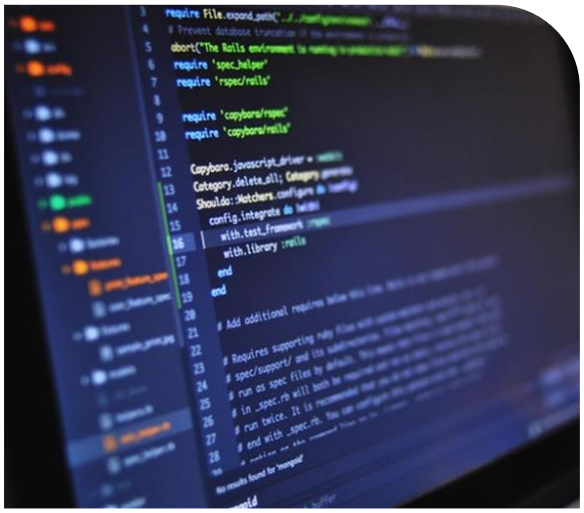
AUSTRALIAN BUSINESS INVESTMENT IN INNOVATION: levels, trends, and drivers

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αlphaβeta
strategy x economics

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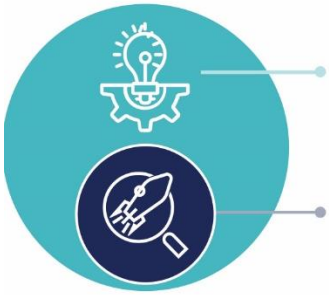
KEY FINDINGS

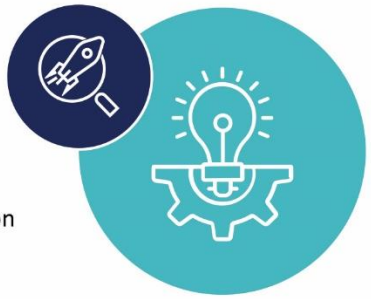
INVESTMENT LEVELS



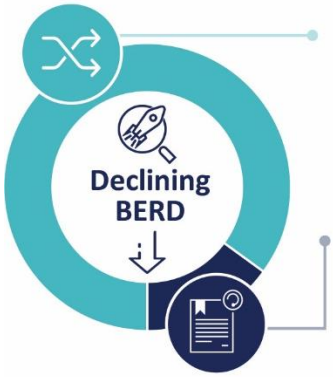
$32-36bn
(2% of GDP)
Innovation investment, including

$17bn
R&D investment

Businesses are
5.5x
more likely
to invest in broader innovation than in R&D only



INVESTMENT DRIVERS



90% of the 2009-2018 decline driven by industry mix and macro factors

10%
driven by other factors

Business services
sectors invest heavily in non-R&D innovation

Manufacturing and Information, Media & Telecoms trail global peers

TRENDS AND IMPACTS

Broader innovation improves business performance,
more so than R&D alone

ASX200 firms that invested in innovation were **more likely to survive and grow** than average firms based on data from 2005-16

Small businesses that accelerated technology adoption grew revenue
3.5ppt
more than other small businesses

Small businesses that use more business software applications grew employment over
2.2ppt
faster than other small businesses

STRATEGIC CHOICES

1.
Should Australia rebalance support for R&D and non-R&D business innovation?

2.
Should Australia prioritise sectors that can lead innovation, and if so, which sectors?

3.
Should Australia customise its innovation agenda by firm size, capability and strategy?

CONTENTS

EXECUTIVE SUMMARY

Australia's prosperity rests to a large degree on the competitiveness of our business sector, and in turn that competitiveness is driven by the rate and character of firm-level innovation. On some aggregate measures like Research and Development (R&D) investment, Australia's business sector appears to be rapidly falling behind in the global innovation race. This has been a concern for business leaders and policymakers alike.

In this project we have put investment in innovation under the microscope. The report creates a baseline for Australian business investment in innovation, diagnosing the key trends and drivers, and the opportunities by sector and firm size, to accelerate innovation investment by businesses. Finally, it defines strategic choices policymakers need to make now to accelerate innovation investment, and help Australia increase jobs, growth and productivity.

We find that while falling R&D is a concern, the distinctive structure of Australia's economy means that economy-wide R&D only gives a partial picture of Australia's innovation performance. In the past decade, structural and cyclical factors – including the mining cycle – have further muddied the waters. In many sectors, Australia invests more in R&D than our global peers do. But Australia is not competing as intensively in what many believe are the most lucrative parts of the global innovation race.

For a holistic view, we have analysed a range of data sources on a broad spectrum of innovation investment. Unlike R&D, aggregate investment in innovation appears to have been stable as a share of GDP since the early years of this decade. It includes R&D but also encompasses investments in a range of areas such as digital, data, design, and organisational capability. Non-R&D investment by firms in Australia now appears to equal or exceed investment in R&D.

Investment in non-R&D innovation is more widespread than R&D innovation, and it may also be a stronger driver of productivity than R&D. For every Australian business that invests in R&D, more than five firms invest in innovation more broadly. Small firms are much more likely to invest in non-R&D innovation than in R&D. Productivity growth also tends to be stronger in sectors where more firms are making these non-R&D innovation investments. And positively, since 2013 there has been an increasing number of firms identifying as making such investments.

International studies on intangible assets (created by firms when they invest in innovation) suggest they are growing in importance. While Australia's large firms overall appear to lag on intangibles, in fact, the gap to global peers is due Australia's industry mix, as Australia has smaller manufacturing and information, media and telecommunications (IMT) sectors than global peers.

Meanwhile, only 25 – 40 per cent of small firms undertake innovation, and when they do, they tend to focus on non-R&D activities. Those small firms that are investing in digital and ICT technologies experience better employment and growth outcomes.

This data brings Australia's innovation challenges into greater focus. First, Australia's unique mix of sectors results in a significantly different pattern of innovation investment to global peers, both in R&D and beyond it. Second, innovation beyond R&D plays a key and perhaps under-appreciated role in many sectors. And third, firms of different types innovate in different ways.

For policymakers, we believe the findings emphasise the need to lift both R&D investment and non-R&D innovation investment. The policy mix required to achieve this will be shaped in part by three key choices:

- Should policymakers rebalance support for R&D and non-R&D business investment in innovation?
- Should policy focus on growing our activity in the most R&D-intensive sectors, namely Manufacturing and IMT, or in other sectors, and if so which ones?
- Should the innovation policy mix be customised based on firm characteristics, capability, and strategy?

This report has clearly identified the growing complexity of the innovation landscape in Australia, which in turn raises issues around what types of innovation investments policymakers should measure, compare and target. We are mindful that the Government's Innovation Metrics Review has been working on this problem intensively over recent months, and commend that work whilst noting that the ongoing evolution of the economy will ensure that remains an ongoing challenge.

1. AUSTRALIAN BUSINESSES INVEST EQUALLY IN R&D AND OTHER FORMS OF INNOVATION

Australian businesses perform a range of innovation activities, including R&D as well as broader product, process, and business model innovations. Australian business investment in innovation is estimated at $32-36 billion annually, or 1.9 per cent of GDP in 2016-17, of which about half is R&D ($16.7 billion in 2015-16, and $17.4 billion in 2017-18).[1] This investment generates economic benefits for the investing firms and their customers in the form of higher incomes, better products and lower prices.

1.1. Innovation includes both R&D and other activities

Australian businesses invest in many activities that support innovation. These range from research and development using scientific methods and experimentation, through to product design, and investments in training and in staff that undertake innovative work. These different innovation-supporting activities are tracked in two main ways in official statistics:

1. **Research and Development (R&D).** Research and Experimental Development (R&D) is defined by the OECD's Frascati Manual as "creative and systematic work undertaken in order to increase the stock of knowledge - including knowledge of humankind, culture and society - and to devise new applications of available knowledge".[2] To qualify as R&D, an activity must be novel, creative, uncertain, systematic, and result in transferable and/or reproducible knowledge. There are three types of R&D activity:
    - **Basic research:** experimental or theoretical work that aims to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view;
    - **Applied research:** original investigation that aims to acquire new knowledge directed primarily toward a specific, practical aim or objective;
    - **Experimental development:** systematic work that draws on prior research and practical experience to produce additional knowledge, which used to produce new products or processes or to improve existing products or processes.

    In Australia, Business Expenditure on R&D (BERD) is measured in the ABS series *8104.0 Research and Experimental Development, Businesses, Australia*.[3] This report uses the Frascati definition when referring to R&D.

[1] See Exhibit 2 and its sources.

[2] OECD (2015), *Frascati Manual 2015*, p44.

[3] ABS (2019), *8104.0 – Research and Experimental Development, Businesses, Australia, 2017-18* – Explanatory Notes; Office of the Chief Economist (2019), 'Comparison of R&D Expenditure from BERD, RDTI and BIT data sources'.

2. **Innovation**. Innovation is distinct from R&D but may include it. The OECD's Oslo Manual defines a business innovation as "a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous product or business processes and that has been introduced on the market or brought in to use by the firm".[4] The OECD recognises two main types of innovation:
    - **Product innovations**, which are "new or improved goods or services that differ significantly from the firm's previous goods or services and that have been introduced on the market"; and
    - **Business process innovations**, which are "new or improved business processes for one or more business functions that differ significantly from the firm's previous business processes and that have been brought into use by the firm".[5]

In Australia, innovation is measured in the ABS' Business Characteristics Survey and reported in its publication *8158.0 Innovation in Australian Businesses*.[6] This report uses the Oslo definition of innovation almost exclusively.[7] When this report refers to "non-R&D innovation" it refers to the difference between the Oslo definition of innovation and R&D (Exhibit 1).[8]

On occasion, the report also uses the terms "innovation" and "innovation-related" in connection with activities that may fall outside the Oslo definition. For example, the report cites evidence on firms' intangible assets and on their investment in information technology and adoption of new processes such as online software applications. Such measures can provide insights into innovation-related activity, but they are likely to be noisier indicators of innovation. For example, intangible investment encompasses a broad range of activities, including R&D, non-R&D innovation, and non-innovation related advertising and staff training.[9]

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[4] OECD (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation,* 4th Edition. This definition includes innovations developed by a firm, as well as those developed externally and introduced by the firm. The definition therefore captures the diffusion of innovations from firm to firm throughout the economy.

[5] The most recent issue of ABS *8158* was released prior to the most recent Oslo Manual, and uses a definition of innovation that breaks out business process innovation into several parts: "An innovation is the introduction of a new or significantly improved good or service; operational process; organisational/managerial process; or marketing method."

[6] ABS (2019), *8158.0 Innovation in Australian businesses*, 2016-17 Explanatory Notes.

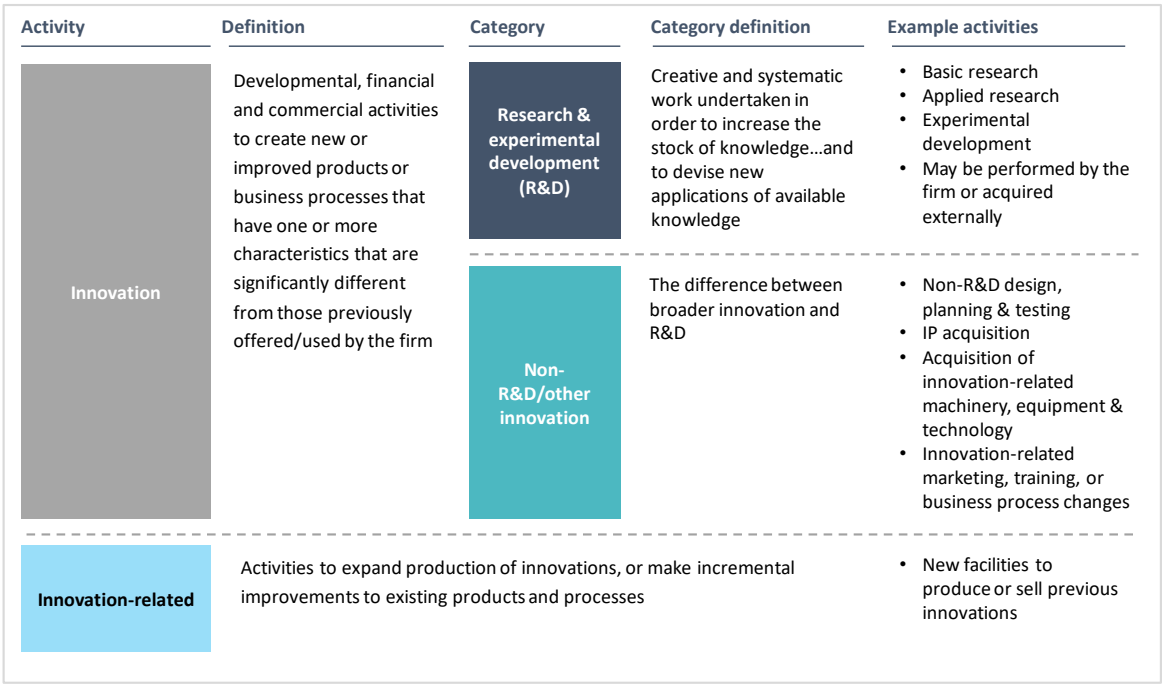
[7] For a review of approaches to measuring innovation, see Rogers, M (1998), 'The definition and measurement of innovation', Melbourne Institute Working Paper no. 10/98, Melbourne Institute of Applied Economic and Social Research.

[8] Surveys of innovation based on the Oslo Manual, such as ABS 8158, do collect information about expenditures on R&D. But estimates of R&D from such surveys may be less reliable than statistics dedicated to BERD. For example, in collecting data for ABS 8158, "a detailed definition of Research and Experimental Development was not provided. No interpretation checks were made." In addition, the sample coverage of firms that undertake R&D in ABS 8158 may not be as comprehensive as that of ABS 8104.

[9] Productivity Commission (2009), *Investments in Intangible Assets and Australia's Productivity Growth*; Elnasri A, Fox K (2017), 'The contribution of research and innovation to productivity'; UK Office for National Statistics (2019), *Developing experimental estimates of investment in intangible assets in the UK: 2016*

Exhibit 1

Businesses invest in a wide variety of innovative activities



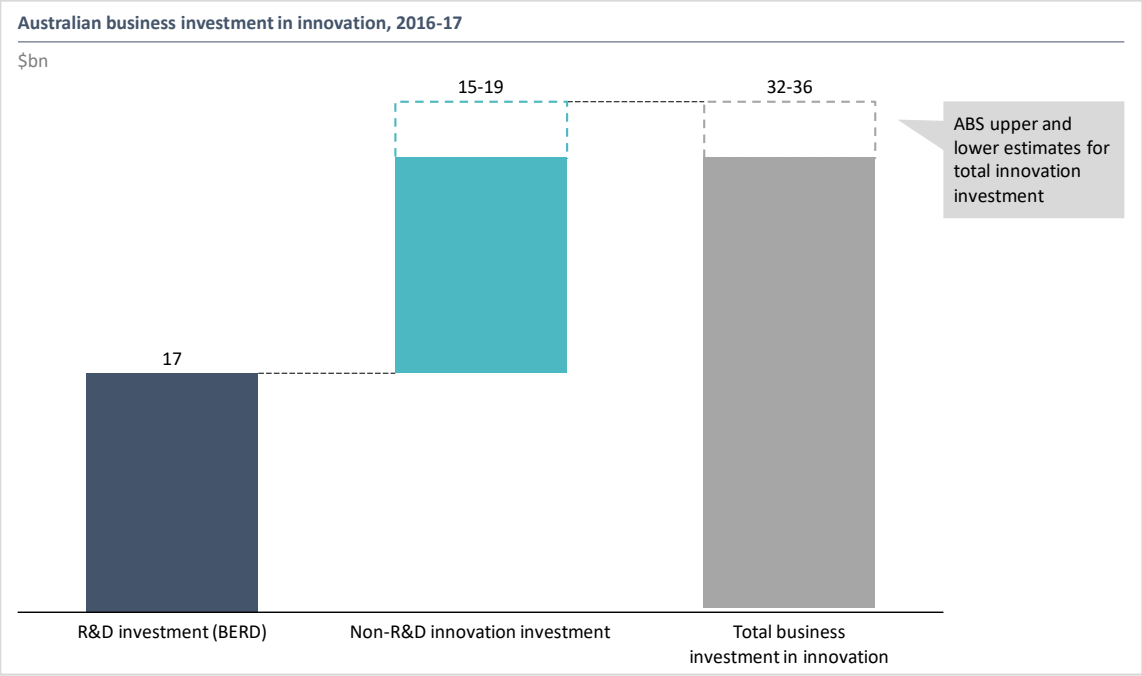
Source: 1. OECD (2015) Frascati Manual. 2. OECD (2018) Oslo Manual.

1.2. R&D accounts for half of Australian businesses' innovation expenditure

While BERD is the focus of much discussion on business investment in innovation, it only tells half the story. Australian businesses spent an estimated $32-36 billion, or just under 2 per cent of GDP, on innovation in 2016-17 (Exhibit 2).[10] About half of that investment is likely to have been R&D – $17 billion or just under 1 per cent of GDP.[11]

Exhibit 2

R&D constitutes about half of Australian businesses' innovation investment



Source: BERD: ABS (2017, 2019), 8104 (mean of 2015-16 and 2017-18 values); Total business investment in innovation: ABS (2018) 8158.0 Appendix 1: Explanatory Notes: Innovation Expenditure by Dollar Ranges (for 2016-17); Non-R&D innovation calculated as the difference between BERD and Innovation. (As explained in footnote 8, it is likely that the measure of R&D in ABS 8104 is more reliable than any measure that could be inferred from ABS 8159.)

[10] The $32-36 billion range reflects uncertainty about firm-level investment in the broader measure of innovation, in part because firms report expenditure in ranges to the ABS (ABS *8158*). Estimates of BERD in ABS 8104 are free from this source of uncertainty.

[11] The ABS publishes BERD statistics every two years. Australian businesses invested $16.7 billion in R&D in 2015-16 (1.00 per cent of GDP) and $17.4 billion in 2017-18 (0.94 per cent of GDP).

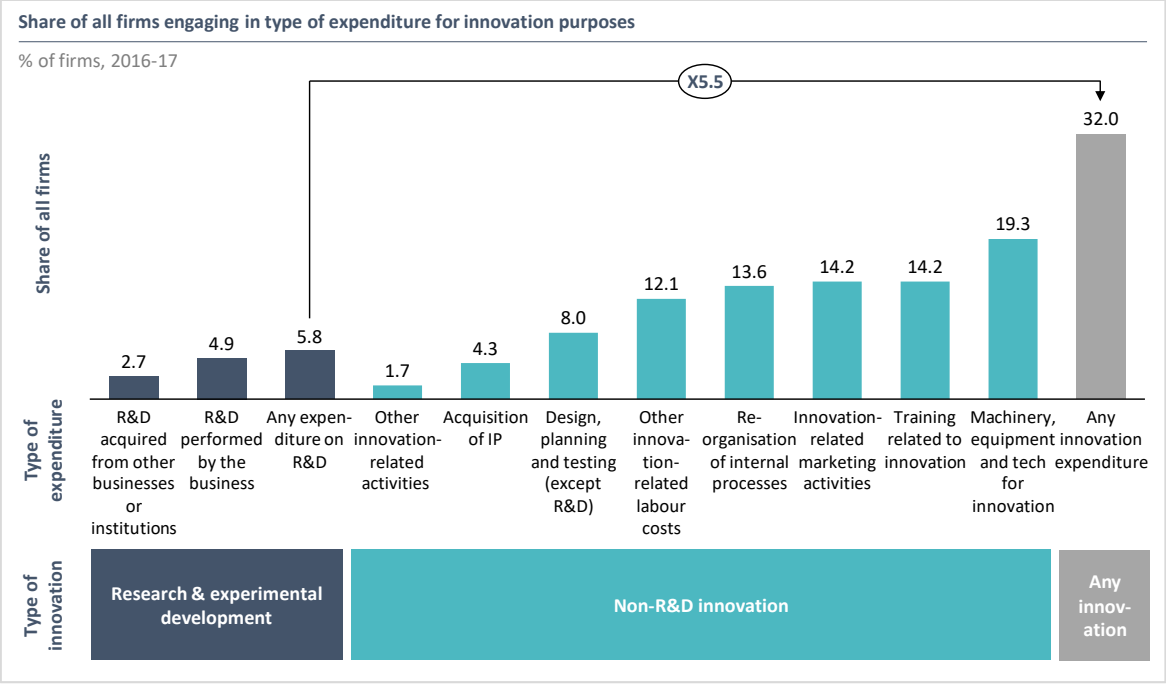
1.3. Many more Australian firms invest in innovation than in R&D alone

Almost a third of Australian firms invest in some form of innovation, while just 5.8 per cent of firms invest in R&D (Exhibit 3). Of the firms that do invest in R&D, four in five spend more than half their total innovation budget on non-R&D activity.

