



Australian Government
Department of Industry,
Innovation and Science

Secretary

Mr John Carter
Inquiry Secretary
Joint Select Committee on Trade and Investment Growth
Parliament House
CANBERRA ACT 2600

Dear Mr Carter

Thank you for the invitation to provide a submission to the Joint Select Committee on Trade and Investment Growth concerning the inquiry into Australia's Future in Research and Innovation.

As you are aware the Government's National Innovation and Science Agenda (NISA) released in December 2015 is a whole of the government initiative that responds to areas where Australia's innovation system needs to improve. The NISA website at www.innovation.gov.au provides further details about agenda.

I am glad to attach our submission. For the benefit of the Committee the submission includes key data about how the research and innovation sector can assist in overcoming Australia's geographic, economic and labour challenges noted in your letter. The submission focuses on evidence about Australia's innovation performance. Further information can be obtained from the Department's Australian Innovation System Report annual series at www.industry.gov.au/innovationreport

I hope this submission will be a useful input to the Committee's considerations.

Yours sincerely

Glenys Beauchamp

15 February 2016



Australian Government
**Department of Industry,
Innovation and Science**

Submission to the Joint Select Committee on Trade and Investment Growth - Parliamentary Inquiry into Research and Innovation

Department of Industry Innovation and Science

February 2016

www.industry.gov.au

1. Introduction

Innovation and research are critical for Australia to deliver new sources of growth, maintain high-wage jobs and seize the next wave of economic prosperity. Innovation is a tool for creating and capturing value for a business and its customers, translating into increased productivity and profitability. This gives businesses a competitive advantage in the market that, when aggregated, drives sectoral and national competitiveness, and the productive re-allocation of resources throughout the economy.

Innovation is also about creating a culture that backs good ideas and learns from taking risks and making mistakes. Innovation is important to new and existing businesses in every sector of the economy – from ICT to healthcare, education to agriculture, and defence to transport. Innovation keeps us competitive. It keeps us at the cutting edge.

Innovation activities are best optimised in the context of an innovation system. At its most basic level, an innovation system is an open network of organisations to produce and use new knowledge and technology to create economic and social value. It is about the way these organisations interact to generate and exploit knowledge and ideas. Innovation activities, networks and framework conditions collectively function to produce and diffuse innovations throughout the economy and society. Innovation is highly contextual, evolving out of varying mixes of activities. A systems approach to innovation recognises the important role of organisations other than businesses, such as the education and training system which creates the skill base of the economy, and the research sector which generate and exploit knowledge. Links between research organisations and businesses are crucial in order to diffuse knowledge and commercialise research. Research collaboration is also fundamental to scientific excellence and technological breakthroughs.

An implicit characteristic of a high-performing innovation system is that the actors within it are interconnected and able to effectively collaborate, thereby maximising the sharing of resources and ideas. For example, private and public sector investment in R&D in Australia can complement each other in targeting different socioeconomic objectives, with most private R&D investment going to applied research and experimental development, and most government support to basic research.¹ Industry-research collaborations can also lead to great payoffs, although such collaborations need to be long-term relationships and involve a significant investment of resources by both parties.

This submission draws primarily from the Department's Australian Innovation System Report annual series, which are available at www.industry.gov.au/innovationreport.

The National Innovation and Science Agenda (NISA) released in December 2015 highlights the areas where Australia's innovation system needs to improve. Further details are available at <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report>

¹ For more detail see Australian Innovation System Report 2013, Chapter 2: Business innovation and collaboration, section on Collaborative innovation <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Policy/AustralianInnovationSystemReport/AISR2013/chapter-2-business-innovation-and-collaboration/collaborative-innovation/index.html>

2. Public policy plays a decisive role in innovation-led inclusive and sustainable growth

The role of government in engaging with the historical challenges of Australia's geographic isolation and small domestic market can be seen right through its history. 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, and the iconic nation-building symbols of post-World War II reconstruction like the Snowy Hydro Scheme, mass migration from Europe to build future industries, and the establishment of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to tackle 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. The role of government is not about prescribing specific technologies, but about providing directions of change which firms can then experiment around. The more demanding the innovation challenges, the greater becomes the importance of effective public policy.²

In its National Innovation and Science Agenda, the Australian Government has committed to support smart ideas that gave potential to be commercialised and create jobs and drive economic growth. NISA thus provides a comprehensive set of incentives, programmes and measures that put Australia in the path to a more entrepreneurial and innovative economy. NISA has also committed the Australian Government to changing the way it delivers services to the Australian people by trialling good ideas, sharing information, looking for innovative suppliers and changing policies when they no longer work. More details on NISA initiatives dealing with collaboration can be found at <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report>

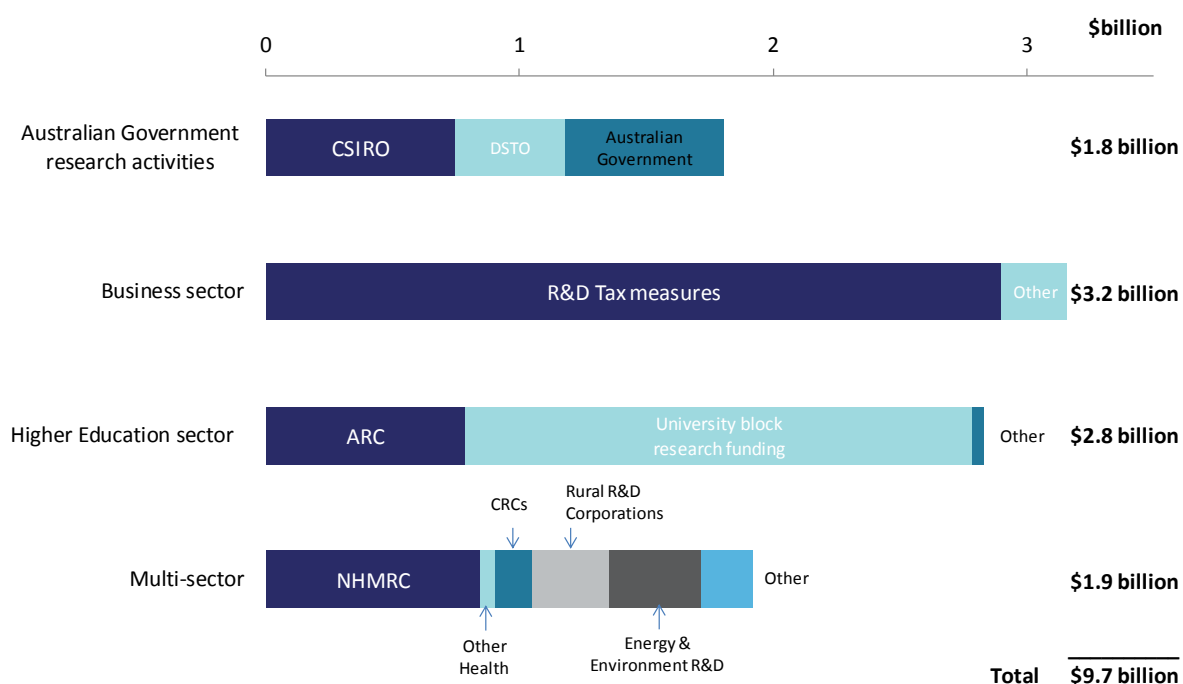
The Australian Government's contribution to innovation and science

The Australian Government makes a sizable contribution to innovation and science. Government supports innovation by investing in enablers such as education, science and research, and infrastructure; incentivising business investment through a number of measures such as the R&D Tax incentive and programmes like the Entrepreneurs Programme; and removing regulatory obstacles such as restrictions around employee share ownership or access to crowd-sourced equity funding. The Government also facilitates networks and relationships, e.g. international collaborations.

The Government is investing around \$9.7 billion in science, research and innovation in 2015-16, with around \$3.2 billion directly supporting business sector R&D and much of the rest funding research in universities and research agencies such as the CSIRO and the Defence Science and Technology Organisation (DSTO). (Figure 1) Government also enables innovation by investing in traditional infrastructure such as research laboratories, roads and rail and digital infrastructure such as the National Broadband Network (NBN).

² For more detail see Australian Innovation System Report 2015, Feature article: The entrepreneurial state (pp. 15-21) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2015.pdf>

Figure 1: Australian Government's expenditure on science, research and innovation, 2015-16



Source: Science, Research and Innovation Budget tables 2015-16

The Government also has a key role to play in setting a vision for the future of the nation by putting in place the policies that further boost innovation and research. The National Innovation and Science Agenda (NISA) <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report> is an important step on the path to a more innovative economy. It documents Government's commitment to making innovation central to all its major policies in the future. It builds on key measures already in place, such as Industry Growth Centres, Employee Share Schemes, Entrepreneurs' Programme, and international free trade agreements to further nurture a healthy national innovation system.

3. The benefits and opportunities of innovation and research

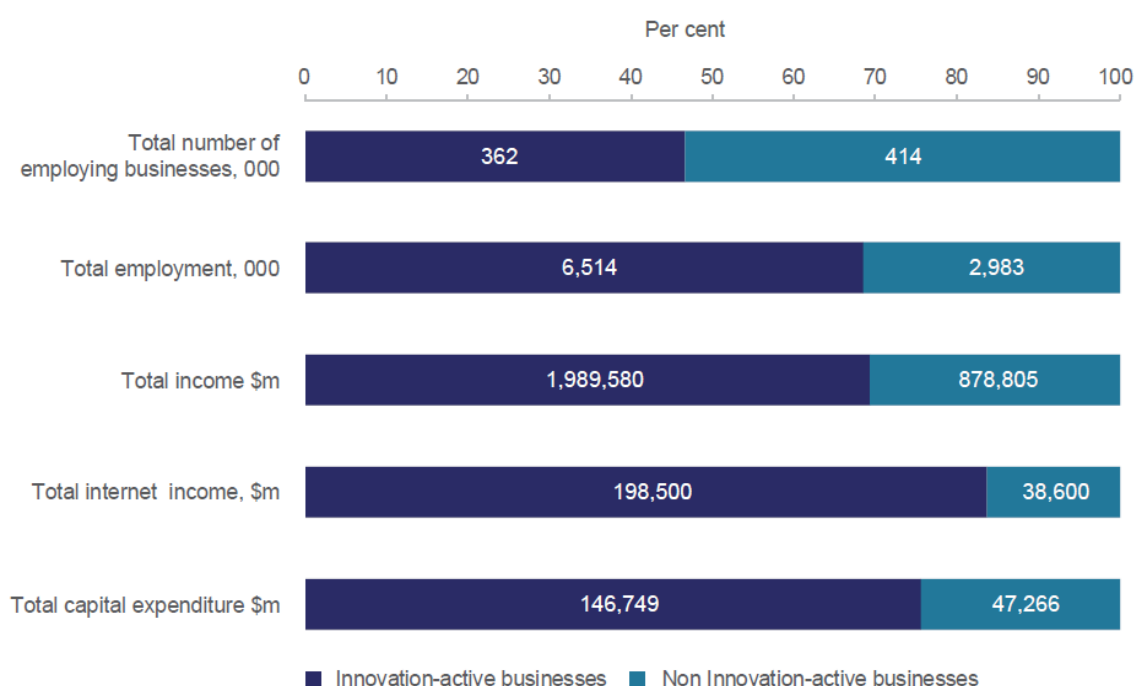
Innovation creates jobs

Innovation is strongly correlated with business performance. It is also about creating jobs. Despite representing less than half of all employing businesses in the economy in 2011–12, innovative businesses accounted for around 70 per cent of total employment, total capital expenditure and total business income, and more than 80 per cent of total income.³ (Figure 2) These findings reinforce other studies that show that innovative sectors disproportionately drive job creation and income growth.

