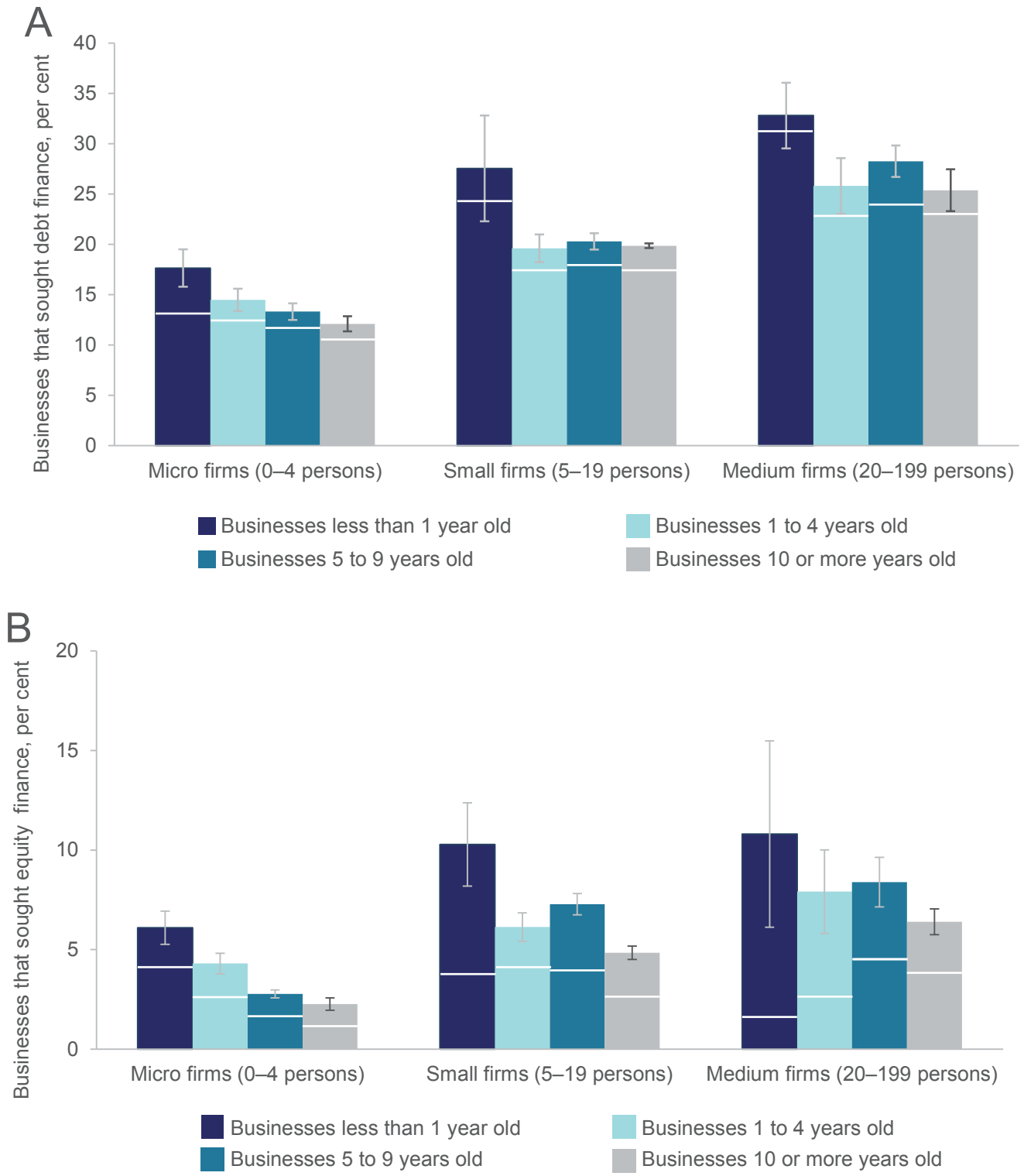
Start-ups of less than one year in age were much more likely to seek finance. This reflects the unsurprising reality of the need to seek finance at the commencement of a venture. The staggered drop-off in the proportion seeking finance as businesses age was more apparent for equity than for debt finance.

According to the most recent ABS data, in 2013–14, between 83 and 88 per cent of Australian SMEs seeking debt financing were successful. But for equity finance, this was much lower at between 38 per cent and 60 per cent.[123] These much lower success rates for equity finance are consistent with levels of success shown in Figure 5.2. Equity finance success rates are particularly low for medium-sized SMEs aged under five years. This probably indicates the more complex procedures involved in securing equity finance, as well as its application to larger, more risky and more novel ventures.

122 *Ibid,* pp.6–7

123 ABS (2014) *Selected Characteristics of Australian Business 2013–14*, cat. no. 8167.0, Business Finance

Figure 5.2: SME businesses seeking and obtaining debt finance (Panel A) or equity finance (Panel B) per annum, by firm age, size and success rate, averaged from 2006-07 to 2012-13



Notes: Values are annual averages ± standard errors. Lower columns represent the proportion of firms seeking finance that are successful in obtaining finance. Note different Y-axis scales in each panel. The standard errors calculated and shown in the charts are average of yearly means to show year on year variation of a mean, and not within year variation in the population.

Source: ABS (various) *ABS Business Characteristics Survey*: customised report

Griffin Accelerator

Collaboration is at the heart of what accelerators do

Mentors working with entrepreneurs

Case study: Griffin Accelerator[124]

Innovation activities take many different forms. One model gaining increasing favour is that of the accelerator.

The Griffin Accelerator, established in Canberra in 2014, brings to the table various actors in the innovation and start-up space in a part of Australia not normally associated with entrepreneurship. It therefore provides some insight into what the start-up community, its drivers and impediments, looks like in a city with Australia's highest educational levels and a close-knit investor community.

With initial seed funding from the Australian Capital Territory Government's Strategic Opportunities Fund in 2014, 40 prospective start-ups applied to take part in Griffin's initial competitive round, out of which just five teams were successful. A further seven teams were selected in 2015 from over 80 applicants. The teams receive a small initial investment of $25,000 each plus tailored mentoring, targeted introductions to potential investors, a governance structure, free co-working space for the 3 month core program and targeted workshops to build skills. The mentoring is provided by earlier successful entrepreneurs and is the idea behind the accelerator. It was such community spirit and a willingness to help newcomers that helped drive the Silicon Valley.

A key factor, as Griffin Accelerator CEO and Founding Mentor Dr Craig Davis explains, is Griffin's 'skin in the game' with its $25,000 investment earning it an entitlement to a 10 per cent share out of future earnings by the entrepreneurial venture. Craig expands: "we tell the entrepreneurs 'if we give you bad advice, we lose our money' and that closeness of the relationship is at the core of the way we [work]". Only after three months of mentoring can teams approach potential investors, which are typically Australian-based boutique angel investor funds. Craig confirms that the start-ups need to grow very quickly in the early years.

The start-ups chosen for Griffin Accelerator are not all high-tech. But they are all associated with innovation in some way. This need not always be a new product. It can be business process innovation or logistical innovation. An important factor is determining whether the product is 'defensible' and whether competitors can easily copy it. But even more than the quality of the innovation, Craig looks at the quality of the team proposing it: "The team is the heart and soul of it".

Successful start-ups will usually be focused on niche products for niche markets. But according to Craig, it is often too limiting for even small start-ups just to focus on the Australian market. Targeting the USA and then potentially Asia or Europe is often a favoured strategy. The entire detail of the value proposition need not be there when the start-up makes its first pitch. It can seek investors based on a lean prototype and then move to the next step based on initial customer feedback.

Interestingly, the demographic profile of GRIFFIN's successful teams for 2015 do not match the stereotypical image of young white or Asian males often associated with the tech industry and start-ups. For instance, four of the seven teams selected for 2015 are female

124 Based on an interview conducted on 28 May 2015.

dominated. One is indigenous. The age range includes both the young and middle-aged. Mid-career aged 30s to early 40s is typical for the innovative entrepreneur in Canberra, according to Craig. But he adds: "Past failure as an entrepreneur is a good thing as experience is the best teacher. There is often a recycling of entrepreneurs in the start-up community. The best innovation often comes from life experience".

So what does Craig see as the essence of innovative entrepreneurship? For him, ideas that are different and ambitious are the most attractive. "Making money is a necessary objective of successful entrepreneurship. But the key ingredient is the need to want to make a difference".

5.5 *Debt and equity financing is more important for innovation active SMEs*

As noted at Section 5.1, in 2012–13, a lack of access to additional funds was identified by both innovation-active and non-innovation-active businesses as their biggest barrier to innovation.[125] But innovative businesses were much more likely to report this than non-innovative businesses: 29.3 per cent of innovation-active Australian businesses in 2012–13 compared to 13.7 per cent of non-innovation-active businesses.[126] Younger businesses were also in general more likely to report this as a barrier than older firms.[127]

Alinejad *et al*. found that innovation-active SMEs were much more likely to seek debt or equity finance in 2012–13 as compared to their non-innovation-active counterparts. Innovation-active SMEs were also significantly more likely to be successful in obtaining equity finance. Young SMEs introducing more novel new-to-market innovation, although no more likely to seek equity finance than their new-to-firm innovator counterparts, were significantly more likely to obtain finance.[128]

Not all early stage businesses obtain the finance they require. Figure 5.3 estimates the demand and supply for debt and equity finance, by looking at new SMEs (businesses less than one year old) and young businesses (one to four years old) in 2012–13. Consistent with Figure 5.2, it shows getting access to equity finance is more difficult than debt finance. The equity finance gap (~4,500 new and young SMEs) is larger than the debt finance gap (~3,700 new and young SMEs) because of the lower success rate. This indicates that a number of potentially innovative high growth businesses are missing out on funding.

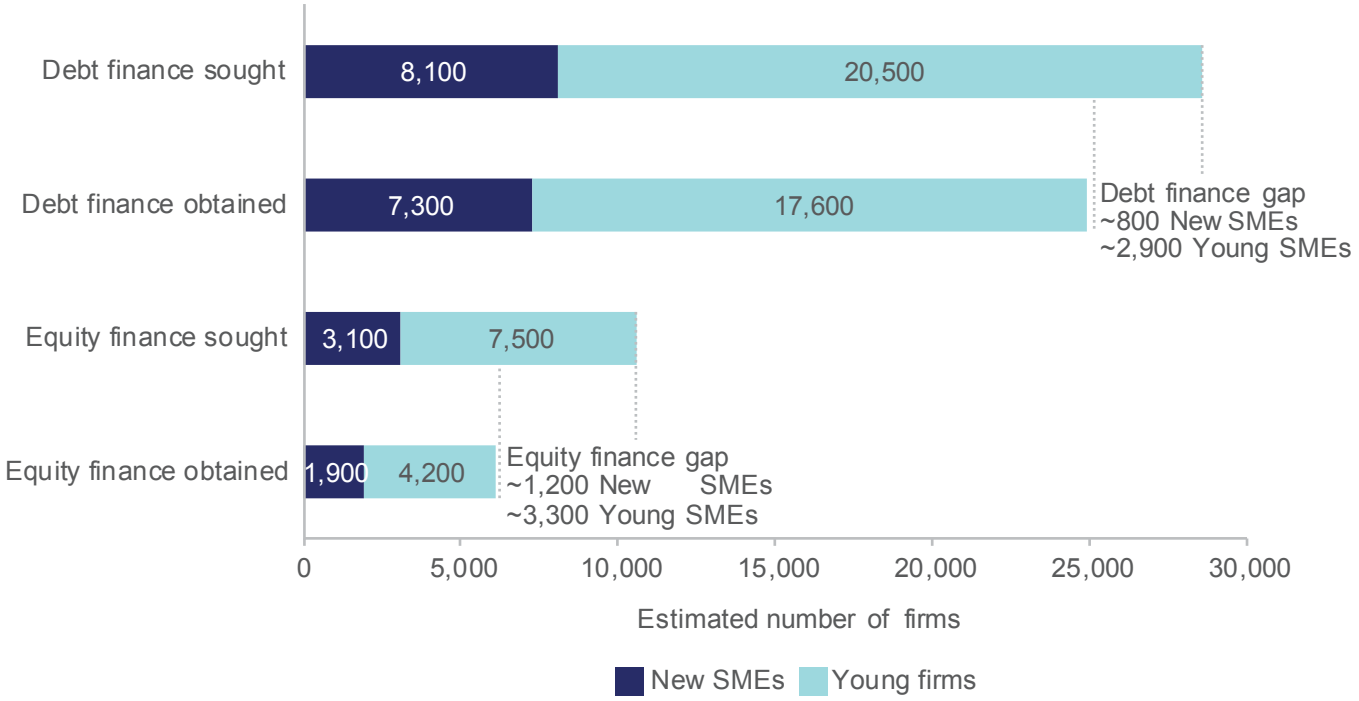
125 The Business Characteristics Survey (BCS) covers four broad types of innovation (goods or services, operational processes, organisational/managerial processes and marketing methods) across three innovation statuses (introduced, still in development and abandoned). These are combined to group businesses into two categories of innovation: innovating businesses (includes businesses that introduced at least one type of innovation during the reference period) and innovation-active businesses (includes businesses that undertook any innovative activity irrespective of whether the innovation was introduced, still in development or abandoned).