When Australian firms invest in non-R&D innovation, many of them invest in technology. Almost one in five firms purchased machinery or equipment for innovation in 2017. Around 14 per cent of firms spent money on internal business re-organisation for innovation. About the same proportion of firms report spending on marketing or training related to innovation (Exhibit 3).

Exhibit 3

More than 5 times as many Australian businesses invest in innovation than in R&D alone



Source: ABS (2018), 8158.0. Excludes responses of firms that say they are innovation-active but report no expenditure on innovation.

2. RECENT BUSINESS R&D DECLINES ARE MOSTLY DUE TO THE MINING CYCLE AND CHANGING SECTOR MIX

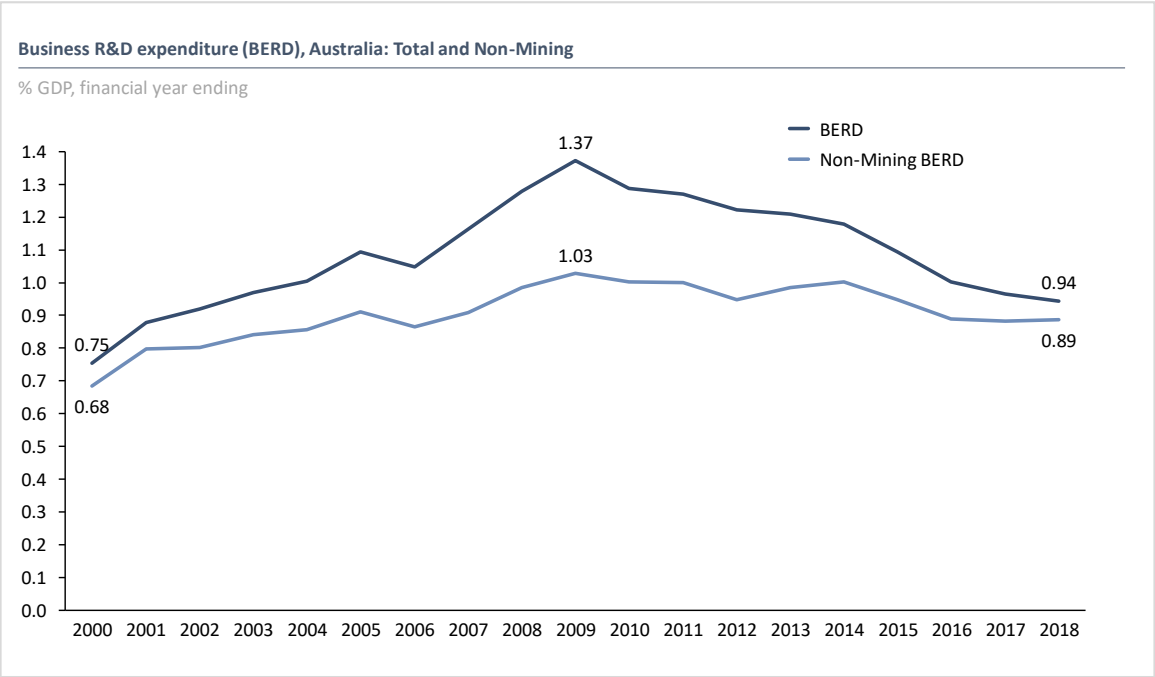
Australian BERD has declined by over 30 per cent since its 2008-09 peak. This is mostly due to its changing industry mix and macroeconomic factors, such as the decline of mining exploration.

2.1. Australia's business R&D has declined 30 per cent as a share of GDP since its peak

Australian BERD peaked in 2008-09 as a share of GDP at 1.37 per cent, and has since declined by over 30 per cent, to 0.94 per cent of GDP. Australia's BERD is also low by OECD standards. These facts have created concern about the causes and effects of declining BERD, and about how Australian policymakers should respond.[12]

Exhibit 4

Australian business investment in R&D peaked as a share of GDP in 2008-09



Source: ABS 8104 and 5204, AlphaBeta analysis. 2012-13, 14-15 and 16-17 BERD linearly interpolated.

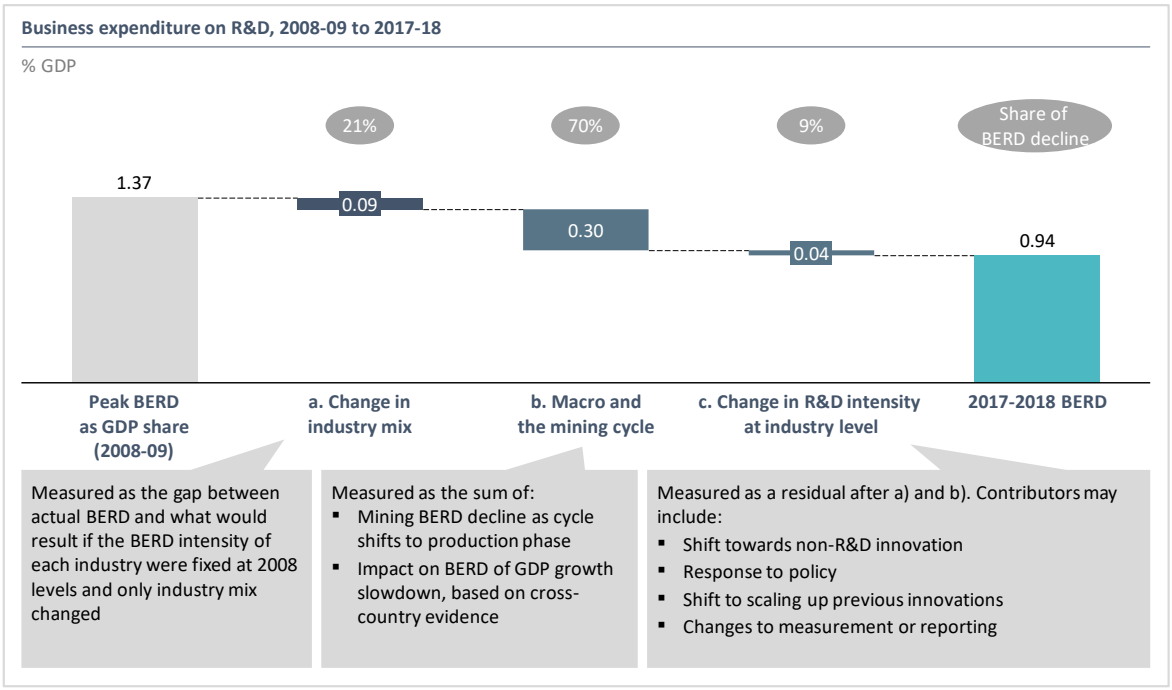
[12] Department of Industry, Innovation and Science (2017), *Australia 2030: Prosperity through Innovation* and *Australian Innovation System Report 2017*.

Australian BERD peaked at 1.37 per cent of GDP in 2008-09, and declined to 0.94 per cent by 2017-18 (Exhibit 4). Non-mining BERD also peaked in 2008-09, at 1.03 per cent of GDP. It declined to 0.89 per cent by 2015-16, where it remained in 2017-18, the latest year for which there is data.

Over 90 per cent of the decline in BERD as a share of GDP since it peaked has been due to macroeconomic factors – primarily a decline of mining exploration and development after the boom of the late 2000s – and Australia's changing industry mix (Exhibit 5). Under 10 per cent of the drop was due to other factors, such as declining BERD intensity at an industry level.

Exhibit 5

Australia's industry mix and macroeconomic factors explain over 90% of the change in BERD in the last decade



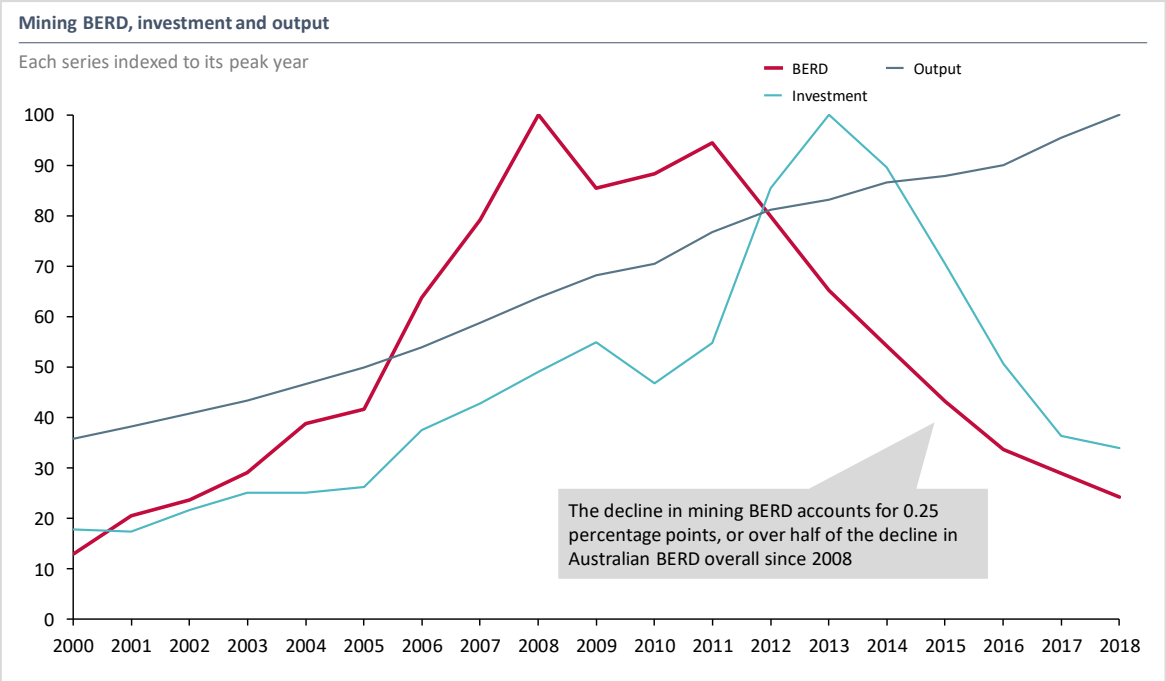
Source: ABS 8104 and 5204, AlphaBeta analysis

2.2. The mining cycle explains 70 per cent of the decline in Australian BERD

The mining cycle explains about 70 per cent of the decline in BERD's share of Australian GDP since it peaked in 2008-09. Mining contributed a quarter of total Australian BERD in 2008-09, or about 0.37 per cent of GDP. As Australia's mining cycle moved from its development phase to production, mining sector BERD fell 63 per cent, to comprise only 6 per cent of total BERD in 2017-18 (Exhibit 6), and just 0.06 per cent of that year's GDP. Lower economic growth since 2008-09 is also likely to have contributed to the reduction in BERD/GDP, but only modestly.[13]

Exhibit 6

Mining BERD declined as the cycle shifted to production phase



Source: ABS 5204, Table 1 and 52; ABS 8104. BERD is per cent GDP; Investment is Gross Fixed Capital Formation, per cent GDP. Output is chain volume Gross Value Added. BERD data linearly interpreted for FY12-13, FY14-15, and FY16-17

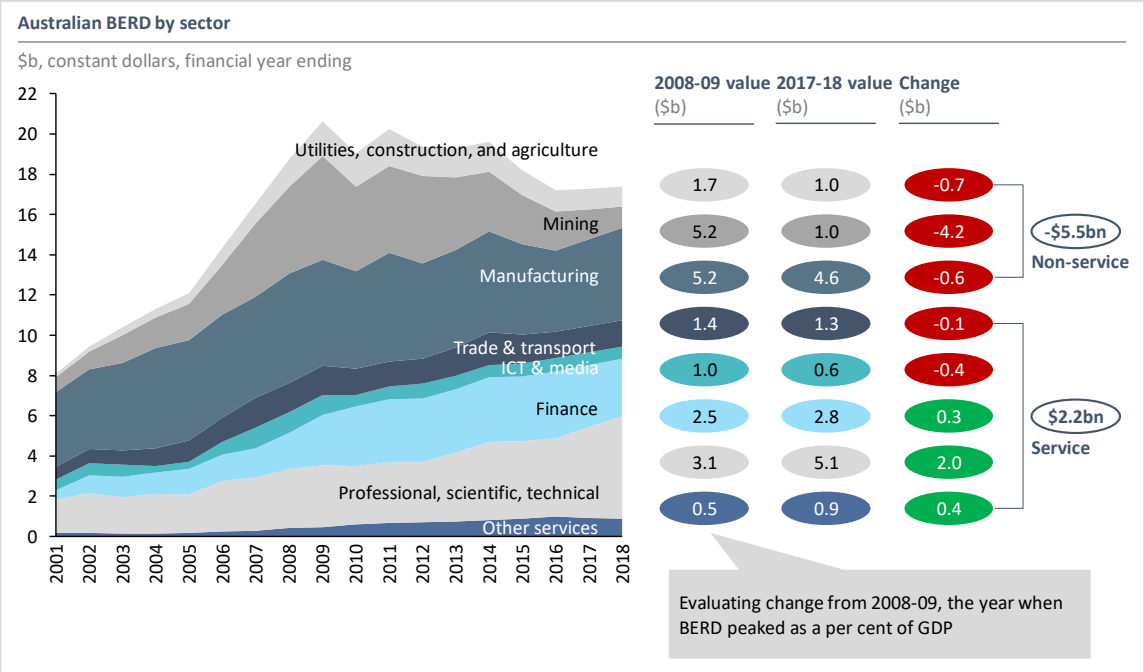
[13] BERD tends to be a little lower during periods when growth is slower: the elasticity of BERD / GDP to GDP growth is about 1.2 for OECD economies since 2000 (AlphaBeta analysis of data from stats.oecd.org). Australia's real GDP grew about 1 percentage point more slowly in the last few years than it did in the years around 2008-09. The growth slowdown since the late 2000s may have reduced Australia's BERD / GDP ratio by about 1.2 per cent, or just 0.01 percentage points of GDP.

2.3. Changing industry mix explains a fifth of BERD's decline

Changes in industry mix account for a further fifth of Australia's decline in BERD's share of GDP between 2008-09 and 2017-18, or a reduction of 0.09 percentage points of GDP. The main cause is a decline in manufacturing and an increase in services. Manufacturing sector BERD declined from $5.2 billion to $4.6 billion (Exhibit 7). BERD did increase in service sectors by $2.2 billion, while non-services BERD fell $5.5 billion between 2008-09 and 2017-18 (and by $1.3 billion excluding mining).

Exhibit 7

Post-GFC BERD reflects Australia's changing industry mix, with non-service BERD falling $5.5b and service BERD growing $2.2b



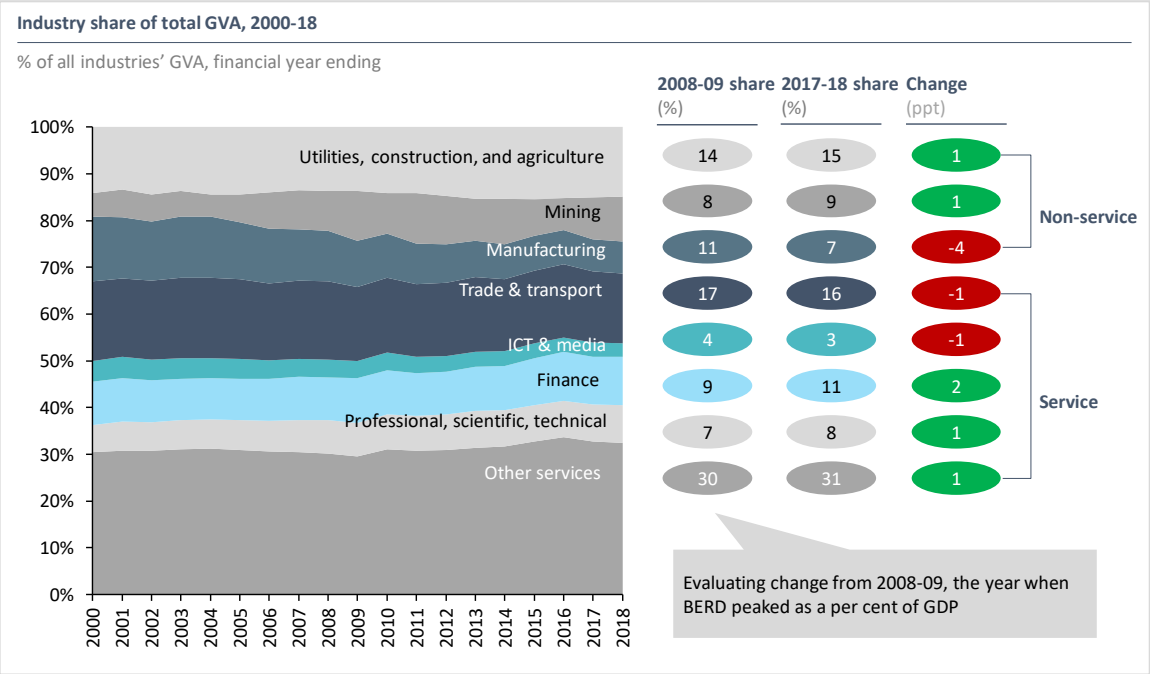
Source: ABS (2019), 8104.0; ABS (2019), 5204.0 Tables 1 and 4. Deflated by CPI. BERD data linearly interpreted for FY12-13, FY14-15, FY16-17.

Changes in the relative size of sectors contributed to these changes in BERD. Manufacturing's contribution to Gross Value Added (GVA) decline from 11 to 7 per cent between 2008-09 and 2017-18 (Exhibit 8).

Differences in sector mix also account for much – but not all – of the difference in the BERD share of GDP between Australia and its OECD peers. Australia has relatively small manufacturing and IMT sectors. They are also less BERD-intensive than their global competitors (Section 3.1 below).

Exhibit 8

Since the GFC, non-services industries' share of GVA has declined



Source: ABS 5204, current price GVA. AlphaBeta analysis.

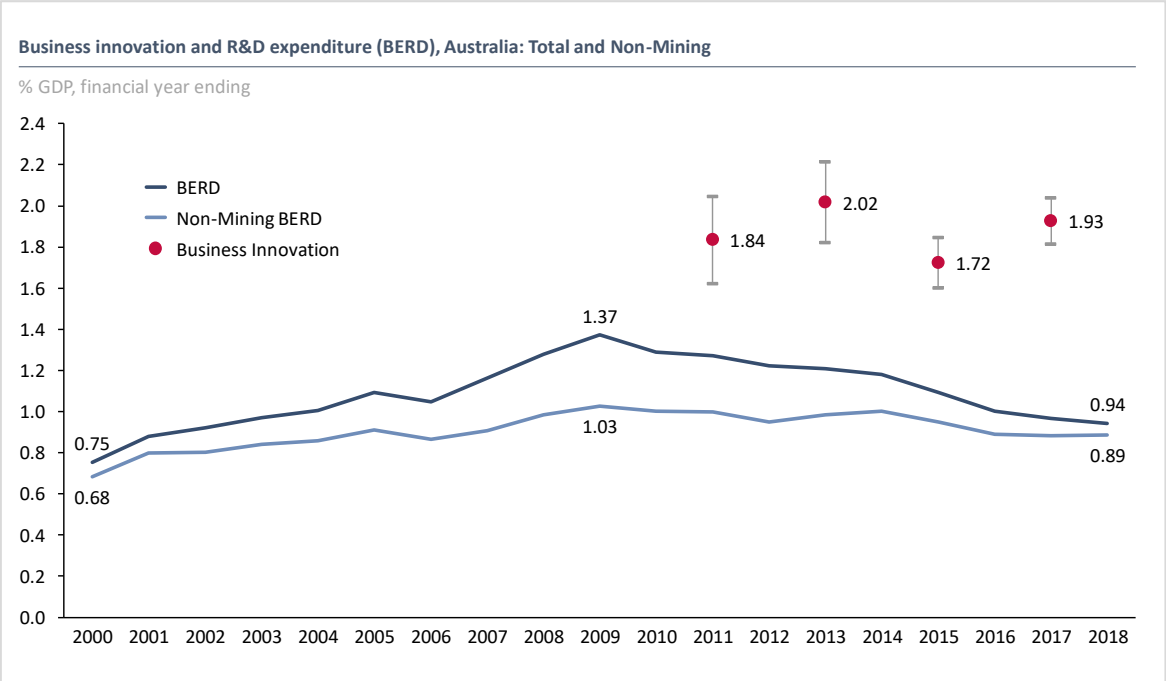
2.4. Declines in sector-level R&D intensity explain about 10 per cent of BERD's decline

Only a tenth of the decline in BERD as a share of GDP since 2008-09 is due a decline in non-mining R&D intensity at the industry level.[14] Non-mining BERD peaked in 2008-09 at 1.03 per cent of GDP, and has then declined to 0.89 per cent of GDP by 2017-18. Of that decline, most was explained by the shift in industry mix discussed above. Only the remaining 0.04 percentage point fall in BERD/GDP (about a tenth of the total) is due to a fall in non-mining R&D intensity within non-mining sectors.