³ For more detail see Australian Innovation System Report 2014, Chapter 2: Section 2.1 (p. 37) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

It is estimated that, over the period 2006 to 2011, 1.04 million full time equivalent jobs were added to the Australian economy. When this 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. Australian start-ups consistently added to employment in the economy even through the global financial crisis.⁴ (Figure 3)

Figure 2: Total estimated number of employing businesses that are innovation-active and their contribution to employment, income and capital investment, 2011–12



Source: ABS (2014) Customised report based on the Business Characteristics Survey data commissioned by the Australian Government Department of Industry and ABS (2014) Selected characteristics of Australian business, 2011–12, cat. no. 8167.0

Notes: Estimates of the number of businesses operating in Australia can be derived from a number of sources within the Australian Bureau of Statistics. Variations will occur because of differing data sources, differing scope and coverage definitions between surveys, as well as variations due to sampling and non-sampling error.

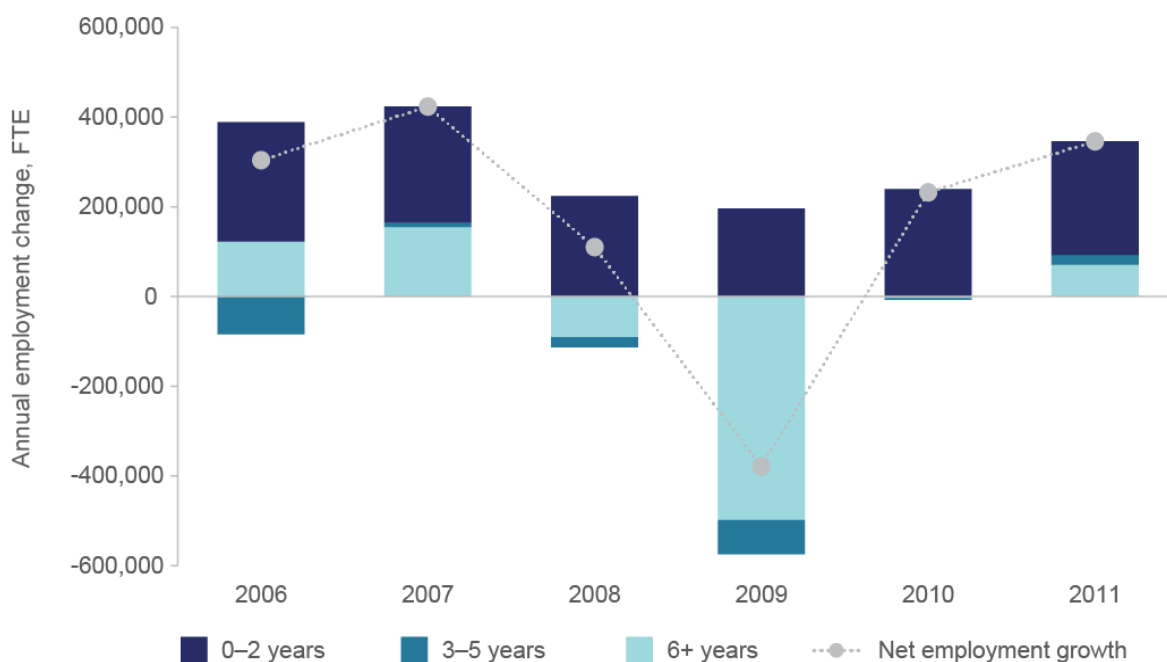
Innovative knowledge-based start-ups offer high skilled employment opportunities. This assists both to retain talent in Australia and to attract high skilled employees from overseas where the skills are not available locally. Productivity and competitiveness are key drivers of innovation. Through the NISA the Australian Government is addressing barriers to innovation. The NISA contains a broad range of initiatives aimed at spurring innovation and entrepreneurship. These measures are grouped around four pillars: Culture and Capital; Collaboration; Talent and Skills and Government as an Exemplar. <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report>

While innovation can disrupt competitive markets, it also has the potential to nurture business dynamism and economic growth. The role of the entrepreneur is central to this process. Productivity

⁴ For more detail see Australian Innovation System Report 2015, Chapter 3: section: 3.2 (pp. 48-49) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2015.pdf>

differences between firms have a large impact on their survival and growth. Both productivity and profitability are closely linked to business dynamism. 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 and growth through the capture of new market share.⁵

Figure 3: Net employment growth by firm age, 2006–2011



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

Notes: Employment is measured in Full Time Equivalents. Results are for all non-government sectors and exclude non-employed firms. 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.

Innovation drives businesses performance

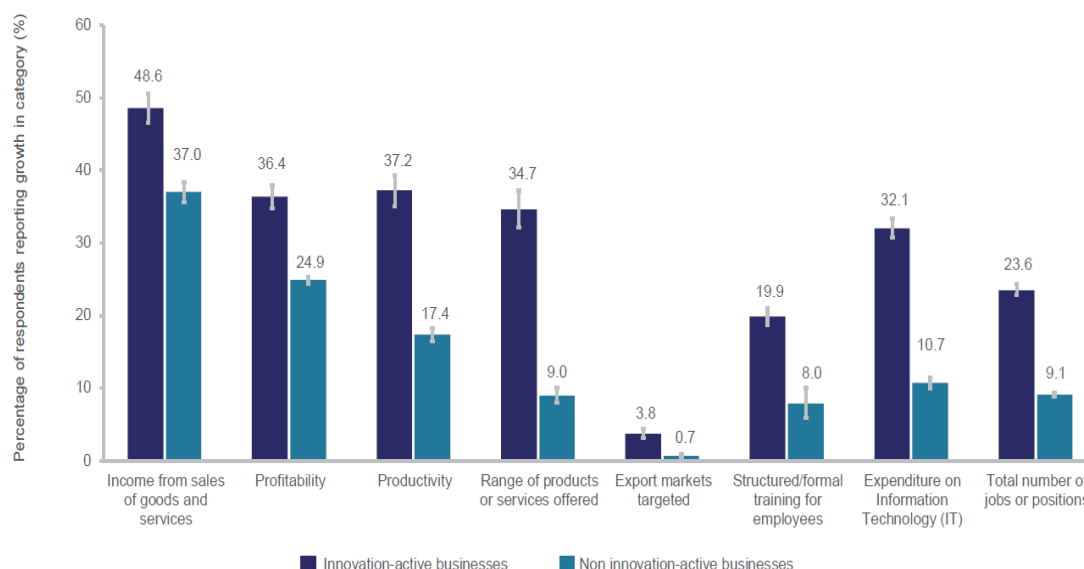
Innovation drives business productivity growth, employment growth, increasing market diversification (via increasing the range of goods and services being offered and the number of export markets being targeted by innovative businesses) and a range of other performance outcomes.

Compared to businesses that don't innovate, innovative Australian businesses report that they are: 31 per cent more likely to increase income and 46 per cent more likely to increase profitability; twice as likely to export and five times more likely to increase the number of export markets targeted; twice as likely to increase productivity, employment and training; three times more likely to increase

⁵ Lentz R & Mortensen DT (2008) An empirical model of growth through product innovation, *Econometrica* 76(6): 1317–73

investment in ICT; and three times more likely to increase the range of goods and services offered.⁶ (Figure 4)

Figure 4: Average reported increases in business performance and activities compared to the previous year, by innovation status, 2006–07 to 2011–12



Source: ABS (various) *Selected characteristics of Australian business, 2006–07 to 2011–12*, cat. no. 8167.0

Note: Averages and standard errors are generated from year-on-year variation in each indicator by the Australian Government Department of Industry.

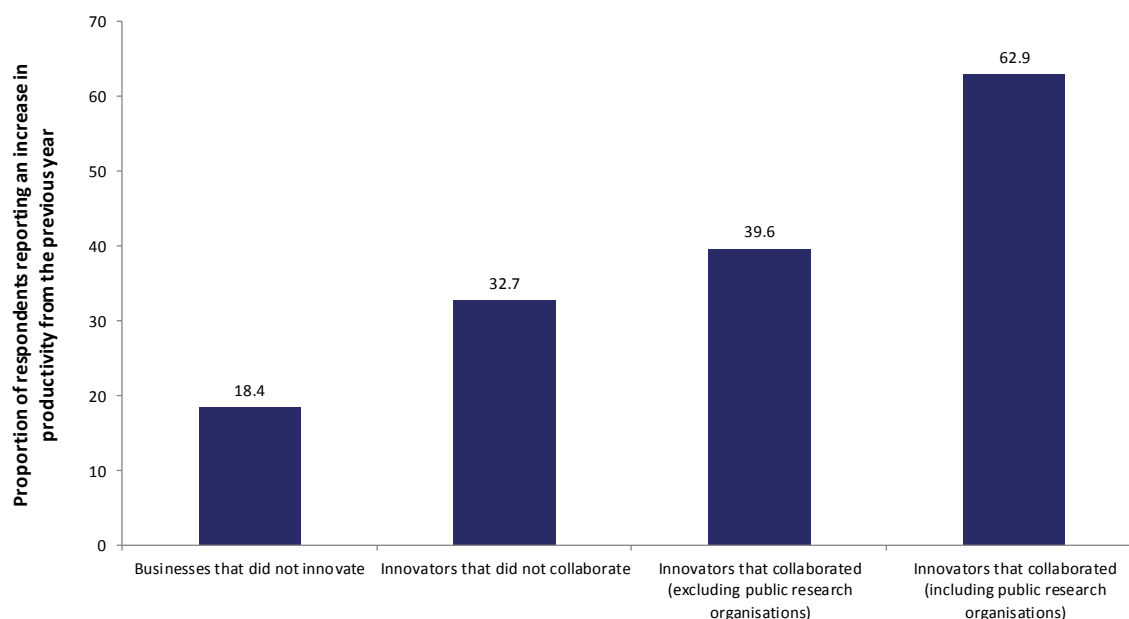
Collaboration is fundamental to a healthy innovation system. ABS data shows that collaborative innovation with research organisations more than triples the likelihood of businesses reporting productivity growth compared to businesses that neither innovate, nor collaborate.⁷ (Figure 5)

Moreover, businesses that collaborate on innovation with research organisations are almost twice more likely to report increased productivity than businesses that innovate but do not collaborate. They are also around 24 per cent more likely to report an increase in productivity than businesses that collaborate on innovation with parties other than research organisations.