126 ABS (2014) *Innovation in Australian Business*, *2012–13*, cat. no. 8158.0

127 Smith R and Hendrickson L (2015) *Business Age and Performance in Australia*, forthcoming

128 Alinejad M *et al.* (2015) op cit, pp.10–13

Figure 5.3: Estimated number of new (less than one year old) and young (one to four years old) SMEs seeking debt or equity finance, by the type of finance obtained, 2012–13



Source: ABS (2014) *Selected characteristics of Australian businesses, 2012-13*, customised report, cat. no. 8167.0

"I have never looked only at the business plan as a serious measure for decision making. I look at people. If the proposal looks interesting, the most important thing is the character of the people I am going to work with"
Alberto Chang-Rajii
(Future Solar Technologies)

5.6 *Venture capital facilitates early stage innovative entrepreneurship, but its scale and scope preclude a larger role*

Given the importance of venture capital to new, innovative firms (and private equity more generally), its availability and usage warrant particular attention. Here we present recent Australian trends.

Venture capital markets are cyclical. The peaks are often correlated with periods of intense market activity and favourable economic conditions.[129] The global financial crisis suppressed venture capital investment in Australia. Total venture capital investment in Australia has declined to 0.017 per cent of GDP, ranking it low compared to many competitor countries. While Australia is performing slightly above the OECD median for later-stage investment, early-stage investments as a percentage of GDP at 0.007 per cent of GDP are just half the OECD median

129 Lerner J (2010) *Innovation, Entrepreneurship and Financial Market Cycles*, OECD Science, Technology and Industry Working Papers, 2010/03, OECD Publishing, p.34

(0.015 per cent GDP).[130] Unlike in the United States, Israel and many other countries, Australian venture capital investment has not bounced back to pre-GFC levels. In 2014 such investment was 40 per cent of its level in 2007, with a substantial decrease in the amount being put into new companies. Instead the capital is being channelled into follow-on investments in existing companies. Venture funds in Australia also tend to be narrowly focused on the information technology and life science sectors.[131]

The success rate of firms applying for venture capital investment has fallen from three per cent in 2005–06 to just over one per cent in 2013–14 even though the number of proposals has recovered to pre-GFC levels.[132] In 2013–14, 108 firms were funded out of 8,133 proposals considered. In that same year, the ABS estimates there were 94,000 firms seeking equity funding, showing that venture capital caters for a tiny fraction of these firms. Although the average investment per firm of US$1.5 million is moderately ranked, Australia has the lowest proportion of venture capital invested in high-risk, early stage venture capital (i.e. seed, start-up and other early stage investment) compared with other OECD countries. This is the case both in terms of the number of firms invested in and the proportion of money invested.[133]

Figure 5.4 shows total venture capital and later stage private equity investment activity in Australia in 2013–14 at various stages of business development in terms of the number of investments (Panel A) and the value of investment (Panel B). The data shows that the investments are most numerous in start-up and early expansion. However, Panel B indicates that in terms of value, the bulk of investment is made in late expansion and turnaround stages.

Mature businesses are receiving a significant share of start-up and early expansion capital. Alinejad *et al*. also found that mature firms generally receive more than twice the investment per firm compared to young firms at all stages except the start-up phase. It is possible that these more mature businesses are in life sciences, where the life cycle of a typical firm is longer. The viability of many pharma/biotech start-ups depends on the production of promising clinical trials data. This can take many years. A six-to- ten year-old pharma/biotech firm may therefore be relatively 'young' in terms of their activities and prospects for commercialisation.

---

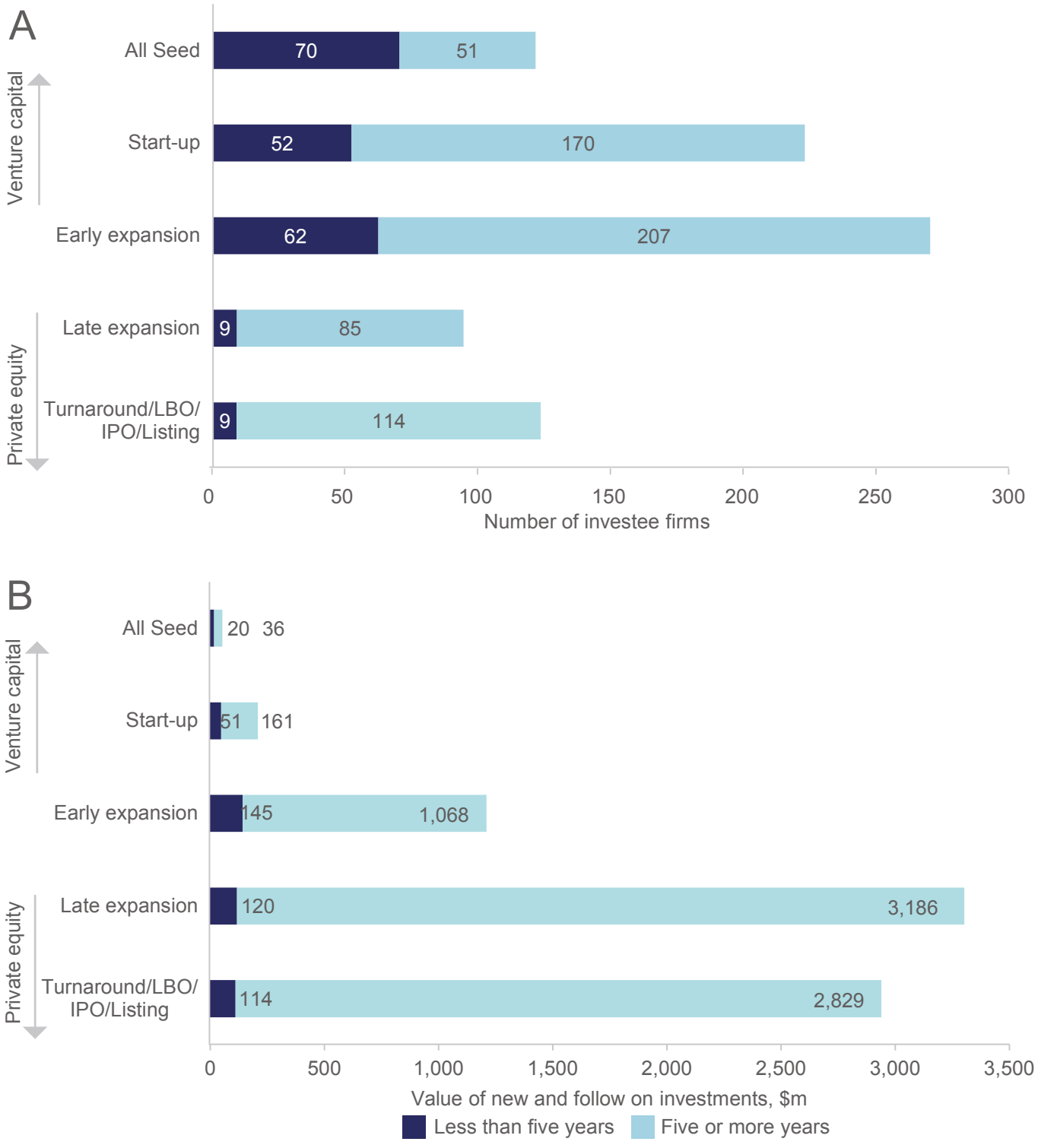
130 The ABS reports that Australia's venture capital investment is 0.11 per cent of GDP in its publication Venture Capital and Later Stage Private Equity, Australia, 2013-14 cat. no. 5678.0. This is different from the 0.017 per cent of GDP reported by the OECD in the publication *Entrepreneurship at a Glance 2014.* The large difference between these two figures is due to differences in their respective definitions. The ABS definition of venture capital includes pre-seed, seed, start-up and early expansion investments. The OECD includes as venture capital investment pre-seed/seed, start-up/other early stage and later stage venture.

131 Based on Australian Private Equity and Venture Capital Association Limited (AVCAL) sector distribution investment data from 2011 to 2014, http://www.avcal.com.au/stats-research/yearbooks.

132 ABS (2015) *Venture Capital and Later Stage Private Equity, Australia, 2013-14*, cat. no. 5678.0

133 OECD (2015) *Entrepreneurship at a Glance 2015*, OECD Publishing; Alinejad *et al* (2015), *op. cit*., p.14

Figure 5.4 (a): Total venture capital and later stage private equity investment activity, by firm age, by number of firms (panel A) and value of investments (panel B), 2013–14



Source: ABS (2014) *Venture Capital and Later Stage Private Equity 2013–14*, cat. no. 5678.0 – customised report

Although data analysed here indicates no significant problem with businesses receiving the debt financing needed to innovate, persistent issues arise about the capacity of the equity market, particularly venture capital, to support Australian businesses with high growth potential. This is particularly so given Australia's low levels of early-stage venture capital relative to other OECD countries. Typically, only some hundreds of businesses are being invested in every year, despite thousands of high growth businesses (identified in Chapter 2) starting up each year.

"We tell the entrepreneurs 'if we give you bad advice, we lose our money' and that closeness of the relationship is at the core of the way we work"
Craig Davis
(Griffin Accelerator)

Indicative trends suggest those Australian firms seeking to raise later stage venture capital (more than $5 million) are turning to international investors (mostly in the ICT/digital sector).[134] Some firms undertaking high impact innovation may prefer international investors, as they bring expertise and networks not available from Australian investors.

Since innovating businesses tend to exhibit superior performance over non-innovators (as seen at Chapter 1), the market is working well in that investment is flowing to more competitive SMEs. The official data cannot, however, differentiate between the sources of finance and the amounts sought, but information about flows of investment suggests that early stage equity finance, and venture capital in particular, is still insufficient to nurture Australia's innovation potential. In order to clarify this issue further, the ABS's Business Characteristic Survey finance questions could be supplemented to include the sources of debt and equity finance and the quantum of money sought and received. This will help policy makers better determine the extent to which access to finance is a constraint on growth.

134 A key contributing factor to venture capital activity has been US-based venture capital firms, including the $250m investment from Insight Venture Partners into Campaign Monitors and Technology Crossover Partner's $30m investment in SiteMinder. In 2013-14 international venture capital funds invested $484m into 9 companies across 11 investments with an average of $54m per company and $44m per investment (Source: AVCAL Deal Metrics report 2014 and personal communication). The vast majority of this funding was directed at the ICT/digital sector.

Dr Hugh Bradlow

Feature: Encouraging innovative entrepreneurship at Telstra

By Dr Hugh Bradlow, Chief Scientist of Telstra

Background:

Three necessary conditions for innovation to thrive

For an activity to qualify as innovation it must meet three conditions, all of which are necessary but not sufficient on their own:

- **Novelty:** an idea can only be innovative if it is a new approach to solving an existing problem (e.g. based on the emergence of new technology), or it creates a new approach to economic activity which disrupts and bypasses the previous approach (e.g. Uber).
- **Risk:** If an idea can be developed and marketed without experimentation it does not qualify as innovation. By their very nature, innovative ideas require experimentation in how they are developed technically and how they are marketed. As a result, innovation involves a level of risk because inevitably any experiments, both technical and market can and do fail.
- **Commercialisation:** As a rule of thumb, the cost of developing a novel idea and introducing it to market goes up an order of magnitude through each of three phases:

  a) Proof-of-concept (POC)

  b) Technical development

  c) Market introduction. An innovation activity must be prepared to go all the way through the chain to market introduction.

Discovery or problem solving

There are two main forms of innovation:

- **Discovery:** where the starting point is an exploration of a topic with the objective of understanding the technology and science behind the discipline, which can then create new technologies that have commercial application (e.g. Laser).
- **Problem solving:** where the starting point is a business (or societal) imperative and innovators apply existing or emerging technology to develop a solution that meets market needs. Consider the development of mobile internet where the aim was to allow people to access information on the move. This required a combination of solutions in both the handset and the networks to create a usable internet experience for a mobile customer.

Telstra's business imperatives

Telstra is a service business based on technology. As such, our business enables our customers, consumers, enterprises, and government, to utilise technology. We turn the technology on for them ("activation"), fix it when it goes wrong ("assurance") and in return charge a fee for usage of the service ("billing"). This does not require us to develop technology ourselves (although there are many instances in which we do) but to leverage technology developments in a way that meets our customer needs. Our role is to "brilliantly connect" our customers to technology.

Accordingly, Telstra's innovation is focussed on the second type of innovation above (problem solving) with the aim of achieving one or more of three overlapping outcomes: (a) introducing new services (e.g. cloud services), (b) improving the customer experience (e.g. ensuring that our mobile network has the widest coverage and most reliable performance) and (c) improving our operational efficiency (e.g. optimising the performance of our networks).