And even that decline may not represent a fall in overall innovation effort: there is evidence for a **shift from R&D to non-R&D forms of innovation** (Exhibit 9). The ABS's estimates of aggregate innovation expenditure have not changed much, averaging 1.7-1.9 per cent of GDP since 2011-12.

Exhibit 9

Business investment in innovation overall has not declined as much as business investment in R&D, as a share of GDP



Source: BERD: ABS 8104; Business Innovation: ABS 8158 appendices; GDP: ABS 5204. 2013 and 2015 nominal BERD values are linearly interpolated. Innovation values are midpoints of the ABS estimated business innovation expenditure ranges that are represented by the grey bars on the chart.

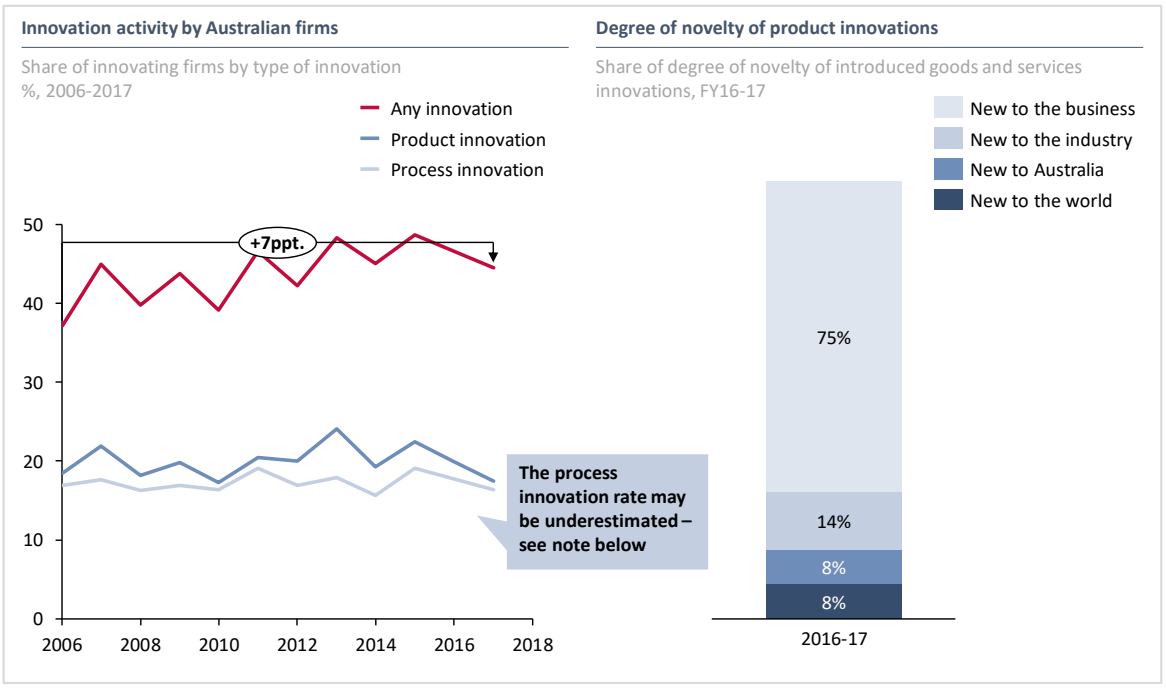
The proportion of firms that report being innovation-active increased in this period, from about 40 per cent to 45-50 per cent in the decade to 2015-16 (Exhibit 10). Firms may be reallocating a stable or growing innovation budget from R&D to non-R&D innovation.

[14] Excluding the likely small effect of lower GDP growth, as discussed above.

While the share of Australian firms that actively innovate has risen in the last decade, relatively few are producing innovations that are new to Australia and the world. Only 28 per cent of innovations introduced by Australian firms in 2014-15 were new to market, and only 8 per cent of innovations introduced in that year were new to the world. Australia's performance in innovation novelty was ranked 23rd out of 31 countries in the OECD in 2012-13 (Exhibit 10), raising the question of whether accelerating product or novel innovation is sufficiently incentivised or prioritised.

Exhibit 10

More Australian firms are innovating than in the past, though few of them make world-first innovations



Source: ABS 8158. Includes some firms that do not report any expenditure on innovation. Innovation activity is linearly interpolated for FY15-16. "Innovating firms" introduced an innovation in the financial year, except if the innovation is in development or abandoned. An overall process innovation rate cannot be extracted from reported data: chart shows largest process innovation category in each year.

Policy change to R&D tax incentives may have prompted some firms to cut R&D, though evidence is not clear cut.[15] Perceptions of announced but unlegislated policy changes could also change innovation effort.[16] However, it is difficult to detect such impacts on the overall BERD rate (Exhibit 11).[17]

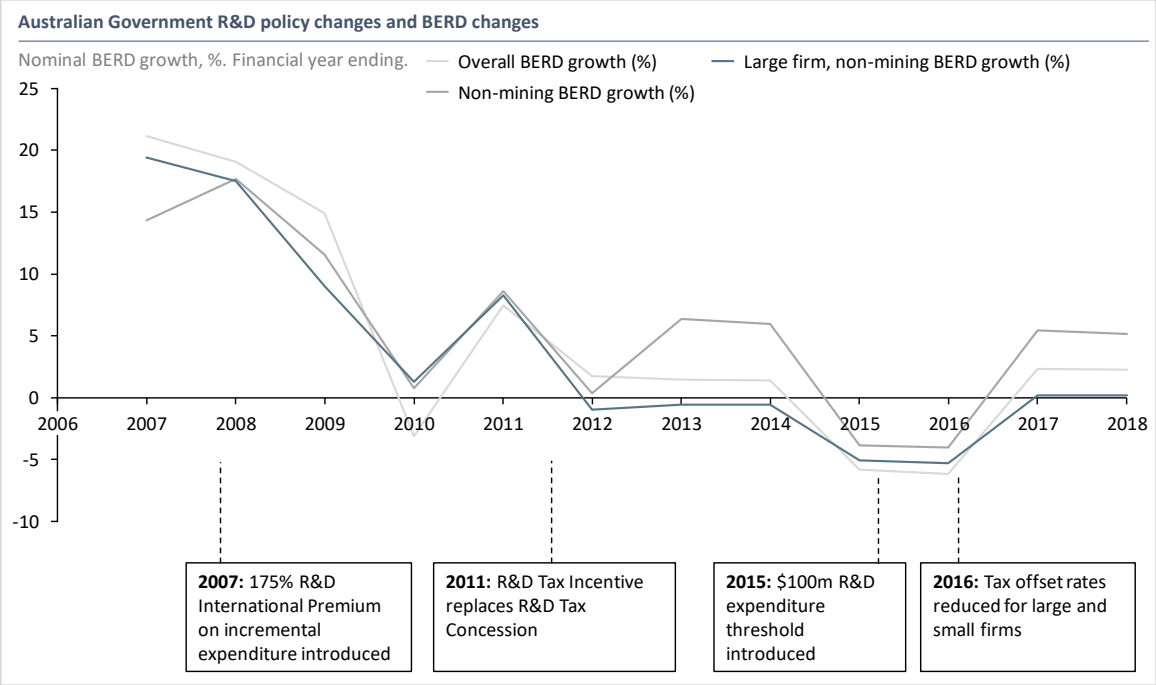
[15] Office of the Chief Economist (2019), 'Comparison of R&D Expenditure from BERD, RDTI and BIT data sources'. At the firm level, the ABS's BERD measure is positively correlated with ATO RDTI claims.

[16] Startup Aus (2019), *Crossroads V*; Holt J, Skali A, and Thomson R (2016), 'The additionality of R&D tax policy in Australia'

[17] More generally, micro-data is likely to be needed to identify the effects of recent R&D tax reforms on firm R&D, as each reform will have changed firms' incentives differently depending on their profitability, size, and how much they spend on R&D.

Exhibit 11

RDTI changes may affect BERD



Source: ABS 8104.0; DIIS, History of the R&D Tax Concession; Office of the Chief Economist (2019), Comparison of R&D expenditure from BERD, RDTI and BIT data sources. Annual BERD growth rates starting in FY2012 are based on biannual data: values for FY2013, FY2015 and FY2017 linearly interpolated from adjacent years.

A **shift from innovation to scale-up** could also cause R&D to decline at the sector level. Neither BERD nor the Oslo measure of innovation include efforts to scale up existing innovations for production, so measured innovation may stagnate even as firms invest to scale up and roll out innovations through the economy. But outside of the mining sector (shown in Exhibit 6 above) there is little evidence for a shift from R&D to expansion: Australian capital investment has been weak in recent years, suggesting that firms have probably not intensified their efforts to scale up previously made innovations.[18]

Finally, while **changes to measurement or reporting** could explain changes in R&D at the sector level, again evidence is lacking. For example, if expenditure on R&D-related intangible assets is less completely reported than expenditure on tangible assets, then a shift towards intangibles might explain the decline in reported R&D. Intangible assets have increased as a share of the overall capital stock, and (at least in the US) firms do not report all their efforts to build such assets as part of their

[18] Grattan institute (2016), *Stagnation Nation: Australian Investment in a Low-Growth World*; Reserve Bank of Australia (2018), *Private Non-mining Investment in Australia*.

capital investment.[19] But there is no evidence on whether the economy-wide shift towards intangibles has changed how much of firms' R&D expenditure is reported. Without further research, there is little reason to think that measurement or reporting changes account for changes in sector-level R&D intensity.

Overall, the mining cycle and economic structural change in Australia account for most of the decline in BERD since it peaked in 2008-09, with a minor contribution from slower economic growth. The modest decrease in R&D intensity at the sector level seems likely to reflect a shift towards non-R&D innovation investment.

[19] Productivity Commission (2009), *Investments in Intangible Assets and Australia's Productivity Growth*; Elnasri A and Fox K (2017), 'The contribution of research and innovation to productivity'. US National Bureau of Economic Research (2019), 'Understanding Weak Capital Investment: The Role of Market Concentration and Intangibles'. US firms that report more intangible assets report lower levels of capital investment, given their market and book values. That may be because they record expenditure that builds intangible assets as operating rather than capital expenditure.

3. AUSTRALIAN BUSINESS INVESTMENT IN INNOVATION REFLECTS SECTOR MIX AND FIRM SIZE

While Australian businesses and industries are not laggards at innovation investment, they are also not realising their full potential or the full benefits of innovation investment. Compared to their global peers, Australian firms as a group invest less in R&D, and there is evidence that large firm balance sheets are less rich in intangible assets such as patents and trademarks.

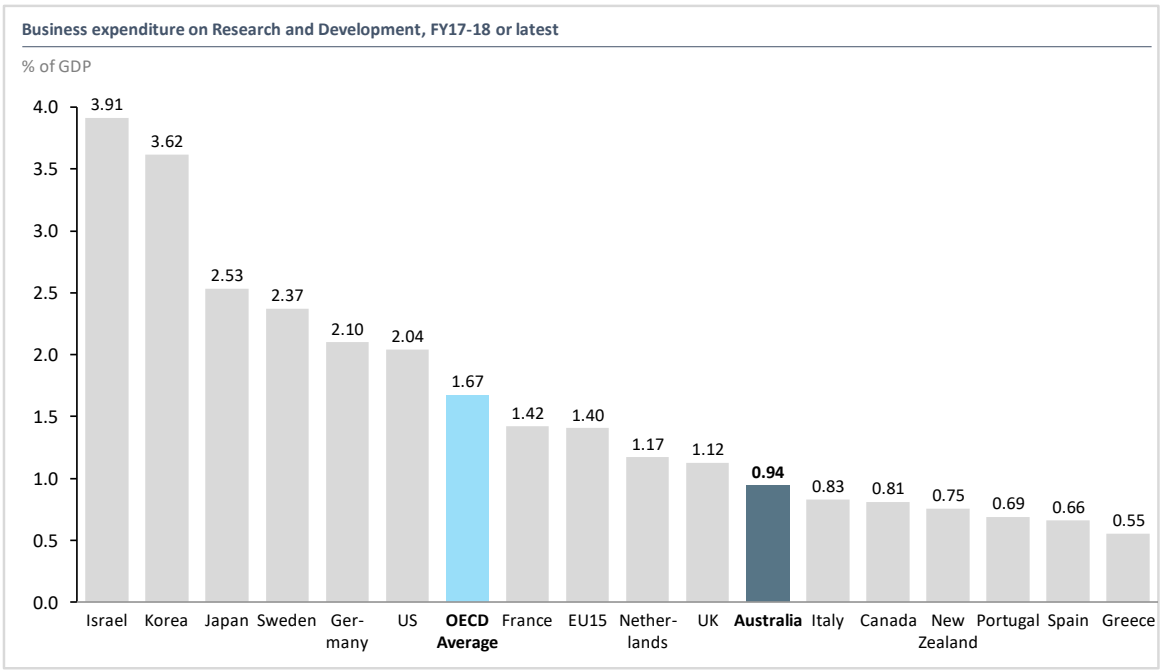
Much of the gap to peers is due to industry mix: manufacturing and ICT comprise a smaller share of the Australian economy than in peer economies. But the sectoral intensity of R&D and innovation in Australia also differs from peer economies. For example, many Australian services firms invest relatively strongly in innovation. One promising area for Australia is business services, including professional services and financial services, and segments within ICT, such as business-to-business (B2B) software and services.

3.1. Australian firms invest less in R&D than peers, mostly due to industry mix

Australia's business expenditure on research & development (BERD) is low compared with OECD countries. BERD is under 1 per cent of GDP, less than two-thirds of the OECD average of 1.67 per cent as a share of GDP (Exhibit 12). For comparison, businesses in Israel and South Korea invest over 3.5 per cent of GDP in innovation. The US and Germany invest just over 2 per cent of GDP. Australia invests a higher proportion of GDP in R&D than Italy, Canada, New Zealand, Portugal, Spain and Greece.

Exhibit 12

Australian businesses invest less in R&D than many peers do



Source: BERD as a percentage of GDP, OECD Main science and technology indicators; ABS.

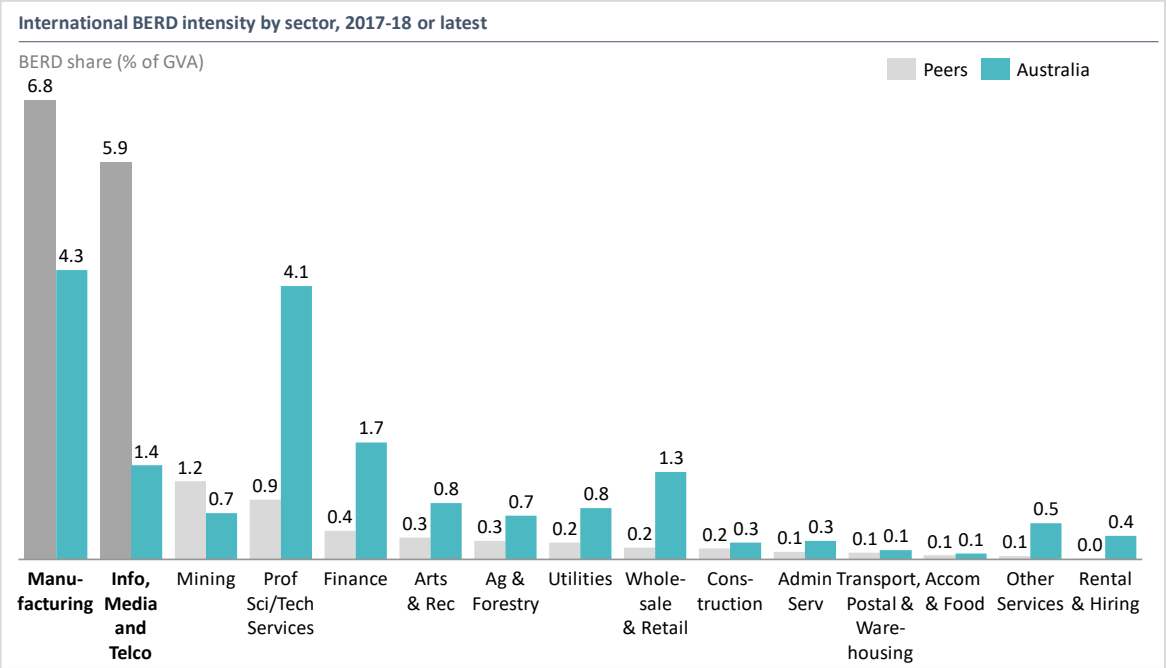
The two sectors that contribute most to BERD in other advanced economies contribute significantly less in Australia. Manufacturing drives 70 per cent of BERD in a group of peer economies – Canada, the US, UK, Korea, Japan, and Germany – but only about a quarter of BERD in Australia.[20] Similarly, the IMT sector accounts for 24 per cent of BERD in the OECD, but just 3.5 per cent in Australia.

In part, this is because the Manufacturing and IMT sectors are less BERD-intense in Australia than they are in the rest of OECD, as shown in Exhibit 13. Australian manufacturers invest 4.3 per cent of Gross Value Added (GVA) in R&D; elsewhere in the OECD, manufacturers invest 5.9 per cent. Australian IMT firms invest 1.4 per cent of GVA in R&D, but on average in the OECD IMT firms invest 5.9 per cent of GVA.

[20] OECD (2019), *Main Science and Technology Indicators*; AlphaBeta analysis

Exhibit 13

The manufacturing and ICT sectors drive BERD globally, but the R&D intensity of those sectors is lower in Australia



Source: ABS (2019), 8104.0; ABS (2019), 5204.0; OECD (2016) ANBERD databases.
Note: Latest available is 2017-18 for Australia and 2015-16 in most other cases. Global peers are the US, Canada, Korea, Japan, UK and Germany. BERD intensity is GVA-weighted average of BERD intensity of each country's industries.

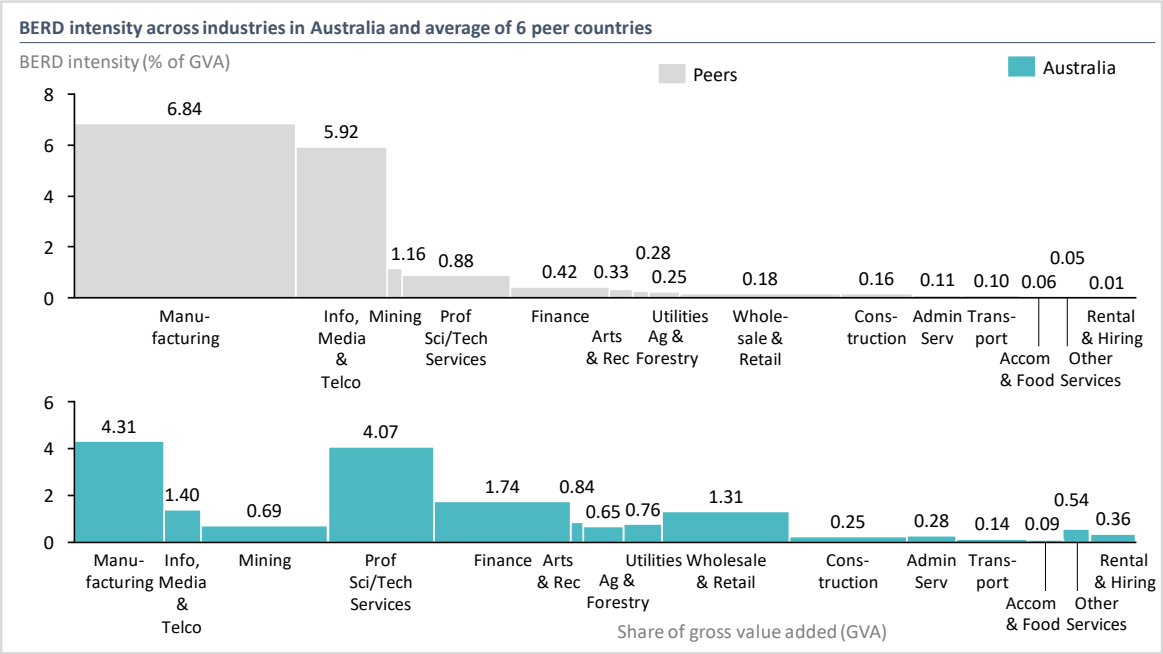
However, Australian firms in all other sectors report higher R&D intensity than firms. In particular, the Australian Finance, Professional, Scientific and Technical Services, and Wholesale & Retail Trade sectors report much higher R&D intensity than do those same sectors in leading peer economies.