⁶ For more detail see Australian Innovation System Report 2014, Chapter 2: Section 2.2 (p. 42) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

⁷ For more detail see Australian Innovation System Report 2013, Chapter 2: Business innovation and collaboration, section on Collaborative innovation <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Policy/AustralianInnovationSystemReport/AISR2013/chapter-2-business-innovation-and-collaboration/collaborative-innovation/index.html>

Figure 5: Effect of innovation and collaboration on businesses reporting increased productivity, 2010–11



Source: Customised data from the ABS (2012) Innovation in Australian Business 2010–11, cat. no. 8158.0

Innovation boosts global trade

With the end of mining boom, Australia must find new sources of growth for its continued prosperity. As an advanced economy, these new sources of growth will arise through innovation. Innovation is the core driver of business competitiveness and productivity, which in turn support economic growth.

Global trade is one of the most powerful modes of international engagement, as it requires connecting producers and users in global supply chains across the world. Facilitating innovation involves enabling disruptive technologies, integrating into global value chains and accessing global markets with innovative products and services.⁸ There is a significant correlation between export activity and innovation activity across all business sizes and ages in Australia. Innovation and exporting activity are positively associated, with exporting businesses significantly more likely to engage in innovation of all types compared to non-exporting businesses.⁹ (Figure 6)

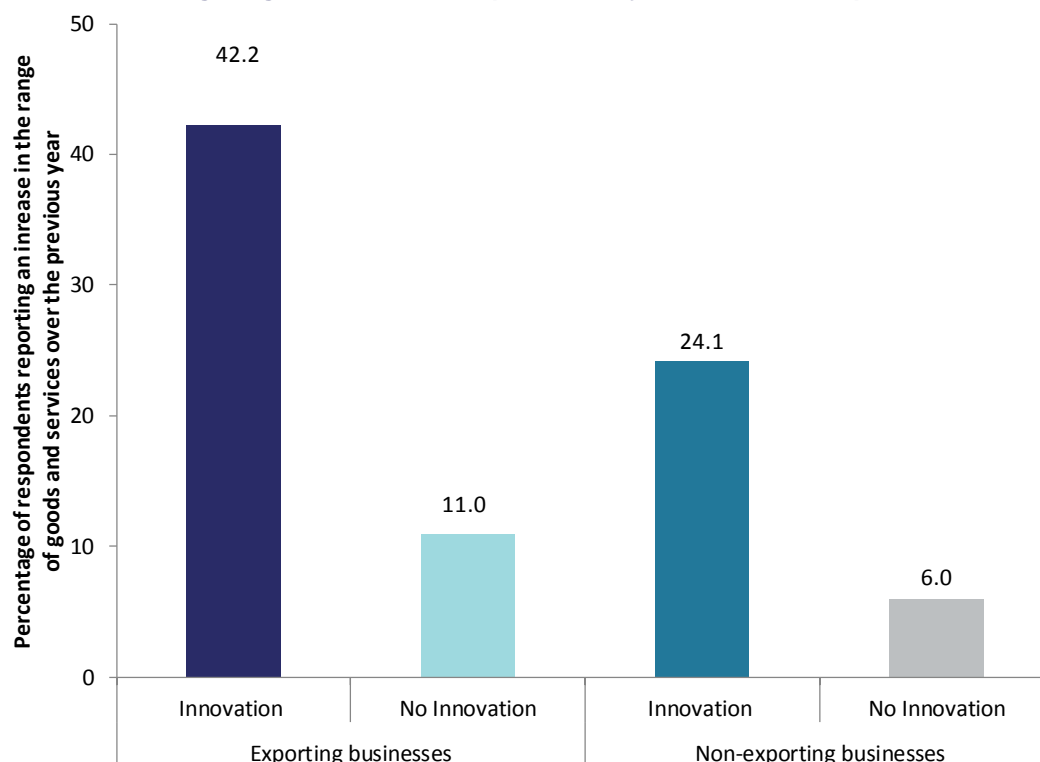
⁸ For more detail see Australian Innovation System Report 2013, Chapter 1 (p. 25)

<http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Policy/AustralianInnovationSystemReport/AISR2013/wp-content/uploads/2013/11/AIS-Innovation-Systems-Report-2013-v3.pdf>

⁹ For more detail see Australian Innovation System Report 2014, Chapter 2: Section 2.2.1 (pp. 44-46)

<http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

Figure 6: Growth in the range of goods and services produced, by innovation and export status, 2012–13



Source: ABS (2014) Customised report based on the Business Characteristics Survey data commissioned by the Australian Government Department of Industry

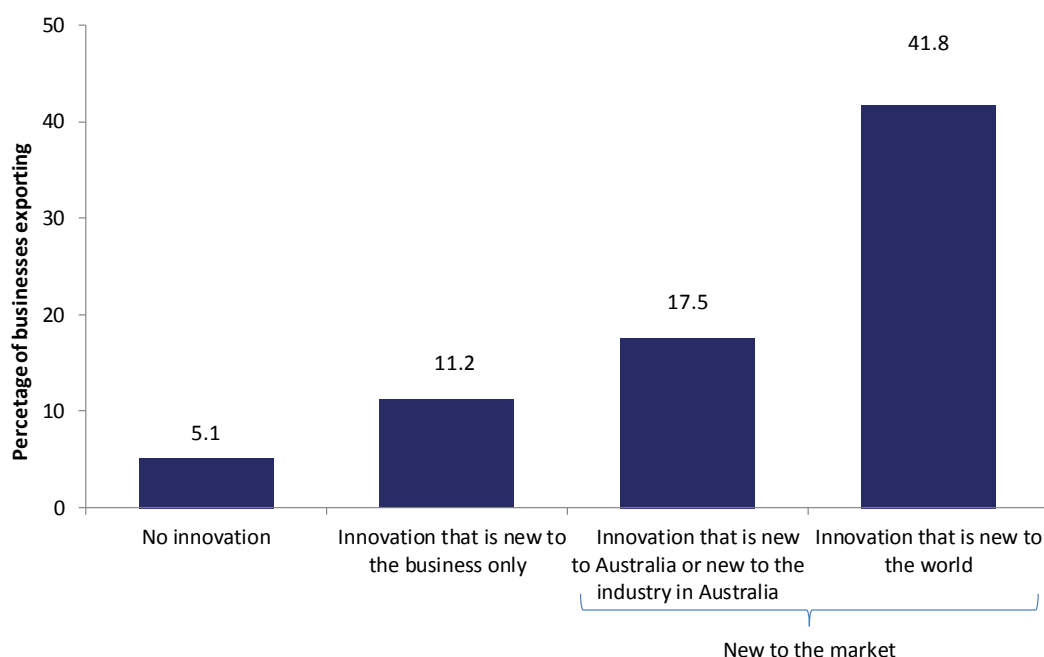
Firms that are first in the world to develop innovations represent the technology or innovation frontier. This degree of novelty can have a big impact on the international competitiveness of businesses. Australian world-first innovators are over eight times more likely to export than non-innovators. They are also twice more likely to be exporting than businesses introducing less novel forms of new-to-market innovation (new to Australia or new to the industry innovations). This association is strongest in small and medium sized enterprises.¹⁰ (Figure 7)

High impact entrepreneurs are vital to the transition to future growth opportunities, increasing market diversity and building resilience to adverse global economic events. On 30 October 2015, the report *Boosting High-Impact Entrepreneurship in Australia* was released by the Office of the Chief Scientist. The report highlights entrepreneurship as the key to a high-growth, innovation-led economy, able to capitalise on Australia's investment in research and skills.¹¹ It also emphasizes the central role universities have to play in bringing about cultural change and fostering entrepreneurship. In addition to shorter term measures to support entrepreneurs, NISA will encourage increased engagement with science, technology, engineering and mathematics through the Inspiring STEM literacy initiative.

¹⁰ For more detail see Australian Innovation System Report 2014, Chapter 2: Section 2.2.2 (pp. 46-51) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

¹¹ For more detail see <http://www.chiefscientist.gov.au/2015/10/new-report-boosting-high-impact-entrepreneurship-in-australia/>

Figure 7: Australian business exporting activity by innovation status and novelty, 2012–13



Source: ABS (2014) Customised report based on the Business Characteristics Survey data commissioned by the Australian Government Department of Industry

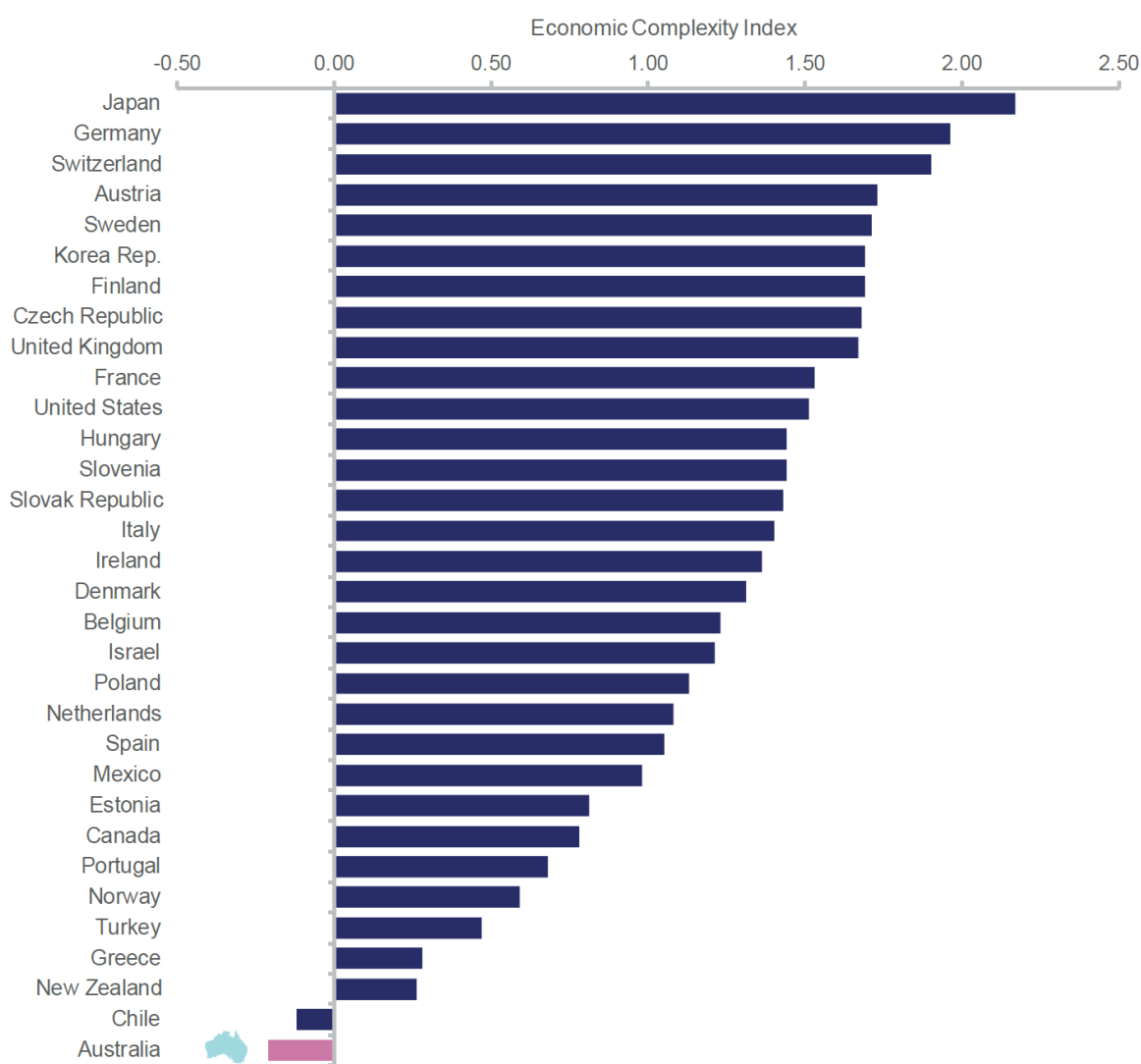
Innovation enables diversification of export profile