As a global technology service provider, we interact with a wide range of products and services in a field that's constantly evolving in a revolutionary manner. It's therefore essential that we work with our customers on innovation that meet their needs, capture a wide range of opportunities so that our innovation ecosystem encompasses external collaboration and identify early the revolutionary changes that will impact our company in the years beyond our current business horizon. The Telstra innovation ecosystem that we have established, attempts to encompass all these objectives using a number of different initiatives.

The Telstra Innovation Ecosystem

Telstra's innovation ecosystem encompasses five key components which aim to address the challenges described above.

The Innovation Hub

The Innovation Hub is a web-based environment designed to allow employees of Telstra to submit ideas and then progress them through the stages of innovation (POC, development, market introduction). The Innovation Hub is designed to address the challenge that there's no shortage of ideas, from both our people and customers, on how to improve our business. The Hub is the systematic mechanism required to prioritise and progress ideas through the platform, especially in the latter phases where the amount of "bandwidth" for development and commercialisation is limited.

The Innovation Hub is "gamified" in that when team members sign up for it, they are allocated "Innovation Dollars", which they can "invest" in specific projects which they believe are worthwhile. If the projects progress, they will receive a return on their "Innovation Dollars" (which they can reinvest in other projects), if the projects fail they lose their investment (just as with real investments). Projects progress through the phases based initially on their investment, then their business support and finally their capital allocation.

The Telstra Innovation Hub has been in operation for two years, more than 16,500 staff members signed up, 1,400 ideas submitted with 46 having progressed to commercialisation.

The technology and the methodology of the Innovation Hub have applicability beyond Telstra and have now been adopted by organisations outside Telstra. It has been adopted by 14 Departments of the Australian Government who are using it to improve government services.

Telstra Ventures

In recognition of the fact that much innovation comes from outside emerging companies, Telstra established Telstra Ventures in 2011 to identify and invest in early stage companies with products or platforms that enhance Telstra's business.

The team has reviewed over 2,500 businesses and made over 20 investments. Key elements of a Telstra Ventures' investment are: world leading product or service; lighthouse management team; and positive technology, demographic or industry trends. Additionally each investment can drive significant revenue, capability, cost or corporate development synergies for Telstra. Additionally, each investment generally has significant revenue, capability, cost or corporate development synergies for Telstra. Approximately, one-third of the portfolio was been awarded Gartner Leaders or Cool Vendors accolades (e.g. Adnear, Box, DocuSign, Kony, MATRIXX, Nexmo, Panviva, and TeleSign). During CY2014, Telstra Ventures portfolio companies grew their revenues by a 64 per cent year/year increase.

Current areas of investment interest include: next generation networking/5G, big data, Internet-of-things, security, cloud, mobile applications, health care IT. Emerging areas of interest are machine learning/AI, marketplaces/fintech, robotics/drones, and selected vertical applications.

Telstra Ventures has personnel in Beijing, Brisbane, Melbourne, San Francisco and Sydney.

muru-D Accelerator

An innovation ecosystem needs to capture opportunity at many different stages of the development cycle. While Telstra Ventures invests in early stage companies that are relatively mature (they invariably have revenue), the muru-D accelerator was established to assist companies at their very inception. muru-D provides startups who wish to establish digital businesses with seed investment and mentoring over a six month program.

To date 20 startups have graduated through the muru-D program which was established in Sydney in October 2013. Collectively, the startups have attracted investment of more than $4 million and have generated more than $5 million in revenue creating 40 new jobs.

muru-D recently launched a second academy in Singapore where the first batch of startups were just selected and muru-D now boasts strategic partnerships in Brisbane, New Zealand, China and the USA.

Telstra Research Partners Program (TRPP)

Besides capturing innovation and entrepreneurship in early stage commercialisation, we also wish to nurture ideas emerging from discovery projects that are incubated out of universities and research institutions.

The TRPP was established to engage with institutions in a mutually beneficial way to ensure that research is informed by commercial expectations and Telstra's capturing new disruptive and emerging ideas.

To date, the TRPP has funded major projects in NICTA and a number of universities across a range of topics such as network performance, Big Data, robotics and health. The program has completed over seven collaborative projects, with the majority on a clear path to commercial outcomes that directly benefit our customer's experience.

Gurrowa Innovation Centre

The latest Telstra innovation initiative is the recently launched Gurrowa Innovation Lab. Gurrowa, which means Interchange in the Wurung language, signifies the interchanging of ideas that will take place in this unique co-creation space that will drive the new wave of innovation at Telstra. The Lab also houses Telstra's Chief Technology Office and is designed to enable collaboration and prototyping between Telstra, our customers and external developers. It will offer high end 3D Printing and electronic prototyping facilities as well as an advanced software environment to enable POC projects encompassing both hardware and software.

Conclusion

As stated above, Telstra operates in a broad and rapidly changing environment. Our innovation ecosystem is designed to encourage, nurture and facilitate both internal and external entrepreneurship ranging from early stage research ideas to commercial outcomes.

In recognition of the essential risk component of innovation, our investments take a portfolio approach at all stages and require substantial time and investment to establish.

The huge growth in the capability of new technologies and software will drive more change in the world in the next 10 years than we have seen in the last 50. In this environment it is the ability to innovate that will mean the difference between making the most of the many opportunities ahead, or falling behind. Telstra's vision is to be a world class technology company that empowers people to connect. To realise that vision we will need to be world class innovators as well.

APPENDIX A

Perth, a renowned Australian innovation centre for mining

Appendix A

Performance indicators of the Australian Innovation System

This chapter provides tables that illustrate innovation performance in Australia

It is not possible to understand the breadth and depth of the Australian Innovation System, through a single indicator. As such, we have produced a series of tables that measure the input, output and outcomes of Australia's innovation system. These tables explore a multitude of aspects, including innovation and R&D investments, businesses collaborative performance, outputs of the education and research systems, framework conditions for innovation and levels of entrepreneurship and international engagement within Australia through time. We also compare Australia internationally to provide a benchmark and an understanding of how close Australia is to the innovation frontier.

The Tables in this Appendix present annual data. Some indicators provide data based on financial year (FY), others on calendar year. This is explained in the Tables notes. We use the criterion of latest available annual data for the all indicators.

The *Australian Trend Data* tables gives an overview of the trends and shows how Australia is performing over time in a particular indicator. The *OECD+ Comparisons* tables compare Australia to the category OECD+. This category includes all countries belonging to the OECD, plus Singapore, China and Taiwan. These three countries have been included in our calculations because they are also actively involved in improving their own innovation systems and close to the frontier in many indicators.

There are a number of rules applied for any indicator with OECD+ comparisons. Firstly, there must be a minimum of 15 countries which have data available for the same year.

We have also had to account for methodological differences when comparing Australia internationally. This is particularly apparent when indicators are separated by firm size. Australia's definition of a SME is a business with between 0–199 employees, whereas the OECD defines a SME as having between 10–249

employees. Therefore, to compare Australian to our OECD+ counterparts, we have instituted a similar definition for only this section of the table, meaning that the 'Australia's score' column may not always match the data that is present in the left hand 'Australian Trend Data' section of the table. This is particularly the case for business innovation data.

Additionally there may be other methodological differences between data that is available internationally and those that are produced for Australia that may cause a difference between these figures. For example, large variations are recorded for the indicator named 'Percentage of innovation-active SMEs collaborating on innovation that collaborate with non-commercial research institutions' as Australia's data is traditionally calculated as a percentage of all types of innovation performed by firms, while the OECD+ data is calculated by looking at a specific cohort of those firms that introduced product or process of innovation only.

The original source material is referenced at the bottom of each table.

Table A1(a): Outcome indicators

Australian Trend Data (i)											
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
GDP per capita relative to the USA (USA = 100), index [1]	78	77	80	82	88	87	88	85	84	84	–
Index of Economic Freedom [2]	74	77	79	82	83	83	83	83	83	82	81
Resilience of the economy, score [3]	–	–	7.6	6.8	5.8	7.0	7.7	7.3	6.5	6.8	5.3
Economic Complexity Index [4]	0.05	-0.09	-0.22	-0.42	-0.61	-0.45	-0.46	-0.42	-0.43	–	–
Hannah-Kay index of industrial specialisation [5]	–	–	–	–	–	0.55	–	–	–	–	–
Global Competitiveness Index, score ranges from 1-7 (best) [6 21]	–	–	5.2	5.2	5.2	5.1	5.1	5.1	5.1	5.1	5.1
Global Innovation Index [7]	–	–	–	–	–	–	49.9	51.9	53.1	55.0	55.2
GDP per hour worked (USA = 100), index [1]	81	83	80	79	81	79	80	80	81	82	–
Production-based CO2 productivity, GDP per unit of energy-related CO2 emissions, US$/kg [8]	1.8	1.8	1.9	2.0	2.0	2.1	2.2	2.3	–	–	–
Energy productivity, GDP per unit of Total Primary Energy Supply (TPES) [8]	5,421	5,609	6,334	6,425	6,571	6,702	6,930	6,805	6,922	–	–
Energy productivity, GDP per unit of Total Primary Energy Supply (TPES)[8]	5,421	5,609	6,334	6,425	6,571	6,702	6,930	6,805	6,922	–	–
Non-energy material productivity, GDP per unit of domestic material consumption (DMC), US$/kg[8]	0.85	0.89	1.01	0.97	0.92	1.13	1.16	–	–	–	–
Water productivity, total (constant 2005 US$ GDP per cubic meter of total freshwater withdrawal) [9 14 15]	23.4	27.7	–	–	–	–	36.1	–	38.4	–	–
UNDP Human Development Index [10 16 17]	0.87	0.90	0.91	0.92	–	0.93	0.93	0.93	0.93	–	–
Environmental Performance Index [11 15]	–	80.5	81.2	81.7	81.9	82.2	82.4	82.4	–	–	–
Social Progress Index [12]	–	–	–	–	–	–	–	–	–	86.1	86.4
Gini coefficient, score ranges from 0 (perfect equality) to 1 (perfect inequality) [13 18 19 20]	–	–	–	–	–	–	–	0.326	–	–	–

Table A1(b): Outcome indicators

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
GDP per capita relative to the USA (USA = 100), index[1]	84	72	118	29	7th of 34
Index of Economic Freedom[2]	81	71	82	1	3rd of 37
Resilience of the economy, score[3]	5.3	5.2	6.8	21	19th of 37
Economic Complexity Index[4]	-0.43	1.21	2.09	120	34th of 34
Hannah-Kay index of industrial specialisation[5]	0.55	0.56	0.67	17	20th of 31
Global Competitiveness Index, score ranges from 1-7 (best)[6 21]	5.1	5.0	5.6	8	17th of 37
Global Innovation Index[7]	55.2	52.6	63	12	16th of 36
GDP per hour worked (USA = 100), index[1]	82	73	113	28	13rd of 34

OECD+ Comparisons (ii) (continued)

Indicators	Australia's score (iii)	OECD+ Average (iv)	OECD+ top 5 average (vi)	Gap from the top 5 OECD+ performers (per cent) (vii)	Ranking against OECD+ countries (viii)
Production-based CO2 productivity, GDP per unit of energy-related CO2 emissions, US$/kg[8]	2.3	4.0	7.2	68	33rd of 35
Energy productivity, GDP per unit of Total Primary Energy Supply (TPES)[8]	6,922	8,165	11,704	41	25th of 34
Energy productivity, GDP per unit of Total Primary Energy Supply (TPES) [8]	6,922	8,165	11,704	41	25th of 34
Non-energy material productivity, GDP per unit of domestic material consumption (DMC), US$/kg [8]	1.16	2.26	3.56	67	13rd of 15
Water productivity, total (constant 2005 US$ GDP per cubic meter of total freshwater withdrawal) [9 14 15]	38.4	127.1	531.5	93	23rd of 36
UNDP Human Development Index [10 16 17]	0.93	0.87	0.92	no gap	2nd of 36
Environmental Performance Index [11 15]	82.4	73.0	83.3	1	3rd of 37
Social Progress Index [12]	86.4	80.9	87.8	2	10th of 34
Gini coefficient, score ranges from 0 (perfect equality) to 1 (perfect inequality) [13 18 19 20]	0.326	0.308	0.252	30	20th of 31