Australia's sector mix also strongly affects its overall R&D intensity. Exhibit 14 combines each sector's R&D intensity with its size, both for Australia and for a set of high-performing peer economies: Canada, the US, the UK, Korea, Japan, and Germany. The height of each block in Exhibit 14 is a sector's BERD intensity, and its width denotes its share of GVA, so the area of each "block" is proportional to that sector's total contribution to BERD. Manufacturing and IMT are significantly smaller in Australia (as well as being less BERD-intense, as shown above), so their contribution to overall BERD is much lower in Australia than elsewhere. By contrast, the Finance, Professional, Scientific and Technical Services are larger and more BERD-intense in Australia than in international peer economies, and so they contribute much more of overall BERD in Australia than they do in our peers.[21]

[21] Earlier studies have also found that industry mix accounts for part of the difference between Australia's BERD and that of global peers. For example, a 2005 study found that the gap between Australia's BERD intensity and that of Japan and the US was in part explained by industry mix (Davis, G and Tunny, G, 'International comparisons of research and development', *Economic Roundup*, Spring 2005, Australian Treasury).

Exhibit 14

The composition of Australia's BERD and output differs from global peers



Source: ABS (2019), 8104.0; ABS (2019), 5204.0; OECD (2016) ANBERD databases. Peers are Canada, the US, UK, Korea, Japan, and Germany
Note: Latest available is 2017-18 for Australia and 2015-16 in most other cases. Global peers are the US, Canada, Korea, Japan, UK and Germany. Excludes public administration, health and education.

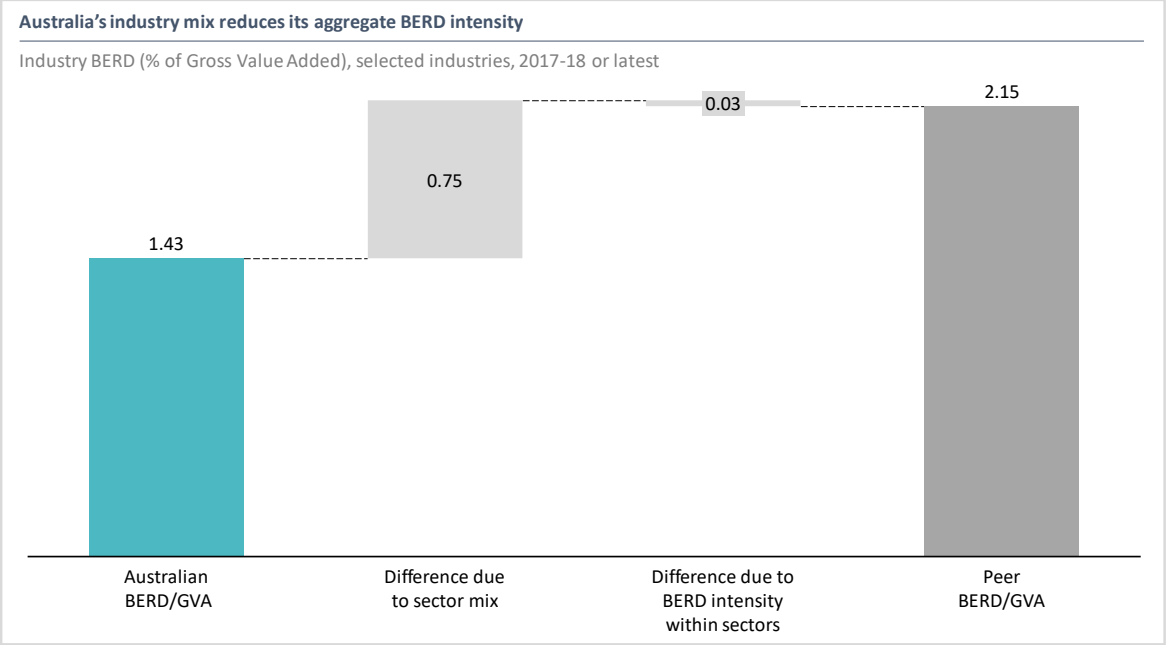
Exhibit 15 combines industry mix and intensity and shows how they contribute to the overall gap between Australia's BERD rate and that of its leading global peers. It shows how the Australian economy-wide BERD rate would change if Australia had the same industry mix as leading global peers.

It is Australia's industry mix, not its BERD intensity at the sector level, which explains why its BERD level is below global peers. On the left of Exhibit 15 is the BERD / GVA ratio for the market sector in Australia (that is, all industries except public administration, health and education, and also excluding owner-occupied housing), at 1.45 per cent of GVA.[22] On the right is the average for the market sector in the same six leading peer economies discussed above, at an average of 2.15 per cent of GVA. Differences in sector mix account for the difference between the two. Australia's overall BERD rate would rise to about the current global peers' average if Australia had their industry mix and retained Australian BERD intensities, or if the peers had Australia's current industry mix and retained their BERD intensities.

[22] The BERD / GVA ratio is higher than the economy-wide BERD / GDP value because the excluded nonmarket sectors invest less in BERD than market sectors do.

Exhibit 15

Sector mix accounts for the gap in BERD as a share of GVA between Australia and leading global peers



Source: ABS (2019), 8104.0; ABS (2019), 5204.0; OECD (2016) ANBERD databases.
Note: Latest available is 2017-18 for Australia and 2015-16 in most other cases. Global peers are US, Canada, Korea, Japan, UK and Germany. BERD intensity is GVA-weighted average of BERD intensity of each country's industries. Sector mix attribution is the average of applying Australia's sector mix to peer BERD intensity, and vice versa. Excludes public administration, health and education.

That Australia's industry mix accounts for its BERD shortfall to peers should not, however, be taken to mean that Australia's BERD is unchangeable or optimal. Australia's industry mix may partly reflect Australian business R&D capabilities. Policy changes that strengthen Australian education, research and innovation capabilities and incentives can affect both industry mix and industry R&D intensity.

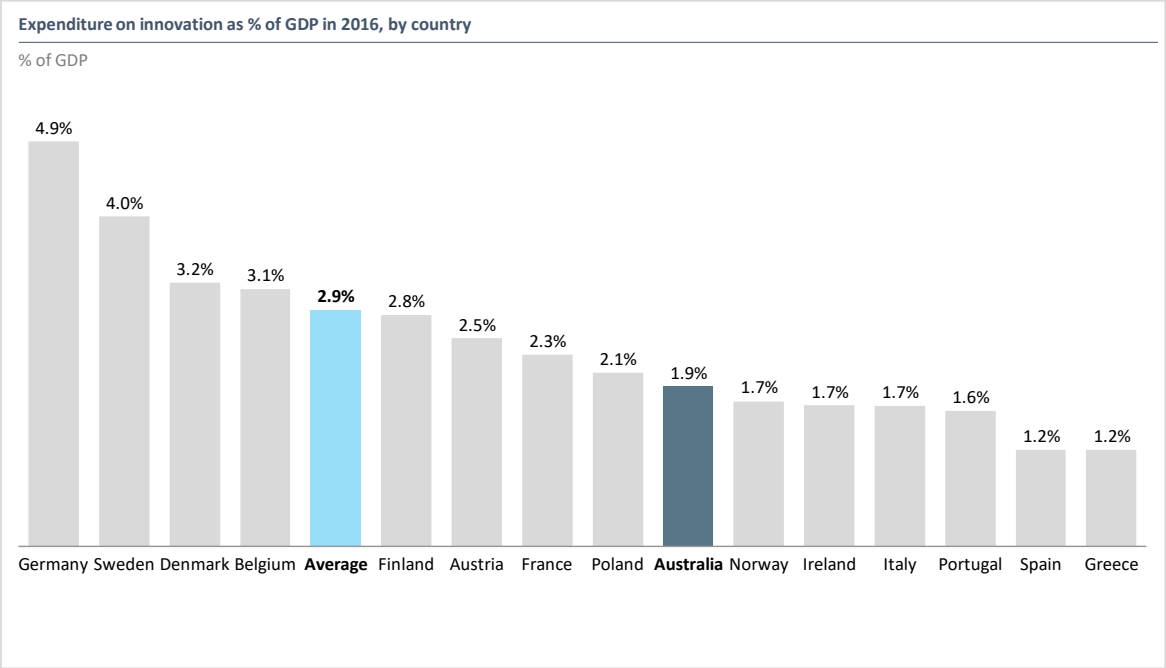
3.2. Australian firms also invest less in broader innovation

Australian policymakers have historically tended to monitor BERD as the main private sector innovation measure and a key proxy for business investment in innovation. There is, however, increasing acknowledgement that BERD gives an incomplete picture of innovation performed by Australian businesses.[23]

Australia's business investment on broader innovation lags developed country averages, much as does Australia's business R&D expenditure. Australian business innovation as a share of GDP, at 1.9 per cent, is just two-thirds of the European average of 2.9 per cent (Exhibit 16). Some economies invest far more: German businesses report that they spend almost 5 per cent of GDP on innovation.

Exhibit 16

Australian businesses invest less in innovation than many peers do



Source: Eurostat Community Innovation Survey (CIS) 2016, Eurostat National accounts and ABS. Defined as 'Expenditure on innovation' as measured by Oslo manual-style surveys in the EU (CIS) and Australia (BCS). Average is weighted by GDP across all reporting countries with available Eurostat or ABS data. Only the largest 15 countries by GDP are shown. Australia's innovation expenditure is the midpoint of most recent ABS estimates.

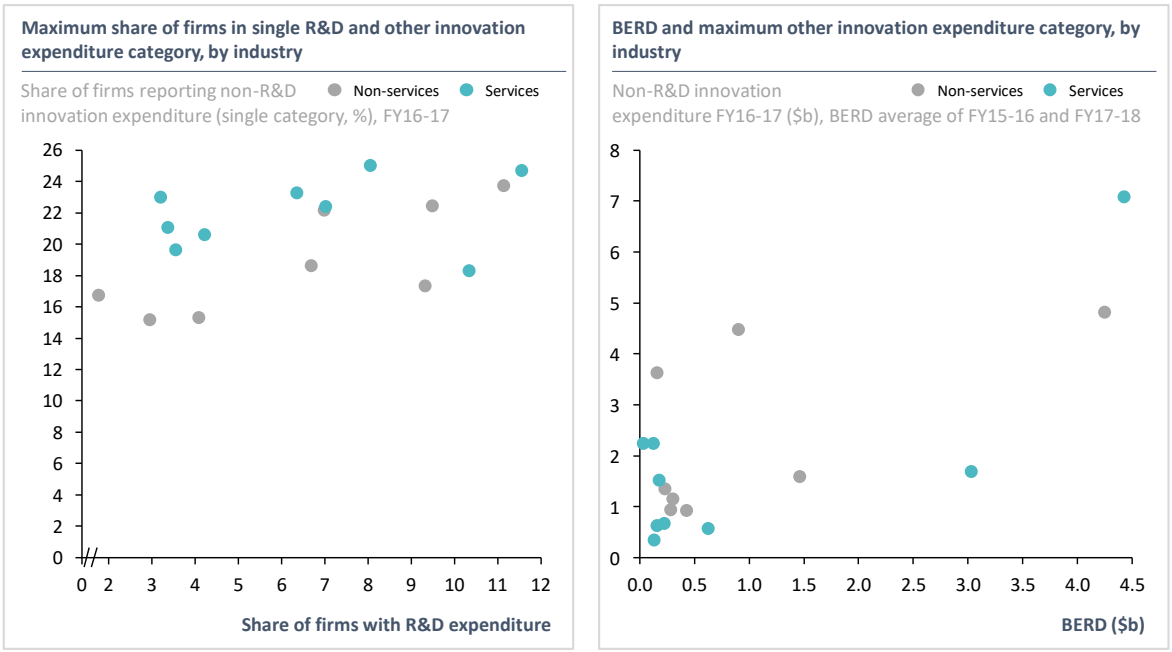
BERD by itself is not a good predictor of other forms of business innovation. While the two are correlated, much variation in non-R&D is not explained by variation in R&D (Exhibit 17). In addition, non-R&D innovation may play a role in the economy that is complementary to R&D investment. For example, R&D may generate significant local process or product innovations, while non-R&D innovation diffuses global and local innovations through the economy, and boosts business

[23] See, for example the Department of Industry, Innovation and Science's Innovation Metrics Review Workshop Proceedings 13-14 March 2019.

performance through many small improvements. Section 4.3 below reviews some evidence that sector-level productivity is more strongly correlated with broader innovation than with R&D.

Exhibit 17

Investment in R&D is not highly correlated with other innovation expenditure or activity



Source: ABS (2018 and 2019) 8158.0 and 8104.0
Notes: The largest non-R&D innovation expenditure category for all sectors is Acquisition of Machinery, Equipment and Technology, except the Accommodation sector where it is Marketing Innovation, and the Finance & Insurance sector where it is Innovation-related Training. GVA is gross value added. The measure of non-R&D innovation expenditure is likely to have significant measurement error, as firms only report their expenditure in ranges.

3.3. Large firms are most innovation-active in Australia

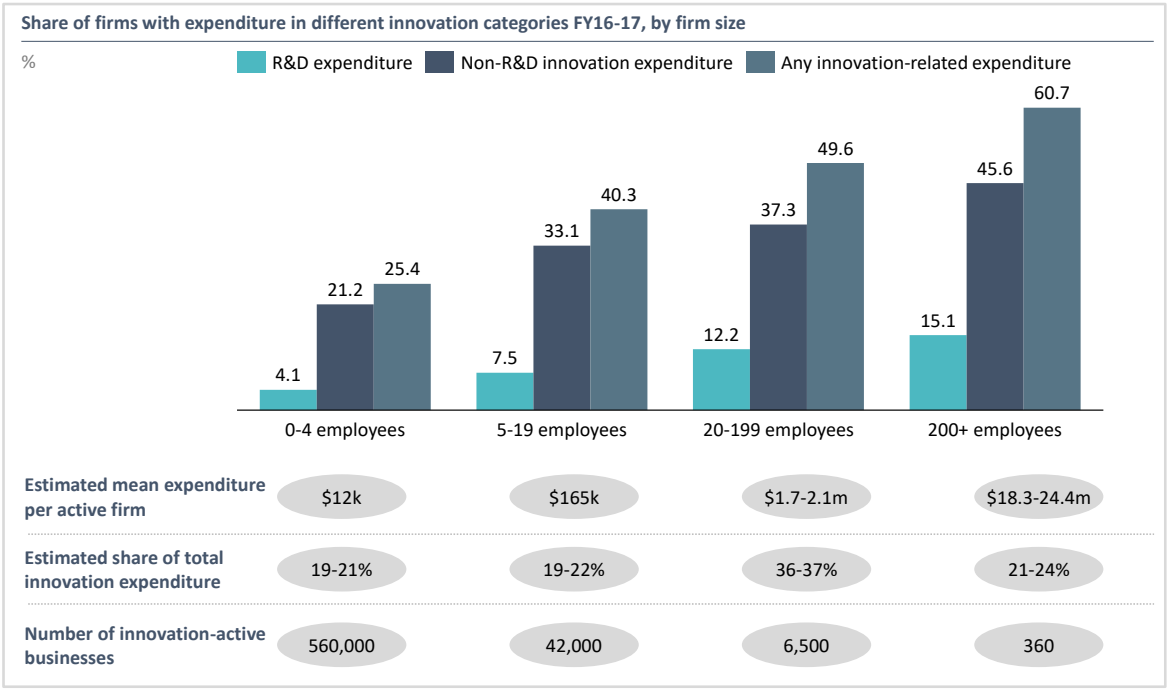
In Australia, larger firms are more likely to invest in R&D or other innovation than small firms (Exhibit 18). The estimated mean expenditure of innovation-active businesses with over 200 employees is $18-25 million, about ten times as much as firms with 20-199 employees, and 100 times as much as firms with 5-19 employees, as shown in Exhibit 18.

However, firms of every size make a significant contribution to overall innovation expenditure. Micro firms (with 0-4 employees) and small firms (5-19 employees) each contribute about 20 per cent of total innovation investment, while medium and large firms together contribute the other 60 per cent.

Medium firms likely make a larger contribution in total than large firms do, though public data is not sufficient to be certain.[24]

Exhibit 18

While larger Australian firms innovate more than small firms do, firms of all sizes contribute to aggregate innovation



Source: ABS (2018), 8158.0 Appendix, Summary Statistics & Financial Indicators; AlphaBeta analysis. Note: Non-R&D category is a minimum calculated from the other two categories as if no firms have expenditures on both R&D and non-R&D.

Innovation investment is, however, highly concentrated. Just the 14 Australian firms listed in the top 2,500 industrial innovators worldwide in 2017-18 collectively spent around $4.8 billion on R&D, or about 30 per cent of Australia's total BERD. But more than 90 per cent of innovation-active Australian businesses spend less than $100,000 per year on innovation (Exhibit 20).[25] 47 per cent of large firms that invest in innovation spend less than $100,000, and 30 per cent spend less than $25,000 per year.[26] Most businesses with fewer than 200 employees spend less than $25,000 per year on innovation. Among the small businesses that do spend money on innovation, less than a quarter spend more than

[24] These estimates are calculated on the basis that (1) total business expenditure on innovation was $32-36bn in 2016-17 (ABS (2018) *8158.0 Appendix*), and (2) business expenditure on innovation is uniformly distributed within reported ranges so that the average expenditure is equal to the mid-point of the range and (3) any firm reporting $5m or more is assumed to spend the same amount. Assumption (3) may bias estimates of medium firm expenditure upwards.

[25] Note that the ABS considers disaggregate (e.g. sector-level) dollar estimates of innovation expenditure made using their *Business Characteristics Survey* responses on innovation to be relatively unreliable, as respondents reported their expenditure in ranges.

[26] These findings are consistent with those of previous Australian studies. For example, one study found that larger firms were more likely to be innovation-active and better prepared for "absorbing" innovations as well (de Rassenfosse, G and E Webster, 2013, "An Assessment of Australia's Absorptive Capacity", Melbourne Institute of Applied Economic and Social Research).

$25,000 per year, while about 45 per cent of medium-sized businesses do. Many smaller firms do invest, however, including rapidly growing technology startups. In addition, digital app adoption patterns suggest there is willingness to adopt new technology for the right reasons, as discussed below.