Wealthy, competitive countries are characterised by a high degree of diversification of exports, where countries produce all the possible products they can, limited only by their level of innovation, development and natural resources. Product complexity is, therefore, an indication of the capabilities that each country possesses. Product complexity could also be predictive of the complexity of future exports, growth and prosperity. Australia has a low level of economic complexity in terms of its export profile.

The economic complexity index (ECI) incorporates two key concepts: diversity and ubiquity of exports. Diversity is related to the number of products that a country exports, whereas ubiquity tells us how unique the products that a country exports are. Complex economies are highly diverse with many niche export products. The exceptions are resource-rich countries such as Australia, Norway and New Zealand. Australia has the lowest ECI score of most advanced economies, (Figures 8) but has maintained high per capita income. (Figure 9) As global demands for resources decline, low economic complexity would pose a risk for Australia's export revenues, and hence affect per capital income.¹²

¹² For more detail see Australian Innovation System Report 2014, Chapter 3: Section 3.5 (pp. 97-107) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

Figure 8: Economic complexity index, OECD countries, 2010

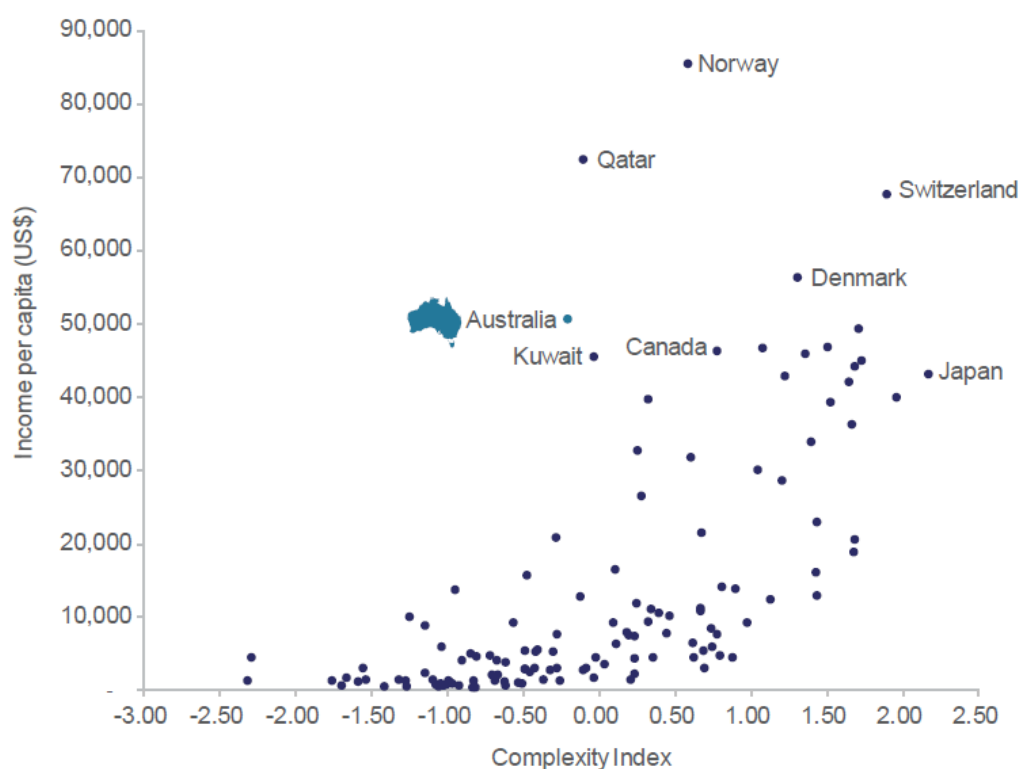


Source: Hausmann R & Hidalgo, C et al. (2013) The atlas of economics complexity: mapping paths to prosperity, Center for International Development, Harvard University

Innovation can diversify our export profile beyond the resources sectors by enabling new industries and goods and services. Innovation is a key driver of market diversification as shown through its influence on the range of goods and services offered by businesses. The diversity of exports of a country can also be seen as an indirect measure of the knowledge, skills, technologies, resources, framework conditions and other capabilities of that country at any point in time. The set of capabilities used by a nation to produce certain goods and services is conceptually linked to the definition of a national innovation system.¹³

¹³ For more detail see Australian Innovation System Report 2014, Chapter 3: Section 3.5 (pp. 97-107)
<http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

Figure 9: Income per capita vs economic complexity index, 2010



Source: Hausmann R et al. (2013) *The atlas of economics complexity: mapping paths to prosperity*, Center for International Development, Harvard University.

Note: An exponential curve fits the data with an R-squared of 0.56.

Although with the drop in the value of the Australian dollar in recent years some sectors have experienced a significant increase in the value of their exports, this cannot preclude the need for the diversification of exports. The most dramatic example of increase in the value of export in recent times has been the international education sector. Australian international education exports increased 15 per cent (or \$2.3 billion) between 2013-14 and 2014-15 from \$15.9 billion to \$18.2 billion.¹⁴

Australia's innovation capabilities are aligned with its export competitiveness

To understand Australia's competitiveness in individual industries, it is useful to analyse Australia's Revealed Comparative Advantage (RCA) based on exports from those industries. There is alignment between Australia's innovation capabilities (using R&D, patents and trademark data) and sectors with high values of RCA, which indicates sectors where Australian exports are more competitive than the world average. (Figure 10)

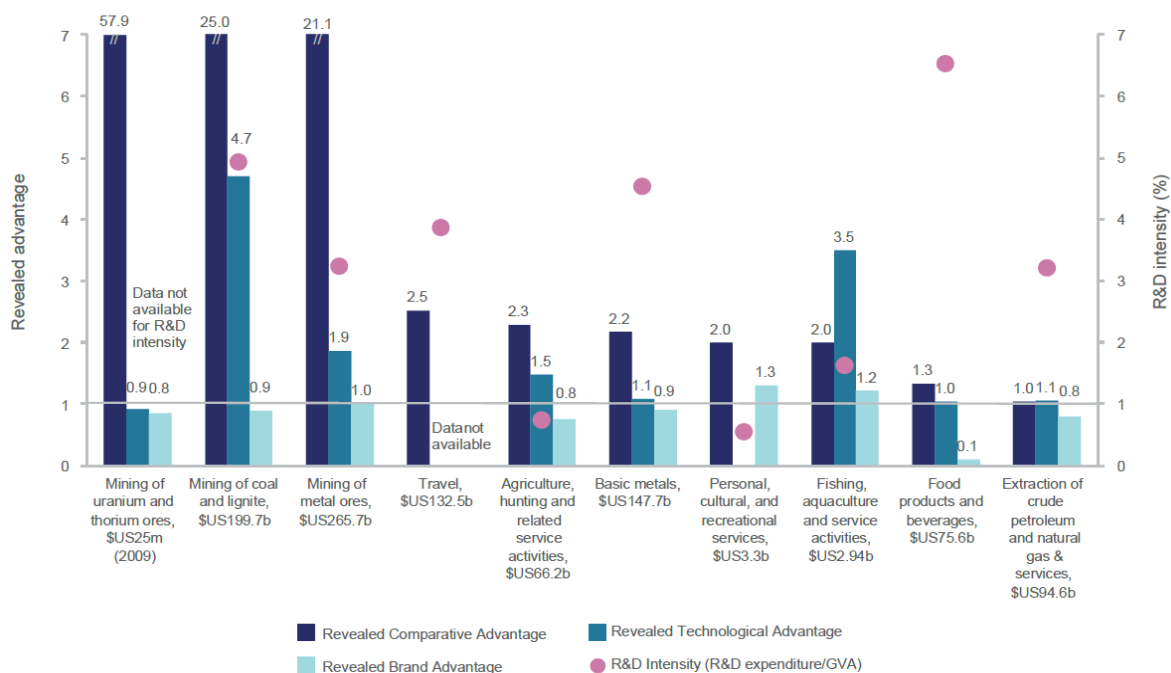
For example, the mining sector, which is Australia's area of greatest international competitiveness, both in terms of comparative advantage and export value is supported by outstanding innovation capabilities in many areas—mining and agglomeration coal, oil and gas, and iron ore have very high

¹⁴ Australian Bureau of Statistics, *International Trade in Services, by Country, by State and by Detailed Services Category, Financial Year, 2014-15* (ABS Catalogue no. 5368.0.55.003) published on 20 November 2015.

technological advantages and high R&D intensities. Mining exploration and other mining support services, with a relatively high R&D intensity, contribute heavily to the technological and scientific capabilities that the rest of the mining sector enjoys.