Table notes: (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Sources (1 - 13): [1] OECD (2015) *GDP per capita and productivity levels, OECD Productivity Statistics* (database), June 2015, URL: http://stats.oecd.org/; [2] The Heritage Foundation (2014-2015) Index of Economic Freedom, 2014 - 2015, URL: http://www.heritage.org/; [3] IMD (2014-2015) *World Competitiveness Online, 2014 - 2015,* URL: https://www.worldcompetitiveness.com; [4] Center for International Development at Harvard University (2015) *Atlas of Economic Complexity, July 2015,* URL: http://atlas.cid.harvard.edu/; [5] OECD (2014) Structural Analysis (STAN), 2014, URL: http://stats.oecd.org/; [6] World Economic Forum (2014-2015) *Global Competitiveness Index, 2014-15 - 2015-16,* URL: http://www.weforum.org/; [7] Cornell University, INSEAD, WIPO (2011-2015) *Global Innovation Index, GII 2011 - GII 2015*, URL: http://www.globalinnovationindex.org; [8] OECD (2015) Green growth indicators, 2015, URL: http://www.oecd.org/; [9] World Bank (2014-2015) *World Development Indicators, 2014 - 2015,* URL: http://data.worldbank.org/; [10] United Nations Development Programme (2014) *Human Development Index, 2014*, Table 2: Human Development Index trends, 1980-2013, URL: http://hdr.undp.org/; [11] Yale University and Columbia University (2014) *Environmental Performance Index, 2014,* URL: http://epi.yale.edu; [12] Social Progress Imperative (2015) *Social Progress Index, 2014 - 2015,* URL: http://www.socialprogressimperative.org/; [13] OECD (2015) *Income Distribution and Poverty,* 2014

Indicator notes (14 - 21): [14] 1997 data used in place of 1995 data.; [15] 2002 data used in place of 2000 data.; [16] 1990 data used in place of 1995 data.; [17] See Technical note 1 (http://hdr.undp.org/en) for details on how the HDI is calculated; [18] A lower score is better, gap from the top 5 performers represents absolute gap; [19] Gini (disposable income, post taxes and transfers); [20] New income definition since 2012; [21] 2006 data used in place of 2005 data

Table A2(a): Indicators of Australia's innovation and entrepreneurship activity

Australian Trend Data (i)											
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Intangible capital stock, AU$ billion[1]	141.5	180.1	223.6	260.4	270.8	279.5	288.3	297.4	–	–	–
Intangible capital stock, per cent of GDP[2]	16.6	18.0	17.8	18.3	18.5	18.4	–	–	–	–	–
Business expenditure on R&D (BERD), per cent of GDP[3]	0.82	0.71	1.05	1.37	1.29	1.28	1.23	–	1.19	–	–
Percentage of Business expenditure on R&D (BERD) financed by government, per cent [3]	2.4	3.8	4.0	2.0	2.0	1.7	1.9	–	2.1	–	–
Percentage of innovation-active firms, per cent [4 5 21 33]	–	–	37.1	39.8	43.8	39.1	46.6	42.2	48.3	–	–
Percentage of innovation-active SME firms, per cent [4 6 22]	–	–	36.7	39.7	43.7	38.9	46.6	42.0	48.1	–	–
Percentage of innovation-active large firms, per cent [4 6 7 22 23]	–	–	66.2	66.7	74.3	65.9	76.0	74.3	79.5	–	–
Proportion of businesses introducing goods or services innovation, per cent [5 9 24 25]	–	–	19.3	18.2	19.8	17.3	20.4	20.0	24.1	–	–
Proportion of businesses introducing operational/ process innovation, per cent [5 7 24 25]	–	–	20.8	16.3	16.9	16.4	19.1	16.9	17.9	–	–
Proportion of businesses introducing organisational/managerial process innovation, per cent [5 9 24 25]	–	–	20.7	19.4	20.7	18.9	23.0	20.2	21.7	–	–
Proportion of businesses introducing marketing innovation, per cent [5 7 24 25]	–	–	14.3	17.2	16.7	16.8	19.9	18.8	20.3	–	–
Proportion of innovation-active businesses innovating to reduce environmental impacts, per cent [10 33]	–	–	12.1	11.4	–	12.9	–	11.7	–	–	–
Share of high and medium technology manufacturing as a percentage of GDP [11 12 13]	–	–	2.37	2.19	2.00	1.85	1.87	1.71	1.65	–	–
Employer Enterprise Birth Rate, per cent [14 15]	–	–	16.3	14.4	16.7	13.9	13.5	11.2	13.7	–	–
Total early-stage entrepreneurship activity (TEA), per cent [16 26]	–	14.7	10.5	–	–	7.8	10.5	–	–	13.1	–
Employer Enterprise Death Rate, per cent [14 15 27]	–	–	15.0	15.4	13.1	13.5	13.1	14.0	12.7	–	–
Churn Rate, per cent [14]	–	–	1.3	-1.0	3.6	0.4	0.4	-2.9	1.0	–	–
1-year survival rate (employer enterprises), per cent [14 15]	–	–	85.0	84.6	86.9	86.5	86.9	86.0	87.3	–	–
Patents granted by IP Australia, for Australian residents [17 28]	–	–	–	925	926	1,178	1,262	1,311	1,110	1,199	–
Innovation Patents by AU residents [17 29]	–	–	926	1,028	1,109	1,127	1,204	1,205	1,131	1,021	–
Industrial designs certified by IP Australia, for Australian residents [17 30]	–	–	115	342	274	327	265	318	217	569	–
Triadic patent families per million population [3]	13.2	27.2	23.7	14.8	16.1	13.8	13.4	13.1	13.1	–	–
Patent applications filed by AU residents under PCT per million population[15 28 30]	–	–	96	90	79	79	77	75	69	73	–
Share of world triadic patent families [5]	0.7	0.9	0.8	0.6	0.7	0.6	0.6	0.6	0.6	–	–
Patent applications filed under PCT per million population [5]	46	92	103	86	85	79	80	75	78	–	–
Development of environment-related technologies, per cent all technologies [18]	8.11	7.79	5.40	8.20	9.93	10.97	10.27	–	–	–	–
Development of environment-related technologies, inventions per capita [18]	4.35	7.27	1.21	1.58	1.65	1.87	1.82	–	–	–	–
Diffusion of environment-related technologies, per cent all technologies [18]	6.6	5.7	7.0	10.2	10.8	11.8	10.5	–	–	–	–
Madrid system trademark registrations by country of origin [19]	–	–	–	–	–	–	–	–	16.3	–	–
Patent Cooperation Treaty resident applications, per billion PPP$ GDP [19]	–	–	–	–	–	–	27.8	–	31.5	31.4	19.2
Industrial design registrations (AU resident) per million population [17 32]	121	98	136	113	119	111	111	107	125	111	–

Australian Trend Data (i) (continued)											
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Trade Mark applications from Australian residents[17]	19,036	27,175	38,193	38,381	38,466	39,633	40,056	41,106	39,663	41,655	–
Trademark registrations (AU resident) per million population [17 32]	429	504	1,091	1,245	1,123	1,077	1,062	1,063	1,069	994	–
National office resident trademark registrations, per bn PPP$ GDP [19]	–	–	–	–	–	–	–	–	26	–	–

Table A2(b): Indicators of Australia's innovation and entrepreneurship activity

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
Intangible capital stock, per cent of GDP[2]	18.4	25.6	31.9	42	14th of 21
Business expenditure on R&D (BERD), per cent of GDP[3]	1.19	1.35	2.79	57	15th of 33
Percentage of Business expenditure on R&D (BERD) financed by government, per cent [3]	2.1	7.2	13.0	84	23rd of 26
Percentage of innovation-active SME firms, per cent [4 6 22]	62.2	48.7	67.4	8	5th of 30
Percentage of innovation-active large firms, per cent [4 6 7 8 23 33]	77.9	75.3	89.8	13	18th of 30
Employer Enterprise Birth Rate, per cent [14 15]	15.3	11.4	15.1	no gap	3rd of 16
Total early-stage entrepreneurship activity (TEA), per cent [16 26]	13.1	9.2	17.7	26	5th of 31
Employer Enterprise Death Rate, per cent [14 15 27]	15.0	9.2	6.7	123	16th of 16
1-year survival rate (employer enterprises), per cent [14 15 27]	84.7	81.7	87.8	4	7th of 15
Triadic patent families per million population [3]	13.1	30.1	94.6	86	21st of 37
Share of world triadic patent families [5]	0.6	2.6	15.4	96	18th of 37
Patent applications filed under PCT per million population [5]	78	107	271	71	21st of 37
Development of environment-related technologies, per cent all technologies [18]	10.27	11.77	21.86	53	18th of 35
Development of environment-related technologies, inventions per capita [18]	1.82	11.08	36.44	95	28th of 35
Diffusion of environment-related technologies, per cent all technologies [18]	10.5	12.2	19.3	46	22nd of 33
Madrid system trademark registrations by country of origin [19]	16.3	26.7	72.2	77	18th of 32
Patent Cooperation Treaty resident applications, per billion PPP$ GDP [19]	19.2	37.2	98.6	81	23rd of 36
National office resident trademark registrations, per bn PPP$ GDP [19]	26	27	56	54	18th of 36

Notes: – = data not available (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Sources: (1–19): [1] ABS (2012) *Australian System of National Accounts*, cat. no. 5204.0; Elnasri A & Fox K (forthcoming) The Contribution of Research & Innovation to Productivity & Economic Growth. [2] IntanInvest database, http://intan-invest.net/. Accessed 2014-11-06; Melbourne Institute of Applied Economic and Social Research (2012) *Figures*

commissioned by DIISRTE [3] OECD (2015) *Main Science and Technology Indicators, 2015-1,* URL: http://stats.oecd.org/; [4] ABS (2008–2014) S*ummary of IT Use and Innovation in Australian Business,* cat. no. 8166.0, 2006-07 - 2012–13, Summary of Innovation in Australian Business, URL: http://www.abs.gov.au/; [5] ABS (2014-2015) *Summary of IT Use and Innovation in Australian Business*, cat. no. 8166.0, 2012-13 - 2013-14, Summary of Innovation in Australian Business, by employment size, by industry, URL: http://www.abs.gov.au/; [6] OECD (2015) *Science, Technology and Industry Scoreboard, 2015*, DOI: 10.1787/20725345; [7] ABS (2015) *Special request, 2015–1*; [8] OECD (2013) *Science, Technology and Industry Scoreboard, 2013,* DOI: 10.1787/sti_scoreboard-2013-en; [9] ABS (2008-2013) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2005–06 - 2011–12, Business innovation, URL: http://www.abs.gov.au/; [10] ABS (2008–2014) *Innovation in Australian Business,* cat. no. 8158.0, 2008 - 2012–13, Drivers of Innovation, URL: http://www.abs.gov.au/; [11] ABS (2014) *Australian Industry,* cat. no. 8155.0, 2012–13, Manufacturing Industry by ANZSIC Class; [12] ABS (2015) *Australian Industry,* cat. no. 8155.0, 2013–14, Manufacturing industry; [13] ABS (2015) *Australian National Accounts: National Income, Expenditure and Product,* cat. no. 5206.0, June 2015, Income from GDP and Changes in Inventories, Annual ; [14] ABS (2007–2015) *Counts of Australian Businesses, including Entries and Exits,* cat. no. 8165.0, 2007 - 2014, Businesses by Industry Division, URL: http://www.abs.gov.au/; [15] OECD (2013) *Structural and Demographic Business Statistics (SDBS) Database, 2013*, DOI: 10.1787/sdbs-data-en; [16] Global Entrepreneurship Research Association (GERA) (2015) *Global Entrepreneurship Monitor (GEM)*, 2014, URL: http://www.gemconsortium.org/; [17] Australian Government (2014–2015) *Special data request from IP Australia, 2014–2015*, Ref: O:\Innovation Analysis Branch\Innovation Research\Data\Indicators\IP_SR; [18] OECD (2015) Green growth indicators, 2015, URL: http://www.oecd.org/; [19] Cornell University, INSEAD, WIPO (2011-2015) *Global Innovation Index, GII 2011 - GII 2015,* URL: http://www.globalinnovationindex.org;

Indicator notes (20–33): [20] Intangible capital investment includes R&D, Design, Market research & Branding, Organisational improvement, Business-specific training and skills development, Software development, Mineral exploration and Artistic originals. [21] 0+ employees; [22] 0–199 employees for Australia-only data points; 10–249 employees OECD Comparison; [23] 200+ employees for Australia-only data points; 250+ employees OECD Comparison; [24] Businesses may be counted in more than one category; [25] Proportions are of all businesses in each output category; [26] 2001 data used in place of 2000 data.; [27] A lower score is better, gap from the top 5 performers represents absolute gap; [28] IP Australia's databases country codes are not complete for mainframe applications. As a result, the number of Australian grants may be understated prior to 2008; [29] The innovation patent regime was established in November 2000, and as such the first full year of data available is 2001; [30] Design certificate was introduced with the 2003 act, so no observations before then; [31] PCT data is not currently available prior to 2006; Population has been sourced from ABS Cat. No. 3101.0; [32] Population has been sourced from ABS Cat. No. 3101.0; [33] 2006 data used in place of 2005 data