Exhibit 19

Fewer than 10 per cent of innovative firms spend more than $100,000 per year on innovation

Of innovation-active firms, how much they spend on innovation

% of innovation-active firms, FY16-17

Employment size	No expenditure	$1 to less than $25,000	$25,000 to less than $50,000	$50,000 to less than $100,000	$100,000 to less than $250,000	$250,000 to less than $1,000,000	$1,000,000 to less than $5,000,000	$5,000,000 or more
All firms	28.2	48.8	9.5	4.8	4.2	3.5	0.9	0.1
0–4 persons	30.1	53.2	7.1	4.0	3.4	2.0	0.2	0.0
5–19 persons	28.6	46.4	10.9	4.9	4.4	4.3		
20–199 persons	18.1	37.7	16.5	8.1	7.1	7.2	4.9	0.4
200 or more persons	13.0	17.8	10.5	6.7	12.4	17.6	15.2	6.8

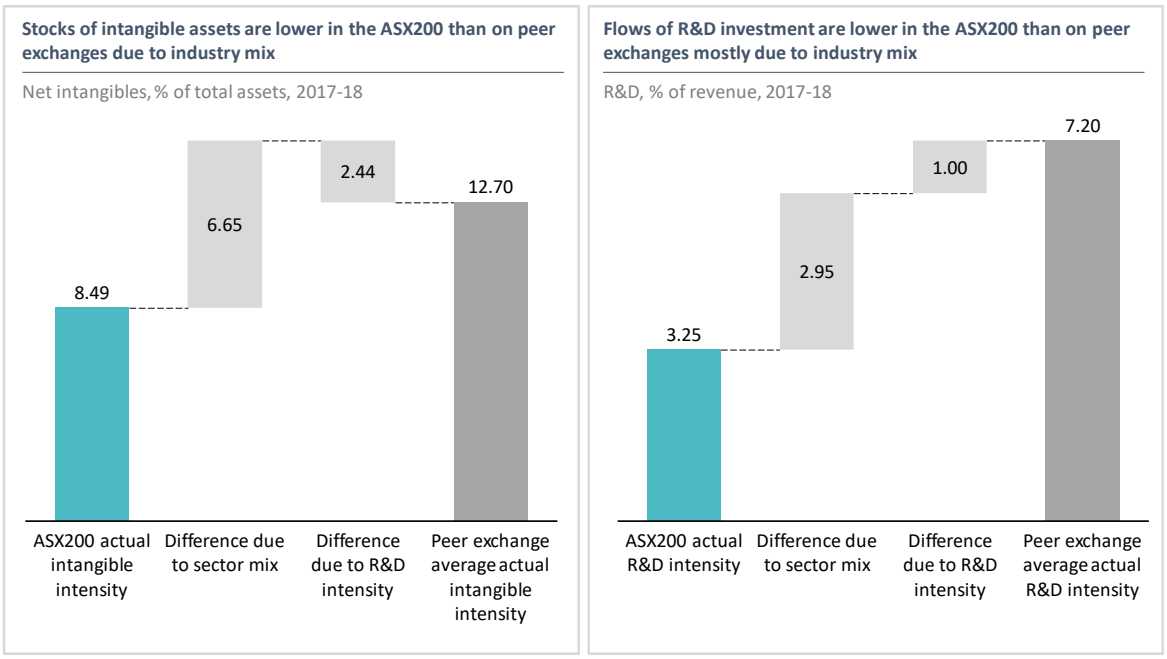
Source: ABS (2016), 8158.0 Financial Indicators

3.4. Large firm innovation reflects Australia's industry mix

Australia's large firms, as a group, nevertheless invest less in innovation than their global peers do. ASX200 firms (the most valuable 200 firms on the Australian Stock Exchange) spend only 3 per cent of their revenue on R&D, compared to a global weighted average of 7 per cent.[27] Australian firms also appear to have accumulated lower stocks of innovation assets: intangible assets (including intellectual property such as patents and copyrights, but excluding goodwill) account for under 9 per cent of total assets among ASX200 companies, compared to a weighted average of almost 13 per cent for large firms on other major exchanges (left panel of Exhibit 20).[28]

Exhibit 20

Industry mix accounts for the low innovation rate of Australian large firms



Source: Sentieo data (2019), AlphaBeta analysis.
Note: Peer exchanges include S&P500, EuroNext150, FTSE250, Nikkei225, and Canada 200. Net intangible intensity excludes goodwill. Intangibles analysis excludes banks and other financial firms.

These large-firm differences are due mostly to Australia's industry mix, as is the case for the gap between Australian R&D overall and our global peers (noted in Section 3.1 above). Australia's large firms already invest in R&D at close to the pace of their global peers in the same sector, but R&D-

[27] Sentieo data; AlphaBeta analysis. Intangible assets include patents, copyrights, franchises, trademarks and trade names; stocks of intangible assets can proxy the accumulated results of previous innovation investment. See Appendices A and C for charts and further discussion. Not all firms report intangibles.

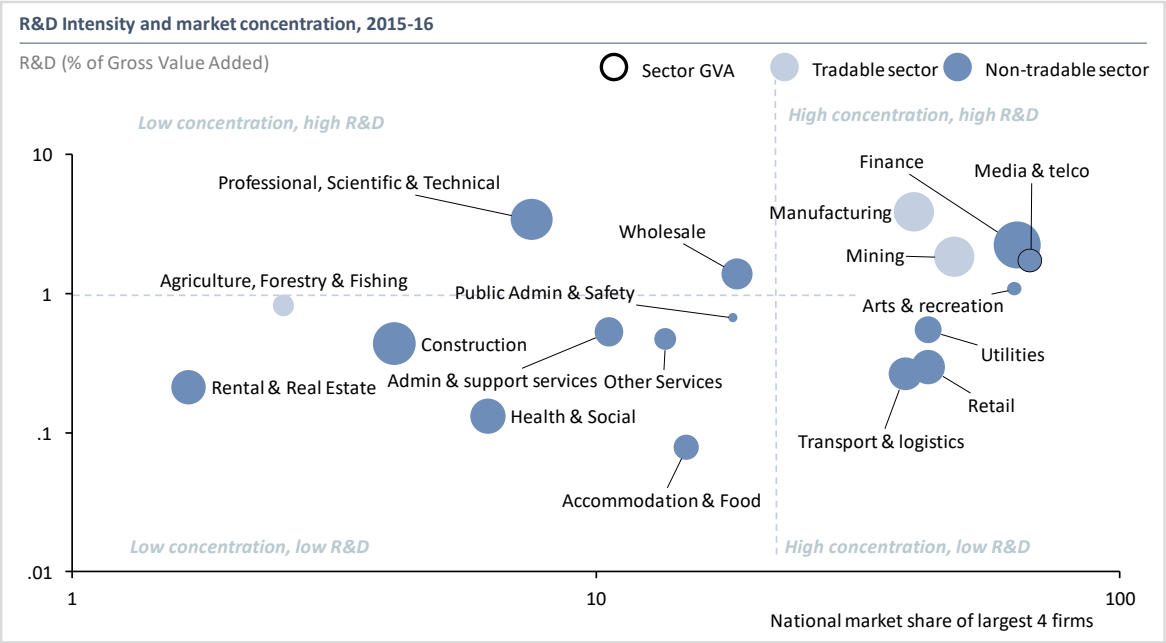
[28] Data is for all intangibles, minus goodwill.

intense sectors (including IMT and manufacturing) comprise less of the ASX, by value, than they do on peer stock exchanges. If the sector mix of Australia's large listed firms were to match that of other leading major exchanges, the R&D intensity of the ASX200 would almost double to 6 per cent, almost equal to the averages on those exchanges (right panel of Exhibit 20).

The same may be true for intangible assets (left panel of Exhibit 20). If the sector mix of Australia's large listed firms were to match that of other leading major exchanges, Australian large firms' intangible asset ratio would increase by an estimated 7 percentage points to over 15 per cent, above the averages on those peer exchanges.[29] See Appendix A for further discussion.

Exhibit 21

Domestic market concentration is uncorrelated with R&D investment



Source: AlphaBeta analysis of ABS, Morningstar and IBIS data. Note: Market shares at the ANZSIC subdivision are averaged to division level by weighting subdivision-level concentration by each subdivision's share of division book equity. Tradable sectors are noted in the chart as firms in those sectors face international competitors even where they are concentrated domestically.

Some economists have argued that some Australian corporates invest relatively little in innovation because oligopolistic industry structures mute competitive pressure.[30] However, this may not be the case. Exhibit 21 shows that R&D investment bears little relation to market concentration: even highly concentrated sectors like Finance and Media have relatively high R&D intensity. The lack of

[29] The analysis includes only firms that report intangible assets. As fewer firms on the Australian exchange reported their intangible assets than firms elsewhere, it is possible that the estimated Australian intangibles ratios is too high.

[30] Australia Institute (2016), 'Oligopoly money: How a company tax cut would be wasted on big business'.

correlation does not, however, prove that competition does not affect R&D efforts by firms in concentrated sectors: intensified competition could spur them to innovate more than they do today. But Australian firms in many sectors are about as exposed to competition as firms in other advanced economies are, so it seems unlikely that lack of competition is constraining Australia's sector-level innovation intensity much, at least compared to peers.[31]

3.5. Small firms focus more on non-R&D innovation

A lesser proportion of small businesses invest in innovation, compared to larger businesses (Exhibit 18), and small businesses' investment in R&D is particularly low. Only 25-40 per cent of Australian small firms with fewer than 20 employees report engaging in innovation, compared to 50 per cent and 61 per cent for medium (20-199 employees) and large businesses (over 200 employees) (Exhibit 18).

The pattern of innovation in small businesses also differs from that in large businesses. Smaller firms invest more of their limited innovation budgets in non-R&D than big firms do. About five times as many small businesses invest in non-R&D innovation as invest in R&D. Among medium and large businesses, non-R&D innovation is only three times as prevalent as R&D.

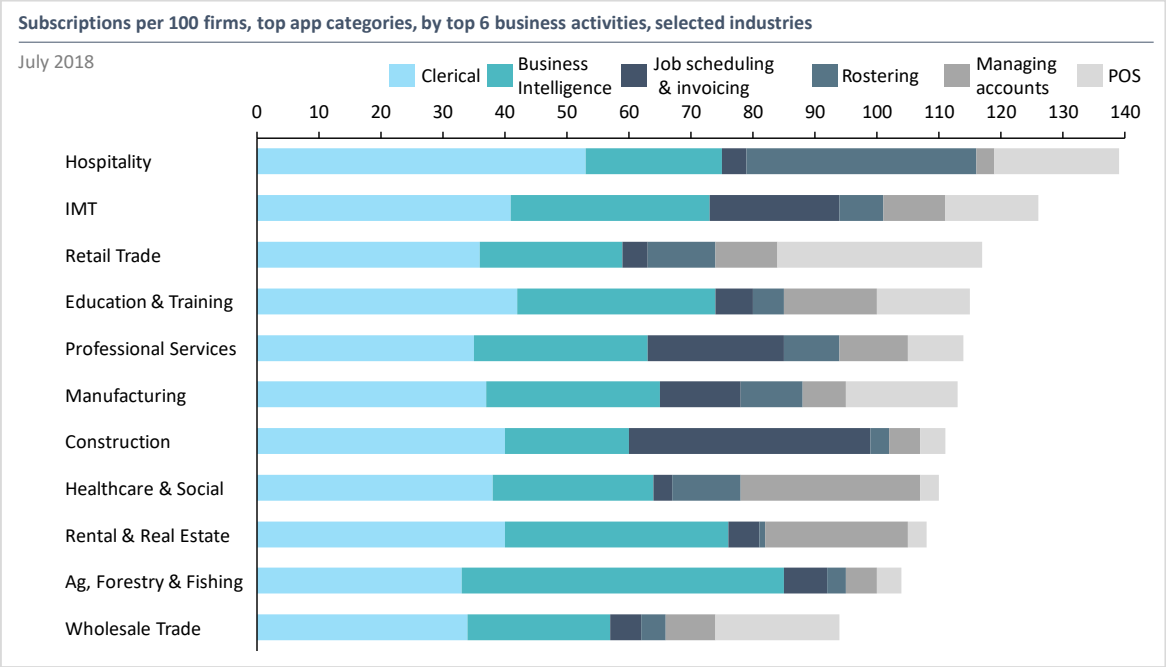
Small businesses tend to adopt software applications ("apps") focused on improving productivity and easing pain points, suggesting that these may be the most significant factors driving small firm innovation more generally. App adoption data from Xero, a small business accounting platform, shows that small businesses are most likely to use apps to automate administrative and operational tasks, improve customer experience, and inform decisions. Usage of new-to-business software tools like these apps can be considered a form of non-R&D innovation.

Firms are most likely to use apps for HR management, and finance, administration, legal, and general management. Apps also tend to be adopted by clusters of industries that share a common business pain point, which also suggests that non-R&D innovation such as internal process improvement is most important for small businesses (Exhibit 22). For example, apps for rostering are most commonly adopted in accommodation and food services; job scheduling and invoicing is most common for construction; and business intelligence apps are most common for small businesses in agriculture, forestry and fishing.

[31] Grattan Institute (2017), *Competition in Australia: Too little of a good thing?* In many sectors Australian firms are just as exposed to competition as firms in other advanced economies are.

Exhibit 22

Apps are usually targeted at clusters of industries that share a common business pain point



Source: Xero SBI; AlphaBeta analysis. Subscriptions per 100 firms can exceed 100 as some firms subscribe to more than one app.

App usage is higher among larger medium enterprises (SMEs) than among smaller firms. SMEs with revenue above $2 million are 76 per cent more likely to use apps than those turning over less than $500,000.

SMEs in business services are also the largest technology purchasers, measured as a share of revenue. The top three sectors by small business spending on technology were all in business services: Professional, scientific and technical services; financial and insurance services, and IMT. Firms in those sectors spend 1.2-1.3 per cent of revenue on technology. Service firms are also heavy app adopters: five of the six high-adopting sectors were in services, both business (IMT, Professional, Scientific & Technical Services) and consumer (Hospitality, Retail, and Education).

3.6. Australian business service firms are active investors in innovation

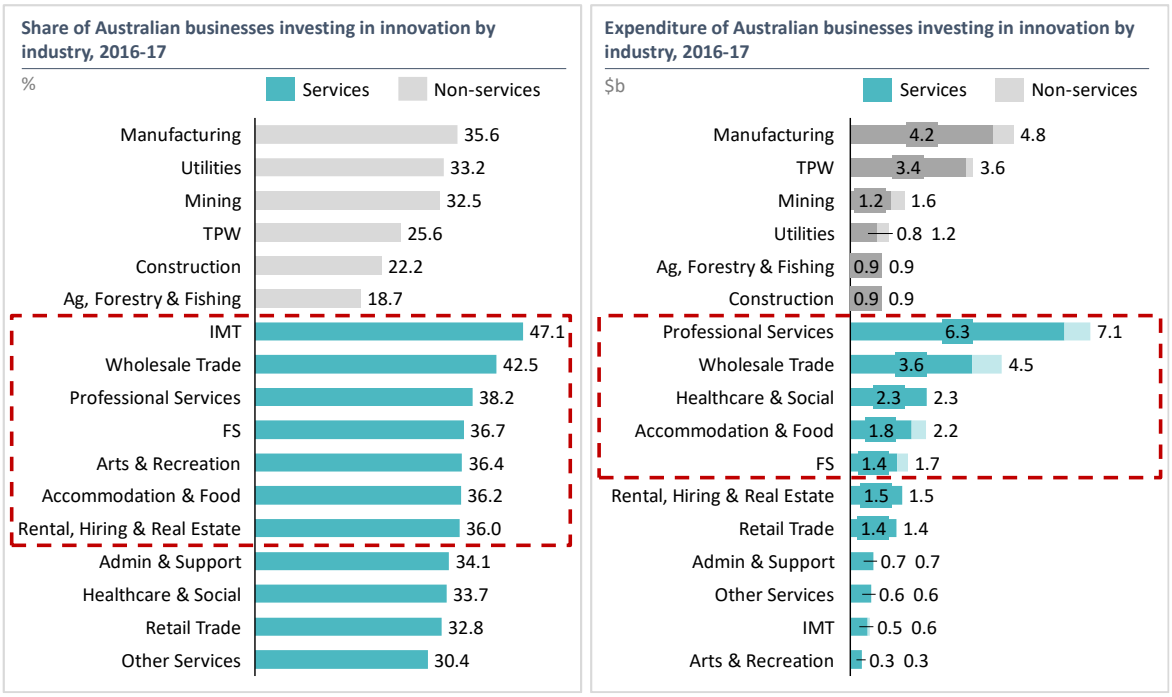
Australian firms in many service sectors are more active innovators – and spend more on innovation – than firms in many non-service sectors.[32] Exhibit 23 shows that service sectors have the highest share

[32] A higher proportion of service firms are new-to-market innovators in Australia than in many OECD economies as shown in OECD (2017), *Innovation in firms,* "New-to-market product innovators, manufacturing and services, 2012-14: As a percentage of all businesses in each sector within the scope of national innovation surveys", https://doi.org/10.1787/sti_scoreboard-2017-graph133-en.

of innovation-active firms in Australia, as well as the highest levels of industry-level expenditure on broad innovation. The seven industries with the highest share of firms spending on broader innovation (highlighted on the left of Exhibit 23) are in services. The three industries with the highest share of firms investing in R&D are also in services (not shown on the chart).

Exhibit 23

Many Australian service sector firms are active investors in innovation



Source: ABS (2018), 8158.0 Key Summary Statistics & Financial Indicators. AlphaBeta analysis. Right chart number pairs are upper & lower estimates.

Business-to-business (B2B) service sectors such as Scientific & Technical Services, Wholesale Trade, Administration & Support Services, and some of Information, Media & Telecommunications and Finance & Insurance Services are highly active innovators. B2B service sectors comprise the top three industries for share of firms investing in R&D, and two of the top three industries for non-R&D innovation activity. They also account for two of the top three industries for overall innovation expenditure.[33]

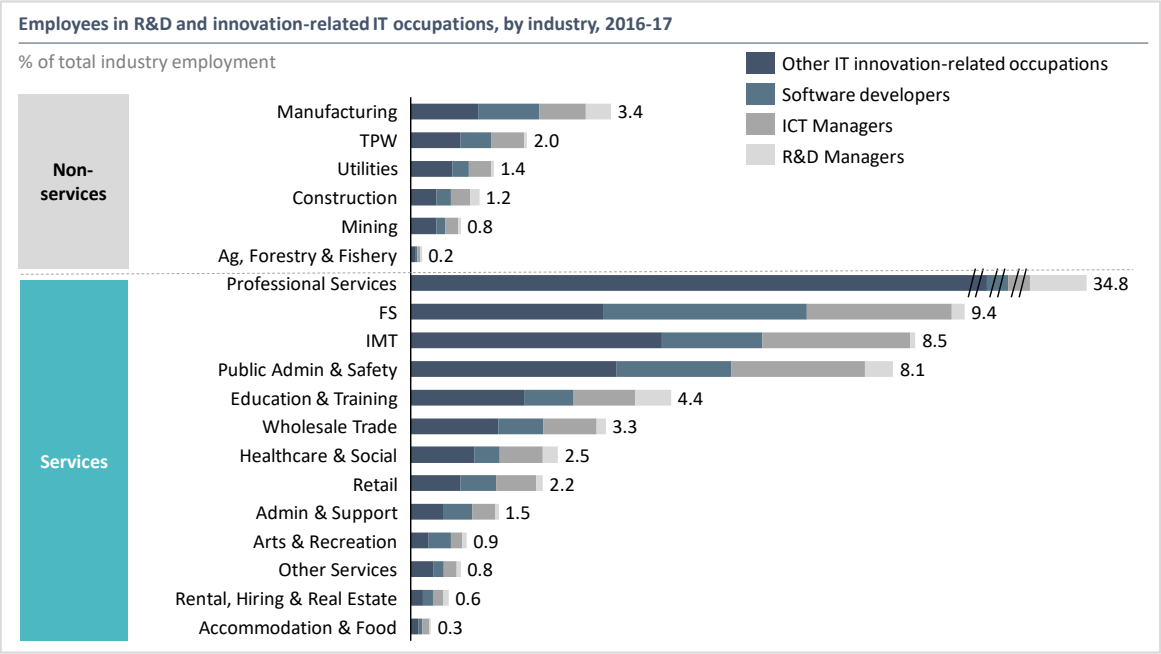
Service sectors in Australia also have higher concentrations of innovation-related occupations than many non-service sectors do (Exhibit 24). The three sectors with the highest concentration of innovation-related occupations (Professional, scientific and technical services, financial services, and

[33] The ABS considers the standard errors of sector-level dollar estimates (the right panel of the figure above) derived from *Business Characteristics Survey* dollar *ranges* to be high (and higher than the BCS estimates of share of businesses that are spend a non-zero amount of innovation, which is on the left of the figure above.

information media, and telecommunications) are wholly or partially B2B services. Manufacturing has the highest concentration of innovation-related occupations of non-service sectors.