By contrast, manufacturing appears weaker in terms of international competitiveness. Only in food product manufacturing and basic metal manufacturing do we have high RCAs, and both these sectors have high levels of innovation and R&D intensity.¹⁵

Figure 10: Australia's revealed advantage, for exports (RCA), patents (RTA), trademarks (RBA) and R&D intensity, high RCA sectors, 2008–12



Source: UNCTAD COMTRADE database; IP Australia customised data request

Innovation enhances global value chain participation

Innovation collaboration and global connectivity are increasingly seen to be imperatives to enable competitiveness in the global economy. There is international evidence that innovation is necessary to drive and sustain global value chain participation. Global value chains allow lead companies to access the best capabilities anywhere in the world for the best price. Growing international trade and greater fragmentation of production processes facilitate global collaboration on innovation along global value chains. A country's integration into global value chains can therefore represent a measure of its international competitiveness for a particular good or service. Evidence suggests that the more businesses engage in international markets, the more their performance improves.¹⁶

¹⁵ For more detail see Australian Innovation System Report 2014, Chapter 3: Sections 3.3 and 3.4 (pp. 82-97) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

¹⁶ Bloom N et al. (2012) Trade-induced technological change? The impact of Chinese imports on innovation, diffusion of IT and productivity, National Bureau of Economic Research working paper 16717, January 2011

McKinsey Global Institute has found that more-globally connected economies see up to 40 per cent more benefit (in economic output) than less connected economies.¹⁷

The goods and services traded globally are composed of inputs from various countries around the world. However, the flows of goods and services within these global production chains are not always reflected in conventional measures of international trade. The joint Organisation for Economic Co-operation and Development – World Trade Organization (OECD–WTO) Trade in Value-Added (TiVA) initiative is an attempt to capture the input of various countries in the flow of international trade by considering the value added by each country in the production of goods and services that are consumed worldwide.¹⁸

Australia has significant competitive advantages in exporting raw commodities, basic metals, food, tourism and education-related travel with some evidence for niche areas in other sectors, such as medical technology. However, the OECD ranking indicates that Australia is not doing well overall in terms of linkage in global value chains. (Figure 11) The low linkage levels may not be a problem for countries like the US where there is a large domestic market. However, for countries with small domestic markets, like Australia, better linkage in global value chains could be significant.

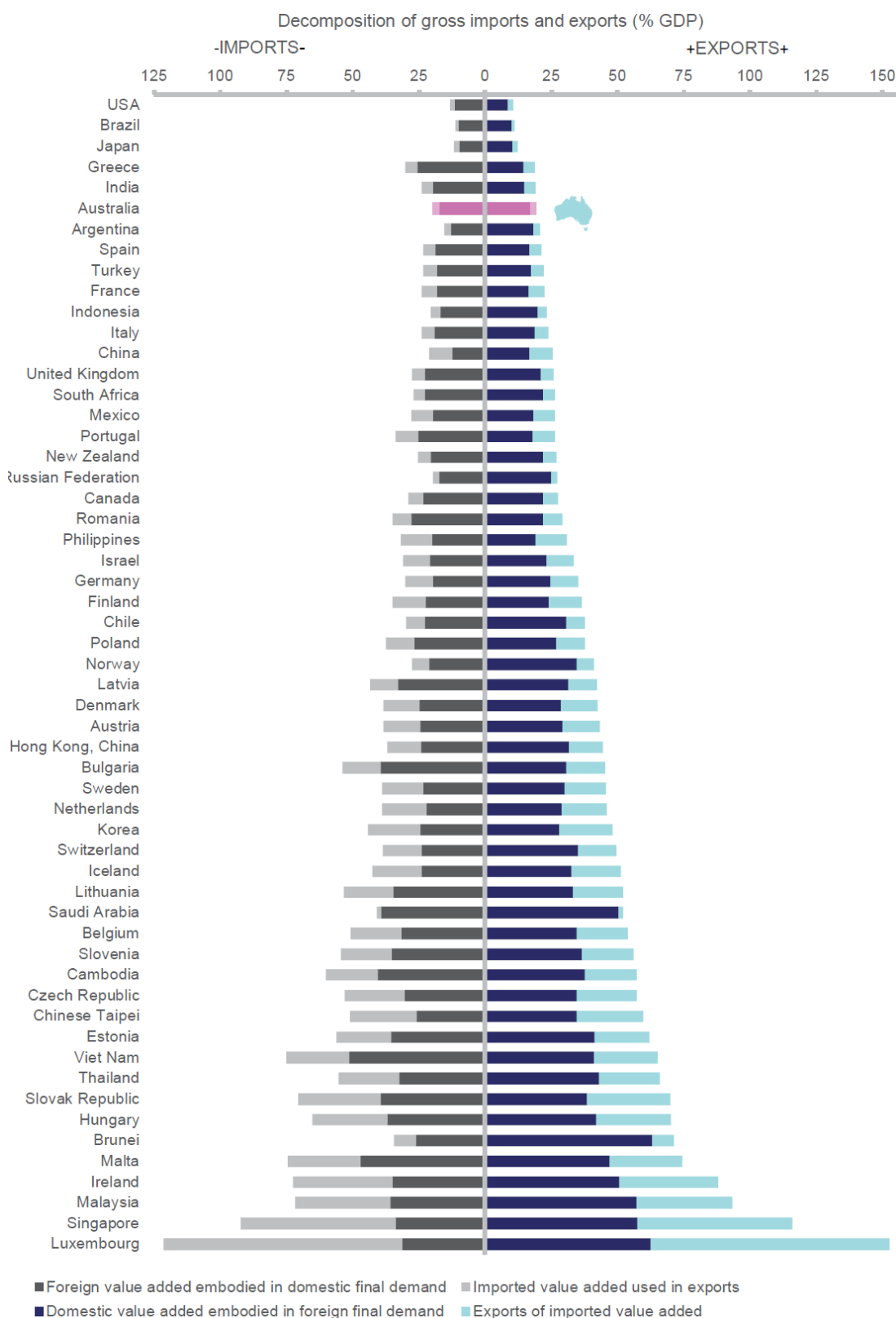
The ‘tyranny of distance’ alone cannot explain Australia’s low international collaboration on innovation. Other countries that are distant from the major markets of Europe and North America—such as Israel, South Africa and New Zealand—are more active in international collaboration on innovation than Australia, and more integrated into global value chains.

NISA initiatives will enhance Australia’s connections with the world by increasing links with key economies to enable Australia to improve research, commercialisation and business performance, and access international supply chains and global markets. It will include access for entrepreneurial Australians to international landing pads, as well as funding for Australian collaborations with international research-industry clusters. More details on NISA initiatives dealing with collaboration can be found at <http://innovation.gov.au/page/national-innovation-and-science-agenda-report>

¹⁷ Manyika J et al. (2014) Global flows in a digital age: how trade, finance, people, and data connect the world economy, McKinsey Global Institute, McKinsey & Company

¹⁸ www.oecd.org/trade/valueadded

Figure 11: Trade linkages in global value chains, by country, 2009



Source: OECD–WTO, Trade in Value-Added (TiVA) Database, May 2013

The rise of prosperous Asian middle classes and Australia's geographic proximity to Asian markets is a comparative advantage for us, which can be complemented by an innovation-driven competitive

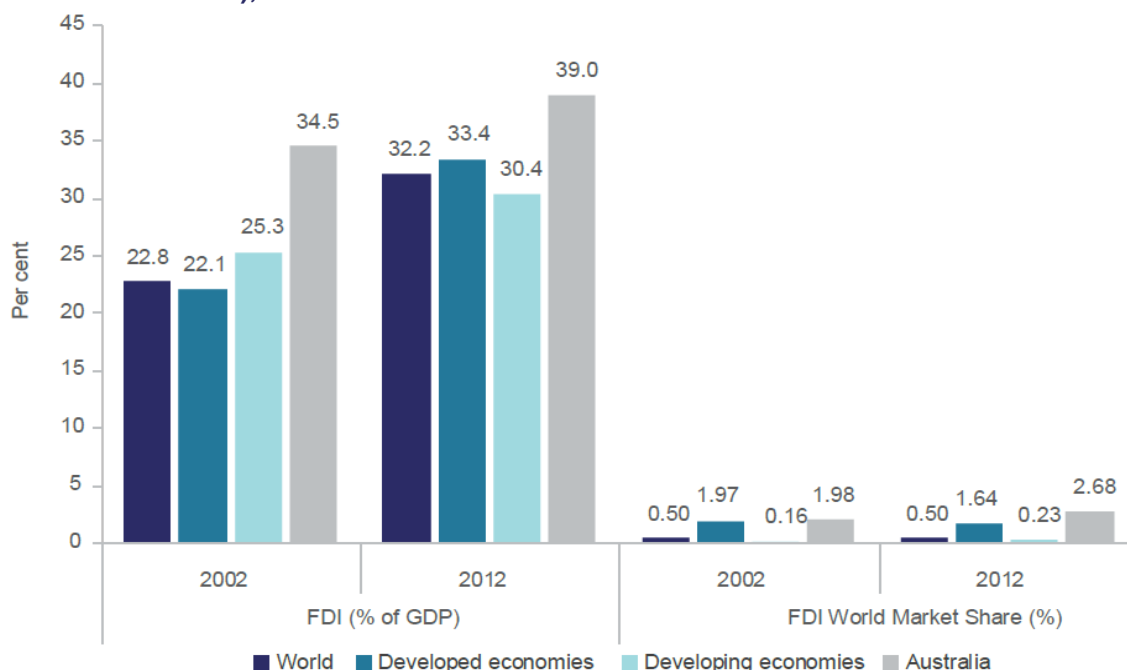
advantage. Australia could exploit this comparative advantage by diversifying its export profile in its existing or potential markets.

Direct foreign investment is a catalyst of transfer of technology and management skills

Investment inflow is an important indicator of economic engagement. Foreign direct investment (FDI) has a positive impact on economic growth. FDI is a key vehicle for transfer of technology and management capability. FDI implies long-term commitment from the investor who acquires business facilities, employs local staff, etc. hence it represents a strong type of linkage. By contrast, debt finance and portfolio investment can be recalled relatively quickly.¹⁹

Australia has performed well in recent years in attracting foreign investment. (Figure 12) Based on data from United Nations Conference on Trade and Development, Australia ranked 13th in the world in terms of its stock of FDI in 2012. Reflecting the strength of the mining boom and other factors, Australia's stock of FDI rose from US\$150 billion in 2002 to US\$611 billion in 2012—a four-fold increase. Just as significantly, and reflecting the ongoing global attractiveness of Australia as a destination country for investment, FDI as a proportion of GDP rose from 34.5 per cent in 2002 to 39 per cent in 2012. This is significantly above the world average of 32.2 per cent.

Figure 12: FDI as percentage of GDP and as a percentage of world total investment (average of individual economies), 2002 and 2012



Source: UNCTAD (2013) Inward and outward foreign direct investment stock, annual, 1980–2012

Levels of FDI by industry sector correlate with exports, innovation and productivity, especially in respect of the investment- and innovation-intensive industries of manufacturing and mining. Together, mining and manufacturing accounted for around half the stock of FDI in Australia in 2012,

¹⁹ For more detail see Australian Innovation System Report 2013, Chapter 1: Global Competitiveness, innovation and integration with Asia, Section on Foreign Investment <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Policy/AustralianInnovationSystemReport/AISR2013/chapter-1-global-competitiveness-innovation-and-integration-with-asia/foreign-investment/index.html>

almost half of Australian businesses' R&D expenditure in 2011–12 and well over half the value of Australian exports—despite only accounting for less than 20 per cent of gross value-added in the Australian economy.