Table A3(a): Main indicators of Australia's international engagement

Australian Trend Data (i)											
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
DHL Global Connectedness Index[1]	–	–	54	58	59	59	58	58	57	–	–
Trade, per cent of GDP[2]	38	41	39	42	45	40	41	43	41	42	–
Exports of goods, per cent of GDP [3 4]	13.5	15.6	13.8	17.6	15.3	16.4	17.6	16.3	16.5	16.4	–
Exports of services, per cent of GDP[4 5]	4.3	4.9	4.0	4.1	3.9	3.6	3.4	3.4	3.5	–	–
Exports in raw commodoities, per cent of GDP [7 8 9]	–	–	–	9.5	8.1	9.6	10.9	9.7	10.0	9.8	–
Net Foreign Direct Investment Inflows, per cent of GDP [7 8 9]	1.3	1.7	-3.7	4.4	3.1	2.8	3.7	3.5	3.5	3.5	–
FDI and technology transfer, score ranges from 1–7 (best) [10 26]	–	–	5.2	5.5	5.4	5.2	5.1	5.0	5.2	5.1	4.8
Business impact of rules on FDI, score ranges from 1–7 (best) [10 26]	–	–	5.4	5.4	5.1	4.9	4.9	5.0	4.9	4.6	4.8
Technology balance of payments - (receipts minus payments), per cent of GDP [9 22]	-0.049	-0.167	-0.092	-0.194	-0.182	-0.211	-0.245	-0.263	-0.323	–	–
Intellectual property balance of payments, million A$ [11 12]	–	-1,319	-1,832	-2,656	-2,588	-2,659	-3,065	-3,214	-3,279	-3,499	–
Percentage of Gross Expenditure on R&D (GERD) financed by abroad, per cent [9 22 23]	2.1	3.5	2.9	1.6	–	–	–	–	–	–	–
Percentage of Business expenditure on R&D (BERD) financed by abroad, per cent [9]	3.0	4.7	1.6	1.0	1.0	0.9	1.2	–	1.6	–	–
Proportion of patents with foreign co-inventors, per cent [13]	9.3	13.1	15.2	16.1	17.5	18.7	17.5	16.4	–	–	–
R&D expenditure of foreign affiliates, per cent of R&D expenditure of the enterprise [14 15 16 17 26]	–	–	36.5	35.5	32.1	29.5	30.5	–	27.2	–	–
Environmentally related government R&D budget, per cent of total government R&D[18]	1.2	3.0	3.2	3.6	5.5	5.6	5.0	5.6	3.6	–	–
Renewable energy public research, development and demonstration (RD&D) budget, per cent of total energy public RD&D [18]	4.6	–	12.4	13.8	19.3	20.2	33.6	33.4	53.9	–	–
Energy public research, development and demonstration (RD&D) budget, per cent of GDP [18]	0.02	–	0.02	0.03	0.04	0.03	0.04	0.05	0.06	–	–
Net gains of skilled people through migration, '000s [19 20 24]	–	–	29.0	44.2	41.1	32.2	25.2	33.6	30.8	30.4	30.4
Short term business trips churn, '000s [21 25]	850	1,043	1,315	1,294	1,353	1,472	1,501	1,453	1,478	1,474	–
Short term education trips churn, '000s [21 25]	156	249	328	400	429	442	438	465	465	517	–
Short term convention and conferences trips churn, '000s [21 25]	205	292	357	353	355	393	415	444	450	481	–
Short term employment trip churn, '000s [21 25]	99	144	247	300	297	317	338	374	371	488	–

Table A3(b): Main indicators of Australia's international engagement

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
DHL Global Connectedness Index [1]	57	64	83	32	26th of 37
Trade, per cent of GDP [2]	42	101	205	79	27th of 28
Exports of goods, per cent of GDP [3 4]	16.4	37.8	83.8	80	30th of 34
Exports of services, per cent of GDP [4 5]	3.5	15.6	50.3	93	32nd of 34
Exports in raw commodoities, per cent of GDP [4 6]	9.8	3.9	11.8	16	4th of 33
Net Foreign Direct Investment Inflows, per cent of GDP [7 8 9]	3.5	1.7	3.9	9	4th of 25
FDI and technology transfer, score ranges from 1–7 (best) [10 26]	4.8	4.9	5.7	16	26th of 37
Business impact of rules on FDI, score ranges from 1–7 (best) [9 22]	4.8	4.9	6.0	21	22nd of 37
Technology balance of payments - (receipts minus payments), per cent of GDP [9 22]	-0.323	0.306	1.501	122	23rd of 26
Percentage of Gross Expenditure on R&D (GERD) financed by abroad, per cent [9 22 23]	1.6	7.4	18.6	91	25th of 30
Percentage of Business expenditure on R&D (BERD) financed by abroad, per cent [9]	1.6	9.0	20.7	92	20th of 26
Proportion of patents with foreign co-inventors, per cent [13]	16.4	24.3	44.3	63	28th of 37
Environmentally related government R&D budget, per cent of total government R&D [18]	3.6	2.6	4.8	25	3rd of 18
Renewable energy public research, development and demonstration (RD&D) budget, per cent of total energy public RD&D [18]	33.4	28.2	51.6	35	8th of 22
Energy public research, development and demonstration (RD&D) budget, per cent of GDP [18]	0.05	0.05	0.11	53	7th of 22

Notes: (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Source: (1–21): [1] DHL (2014) *DHL Global Connectedness Index, 2014,* URL: http://www.dhl.com/; [2] World Bank (2015) *World Development Indicators, 2015,* URL: http://data.worldbank.org/; [3] OECD (2015) *International Trade and Balance of Payments, 2015,* International Trade (MEI), URL: http://stats.oecd.org/; [4] OECD (2015) *National Accounts, 2015, Annual National Accounts,* URL: http://stats.oecd.org/; [5] OECD (2014) *Balance of Payments (MEI),* Sep-14, URL: http://stats.oecd.org/; [6] OECD (2015) *International Trade by Commodity Statistics, 2015–1,* Harmonised System 2007, URL: http://www.oecd.org/; [7] OECD (2014) *Foreign Direct Investment Statistics, 2013,* URL: http://stats.oecd.org/; [8] OECD (2015) *Foreign Direct Investment Statistics, April 2015,* FDI financial flows, main aggregates BMD4, URL: http://stats.oecd.org/; [9] OECD (2015) *Main Science and Technology Indicators, 2015–1,* URL: http://stats.oecd.org/; [10] World Economic Forum (2014–2015) *Global Competitiveness Index, 2014–15 - 2015–16,* URL: http://www.weforum.org/; [11] ABS (2014–2015) *International Trade in Services by Country, by State and by Detailed Services Category,* Calendar Year, cat. no. 5368.0.55.004, 2013– 2014, International Trade in Services, Credits, Calendar Year by Country & Service, URL: http://www.abs.gov.au/; [12] ABS (2014–2015) *International Trade in Services by Country, by State and by Detailed Services Category,* Calendar Year, cat. no. 5368.0.55.004, 2013–2014, International Trade in Services, Debits, Calendar Year by Country & Service, URL: http://www.abs.gov.au/; [13] OECD (2015) *Indicators of international co-operation in patents, 2015,* URL: http://stats.oecd.org/; [14] ABS (2013) R*esearch and Experimental Development, Businesses, Australia,* cat. no. 8104.0, 2013, Business expenditure of R&D, summary statistics, URL: http://www.abs.gov.au/; [15] ABS (2013) *Research and Experimental Development, Businesses, Australia,* cat. no. 8104.0, 2013, Business resources devoted to R&D, by level of foreign ownership, URL: http://www.abs.gov.au/; [16] ABS (2015) *Research and Experimental Development, Businesses, Australia,* cat. no. 8104.0, 2013–14, Business expenditure on R&D, summary statistics, URL: http://www.abs.gov.au/; [17] ABS (2015) *Research and Experimental Development, Businesses, Australia,* cat. no. 8104.0, 2013-14, Business resources devoted to R&D, by level of foreign

ownership - summary statistics , URL: http://www.abs.gov.au/; [18] OECD (2015) *Green growth indicators, 2015,* URL: http://www.oecd.org/; [19] Australian Government (2014) *Special data request from Department of Immigration, 2014;* [20] Australian Government (2015) *Special data request from Department of Immigration, 2015,* Outlook for Net Overseas Migration; [21] ABS (2010-2015) *Overseas Arrivals and Departures, Australia,* June 2010–June 2015, Overseas Arrivals and Departures Tables, URL: http://www.abs.gov.au/

Indicator notes (22–26): [22] 1996 data used in place of 1995 data.; [23] 2004 data used in place of 2005 data.; [24] A new method of categorising visas was introduced in May 2014. The new method assigns visas previously categorised as 'Other' to more appropriate categories, resulting in more visas being included in the category "Skilled". As a result, the data has been historically revised, and is not comparable to the data presented in the 2013 Australian Innovation System Report; [25] Churn is calculated as Arrivals + Departures; [26] 2006 data used in place of 2005 data

Table A4(a): Indicators of Australia's business collaboration activity by innovation-active businesses

Australian Trend Data (i)									
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
Percentage of innovation-active total businesses collaborating on innovation, per cent [1 2 9 10 15]	–	–	17.0	16.9	–	23.6	–	20.3	–
Percentage of innovation-active SMEs collaborating on innovation, per cent [2 3 11 15]	–	–	17.0	16.8	–	23.6	–	20.1	19.7
Percentage of innovation-active large firms collaborating on innovation, per cent [1 2 3 12 15]	–	–	22.4	23.2	–	24.4	–	32.3	25.2
Proportion of innovation-active businesses collaborating for any reason, per cent of respondents [4 5 6]	–	–	16.7	22.5	22.2	22.4	21.3	14.0	14.8
Proportion of non-innovation active businesses collaborating for any reason, per cent of respondents [4 5 6]	–	–	6.0	7.6	6.7	7.4	6.8	4.6	3.8
Percentage of innovation-active total businesses with international collaboration on innovation, per cent [2 3 13]	–	–	–	2.4	–	4.0	–	6.1	–
Percentage of innovation-active total businesses collaborating with universities or other research institutions excluding commercial, per cent [2 14 15]	–	–	12.1	9.5	–	9.6	–	12.6	–
Percentage of innovation-active SMEs businesses collaborating with universities or other research institutions excluding commercial, per cent [2 7 11 15]	–	–	12.1	9.5	–	9.6	–	12.6	–
Percentage of innovation-active large businesses collaborating with universities or other research institutions excluding commercial, per cent [2 7 12 15]	–	–	12.7	15.8	–	13.7	–	10.7	–
International collaboration in development of environment-related technologies, per cent collaboration in all technologies [8]	3.9	3.2	3.1	4.5	5.3	8.2	6.1	–	–

Table A4(b): Indicators of Australia's business collaboration activity by innovation-active businesses

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
Percentage of innovation-active SMEs collaborating on innovation, per cent [2 3 11 15]	24.0	31.7	48.0	50	24th of 31
Percentage of innovation-active large firms collaborating on innovation, per cent [1 2 3 12 15]	33.1	55.5	75.4	56	29th of 31
Percentage of innovation-active total businesses with international collaboration on innovation, per cent [2 3 13]	6.1	18.3	31.6	81	24th of 27
Percentage of innovation-active SMEs businesses collaborating with universities or other research institutions excluding commercial, per cent [2 7 11 15]	2.1	14.4	22.6	91	26th of 26
Percentage of innovation-active large businesses collaborating with universities or other research institutions excluding commercial, per cent [2 7 12 15]	3.0	36.6	55.3	95	26th of 26
International collaboration in development of environment-related technologies, per cent collaboration in all technologies [8]	6.1	10.6	18.0	66	31st of 34

Notes: – = data not available, (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field

presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Sources (1–8): [1] ABS (2008–2012) *Innovation in Australian Business,* cat. no. 8158.0, 2006-07 - 2010-11, Innovation-active Businesses and Collaboration, URL: http://www.abs.gov.au/; [2] ABS (2012–2015) *Special request, 12-Oct-2012 - 2015-2*; [3] OECD (2013) S*cience, Technology and Industry Scoreboard, 2013,* DOI: 10.1787/sti_scoreboard-2013-en; [4] ABS (2008) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2005–06, URL: http://www.abs.gov.au/; [5] ABS (2008-2013) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2006–07 - 2011–12, Collaborative arrangements by innovation status, employment size, and industry, URL: http://www.abs.gov.au/; [6] ABS (2014-2015) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2012–13 - 2013–14, Business structure and arrangements, URL: http://www.abs.gov.au/; [7] OECD (2015) *Science, Technology and Industry Scoreboard, 2015,* DOI: 10.1787/20725345; [8] OECD (2015) Green growth indicators, 2015, URL: http://www.oecd.org/\

Indicator notes (9–15): [9] 0+ employees for Australia-only data points; 10+ employees for OECD Comparison; [10] OECD measures this as a percentage of product and/or process innovative firms; [11] 0–199 employees for Australia-only data points; 10–249 employees for OECD Comparison; [12] 200+ employees for Australia-only data points; 250+ employees for OECD Comparison; [13] 10+ employees; [14] 0+ employees; [15] 2006 data used in place of 2005 data