Exhibit 24

Service sector firms employ many people in innovation-related occupations

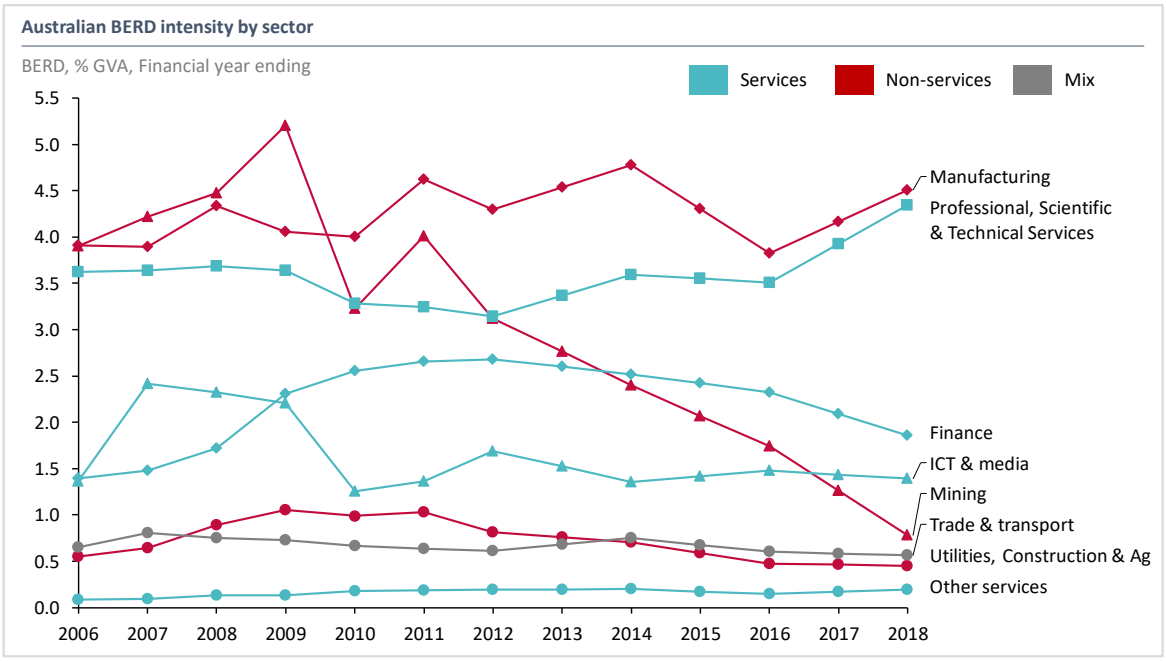


Source: ABS (2016), Census.
Note: Employment shares for professional, scientific and technical services are: Other IT innovation-related occupations: 10.5 per cent; Software developers: 15.7 per cent; ICT Managers: 7.6 per cent; R&D Managers: 0.9 per cent.

The importance of service sector innovation is increasing over time. Service sector innovation has grown as a share of total innovation since 2008 (Exhibit 7), due mostly to growth in services as a share of the economy (Exhibit 8), and to shifts in BERD intensity (Exhibit 25). From 2005, the BERD intensity of all services sectors except IMT has remained steady or increased – with a large increase until 2010 in financial services. By contrast, BERD intensity was stable or decreased in most non-service sectors. The largest contribution was the fall in mining, discussed earlier, and also seen in Exhibit 25.

Exhibit 25

BERD intensity has tended to fall in non-services, while it remained steady or increased in services



Source: ABS (2019), 8104.0; ABS (2019), 5204.0. 2012 and 2014 are linearly interpolated from adjacent years.

4. INNOVATION CAN IMPROVE FIRM PERFORMANCE

Business innovation can drive the performance of firms. In trade-exposed sectors like manufacturing, innovation is critical to survival in the race with global competitors. Even in sectors where trade exposure is lower, innovation helps firms reduce costs and improve quality, and so boosts productivity and living standards across the economy.

Large and small firms that invest in innovation outperform others, on average. The findings reported here are consistent with, and add to, a broader literature on how firm-level survival and performance is linked to investments in innovation. There is also evidence that sectors experience faster productivity growth where a large share of firms invest in innovation.

4.1. Innovation improves large firm performance

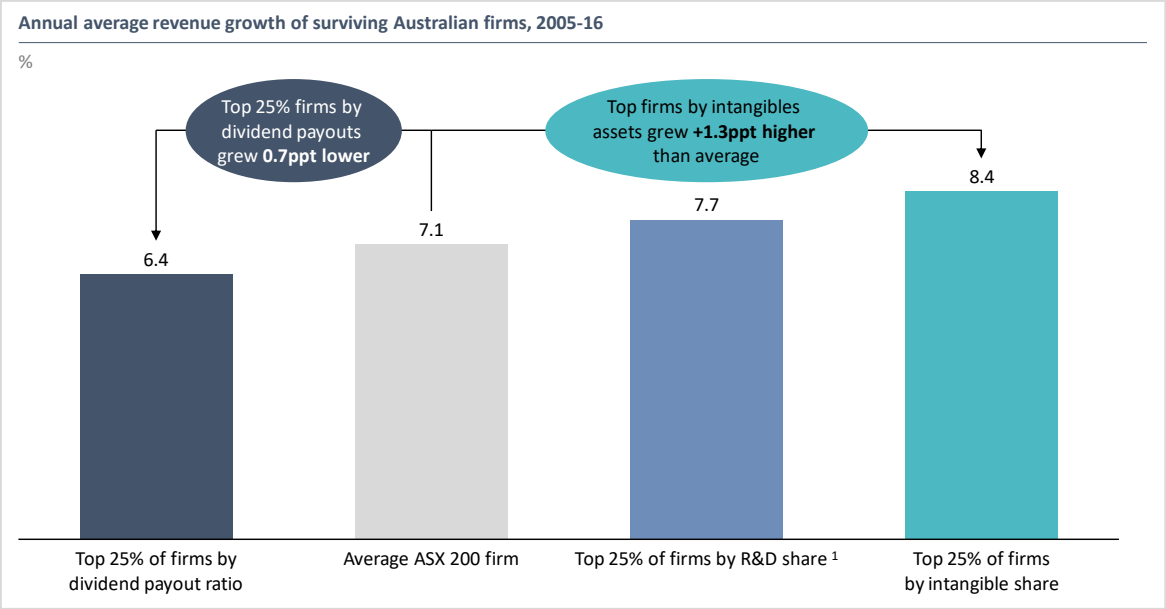
Evidence suggests that Australian large firms that invest more in R&D and are more intangibles-intense perform better than ASX200 firms that prioritise dividends.

Firms that invest more in R&D or are more intangibles-intense perform better than other surviving firms (Exhibit 26). The average nominal revenue growth for an ASX200 firm over the decade to 2016 was 7.1 per cent per year. But firms in the top fourth by R&D expenditure (as a share of sales) grew revenue 0.6 ppt per year faster, at 7.7 per cent. Firms in the top fourth by intangible asset share of total assets grew revenue 1.3 ppt per year faster, at 8.4 per cent. By contrast, firms with a dividend payout ratio in the top 25 quarter grew 0.7 ppt per year more slowly than the average.[34]

[34] The results do not imply that firms following a low-growth strategy are making a mistake. For example, firms in low-growth sectors may best reward shareholders with a high dividend payout ratio.

Exhibit 26

Firms prioritising intangibles and R&D grow faster than the ASX200 average, while firms prioritising dividends grow less



Source: Sentieo, AlphaBeta analysis. Regression of revenue growth from 2003-07 to 2014-18 on intangibles share (net intangible assets) / (net intangible assets + net PP&E), dividend payout ratio, and R&D share of sales in 2003-07. Regression includes surviving ASX200 firms from 2005 to 2016 that report intangibles (n = 47). None of the variables are significantly different than 0 at the 5 per cent level (intangibles: p = 0.11; dividend payout: p = 0.13, R&D share: p = 0.11). Does not control for industry sector. (1) R&D result is based on firms who reported R&D (Only 10 of 47 firms).[35]

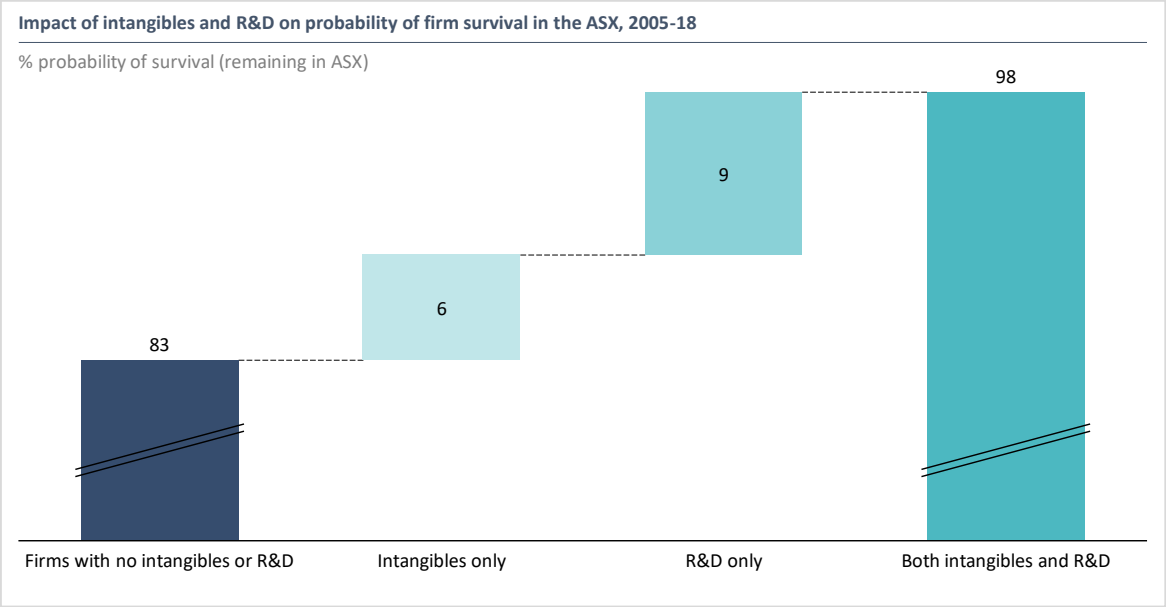
Firms that report intangible assets or spending on R&D were also more likely to survive than those that report neither (Exhibit 27). Over four-fifths of ASX 200 firms that did not report any R&D or intangible assets in 2005 survived as independent entities through to 2018, while almost all firms that reported both R&D expenditure and intangible assets survived. Again, the correlations are relatively weak, with a significant risk that differences at least as big would be observed even if there were no underlying connection, just due to random variation in survival rates. Previous research has also found that more innovative firms are more likely to survive.[36]

[35] The correlations are consistent with previous findings that Australian firms that invest more in R&D grow faster on average, and with the broader literature on R&D, innovation and firm performance. In research noted in the *Australian Innovation System Report 2017*, pages 71-72, R&D is most strongly associated with growth for firms that were already growing quickly (while negatively associated with growth for more slow-growing firms). A review of studies on R&D, innovation and firm performance found that the relationship is generally positive, though it varies with firm and market characteristics (Coad, A, *The Growth of Firms*, Edward Elgar).However, there is a more than 1 in 10 chance that they would be observed even if there was no underlying relationship.

[36] Cefis E and Marsili O (2005), 'A matter of life and death: innovation and firm survival'; Cefis E and Marsili O (2012), 'Going, going, gone. Exit forms and the innovative capabilities of firms'

Exhibit 27

ASX200 firms reporting intangible assets and R&D expenditure in 2005 were 15% more likely to survive to 2018 than those with neither



Source: Sentieo (2019), AlphaBeta analysis. Analysis controls for size of firms. Sample is 188 ASX firms from 2005 to 2018 with available data. Dependent variable is firm survival, defined as having market cap throughout the period. Independent variables are zero/nonzero intangibles and zero/nonzero R&D spend in 2005. Variables are not statistically significant at the 10 per cent level: intangibles (p = 0.28) and R&D (p = 0.41).

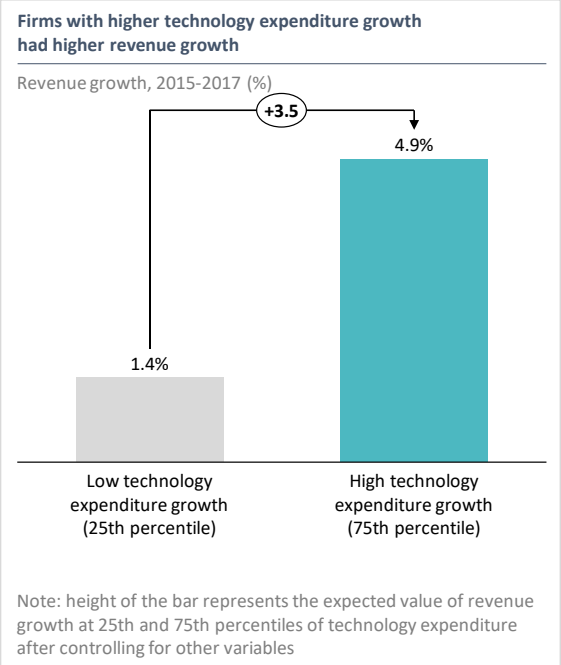
4.2. Digital innovation lifts SME performance

Innovation investment is also associated with tangible benefits for small businesses. Compared to firms without innovation activity or investment, those that accelerate investment in technology and are more sophisticated users of IT have higher revenue and employment growth. SMEs with high technology spending growth also grew revenue 3.5 ppt per year faster, and employment 5.2 ppt per year faster than those with low technology spending growth (Exhibit 28). Causation is likely to flow in both directions between technology expenditure and other drivers of business growth.

Firms on the Xero accounting platform that used at least one cloud-based software application ("app") in FY17-18 increased employment 2.2 ppt faster in that year than others, and revenue growth also increased with the number of apps a business used (Exhibit 29). This holds regardless of the small firm's overall revenue: faster-growing Xero firms are more likely to use apps, irrespective of their business size. As in the case of technology expenditure, causation may flow in both directions between app usage and business growth more broadly, or from other drivers of business performance to app usage and business growth. See Appendix B for further analysis and discussion.

Exhibit 28

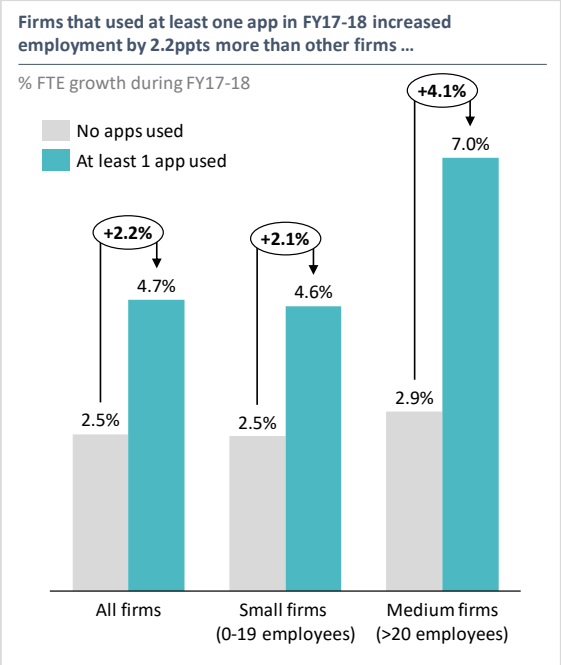
SMEs with high technology spending growth grew revenue and employment faster than those with low technology spending growth



Source: AlphaBeta, Xero Small Business Insights (2019), Connecting Australia: How technology is levelling the playing field for small business, prepared for NBN

Exhibit 29

Xero data shows that sophisticated users of IT grow faster than other firms



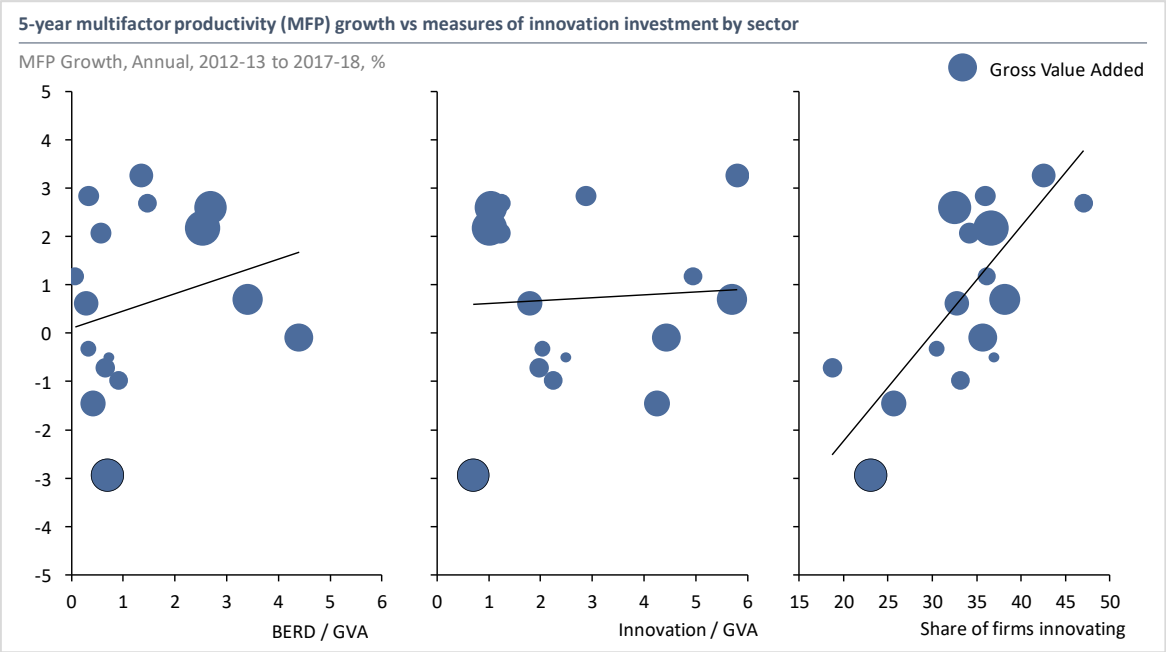
Source: Xero SBI, AlphaBeta analysis.

4.3. Innovation may boost productivity growth

There is also evidence that non-R&D investment is also important for broader sectoral performance. Productivity growth is quite strongly correlated with the share of firms that are actively innovating (Exhibit 30). Neither BERD intensity, nor innovation expenditure as a share of GVA, have much correlation with productivity growth, however.

Exhibit 30

The strongest predictor of productivity growth in a sector is share of innovation-active firms, not R&D or total innovation investment



Source: ABS (2019) 8158.0 and 8104.0; AlphaBeta analysis
Note: BERD / GVA is the average for 2011-2016; Innovation / GVA is a measure of innovation based on the BCS survey, also expressed as a percentage of GVA in 2016-17; Share of firms innovating is the percentage of firms that spend money on innovation in 2016-17.

The correlations in Exhibit 30 suggest that sectors where many firms are actively innovating are more likely to become more productive, whether or not they conduct R&D[37]. That may be because productivity in a sector is most likely to grow if many firms are actively adopting and adapting innovations from elsewhere, or actively making new-to-world innovations.

[37] Palangkaraya, A Spurling, T and E Webster, (2016) 'What drives firm innovation? A review of the economics literature'. The correlations in Exhibit 30 are with multifactor productivity growth; correlations with labour productivity growth are similar. Other studies also find that productivity depends on more than just R&D.

5. POLICY CHOICES FOR AUSTRALIAN BUSINESS INVESTMENT IN INNOVATION

The analysis reported above shows that innovation in Australia varies strongly by sector and firm type and adds to existing findings that innovation can boost performance. It also suggests that policymakers should consider three strategic options to accelerate high-value business investment in innovation.

5.1. Should Australia rebalance support for R&D and non-R&D business innovation?

Overall, Australian and international business performance suggests that some types of innovation investment may lead to better outcomes at the firm level. Large firms' intangible asset stocks and R&D intensity are associated with improved chances of survival and faster growth. Small firms' ICT expenditure and app adoption are associated with higher growth in revenue and employment.

These findings suggest that Australian policymakers should consider whether to **identify types of innovation that have high payoffs, and to focus more intensely on incentivising and promoting them, or to continue with a more broad-based, indirect approach to innovation incentives**. For example, policymakers could seek to sharpen incentives for:

1. Increasing product and business process innovation in non-R&D innovation categories (for example, in areas related to digital innovation).
2. Encouraging more intangibles investment and R&D expenditure.
3. Raising commercialisation performance.

Removing disincentives to the types of investment that are associated with better firm performance could improve economy-wide outcomes. Current policy affects returns from different types of innovation in a range of ways, but may not get the balance right. There are tax incentives for R&D, and some non-R&D innovation investment may benefit from immediate expensing or accelerated depreciation. Intellectual property law provides protection to both R&D and non-R&D innovations.