Foreign ownership helps bring novel business practices and products to Australia

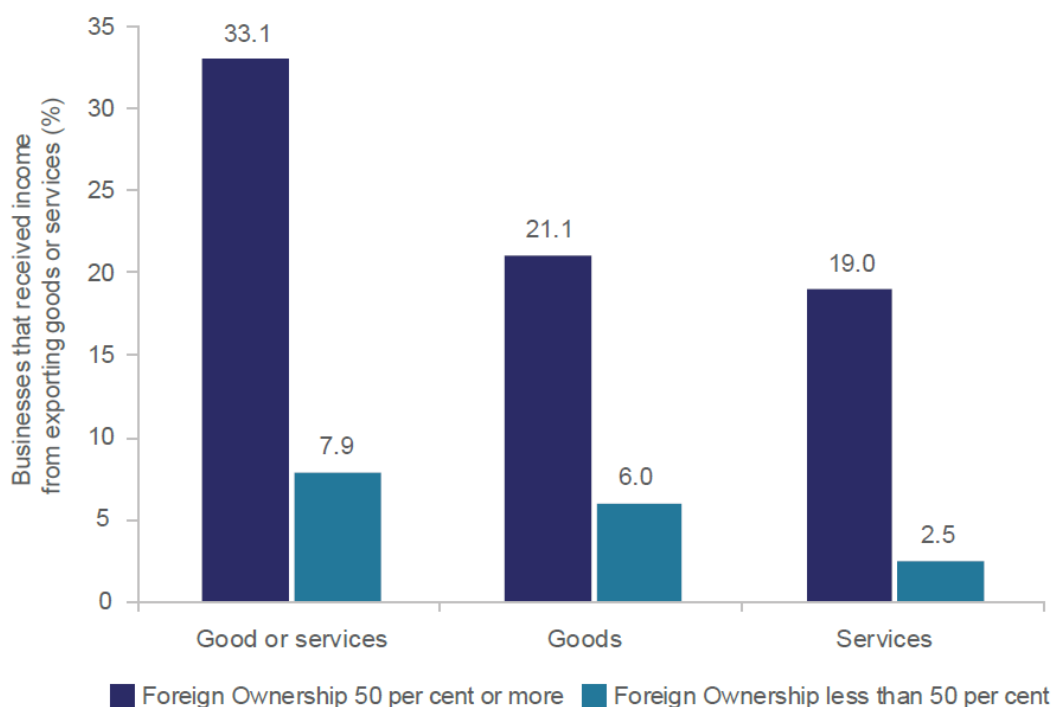
Foreign ownership means that novel business practices and products can be brought into the Australian market. It therefore provides a relatively inexpensive means for Australia to acquire capabilities that were originally developed offshore. This could include new business models that achieve reduced costs, or innovative new niche products or services. Once diffused into the Australian market, such innovations can be adapted or replicated more broadly by Australian industry. There may, in effect, be knowledge spill-overs from foreign-owned firms. An economy that is open to foreign ownership may become more competitive than an economy that restricts foreign acquisitions or places too many regulatory burdens in the way of foreign ownership of businesses.²⁰

ABS data indicate that foreign ownership contributes substantially to innovation. In 2011–12, businesses with more than 50 per cent foreign ownership spent \$5.6 billion on R&D in Australia—representing as much as 31 per cent of total R&D expenditure by businesses in that period. The OECD similarly found that foreign affiliates typically account for a disproportionately high share of the home country's employment and value-add.

Analysis of Business Characteristics Survey has also found that exporting SMEs are more likely to have some degree of foreign ownership as compared to non-exporting SMEs. The difference between exporters and non-exporters was, in fact, quite large, with 18 per cent of exporting SMEs reporting some degree of foreign ownership as compared to just 3 per cent of non-exporters. Moreover, 33.1 per cent of businesses with more than 50 per cent foreign ownership derived some income from exporting compared to just 7.9 per cent of businesses with less than 50 per cent foreign ownership. In the case of the manufacturing and information, media and telecommunications sectors, this was particularly high, with more than 80 per cent of majority foreign-owned businesses deriving income from exports. (Figure 13)

²⁰ For more detail see Australian Innovation System Report 2014, Chapter 6: Section 6.3.1 (pp. 141-146) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

Figure 13: Percentage of businesses that received income from exporting goods or services, by degree of foreign ownership, 2012–13



Source: ABS (2014) Customised report based on the Business Characteristics Survey data commissioned by the Australian Government Department of Industry.

Foreign ownership is associated with a stronger likelihood of higher degrees of novelty of innovation than is pure domestic ownership—businesses with more than 10 per cent foreign ownership are about 60 per cent more likely to achieve new-to-world innovation than businesses that are 100 per cent domestically owned.

4. Australia's innovation performance

Collaboration increases the degree of innovation novelty

The effective translation of R&D performed by the research sector into commercial outcomes is a way to shift more innovative businesses towards world-first innovation. Collaborative innovation is significantly correlated with the introduction of new-to-Australia and world-first innovations.²¹

Business collaboration on innovation is associated with a 70 per cent increase in the likelihood of new-to-world innovation and a 32 per cent increase in the likelihood of new-to-Australia

²¹ For more detail see Australian Innovation System Report 2013, Chapter 2: Business innovation and collaboration, section on Collaborative innovation <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Policy/AustralianInnovationSystemReport/AISR2013/chapter-2-business-innovation-and-collaboration/collaborative-innovation/index.html>

innovations.²² Annual invention disclosures, a formal record of ideas with commercial potential, show strong growth in Australia since 2000 relative to investment in R&D. These rates of invention disclosure are now on par with Europe and trending towards North American levels.²³ The number of licences, options and assignments yielding income from publicly funded research agencies and universities increased from 472 in 2000 to 721 in 2011; and in the same period universities' income from industry increased from \$331 million to \$832 million.²⁴ However, although research commercialisation outcomes from Australian public research institutions generally show positive growth in absolute terms relative to increasing levels of investment in R&D, many indicators such as patenting, licensing and start-up activity are in decline.

In terms of international research collaboration and connectedness, Australian researchers perform relatively well. The rate of international collaboration in Australian research publications has risen from 25 per cent in 1993–97 to 47 per cent in 2008–12. This was 2.19 times the world average rate of international research collaboration. At the institutional level, the 23 Australian universities included in the 2014 Leiden Ranking had an average international collaboration rate of 46 per cent, compared to a world average of 38.6 per cent.²⁵

Collaboration between researchers and institutions, domestically and particularly internationally, improves the average academic impact of research, and its accessibility to wider professional audiences, including businesses and institutions looking to translate research into innovation. This is true of Australia's research collaboration, with Australia's internationally collaborative publications in 2008–12 receiving 72% higher rates of citation than Australian-only publications overall, and in some fields of research the benefit was considerably higher.²⁶

Australia's international research collaboration certainly raises Australia's research profile and absorptive capacity for leading-edge knowledge. However, this does not always lead directly to better innovation performance in terms of business outcomes and competitiveness. Poor collaboration on innovation with universities and other research organisations is likely to diminish Australia's ability to be a part of many world-first innovations. Collaboration between research organisations and industry in Australia is one of the lowest in the OECD. (Figure 14) An improvement in Australia's relatively underdeveloped research–industry relationships would almost certainly further enhance both academic and non-academic outcomes from international research collaboration.

²² For more detail see Australian Innovation System Report 2014, Chapter 5: Section 5.3 (p.126)
<http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

²³ Australian Government (2012) The National Survey of Research Commercialisation 2010–2011, DIISRTE, Canberra

²⁴ For more detail see Australian Innovation System Report 2013, Chapter 4: Public Research Capacity and Innovation, section on Research income and research commercialisation <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Policy/AustralianInnovationSystemReport/AISR2013/chapter-4-public-research-capacity-and-innovation/research-income-and-research-commercialisation/index.html>

²⁵ For more detail see Australian Innovation System Report 2014, Chapter 8 (pp. 167–168)
<http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

²⁶ For more detail see Australian Innovation System Report 2014, Chapter 8 (pp. 167–169 and table 8.6 p. 180)
<http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

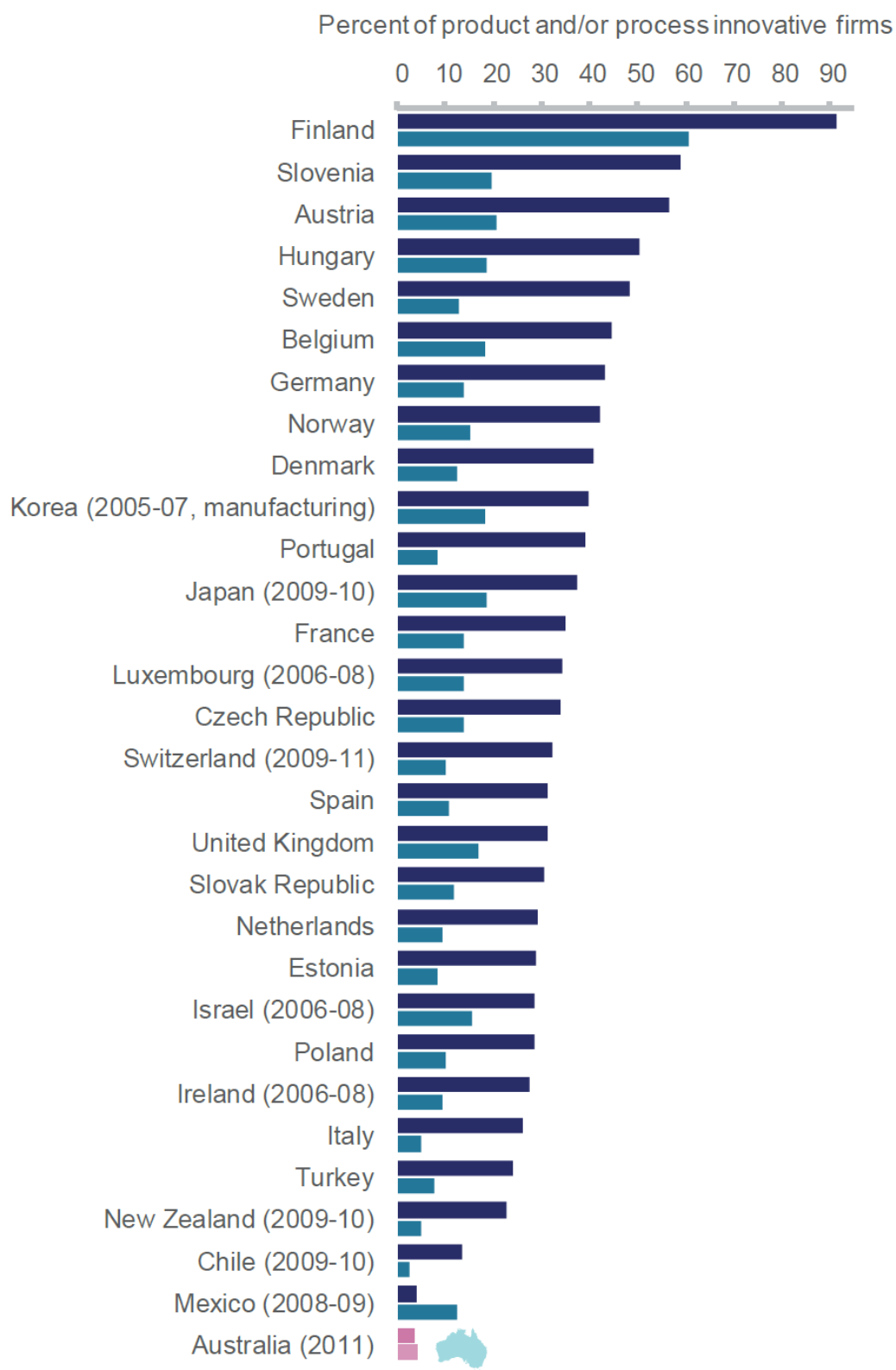
NISA has initiatives that deal directly with issues with collaboration in our innovation system. NISA will build a world-class national research infrastructure by providing long-term funding certainty for cutting-edge, national research infrastructure, introducing new arrangements to encourage collaboration between researchers and industry by streamlining and refocussing a greater proportion of research block grant funding toward collaboration, and by connecting more small and medium businesses with researchers. In addition, NISA also has new clear and transparent measures that will assess non-academic impact and industry engagement as part of university research performance. It also includes the expanding and relaunching of the Research Connections Programme and opening up the Australian Research Council Linkage projects to continuous applications to fast track decisions on collaborative research grants.