Table A5(a): Indicators of framework conditions in Australia

Australian Trend Data (i)											
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Real Gross Domestic Product (GDP) (chain volume measures), billions A$ [1 24]	890	1,074	1,273	1,394	1,422	1,456	1,509	1,546	1,585	1,620	–
Real Gross Domestic Product (GDP) growth from previous year, per cent [1]	3.9	1.9	3.0	1.8	2.0	2.4	3.6	2.4	2.5	2.3	–
Operating surplus, per cent of GDP[2]	22.7	22.6	24.0	26.1	24.8	25.5	25.3	23.8	24.3	23.5	–
Index of Industrial Production [3]	70.5	79.9	84.4	90.2	93.1	94.1	97.4	100.0	103.4	106.8	–
NAB Index of capacity utilisation [4 25 26 27]	79.9	79.3	82.7	79.2	81.9	81.4	80.6	79.3	78.9	81.3	–
Industry Gross Value Added (chain volume measures), billions A$ [5 28]	810	981	1,163	1,278	1,306	1,336	1,387	1,423	1,460	1,494	–
Unemployment rate (ABS), per cent [6]	8.5	6.9	4.8	5.8	5.2	5.0	5.2	5.7	6.1	6.1	–
Inflation Rate (CPI), per cent [7]	3.1	6.1	4.0	1.4	3.1	3.5	1.2	2.4	3.0	1.5	–
Trade Weighted Index (TWI) [8 29]	58.1	49.7	62.2	64.7	67.3	77.8	76.5	71.4	72.0	63.8	–
NAB Business Confidence Survey, score [9 25 27 30]	14.3	18.9	7.7	5.0	7.0	2.4	-2.4	-0.5	6.8	8.2	–
Barrier to innovation: Lack of access to additional funds, per cent of respondents [10 11 31 34]	–	–	15.9	19.5	18.4	21.1	19.9	20.3	18.4	–	–
—Government regulations or compliance, per cent of respondents [10 11 31 34]	–	–	10.3	11.9	14.5	13.0	13.9	12.7	11.9	–	–
—Adherence to standards, per cent of respondents [10 11 31]	–	–	–	4.1	5.2	4.1	4.3	4.5	3.8	–	–
—Cost of development or introduction/implementation, per cent of respondents [10 11 31]	–	–	11.1	12.5	13.1	15.0	14.4	14.6	14.1	–	–
—Lack of access to knowledge or technology, per cent of respondents [10 11 31]	–	–	3.4	3.0	3.8	3.6	4.2	3.3	3.3	–	–
—Lack of skilled persons in any location, per cent of respondents [10 11 31]	–	–	22.8	19.4	20.4	20.0	17.8	17.2	16.4	–	–
—Lack of skilled persons within the business, per cent of respondents [10 11 31]	–	–	14.3	13.2	13.6	13.1	11.8	12.4	11.7	–	–
—Lack of skilled persons within the labour market, per cent of respondents [10 11 31]	–	–	17.3	12.8	13.2	12.5	11.4	9.9	9.4	–	–
—Uncertain demand for new goods or services, per cent of respondents [10 11 31]	–	–	9.4	13.0	13.4	12.8	15.9	14.7	13.1	–	–
—Any of the listed barriers to innovation, per cent of respondents [10 11 31]	–	–	38.1	43.2	44.6	44.9	45.1	44.1	–	–	–
—None of the barriers listed above, per cent of respondents [10 11 31]	–	–	–	56.8	55.4	55.1	54.9	55.9	–	–	–
Proportion of businesses seeking debt or equity finance for innovation, per cent of respondents [12 13]	–	–	12.7	12.7	11.1	8.2	12.6	14.4	9.8	–	–
Financing through local equity market, score ranges from 1–7 (best) [14 34]	–	–	6.31	5.34	4.60	4.59	4.66	4.72	4.97	4.81	4.98
Ease of access to loans, score ranges from 1–7 (best) [14 34]	–	–	4.83	4.95	4.41	3.92	3.68	3.68	3.51	3.32	3.32
Venture capital availability, score ranges from 1–7 (best) [14 34]	–	–	4.83	4.43	3.97	3.83	3.54	3.34	3.56	3.40	3.13
Venture Capital Investment, million A$ [15 32]	–	–	606	683	401	239	320	262	295	–	–
Venture capital investments, per cent of GDP [16 17]	–	–	–	–	–	–	–	0.021	0.017	0.018	–
Early stage venture capital investment, per cent of GDP [16 17]	–	–	–	–	–	–	–	0.009	0.009	0.007	–
Later Stage Private Equity investment, per cent of GDP [16 17]	–	–	–	–	–	–	–	0.012	0.007	0.011	–
Market capitalisation of listed companies, per cent of GDP [18]	66.6	89.8	116.0	64.0	135.9	127.5	86.3	83.8	–	–	–
Stocks traded, total value, billion, current US$ [18]	99	226	616	1,018	762	1,222	1,246	1,052	–	–	–
Stocks traded, total value, per cent of GDP [18]	26.8	54.5	88.9	96.5	82.2	107.1	89.8	68.5	–	–	–

Australian Trend Data (i) (continued)											
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Stocks traded, turnover ratio, per cent [18]	42.5	56.5	78.0	103.1	78.8	90.1	94.0	84.7	–	–	–
Government procurement of advanced tech products, score ranges from 1–7 (best) [14 34]	–	–	4.0	4.1	4.0	4.1	3.9	3.7	3.6	3.4	3.3
Firm-level technology absorption, score ranges from 1–7 (best) [14 34]	–	–	5.5	5.8	5.9	5.9	5.8	5.9	5.8	5.6	5.6
Entrepreneurial intentions, per cent [19 33]	–	7.8	12.0	–	–	8.7	12.3	–	–	10.0	–
Buyer sophistication, score ranges from 1–7 (best) [14 31]	–	–	5.8	4.8	4.7	4.4	4.2	4.1	3.8	3.7	3.8
Percentage of final household consumption expenditure on Health, Communications and Education, per cent [20]	9.6	10.6	11.8	12.1	12.2	12.3	12.5	12.9	13.1	–	–
Statutory corporate income tax rates, per cent [21 34]	–	–	30	30	30	30	30	30	30	30	30
Start-up procedures to register a business, count [18 31]	–	–	3	3	3	3	3	3	3	3	–
Cost of business start-up procedures, per cent of GNI per capita [18 31]	–	–	1.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7	–
ISO 14001 environmental certificates, per billion PPP$ GDP [22]	–	–	–	–	–	–	–	12.7	15.6	14.0	24.8
Total environment related taxes, per cent of GDP [23]	2.57	2.41	2.20	1.81	1.83	1.77	1.77	2.00	–	–	–

Table A5(b): Indicators of framework conditions in Australia

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (%) (vii)*	*Ranking against OECD+ countries (viii)*
Financing through local equity market, score ranges from 1-7 (best) [14 34]	4.98	4.28	5.43	8	10th of 37
Ease of access to loans, score ranges from 1-7 (best) [14 34]	3.32	3.12	4.27	22	18th of 37
Venture capital availability, score ranges from 1-7 (best) [14 34]	3.13	3.35	4.48	30	24th of 37
Venture capital investments, per cent of GDP [16 17]	0.018	0.048	0.175	90	21st of 29
Early stage venture capital investment, per cent of GDP [16 17]	0.007	0.028	0.097	93	18th of 27
Later Stage Private Equity investment, per cent of GDP [16 17]	0.011	0.022	0.080	86	13rd of 26
Market capitalization of listed companies, per cent of GDP [18]	83.8	62.1	132.7	37	10th of 36
Stocks traded, total value, billion, current US$ [18]	1,052	1,226	6,962	85	10th of 36
Stocks traded, total value, per cent of GDP[18]	68.5	38.6	105.4	35	8th of 36
Stocks traded, turnover ratio, per cent [18]	84.7	62.2	146.3	42	9th of 36
Government procurement of advanced tech products, score ranges from 1-7 (best)[14 34]	3.3	3.6	4.5	27	27th of 37
Firm-level technology absorption, score ranges from 1-7 (best)[14 34]	5.6	5.4	6.1	8	19th of 37
Entrepreneurial intentions, per cent [19 33]	10.0	12.2	25.6	61	16th of 31
Buyer sophistication, score ranges from 1-7 (best)[14 34]	3.8	4.0	4.8	21	24th of 37

OECD+ Comparisons (ii) (continued)

Indicators	Australia's score (iii)	OECD+ Average (iv)	OECD+ top 5 average (vi)	Gap from the top 5 OECD+ performers (%) (vii)	Ranking against OECD+ countries (viii)
Percentage of final household consumption expenditure on Health, Communications and Education, per cent [20]	13.1	8.9	15.9	18	4th of 33
Statutory corporate income tax rates, per cent [21 34]	30	25	34	13	6th of 31
Start-up procedures to register a business, count [18 31]	3	5	2	50	4th of 36
Cost of business start-up procedures, per cent of GNI per capita [18 31]	0.7	4.3	0.3	150	9th of 35
ISO 14001 environmental certificates, per billion PPP$ GDP[22]	24.8	37.7	90.2	72	19th of 36
Total environment related taxes, per cent of GDP[23]	2.00	2.28	3.69	46	24th of 35

Notes: – = data not available, Table notes: (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Source: (1–23): [1] ABS (2014) *Australian System of National Accounts,* cat. no. 5204.0, 2013–14, Expenditure on Gross Domestic Product (GDP) , URL: http://www.abs.gov.au/; [2] ABS (2015) *Australian National Accounts: National Income, Expenditure and Product,* cat. no. 5206.0, June 2015, Income from GDP and Changes in Inventories, Annual ; [3] ABS (2015) *Australian National Accounts: National Income, Expenditure and Product,* cat. no. 5206.0, June 2015, Indexes of Industrial Production, Annual ; [4] National Australia Bank (NAB) (2015) *NAB Index of capacity utilisation, August 2015,* Ref: Thomson Reuters Subscription database; [5] ABS (2015) *Australian National Accounts: National Income, Expenditure and Product,* cat. no. 5206.0, June 2015, Industry Gross Value Added, Chain volume measures, Annual ; [6] ABS (2015) *Labour Force, Australia,* cat. no. 6202.0, July 2015, Labour force status by Sex, Australia - Trend, Seasonally adjusted and Original , URL: http://www.abs.gov.au/; [7] ABS (2014) *Consumer Price Index,* Australia, cat. no. 6401.0, 2014, CPI: All Groups, Index Numbers and Percentage Changes, URL: http://www.abs.gov.au/; [8] RBA (2010–2015) Trade Weighted Index (TWI), December 2009 – July 2015, URL: http://www.rba.gov.au/; [9] National Australia Bank (NAB) (2015) *NAB Business Confidence Survey,* July 2015, Ref: Thomson Reuters Subscription database; [10] ABS (2008–2013) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2005–06 - 2011–12, Barriers to innovation - by innovation status, employment size, and industry, URL: http://www.abs.gov.au/; [11] ABS (2014–2015) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2012–13 - 2013–14, Barriers, URL: http://www.abs.gov.au/; [12] ABS (2008–2013) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2005–06 - 2011–12, Reasons for seeking debt or equity finance, by innovation status, by employment size, by industry, URL: http://www.abs.gov.au/; [13] ABS (2014–2015) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2012–13 - 2013–14, Business Finance, URL: http://www.abs.gov.au/; [14] World Economic Forum (2014–2015) *Global Competitiveness Index,* 2014–15 - 2015–16, URL: http://www.weforum.org/; [15] ABS (2015) *Venture Capital and Later Stage Private Equity, Australia,* cat. No. 5678.0, 2013–14, Ref: www.abs.gov.au/ausstats/abs@.nsf/mf/5678.0; [16] OECD (2013) *Entrepreneurship at a Glance , 2013,* DOI: 10.1787/data-00283-en; [17] OECD (2014–2015) Entrepreneurship at a Glance , 2014–2015, URL: http://www.oecd.org/; [18] World Bank (2015) *World Development Indicators, 2015,* URL: http://data.worldbank.org/; [19] Global Entrepreneurship Research Association (GERA) (2015) *Global Entrepreneurship Monitor (GEM),* 2014, URL: http://www.gemconsortium.org/; [20] OECD (2015) National Accounts, 2015, Annual National Accounts, URL: http://stats.oecd.org/; [21] KPMG (2015) *Corporate tax rates by country, 2015,* URL: http://www.kpmg.com/; [22] Cornell University, INSEAD, WIPO (2012–2015) *Global Innovation Index,* GII 2012 - GII 2015, URL: http://www.globalinnovationindex.org; [23] OECD (2014) *Green growth indicators, 2014,* DOI: 10.1787/data-00686-en

Indicator notes (24–34): [24] Series ID A2420912W; series type original; data type derived; collection month is June; [25] 1996 data used in place of 1995 data.; [26] Index is value taken at end June. June 2014 refers to 2013 year. Data code in Thomson Reuters is AUCAPUTLQ; [27] NULL; [28] Series ID A2304757K; series type original; data type derived; collection month is June; [29] May 1970 = 100; values are for December month; [30] Index is value taken at end June. June 2014 refers to 2013 year. Data code in Thomson Reuters is AUNAB…Q (use monthly records); [31] A lower score is better, gap from the top 5 performers represents absolute gap; [32] Venture capital from the ABS data is defined as: pre-seed; seed; start-up; and early expansion; [33] 2002 data used in place of 2000 data; [34] 2006 data used in place of 2005 data