Policymakers will also need to evaluate how best to integrate firm-level performance and the broader benefits of innovation, such as the spillovers to other firms that are one of the main rationales for policy to strengthen incentives for innovation.

5.2. Should Australia prioritise sectors that can lead innovation, and if so, which sectors?

Australia's industry mix differs from that of other advanced economies, driving much of the overall difference in economy-wide R&D and intangibles intensity, as shown in Sections 3.1 and 3.3. The two key sectors that drive much of BERD globally – manufacturing and IMT – are smaller and less BERD-intense in Australia. Meanwhile, the country's industry mix and innovation intensity in services – particularly business services – are above international averages.

These two facts suggest that Australia may not be reaching its full potential: it may be able to improve its innovation effort by growing its manufacturing and information, media and technology sectors and

encouraging innovation in them, and by capitalising further on innovation capacity in business services innovation.

A key choice for Australia is therefore **whether to take a more strategic, targeted approach to accelerating innovation investment in high-potential sectors, and if so, whether the focus should be on newer sectors where Australia may have an emerging competitive advantage, or on playing "catch-up" in the most BERD-intensive sectors globally.** Options include:

1. Focusing on **business services** by encouraging innovation in sectors where Australia may have a genuine opportunity to be a global innovation leader, as in professional, scientific and technical services and financial services, which are Australia's largest and most BERD-intense sectors relative to global peers.
2. Growing the **manufacturing** and **IMT** sectors, which drive a significant portion of innovation and investment globally. Australia could also choose to target segments of the industries where it already has a strong capability and value proposition, such as B2B software in IMT.

These two strategies each present opportunities and risks. Focusing on growing the manufacturing and IMT sectors is not unprecedented internationally, but it would entail entering challenging global markets. Focusing on business services would leverage Australia's existing innovation strengths and sector mix, but these sectors can be less easily traded and so may not offer the same international growth opportunities as other approaches. In assessing options, policymakers will need to evaluate the prospects for a strong return at the firm level and more broadly to R&D and non-R&D innovation.

5.3. Should Australia customise its innovation agenda by firm size, capability and strategy?

Firm size and type strongly influence how businesses incorporate innovation investment into their strategies, as shown in Sections 3.3 and 3.4, and in Appendices A-C. Large firms optimise their investment decisions based on the tax and commercial settings they face beyond just R&D policy, for example. This may contribute to the concentration of R&D expenditure and other innovation investment in some of Australia's largest firms: as discussed in Section 3.3, the top 14 businesses spending on R&D account for 30 per cent of Australia's total BERD.

Small firms are vastly different to large firms in their operations, strategy and financial position. To assume that the same recipe for innovation investment will work for small firms as works for medium and large firms denies the reality of their context and scale. Among small firms, non-R&D innovation is much more common, and most innovation is focused on improving productivity and reducing day-to-day operational pain-points rather than creating new products or services for customers. This suggests that the optimal form of R&D for different business types depends on firm size.

Size is not the only factor. Firms differ in other ways that are correlated to innovation investment. For example, fast-growing and export-oriented firms often invest more in innovation and R&D.[38] Technology start-ups also invest more in innovation than other small firms.

[38] Department of Industry, Innovation and Science (2016), 'Modelling the relationship between innovation and exporting: Evidence from Australian SMEs'.

The diversity of firms' innovation approaches creates a strategic choice for Australian policymakers: **should innovation policy aims, narratives and incentives be more tailored based on firm size or other characteristics to improve relevance and likely take-up, or continue a higher-level, broad narrative about the benefits for all businesses?** Options include:

1. Changing the tax and commercial settings that large firms face to better incentivise innovation investment (such as in intangible assets) over other uses of capital, such as dividend payouts.
2. More directly targeting the country's biggest innovation investors.
3. Tailoring the mechanisms through which small business innovation occurs by focusing on productivity-enhancing technologies that can be taken up broadly; for example, single touch payroll.

Further tailoring innovation incentives based on firm size, growth rate, export orientation or other characteristics would allow policymakers to leverage the different motivations that drive small and large businesses to invest in innovation and to help them overcome the specific constraints they face. However, a more targeted approach risks indirectly or unintentionally raising additional barriers or removing existing incentives to invest in innovation.

6. CONCLUSION

Innovation is essential to economic performance. But business R&D is lower in Australia, as a share of GDP, than it is in many of our peer economies. Since business R&D as a share of GDP peaked in 2008-09, it has fallen by almost a third.

Most of the gap in business R&D between Australia and its international peers can be explained by differences in the sector mix of output. And most of the fall in Australia's business R&D as a share of GDP since it peaked in 2008-09 can be attributed to the ebbing of the mining development boom, with a smaller contribution from changes in Australia's industry mix.

Australian business investment in innovation overall is about twice as large as business R&D investment alone. Broader business investment in innovation appears not to have fallen much as a share of GDP since the start of this decade. While it, too, is lower than in many peer economies, the gap to peers is probably largely accounted for by Australia's sectoral mix.

Accounting for sector mix, then, Australia seems to be less of an innovation laggard.

But there is little basis for complacency: Australia's sector mix itself may reflect weak innovation capacity. Improvements in Australia's innovation capabilities, policies and incentives could improve innovation efforts and outcomes, and even contribute to changing Australia's sector mix.

There are three main sets of findings in this report that are relevant to innovation policy.

First, **innovation is associated with improved business performance, but R&D is not the only type of innovation that drives performance.** Large listed Australian firms that invest in R&D are more likely to survive, and they grow faster, on average; but intangible assets have an independent, additional effect on survival and growth. Smaller firms that invest more in technology, or are heavier adopters of new IT tools such as online software applications, also grow faster than other firms. At the sector level, sectors where more firms are active innovators have had faster productivity growth than other sectors, while R&D appears to have a weaker relationship with productivity growth.

Second, **the sector mix of innovation is different in Australia than in leading peer economies, with services playing a larger role.** The sectors that contribute most to business R&D in other advanced economies – manufacturing and information, media and telecommunications – are smaller and less R&D-intense in Australia. Offsetting this, professional, scientific and technical services (and other business services) sectors are both larger and more R&D intense in Australia. Firms in those sectors also report that intangibles area a relatively high share of their assets.

Third, **firms of different sizes and types are important to innovation investment, but they invest in different things when they innovate.** For example, large firms are more likely to conduct R&D and account for a large share of R&D expenditure, and they are more likely to invest in non-R&D innovation than smaller firms. Medium-sized firms account for a significant share of R&D and of total innovation expenditure. And many smaller firms are active innovators, though they are much more likely to invest in non-R&D innovation than in R&D.

The findings suggest three questions for policymakers in refining the strategic focus for innovation policy. **The first question is whether Australia should rebalance support for R&D and non-R&D innovation.** Current policy likely provides more support for R&D than for other types of innovation; but the evidence suggests an independent, positive role for non-R&D innovation. Policy changes to reduce impediments to intangible investment, or to commercialisation, could have a significant payoff.

The second question is whether Australia should prioritise sectors that can lead innovation, and if so, which sectors. Sectors that drive innovation in leading economies, including manufacturing, are smaller and less innovation-intense in Australia, while some service sectors are leading innovation. There may be opportunities for policy to capitalise on our sectoral strengths, or to overcome weaknesses.

The third question is whether Australia should customise its innovation agenda by firm size, capability, and strategy. Larger firms undertake most of Australia's R&D, while smaller firms invest more heavily in non-R&D innovation. Start-ups and fast-growing firms (not covered explicitly in this report) play a critical role in the diffusion of innovations, and face challenges relating to finance, growth and access to talent. Innovation policy does already differentiate across firm sizes and circumstances, but there may be an opportunity to strike a better balance.

Overall, Australian firms are active innovators, spending just under 2 per cent of GDP on innovation. They do so in diverse ways, and they face a diverse set of challenges. The findings presented here prompts a range of questions about whether and how policy could better respond to that diversity in promoting innovation.

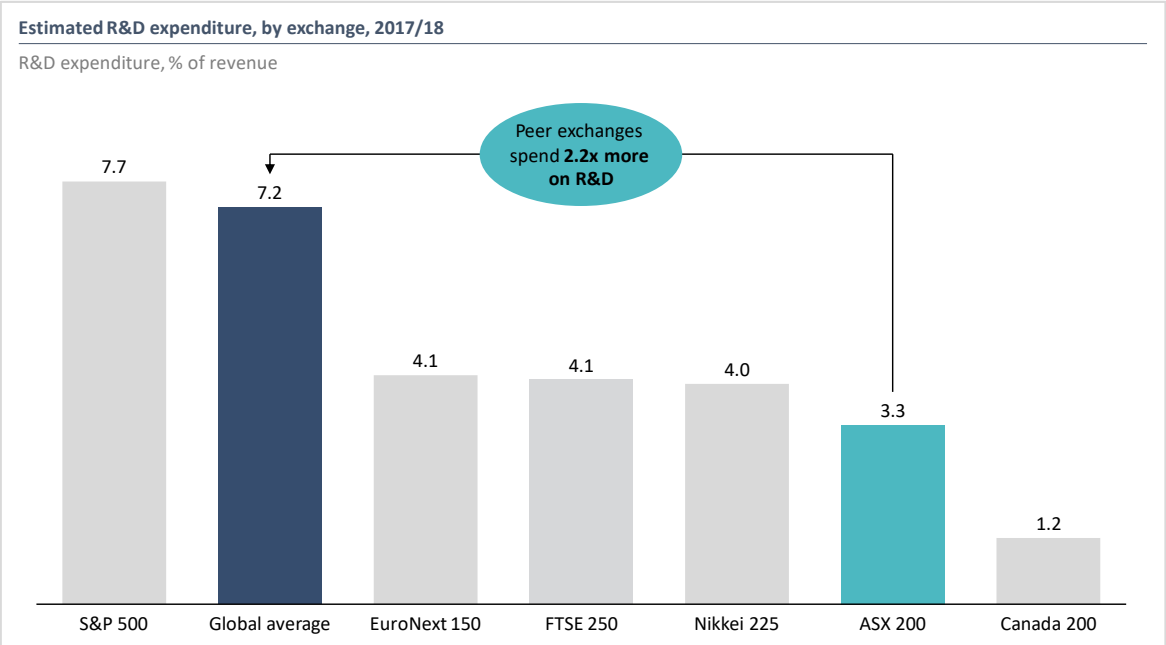
APPENDIX A – LARGE FIRM R&D AND INTANGIBLE ASSET INTENSITY

Industry mix explains most of the gap between large firm R&D on the ASX and other major exchanges.

Australian large listed firms as a group are 2.2 times less R&D-intensive than their peers listed on other major stock exchanges. Australian firms spend only 3 per cent of revenues on R&D, compared to an average of 7 per cent on those exchanges.

Exhibit 31

Australian large listed firms as a group are 2.2 times less R&D intensive than global peers



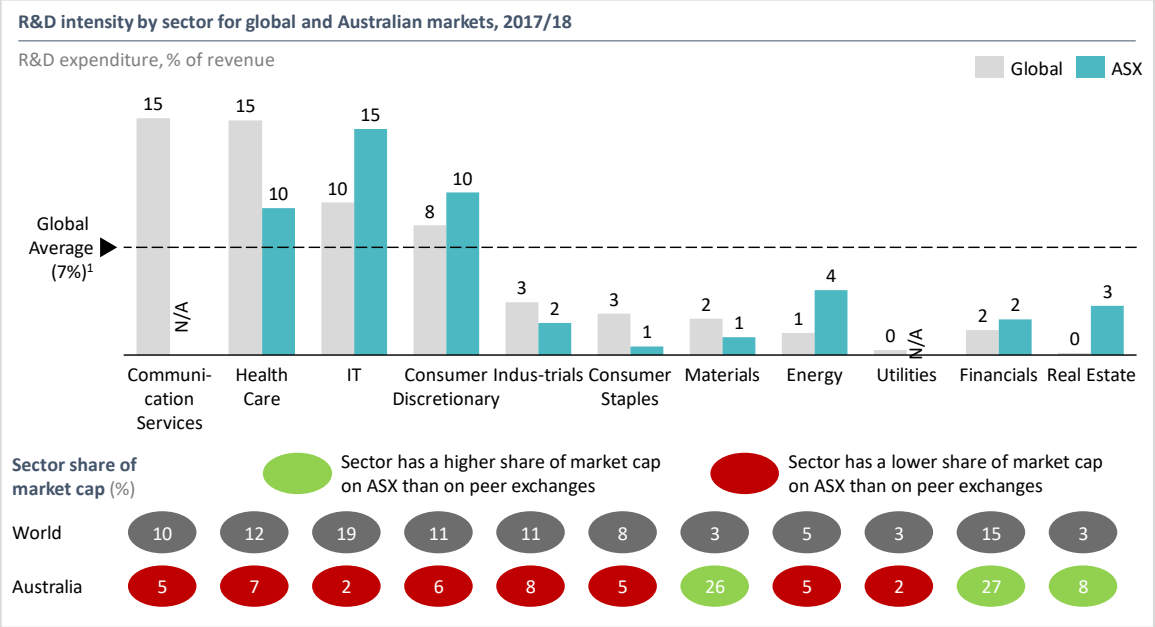
Source: Sentieo (2019), AlphaBeta analysis
Note: Each exchange's R&D intensity is the market-cap-weighted average R&D intensity across firms. Global average excludes ASX and may be biased by higher reporting of R&D by firms listed on the S&P 500. Sample of firms with available data (N= 290 overall and: Euro: 34, Nikkei: 28, FTSE: 19, S&P: 146, Canada: 30, ASX: 33).

The R&D intensity of Australian large firms is on par with peers in the same sector, however. Australia's large firms are predominantly in low-R&D sectors. Other major exchanges have more large firms in R&D-intensive sectors, including healthcare and information technology (Exhibit 32).

As a result, industry mix explains virtually all the gap in large firm R&D intensity between Australia and its peers (Exhibit 33). If Australia's sector mix were to match the average mix on peer stock exchanges, its R&D intensity would increase by 3 ppt as a share of revenue, almost attaining the average on peer exchanges. By contrast, changing the average R&D intensity of large Australian firms in each sector to the average in that sector on peer exchanges, while retaining the Australian sector mix, would have little impact on Australia's overall average intensity.

Exhibit 32

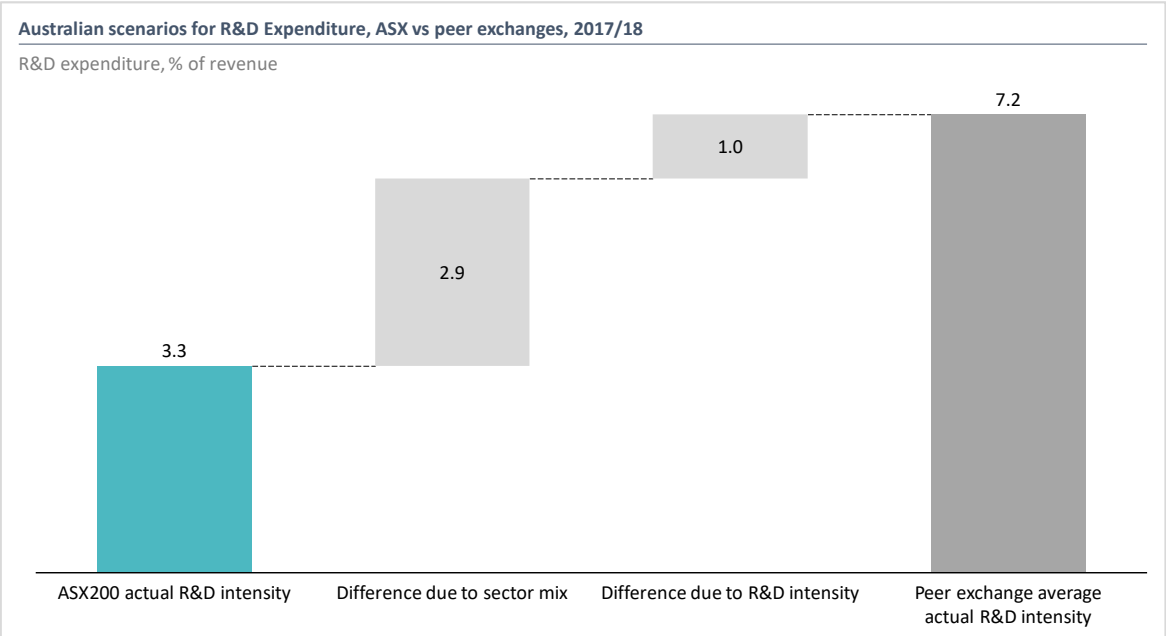
The R&D intensity of large Australian firms is on par with their peers in the same sector in other major markets



Source: Sentieo (2019), AlphaBeta analysis. Global average excludes ASX. Global N=257, ASX N=33

Exhibit 33

Industry mix explains almost three-quarters of the gap in large firm R&D spending between Australia and other major markets

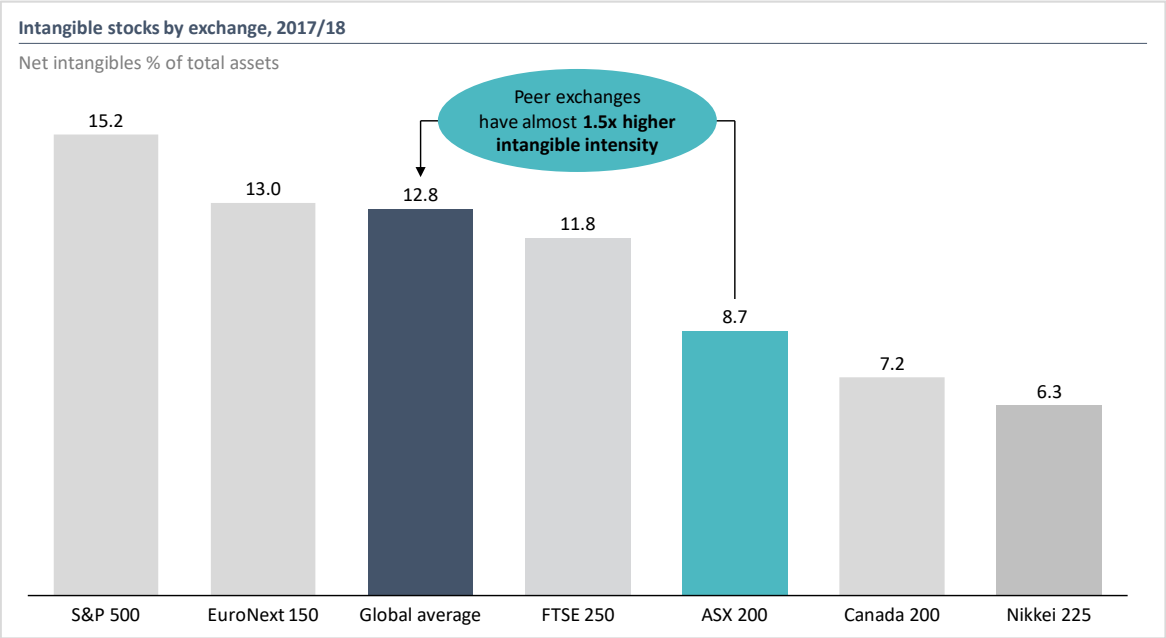


Source: Sentieo data (2019), AlphaBeta analysis
Note: Peer exchanges are the S&P 500, EuroNext150, FTSE250, Nikkei225, and Canada 200. Peer exchange and Australian weighted average is R&D share of revenue.

Similarly, industry mix accounts for the difference between Australian large firms' intangible asset intensity and that of peers. Large Australian listed firms are also less intangible-intense than global peers. Large firms on peer exchanges have 2.5x more intangibles on their balance sheets than do firms on the ASX200 (Exhibit 34). Intangible assets include patents, copyrights, franchises, trademarks and trade names; stocks of intangible assets can proxy existing innovation investment, especially when R&D data is poor.