The Global Innovation Strategy announced as part of the NISA is an initiative to improve Australia's international innovation and science collaboration. The Government is investing \$36 million over five years. The strategy will provide seed funding for Australian businesses and researchers to collaborate internationally on research and promote an open-market approach to industry-research collaboration including regional workshops, multilateral projects and mobility support. It will also support the establishment of five 'landing pads' (in Silicon Valley, Tel Aviv and three other locations) to support entrepreneurial Australians and market-ready start-ups by providing an operational physical space to access the talent, mentors, investors and a wider connected network of innovation hubs in those locations.

Other initiatives aimed at increasing the level of collaboration between industry and researchers include: Innovation Connections (expanding and refocusing the existing Entrepreneur's Programme to drive new industry-led collaborations between researchers and small and medium enterprises; Linkage Scheme (making research linkage project funding available faster to stimulate more collaboration between universities and businesses) and new research funding arrangements for universities to improve Australia's rate of collaboration between industry and universities.

More details on NISA initiatives dealing with collaboration can be found at <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report>

Figure 14: Firms collaborating on innovation with higher education or public research institutions, by firm size, 2008–10



Source: OECD, based on Eurostat (CIS-2010) and national data sources, June 2013

Skilled people drive innovation and competitiveness

Skilled people drive innovation by generating new knowledge and adapting new and old ideas to a changing world. The long-term relationship between skills, innovation and employment may be characterised as a 'virtuous cycle'. In a globalised economy, trade-exposed industries are competing with world's best practice. Exporters therefore need access to business and technical skills sufficient to compete. Universities and the vocational education and training (VET) sector are the knowledge infrastructure of the national innovation system. Workers often need a combination of knowledge acquired from higher education and vocational education to realise workforce gains. As innovation occurs in all sectors throughout the economy, and in all stages of production and distribution, the skills needed are wide ranging. These include technical skills such as those required for the trades, and in design and engineering that are necessary for creating new technologies and products, as well as management skills needed to adopt and adapt innovations.²⁷

Research skills, especially in science, technology, engineering and mathematics (STEM) disciplines, are particularly important for innovation. New-to-world innovators are heavy users of science and research skills. As the pace of social and technological change increases, demand will grow for creative researchers who can push the boundaries of knowledge, and assess and adapt new technologies and emerging ideas. The CSIRO identified global 'megatrends' whose development suggests a significant shift in environmental, economic and social conditions over the coming decades.²⁸ Such shifts will entail a number of challenges, a large number of which will be met through a deeper and all-pervasive knowledge of STEM. This new reality is also supported in a recent Pricewaterhouse Coopers (PwC) report, which noted that 44 per cent of current jobs are at risk of being affected by technology over the next 20 years.²⁹

Universities and other publicly funded research organisations play a fundamental part in training and developing the research workforce and thus enhancing the ability of businesses to conduct R&D. Australia outperforms the OECD average on two indicators: researchers as a percentage of total labour force; and R&D personnel as a percentage of total employment.³⁰ However, there is a highly uneven distribution of researchers, with the majority (nearly 70 per cent) working in the universities and public sector. (Figure 15) Australia's low representation of researchers in the business sector suggests the need for more emphasis on a high level of industry–research collaboration in the short to medium term.

NISA will establish a new \$200 million CSIRO Innovation Fund to co-invest in new and existing spin-off companies, a new Biomedical Translation Fund to co-invest \$250 million with the private sector to increase the capital available for commercialising medical research within Australia. It will also support incubators which play a crucial role in the innovation ecosystem to ensure start-ups have

²⁷ For more detail see Australian Innovation System Report 2014, Chapter 7 (pp. 149-157) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

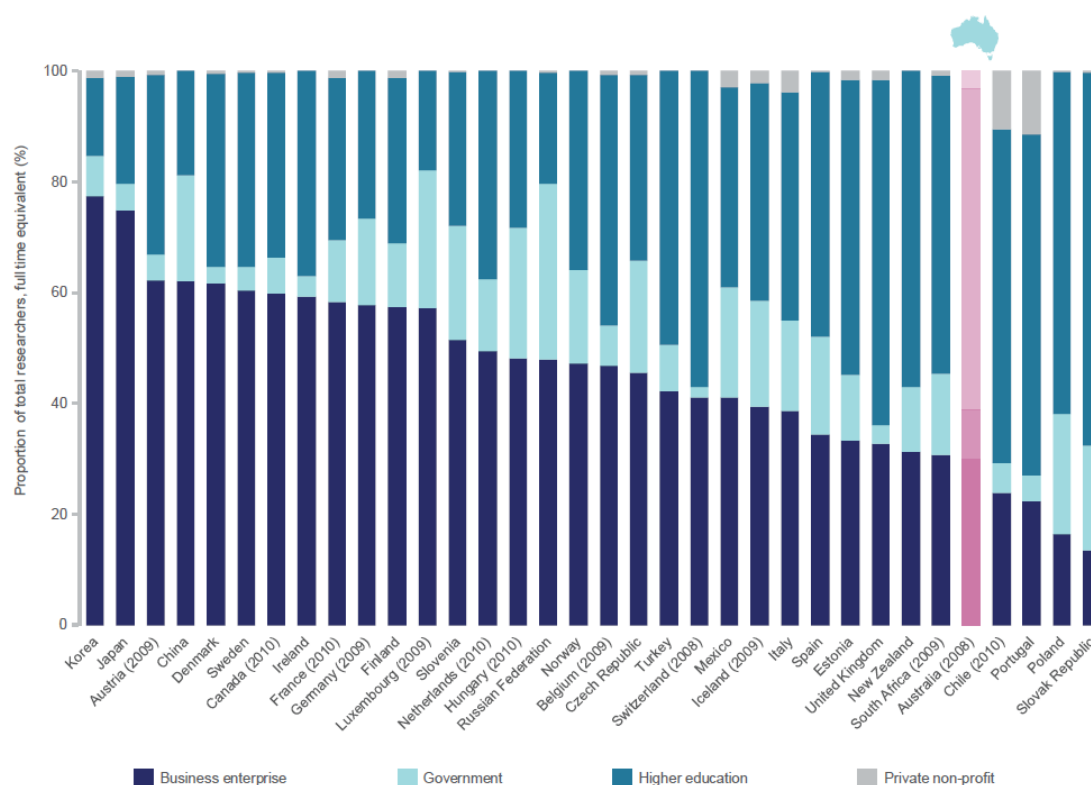
²⁸ Commonwealth Science and Industrial Research Organisation (2012), *Our future world: Global megatrends that will change the way we live*.

²⁹ Pricewaterhouse Coopers (2015), *A smart move: Future-proofing Australia's workforce by growing skills in science, technology, engineering and maths*.

³⁰ For more detail see Australian Innovation System Report 2014, Chapter 8: Sections 8.1 (pp. 164-167) <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf>

access to the resources, and make it easier for promising businesses to hire and retain top staff by introducing new rules which allow companies to offer shares to their employees. More details on NISA initiatives dealing with collaboration can be found at <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report>

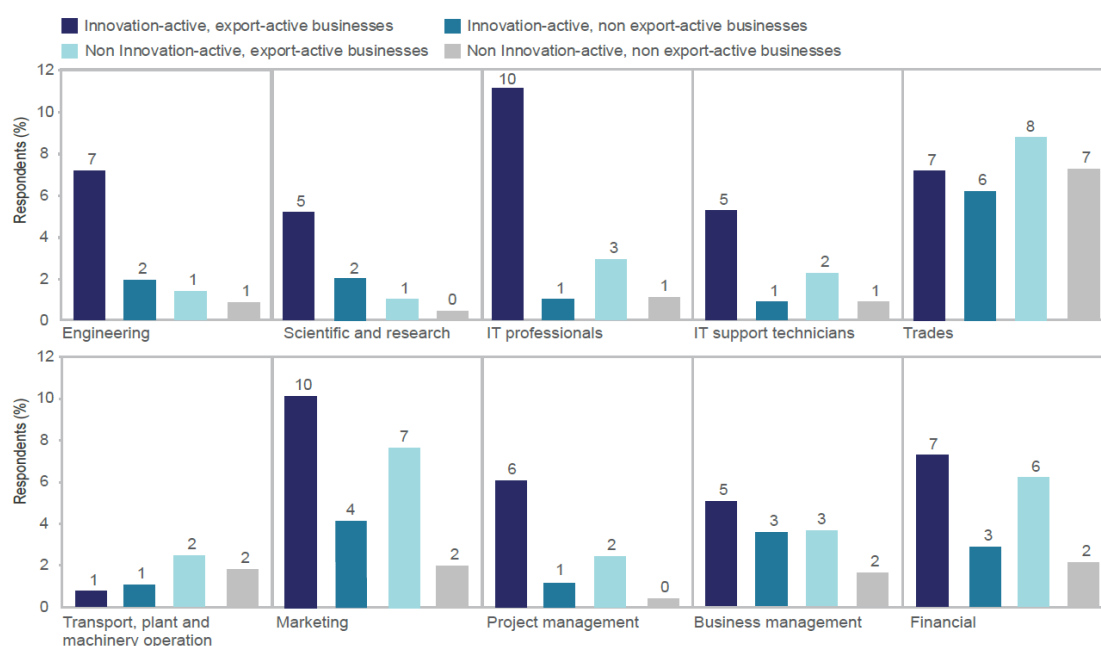
Figure 15: Researchers by sector of employment, 2011



Source: OECD (2013) Research and Development Statistics Database, www.oecd.org/sti/rds

Not surprisingly, a lack of skilled people has been one of the highest reported barriers to innovation in businesses in recent years. Innovation-active firms are generally more likely than non-innovation-active firms to indicate a lack of skills as a barrier to innovation. (Figure 16)

Figure 16: Skill shortage or deficiency reported, by innovation and export status, 2012–13



Source: ABS (2014) Customised report based on the Business Characteristics Survey data commissioned by the Australian Government Department of Industry

A crucial component of international competitiveness is the migration of highly skilled people. Migration can be a cost-effective means for a country to acquire the skills that its economy needs. Retention of international students in Australia will also be important to partially meet the demand for qualified workforce. Data on skilled migration to Australia from the Department of Immigration shows that out of the total of 51,939 people granted 457 Visas in 2013-14, 18,899 had skills in science, technology, engineering, mathematics and medicine (STEM). Moreover, data on migration programme outcome for the skill stream in 2014-15 indicates that out of 59,482 who migrated to Australia in that year 26,607 had STEM skills.