Table A6(a): Australia's education and skills base

Australian Trend Data (i)										
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Total expenditure on educational institutions, per cent of GDP [1 2]	5.05	5.23	5.29	5.34	5.95	6.11	5.85	–	–	–
Public expenditure on education, per cent of GDP [1 3]	4.81	4.58	4.54	4.34	4.94	5.13	4.84	–	–	–
Expenditure on tertiary education institutions, per cent of GDP [1 2]	1.57	1.45	1.46	1.49	1.60	1.62	1.60	–	–	–
Public expenditure on tertiary education, per cent of GDP [1 3]	–	1.16	1.14	0.97	1.10	1.15	1.12	–	–	–
Expenditure on primary, secondary and post-secondary (non-tertiary educational) institutions, per cent of GDP [1 2]	3.40	3.64	3.72	3.72	4.19	4.33	4.10	–	–	–
Percentage of 25–34 year olds with bachelor degree or higher, per cent [1 4 5 6]	14.3	22.2	29.2	35.8	34.6	34.2	35.0	36.7	35.2	37.2
Proportion of population aged 25–64 attaining tertiary education, per cent [6]	–	27.5	31.7	36.2	36.9	37.6	38.3	41.3	39.5	–
Proportion of population aged 25–34 with tertiary education, per cent [6]	–	31.4	38.1	42.0	44.8	44.4	44.6	47.2	45.7	–
Proportion of population aged 25–64 attaining upper secondary or post-secondary non-tertiary education, per cent [6]	–	31.3	33.3	33.8	34.1	35.6	35.7	35.2	36.2	–
Proportion of population aged 25–64 attaining below upper secondary school education, per cent [6 21]	–	41.2	35.0	30.1	29.0	26.8	25.9	23.6	24.3	–
Share of international tertiary education market, per cent [1 7]	–	5.1	6.5	6.9	7.0	6.6	6.1	5.5	–	–
Percentage of adults scoring at proficiency level 3 or above in literacy, per cent [8]	–	–	–	–	–	–	–	–	56.4	–
Percentage of adults scoring at proficiency level 3 or above in numeracy, per cent [8]	–	–	–	–	–	–	–	–	45.9	–
Percentage of adults scoring at proficiency level 2 or above in problem solving in technology-rich environments, per cent [8]	–	–	–	–	–	–	–	–	38.0	–
VET system expenditure (total expenditure per adjusted full year equivalent (FYTEs)), A$ 2014 prices [9 22]	–	–	13,498	12,681	11,907	12,121	11,175	10,656	–	–
Participation rate of Australians aged 15 years and older in VET, per cent [10 11]	–	–	11.4	11.3	11.3	11.6	12.1	12.4	11.8	11.2
Number of qualifications completed by students in VET, '000s [10 12]	–	–	296	352	394	441	519	583	562	–
Number of qualification equivalents completed by students in VET (Management and commerce), '000s [9 13]	–	–	127	159	157	172	200	215	183	190
Businesses reporting some or a lot of difficulty in recruiting staff, per cent of all employers [14]	–	–	40.6	–	33.7	–	34.1	–	36.4	–
Employers who use new product releases to determine training needs, per cent of all employers [14]	–	–	7.1	–	3.0	–	3.5	–	–	–
Barrier to innovation: Lack of skilled persons in any location, per cent of respondents [15 16 21]	–	–	22.8	19.4	20.4	20.0	17.8	17.2	16.4	–
Proportion of graduates employed in labour force after completing VET, per cent [17]	–	–	81	82	80	78	79	78	78	78
VET graduates satisfied with overall quality of training [17]	–	–	87	88	89	88	89	89	87	88
Labour force participation rate [18]	63.5	63.4	64.8	65.4	65.2	65.4	65.1	65.0	64.7	64.9
Percentage of employers recruiting international students, per cent [19]	–	–	15.7	35.3	20.5	19.0	30.8	23.2	–	–
Employer difficulty sourcing/recruiting graduates, per cent [19]	–	–	49.3	53.5	30.7	36.3	42.1	34.3	–	–
Employer overall satisfaction with VET system, per cent [20]	–	–	70.7	–	77.8	–	77.8	–	73.1	–

Table A6(b): Australia's education and skills base

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
Total expenditure on educational institutions, per cent of GDP [1 2]	5.85	6.07	7.63	23	19th of 32
Public expenditure on education, per cent of GDP [1 3]	4.84	5.58	7.83	38	24th of 32
Expenditure on tertiary education institutions, per cent of GDP [1 2]	1.60	1.59	2.50	36	12th of 32
Public expenditure on tertiary education, per cent of GDP [1 3]	1.12	1.36	2.21	49	22nd of 31
Expenditure on primary, secondary and post-secondary (non-tertiary educational) institutions, per cent of GDP [1 2]	4.10	3.81	4.91	17	10th of 33
Percentage of 25–34 year olds with bachelor degree or higher, per cent [1 4 5 6]	35.2	31.9	42.3	17	11th of 33
Proportion of population aged 25–64 attaining tertiary education, per cent [6]	39.5	33.3	47.0	16	11th of 33
Proportion of population aged 25–34 with tertiary education, per cent [6]	45.7	40.5	56.5	19	8th of 33
Proportion of population aged 25–64 attaining upper secondary or post-secondary non-tertiary education, per cent [6]	36.2	44.0	66.2	45	27th of 33
Proportion of population aged 25–64 attaining below upper secondary school education, per cent [6 21]	24.3	23.5	9.0	170	22nd of 32
Share of international tertiary education market, per cent [1 7]	5.5	2.2	9.4	41	5th of 34
Percentage of adults scoring at proficiency level 3 or above in literacy, per cent [8]	56.4	50.0	61.5	8	5th of 22
Percentage of adults scoring at proficiency level 3 or above in numeracy, per cent [8]	45.9	46.8	57.6	20	13rd of 22
Percentage of adults scoring at proficiency level 2 or above in problem solving in technology-rich environments, per cent [8]	38.0	29.4	41.3	8	6th of 22

Table notes: – = data not available, (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available.

Sources (1–20): [1] OECD (2003–2013) *Education at a Glance, 2003–2013,* DOI: 10.1787/19991487; [2] OECD (2014) *Education at a Glance, 2014, Indicator B2: What proportion of national wealth is spent on education,* URL: http://www.oecd.org/; [3] OECD (2014) *Education at a Glance, 2014, Indicator B4: What is the total public spending on education?,* URL: http://www.oecd.org/; [4] ABS (2005–2008) *Education and Work, Australia,* cat. no. 6227.0, 2005–2008, Persons aged 15–64 years, Level of highest non-school qualification and age, URL: http://www.abs.gov.au/; [5] ABS (2014) *Education and Work, Australia,* cat. no. 6227.0, 2014, Education and Work, URL: http://www.abs.gov.au/; [6] OECD (2014–2015) *Education at a Glance, 2014–2015* Interim report, Indicator A1: To what level have adults studied?, URL: http://www.oecd.org/; [7] OECD (2014) *Education at a Glance, 2014,* Indicator C4: Who studies abroad and where?, URL: http://www.oecd.org/; [8] OECD (2013) *Skills Outlook (PIAAC)*, 2013, URL: http://skills.oecd.org/; [9] NCVER (2015) Special data request from NCVER, 2015; [10] *NCVER (2009–2014) Students and Courses, 2009–2013,* URL: http://www.ncver.edu.au/; [11] NCVER (2015) *Students and Courses, 2014, Government-funded students and courses,* URL: http://www.ncver.edu.au/; [12] NCVER (2015) *Students and Courses, 2014, Australian vocational education and training statistics: Government-funded students and courses,* URL: http://www.ncver.edu.au/; [13] NCVER (2014) Special data request from NCVER, 9-Sep-14, Table 1; [14] NCVER (2011–2013) *Employer's Use and Views of the VET System, 2011–2013,* URL: http://www.ncver.edu.au/; [15] ABS (2008–2013) *Selected Characteristics of Australian Business,*

cat. no. 8167.0, 2005–06 - *2011–12, Barriers to innovation - by innovation status, employment size, and industry,* URL: http://www.abs.gov.au/; [16] ABS (2014–2015) *Selected Characteristics of Australian Business,* cat. no. 8167.0, 2012–13 - 2013–14, Barriers, URL: http://www.abs.gov.au/; [17] NCVER (2014) *Student Outcomes, 2014,* Table 1, URL: http://www.ncver.edu.au/; [18] ABS (2015) *Labour Force, Australia,* cat. no. 6202.0, July 2015, Labour force status by Sex, Australia - Trend, Seasonally adjusted and Original, URL: http://www.abs.gov.au/; [19] Graduate Careers Australia (2014) Graduate Outlook Survey, 2013, URL: http://www.graduatecareers.com.au/; [20] NCVER (2014) Special data request from NCVER, 9-Sep-14, Table 2

Indicator notes (21–22): [21] A lower score is better, gap from the top 5 performers represents absolute gap; [22] 2006 data used in place of 2005 data

Table A7(a): Australia's investment in research

Australian Trend Data (i)										
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Gross Expenditure on R&D (GERD), per cent of GDP [1 3 9 10]	1.58	1.48	1.73	2.25	–	2.20	2.13	–	2.12	–
Gross Expenditure on R&D (GERD), billion A$ [2 3 5 9 10]	8.8	10.4	16.0	28.3	–	30.9	31.7	–	33.5	–
Gross Expenditure on R&D (GERD) per capita population, current PPP $ [1 9 10]	366	416	583	893	–	928	932	–	–	–
Business expenditure on R&D (BERD), billion A$ [3 4]	4.4	5.0	10.4	17.3	16.8	18.0	18.3	–	18.8	–
Higher education expenditure on R&D (HERD), per cent of GDP [1 10]	0.39	0.40	0.47	0.54	–	0.58	0.60	0.63	–	–
Higher education expenditure on R&D (HERD), billion A$ [5 9 10]	2.3	2.8	4.3	6.8	–	8.2	–	9.6	–	–
Higher education expenditure on R&D (HERD) financed abroad, per cent [1 10]	1.1	2.2	3.0	2.0	–	2.2	–	2.4	–	–
Percentage of Higher education expenditure on R&D (HERD) financed by industry, per cent [1 9 10]	4.66	5.32	6.20	5.85	–	4.91	–	4.73	–	–
Government expenditure on R&D (GOVERD), per cent of GDP [1 9 10]	0.37	0.33	0.27	0.27	–	0.27	0.24	0.25	–	–
Government expenditure on R&D (GOVERD), billion A$ [6 9 10]	2.06	2.36	2.49	3.42	–	–	3.55	3.73	–	–
Percentage of Government expenditure on R&D (GOVERD) financed by industry, per cent [1 9 10]	12.0	12.3	13.6	9.9	–	–	7.1	7.7	–	–
Public spending in environment-related R&D, per cent total public spending on R&D [7]	1.19	2.95	3.18	3.57	5.47	5.01	4.86	–	–	–
Percentage of Gross Expenditure on R&D (GERD) performed by the Private Non-Profit sector, per cent [1 9 10]	2.11	2.77	3.00	2.63	–	2.96	2.98	–	–	–
Private non-profit R&D, million A$ [8 9 10]	186	289	479	744	–	–	944	961	–	–
Government Budget Appropriations or Outlays for R&D (GBAORD), per cent of GDP [1]	0.57	0.53	0.52	0.46	0.51	0.50	0.48	0.46	0.43	0.41
Government-financed Gross Expenditure on R&D (GERD), per cent of GDP [1 9 10]	0.72	0.67	0.70	0.78	–	–	–	–	–	–

Table A7(b): Australia's investment in research

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
Gross Expenditure on R&D (GERD), per cent of GDP [1 3 9 10]	2.12	2.02	3.69	43	14th of 34
Gross Expenditure on R&D (GERD) per capita population, current PPP $ [1 9 10]	932	770	1,430	35	15th of 36
Higher education expenditure on R&D (HERD), per cent of GDP [1 10]	0.63	0.48	0.83	24	8th of 34
Percentage of Higher education expenditure on R&D (HERD) financed by industry, per cent [1 10]	4.73	6.87	16.80	72	16th of 30
Government expenditure on R&D (GOVERD), per cent of GDP [1 9 10]	0.24	0.22	0.39	37	14th of 34
Percentage of Government expenditure on R&D (GOVERD) financed by industry, per cent [1 9 10]	7.7	5.6	12.8	40	10th of 30
Public spending in environment-related R&D, per cent total public spending on R&D [7]	4.86	2.41	4.50	no gap	2nd of 28

OECD+ Comparisons (ii) (continued)

Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
Percentage of Gross Expenditure on R&D (GERD) performed by the Private Non-Profit sector, per cent [1 9 10]	2.98	2.59	9.80	70	5th of 26
Government Budget Appropriations or Outlays for R&D (GBAORD), per cent of GDP [1]	0.41	0.70	0.96	57	21st of 23
Government-financed Gross Expenditure on R&D (GERD), per cent of GDP [1 9 10]	0.78	0.57	0.87	11	7th of 31

Table notes: – = data not available ,(i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Source: *(1–8):* [1] OECD (2015) *Main Science and Technology Indicators, 2015–1*, URL: http://stats.oecd.org/; [2] ABS (2010) *Research and Experimental Development,* All Sector Summary, Australia, cat. no. 8112.0, 2010, Gross resources devoted to R&D, summary statistics, URL: http://www.abs.gov.au/; [3] ABS (2013) *Research and Experimental Development*, Businesses, Australia, cat. no. 8104.0, 2013, Business expenditure of R&D, summary statistics, URL: http://www.abs.gov.au/; [4] ABS (2015) *Research and Experimental Development*, Businesses, Australia, cat. no. 8104.0, 2013–14, Business expenditure on R&D, summary statistics, URL: http://www.abs.gov.au/; [5] ABS (2014) *Research and Experimental Development,* Higher Education Organisations, Australia, cat. no. 8111.0, 2012, Higher education resources devoted to R&D, summary statistics, URL: http://www.abs.gov.au/; [6] ABS (2014) *Research and Experimental Development*, Government and Private Non-Profit Organisations, Australia, cat. no. 8109.0, 2012–13, Government expenditure on R&D, summary statistics, URL: http://www.abs.gov.au/; [7] OECD (2014) *Green growth indicators*, 2014, DOI: 10.1787/data-00686-en; [8] ABS (2014) *Research and Experimental Development*, Government and Private Non-Profit Organisations, Australia, cat. no. 8109.0, 2012–13, Private non-profit expenditure on R&D, summary statistics, URL: http://www.abs.gov.au/

Indicator notes (9–10): [9] 1996 data used in place of 1995 data.; [10] 2004 data used in place of 2005 data.

Table A8(a): Indicators of Australia's research workforce

Australian Trend Data (i)											
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Share of professionals and technicians in total employment, per cent [1 2 3 4 14]	–	–	37.6	35.8	–	36.1	–	31.8	–	–	–
Number of students completing higher degree by research in Australia [5 6]	–	5,434	6,820	7,178	7,092	7,403	7,961	8,230	9,209	9,579	–
Number of domestic students completing higher degree by research in Australia [5 6]	–	4,557	5,510	5,556	5,382	5,460	5,647	5,601	6,165	6,238	–
Number of international students completing higher degree by research in Australia [5 6]	–	877	1,310	1,622	1,710	1,943	2,314	2,629	3,044	3,341	–
PhD graduation rate, per cent [7 8]	–	1.29	1.70	1.89	1.85	1.89	2.03	–	–	–	–
Proportion of international students enrolled in advanced research programs, per cent [7 5]	–	–	17.8	23.3	26.3	28.7	30.7	32.5	–	–	–
Researchers, per cent of total labour force [10 12 13]	0.67	0.69	0.80	0.82	–	–	–	–	–	–	–
R&D personnel, per cent of total employment [10 12 13]	1.09	1.06	1.19	1.27	–	–	–	–	–	–	–
GCI: Availability of research and training services, score ranges from 1–7 (best) [11 14]	–	–	5.31	5.27	5.28	5.26	5.39	5.32	5.07	5.21	5.65

Table A8(b): Indicators of Australia's research workforce

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
Share of professionals and technicians in total employment, per cent [1 2 3 4 14]	31.8	33.7	44.6	29	21st of 31
PhD graduation rate, per cent [7 8]	2.03	1.60	2.71	25	9th of 34
Proportion of international students enrolled in advanced research programs, per cent [7 5]	32.5	20.5	51.5	37	8th of 32
Researchers, per cent of total labour force [10 12 13]	0.82	0.71	1.20	31	11th of 34
R&D personnel, per cent of total employment [10 12 13]	1.27	1.15	1.90	33	15th of 32
GCI: Availability of research and training services, score ranges from 1–7 (best)[11 14]	5.65	5.15	6.13	8	10th of 37

Notes: – = data not available, : (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Source: (1–11): [1] OECD (2007) *Science, Technology and Industry Scoreboard, 2007*, DOI: 10.1787/sti_scoreboard-2007-en; [2] OECD (2009) *Science, Technology and Industry Scoreboard, 2009,* DOI: 10.1787/sti_scoreboard-2009-en; [3] OECD (2011) *Science, Technology and Industry Scoreboard, 2011,* DOI: 10.1787/sti_scoreboard-2011-en; [4] OECD (2013) *Science, Technology and Industry Scoreboard, 2013,* DOI: 10.1787/sti_scoreboard-2013-en; [5] Australian Government (2014) *Special data request from Department of Education, 2014;* [6] Australian Government (2015) *Higher Education Research Data Collection (HERDC),* 2014–1, Award Course Completions, URL: http://education.gov.au/; [7] OECD (2007–2013) *Education at a Glance, 2007–2013*, DOI: 10.1787/19991487; [8] OECD (2014) *Education at a Glance, 2014*, Indicator A3: How many students are expected to complete tertiary education?, URL: http://www.oecd.org/; [9] OECD (2014) *Education at a Glance, 2014*, Indicator C4: Who studies abroad and where?, URL: http://www.oecd.

org/; [10] OECD (2015) *Main Science and Technology Indicators, 2015–1,* URL: http://stats.oecd.org/; [11] World Economic Forum (2014–2015) *Global Competitiveness Index, 2014–15 - 2015–16,* URL: http://www.weforum.org/

Indicator notes (12–14): [12] 1996 data used in place of 1995 data.; [13] 2004 data used in place of 2005 data. [14] 2006 data used in place of 2005 data.

Table A9(a): Quality measures of Australia's research publications

Australian Trend Data (i)										
Indicators	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Share of world publications, per cent [1 2]	2.45	2.76	2.89	3.09	3.19	3.29	3.38	3.48	3.60	3.71
Number of fields with higher than world average citation rate by field (out of 22)[1]	11	15	19	21	21	21	21	21	21	21
Relative citation impact [1 2 3]	1.04	1.07	1.13	1.18	1.19	1.22	1.25	1.28	1.30	1.33
Share of world's top 1 per cent highly cited publications, all disciplines [1]	2.5	3.1	3.4	4.4	4.9	5.3	5.7	6.1	6.5	6.9
Share of world's top 1 per cent highly cited publications, Natural Sciences and Engineering [1]	2.30	3.02	3.24	4.35	4.66	4.96	5.34	5.85	6.28	6.62
Share of world's top 1 per cent highly cited publications, Social Sciences and Humanities [1 4]	2.37	2.76	2.94	4.07	4.54	4.95	5.31	5.98	6.76	7.61
Share of world's top 1 per cent highly cited publications attributed to international collaboration, All disciplines [1]	1.01	1.68	2.21	2.91	3.33	3.66	4.01	4.47	4.90	5.36
Share of world's top 1 per cent highly cited publications attributed to international collaboration, Natural Sciences and Engineering [1]	1.07	1.80	2.25	3.18	3.44	3.74	4.12	4.62	5.01	5.35
Share of world's top 1 per cent highly cited publications attributed to international collaboration, Social Science and Humanities [1]	0.82	1.17	1.49	2.12	2.40	2.66	3.00	3.37	3.93	4.55
Top 1 per cent publications per Bn PPP GERD Offset [1]	119.1	131.9	123.9	141.1	150.3	150.2	149.3	–	–	–
Top 1 per cent publications per Bn PPP GERD (excluding BERD) [1 4]	224.3	261.8	253.9	309.2	342.1	359.9	374.2	–	–	–
Proportion of publications in top 1 per cent [1]	1.0	1.1	1.2	1.4	1.5	1.6	1.6	1.7	1.7	1.8
Proportion of publications in top 10 per cent [1]	10.5	11.1	11.6	12.9	13.4	13.5	14.0	14.1	14.1	14.2

Table A9(b): Quality measures of Australia's research publications

OECD+ Comparisons (ii)					
Indicators	*Australia's score (iii)*	*OECD+ Average (iv)*	*OECD+ top 5 average (vi)*	*Gap from the top 5 OECD+ performers (per cent) (vii)*	*Ranking against OECD+ countries (viii)*
Share of world publications, per cent [1 2]	3.71	3.02	12.45	70	10th of 37
Relative citation impact[1 2 3]	1.33	1.21	1.60	17	14th of 37
Share of world's top 1 per cent highly cited publications, all disciplines [1]	6.9	4.8	20.1	65	7th of 37
Share of world's top 1 per cent highly cited publications, Natural Sciences and Engineering[1]	6.62	4.93	20.85	68	8th of 37
Share of world's top 1 per cent highly cited publications, Social Sciences and Humanities [1]	7.61	3.91	19.33	61	5th of 37
Share of world's top 1 per cent highly cited publications attributed to international collaboration, All disciplines [1]	5.36	3.22	11.62	54	7th of 37
Share of world's top 1 per cent highly cited publications attributed to international collaboration, Natural Sciences and Engineering [1]	5.35	3.38	12.20	56	9th of 37
Share of world's top 1 per cent highly cited publications attributed to international collaboration, Social Science and Humanities [1]	4.55	1.95	7.78	42	5th of 37

OECD+ Comparisons (ii) (continued)

Indicators	Australia's score (iii)	OECD+ Average (iv)	OECD+ top 5 average (vi)	Gap from the top 5 OECD+ performers (per cent) (vii)	Ranking against OECD+ countries (viii)
Top 1 per cent publications per Bn PPP GERD Offset [1]	149.3	127.4	255.3	42	13rd of 37
Top 1 per cent publications per Bn PPP GERD (excluding BERD) [1 4]	374.2	323.5	642.2	42	12th of 37
Proportion of publications in top 1 per cent [1]	1.8	1.6	2.7	34	14th of 37
Proportion of publications in top 10 per cent [1]	14.2	12.6	17.5	18	16th of 37

Notes: – = data not available, (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Source: [1] InCites (2015) *InCites, 2015*, Ref: Thomson Reuters subscription database

Indicator notes: (2–4): [2] Data cover a five year period e.g. 2013 data covers 2009–2013 inclusive; [3] A value of 1.33 indicates Australian publications received, on average, a citation rate 33 per cent higher than the world average for publications in their discipline and year; [4] Data covers a three year period e.g. 2013 data covers 2011–2013 inclusive. Per cent of world top publications produced by Australian authors. Top publications means papers (articles and reviews) that rank in the top 1 per cent by citations for field and year

Table A10: Research Commercialisation Outcomes

Australian Trend Data (i)									
Indicators	*2000*	*2005*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Number of formal agreements on academic/research collaboration between Australian universities and overseas institutions [1 4 6]	–	3,054	3,419	3,886	–	–	5,086	–	5,559
Adjusted gross income from Licenses, Options and Assignments by publicly funded research agencies and universities, million A$ [2 5]	150	80	104	327	157	106	345	120	–
Number of LOAs yielding income from publicly funded research agencies and universities [2]	489	652	632	695	798	777	759	947	–
Number of Australian patent and plant breeder rights issued worldwide [2]	524	545	849	841	1,020	915	789	1,019	–
Value of equity holdings by publicly funded research agencies and universities, million A$ [2]	184	210	203	252	157	141	91	134	–
Number of start-up companies in which publicly funded research agencies and universities have an equity holding [2]	69	174	187	189	176	174	125	182	–
University income from Cooperative Research Centre (CRC) Research (million A$) [3]	81	130	124	123	119	108	117	104	–
University income from industry (million A$) [3]	331	492	773	666	797	832	830	925	–

Notes: – = data not available, (i) Data are presented in calendar year format. Where the data are in financial years, it is expressed in terms of the year where the financial year begins e.g. 2010–11 is shown as 2010. (ii) OECD+ includes all countries in the OECD, as well as China, Taiwan and Singapore (where data is available). (iii) The 'Australia's score' field presents the Australian values used in the OECD+ comparisons. (iv) This is the arithmetic (simple) average of the OECD+ country scores. (v) This is the median of the OECD+ country scores (vi) This is the arithmetic (simple) average of the top five OECD+ countries in a ranked list. (vii) This represents Australia's distance from the frontier as defined by the average of the top five ranked OECD+ countries. It is calculated as 100*(Top five average - Australia's score)/ Top 5 average. Where the solution is a negative value or zero, 'no gap' is shown in the cell. (viii) OECD+ rankings are performed on those OECD+ countries for which data are available. Individual data availability may vary between indicators.

Source: (1–3): [1] Universities Australia (2014) *International Links of Australian Universities, October 2014,* Type of Agreement, URL: https://www.universitiesaustralia.edu.au/; [2] Australian Government (2015) *National Survey of Research Commercialisation (NSRC)*, 2012–13, URL: http://www.innovation.gov.au/; [3] Australian Government (2013–2014) *Higher Education Research Data Collection (HERDC)*, 2012–2013, URL: http://education.gov.au/

Indicator notes (4–6): [4] 2003 data used in place of 2005 data.; [5] Constant 2013 prices; [6] 2007 data used in place of 2008 data.