NISA new initiatives include the introduction of new Entrepreneur Visa for up and coming entrepreneurial talent, the use of Government overseas networks for encouraging talented individuals to come to Australia and facilitating the pathway to Australian permanent residency for high quality STEM and ICT postgraduate students. More information is provided in NISA's talent and skills section <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report> NISA will also boost STEM literacy by investing \$48 million in encouraging school students to participate and achieve in science and maths, and allocating over \$13 million to expand opportunities for women in enhancing their STEM literacy.

Access to finance is essential for the creation of innovative firms

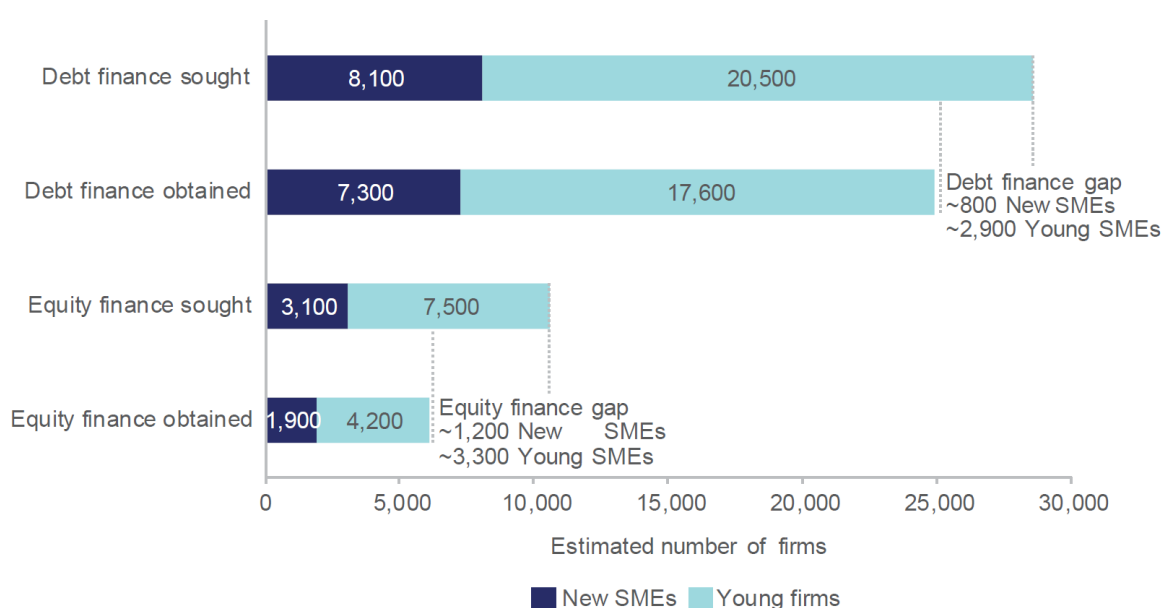
Access to finance is often necessary for the creation, survival and growth of innovative new ventures.³¹ Efficient functioning of capital markets is crucial for entrepreneurs' access to finance. While debt financing by financial institutions plays the most significant role in small firm formation

³¹ Australian Innovation System Report 2015 <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Pages/Australian-Innovation-System.aspx>

after personal savings, equity finance is also an important source of finance particularly for technology- or knowledge-intensive firms.

Innovative start-ups naturally need to seek finance at the commencement of a venture. However, almost a third of innovative Australian businesses have identified a lack of access to additional funds as their biggest barrier to innovation. Innovation-active small and medium sized enterprises (SMEs) are also much more likely to seek debt or equity finance compared to their non-innovation-active counterparts. Access to equity finance is even more difficult than debt finance. The equity finance gap (at around 4,500 new and young SMEs) is larger than the debt finance gap (of 3,700 new and young SMEs) because of the lower success rate. (Figure 17) This indicates that a large number of potentially innovative high growth businesses are missing out on funding.

Figure 17: 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, cat. no. 8167.0 – customised report

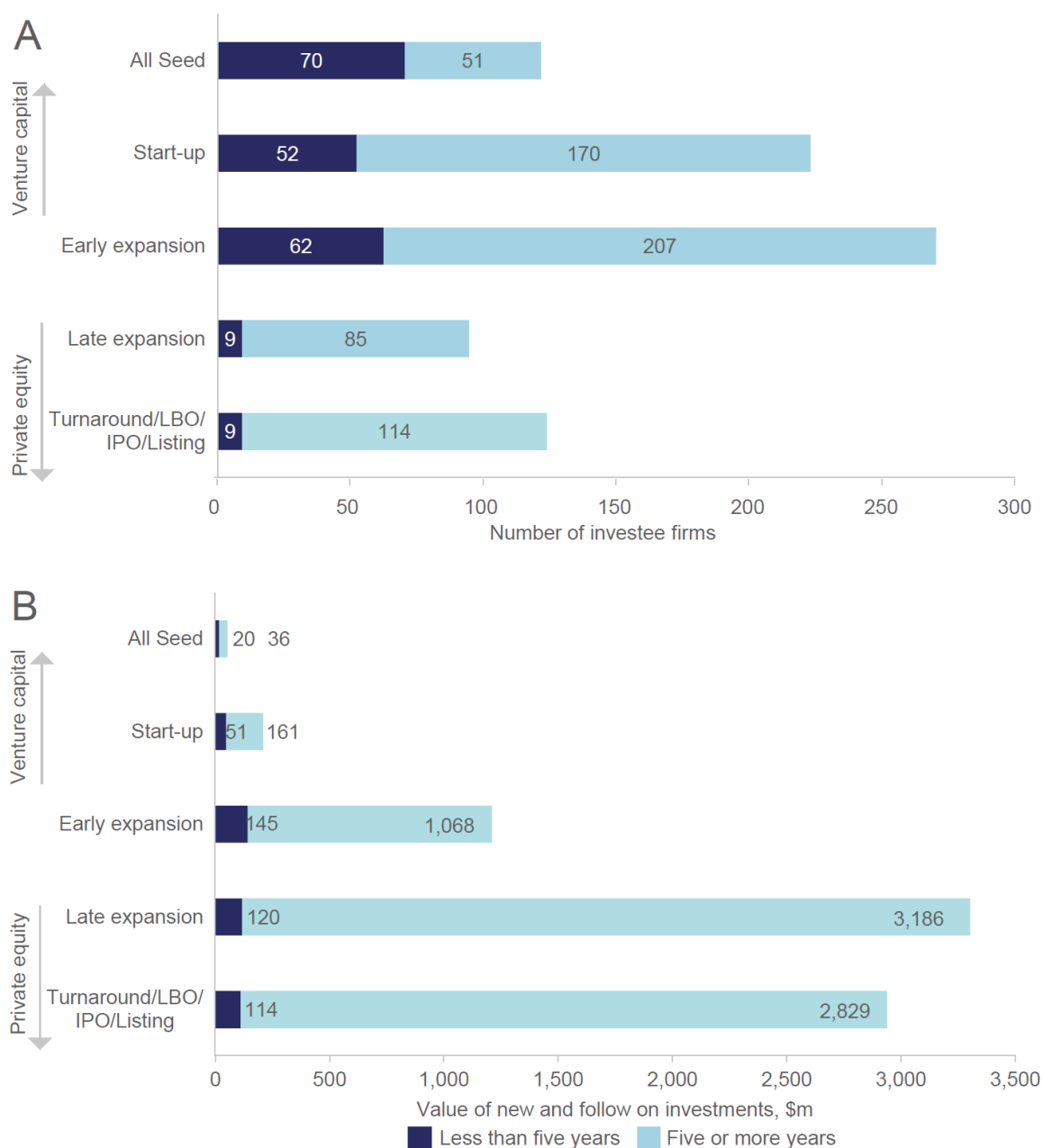
As a specialised form of private equity finance, venture capital can stimulate innovation, spur entrepreneurship, and enhance productivity growth. The venture capital sector is an important component of national innovation systems, playing an important role in driving innovation and supporting skills development by providing finance and other support to turn novel ideas into innovative outputs.

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. 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. 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. In 2013–14, 108 firms were funded out of 8,133 proposals considered. In that same year, there were 94,000 firms seeking equity funding, showing that venture capital

caters for a tiny fraction of these firms. 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.

Data on total venture capital and later stage private equity investment activity in Australia in 2013-14 in various stages of business development in terms of the number of investments shows that the investments are most numerous in start-up and early expansion. (Figure 18: Panels A) However, in terms of the value of investment, the bulk of investment is made in late expansion and turnaround stages. (Figure 18: Panels B)

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

NISA contains measures which will improve the availability of finance for our innovative start-ups to address the existing funding gap for start-up companies and help ensure a steady flow of investment opportunities through to later stage venture capital investors. New initiatives in this area include providing a 20 per cent non-refundable tax offset for early stage investors in innovative start-ups, and a 10 per cent non-refundable tax offset for capital invested in new Early Stage Venture Capital Limited Partnerships (ESVCLPs). They also include increasing the cap on committed capital from \$100 million to \$200 million for new ESVCLPs, reducing the default bankruptcy period from three years to one year and introducing a new regulatory regime for crowd-sourced equity funding. More details on NISA initiatives dealing with collaboration can be found at <http://www.innovation.gov.au/page/national-innovation-and-science-agenda-report>