Exhibit 34

Large Australian firms as a group are also less intangible-intense in their investment than global peers



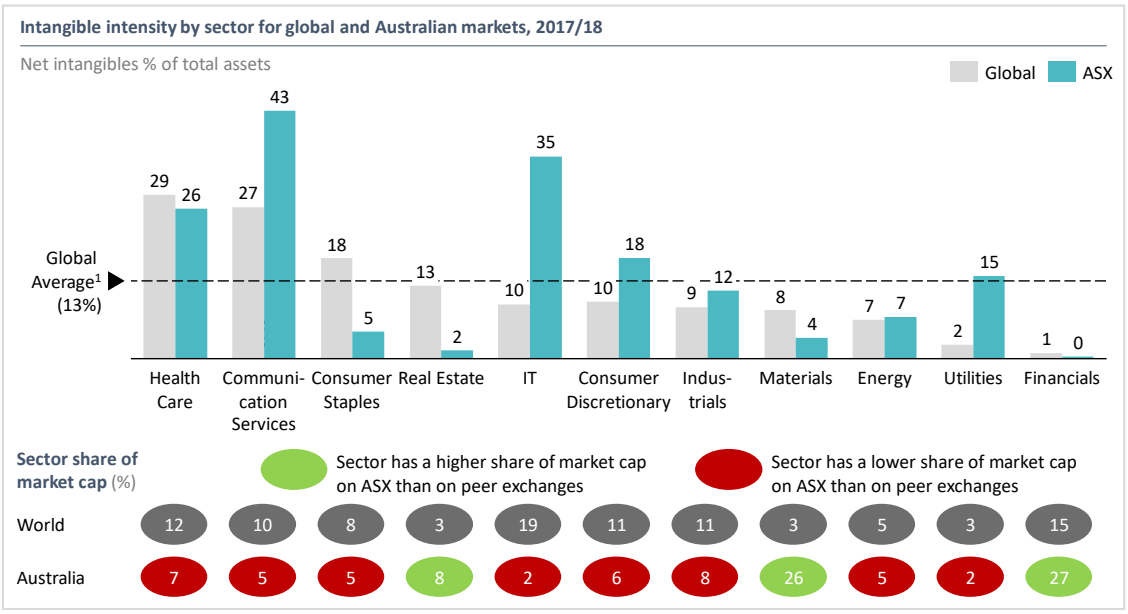
Source: Sentieo (2019), AlphaBeta analysis
Note: Each exchange's intangible share of assets is the market-cap-weighted average intangibles ratio across firms. Each firm's intangibles ratio is net intangibles excluding goodwill, divided by total assets excluding goodwill. Results are for firms that report both intangibles and goodwill. Global average excludes ASX. Firms with available data (Euro: 82, Nikkei: 100, FTSE: 69, S&P:326, Canada: 85, ASX: 50).

However, as Exhibit 35 shows, the ASX is weighted towards sectors that have low intangible intensity, and away from sectors that have high intangible intensity, compared to other major stock exchanges. Australian large businesses' intangible intensity is, however, on par with peers or higher than them in most sectors, for firms that report intangibles.

The differences in sector mix shown in Exhibit 35 explain the overall difference in intangible intensity between large listed firms in Australian and on peer stock exchanges (Exhibit 36). If Australia's sector mix were to match the average mix on peer stock exchanges, the analysis suggests intangibles would rise by almost 7 ppt, as a share of assets, to exceed the average on Australia's peer exchanges.

Exhibit 35

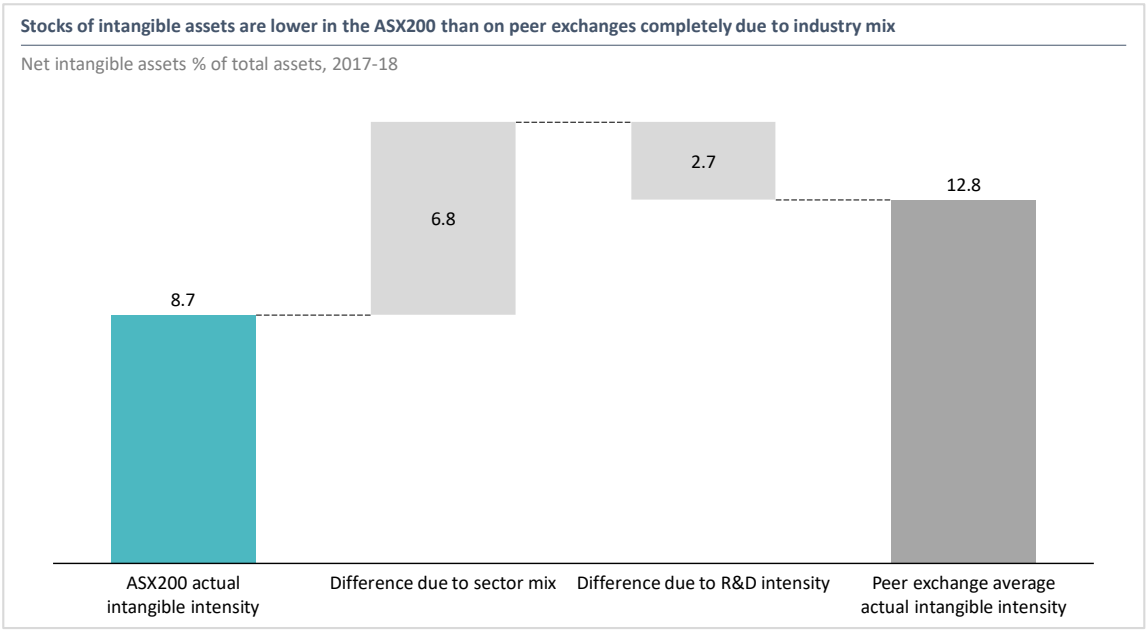
At a sector level, Australian large businesses' intangible intensity is on par or higher than peers in most cases



Source: Sentieo (2019), AlphaBeta analysis
Note: 1. Global average excludes ASX. Results are for firms that report both intangibles and goodwill. Total assets exclude goodwill. Global (N=662). ASX (N= 50), i.e. 25 per cent of ASX 200 firms. Data limitations (such as reporting differences across exchanges and sectors) may affect the findings.

Exhibit 36

Industry mix reduces Australian large firms' intangible asset share



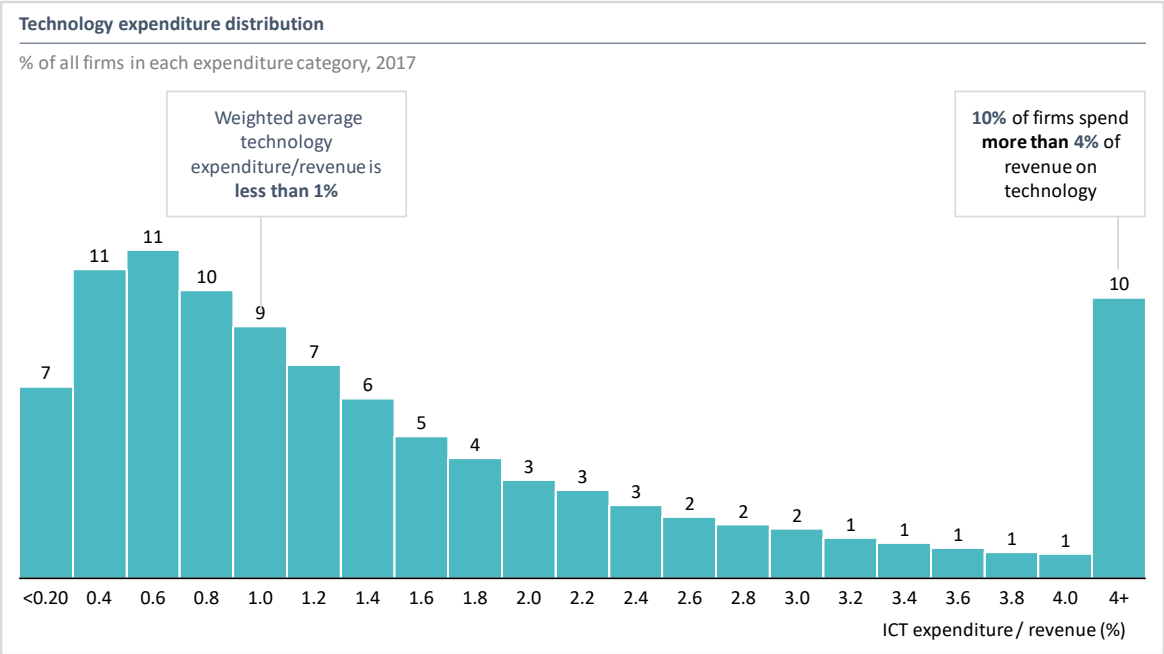
Source: Sentieo (2019), AlphaBeta analysis.
Note: Peer exchanges are the S&P500, EuroNext150, FTSE250, Nikkei225, and Canada 200. Net intangible intensity excludes goodwill. Finance firms are excluded from the analysis.

APPENDIX B – SMALL FIRM TECHNOLOGY EXPENDITURE AND APP ADOPTION

There is wide variation in what small firms spend on technology; while 1 per cent of revenue is the median technology expenditure, 10 per cent of firms spend more than 4 times this amount (Exhibit 37). In this analysis, technology expenditure includes four categories: internet, telephone, ICT hardware, and general ICT.

Exhibit 37

There is wide variation in what small firms spend on technology, with one in ten spending more than 4% of revenue on it



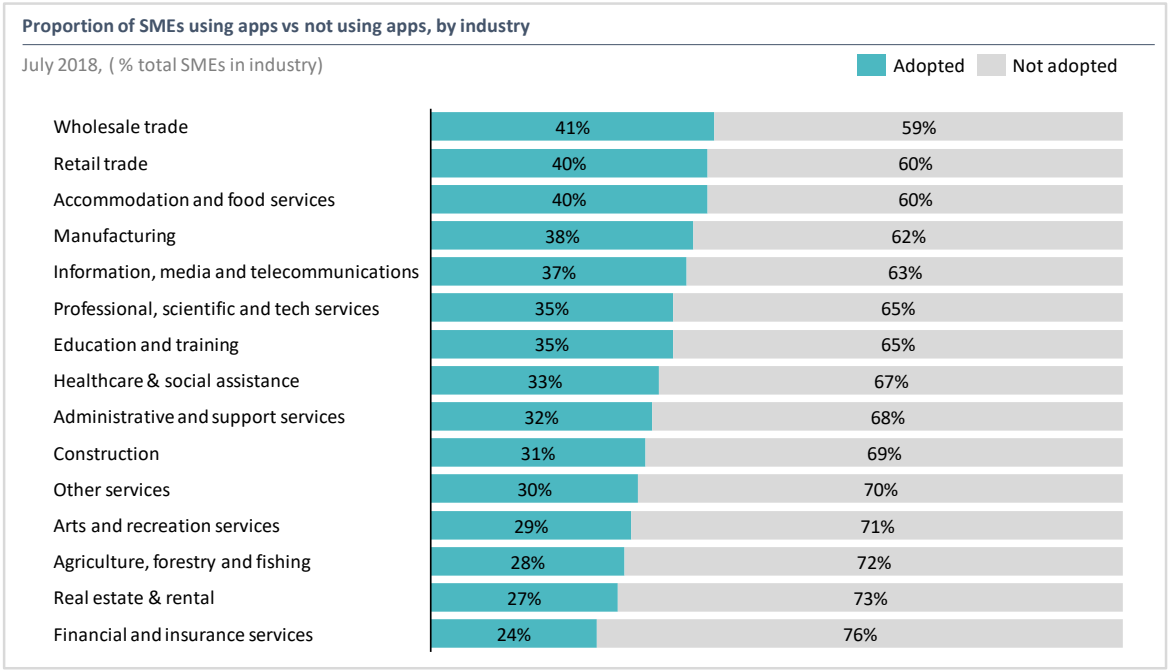
Source: AlphaBeta, Xero Small Business Insights (2019), Connecting Australia: How technology is levelling the playing field for small business, prepared for NBN

Xero SMEs in wholesale trade, retail and hospitality are most likely to invest in apps (Exhibit 38).

Bigger Xero businesses with revenue above $2m are 76 per cent more likely to use apps than small businesses with <$500k revenue (Exhibit 39).

Exhibit 38

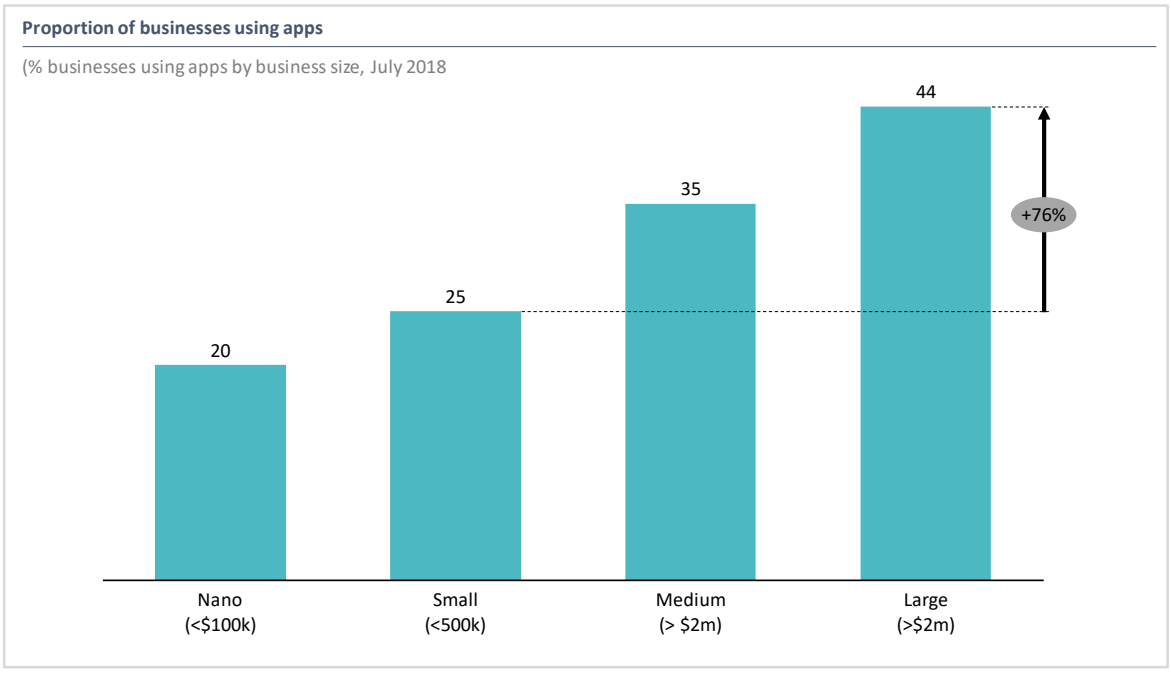
Xero SMEs in wholesale trade, retail and hospitality are most likely to invest in apps



Source: Xero SBI, AlphaBeta analysis. NB: sectors with fewer than 5,000 entities excluded.

Exhibit 39

Larger Xero businesses are more likely than small businesses to use apps



Source: Xero SBI, AlphaBeta analysis.

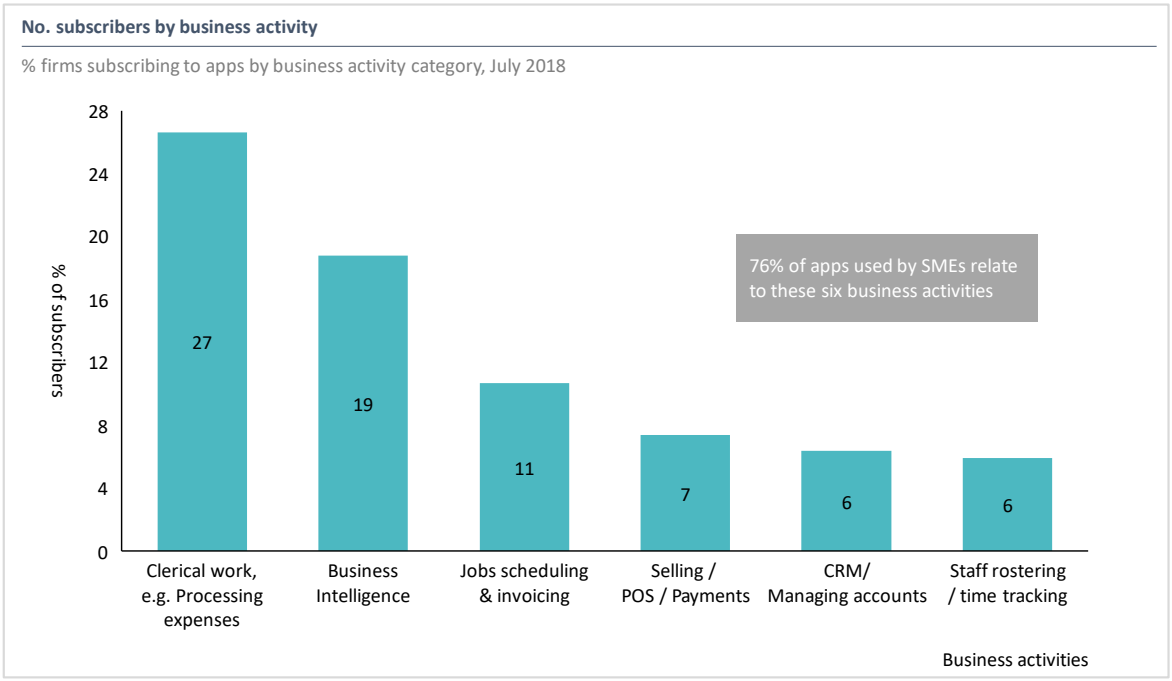
The processes that SMEs automate or enhance using apps are not limited to the back office. Half of all app usage is for core business functions (such as marketing, sales and strategic management) and half for supporting functions (such as HR, finance, and legal).

Within these functions, 76 percent of app use relates to six business activities (Exhibit 40). Apps are most used to automate administrative and operational tasks (e.g. processing expenses, job scheduling and invoicing, staff rostering and time tracking); to improve customer experience (e.g. point-of-sale and other payments technologies, customer relationship management); and business intelligence.

Fast-growing firms are more likely to adopt apps (Exhibit 41), possibly to help manage the increasing complexity of their businesses. App use may then make firms more productive, contributing to better business performance.

Exhibit 40

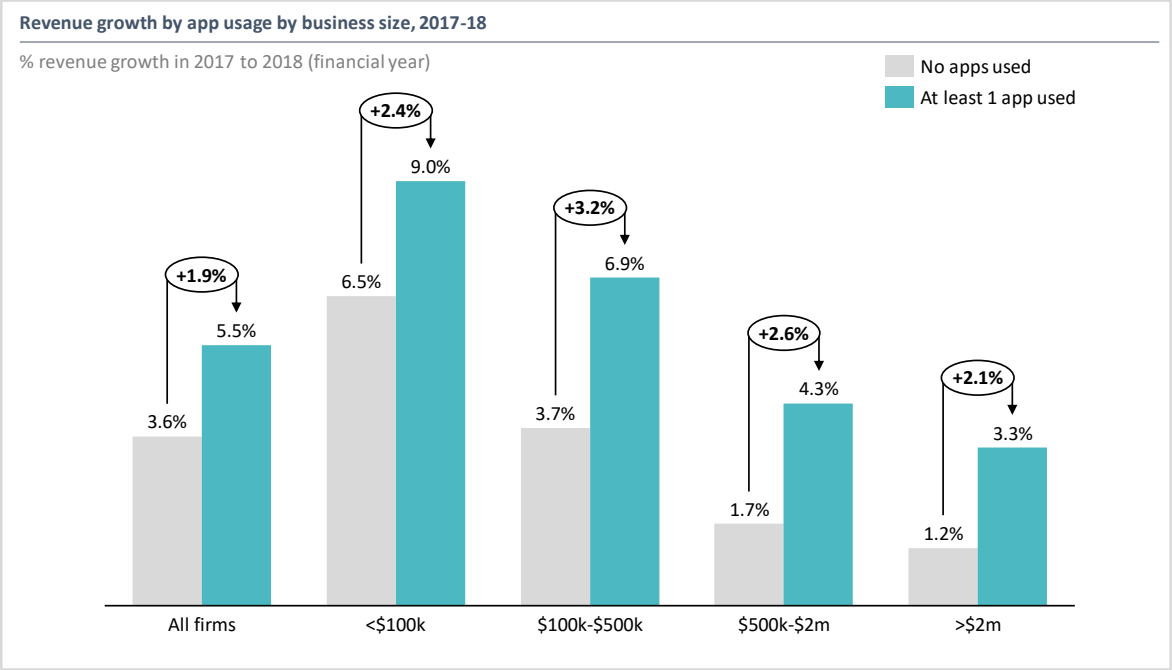
Most apps are used to automate administrative and operational tasks, improve customer experience and inform decisions



Source: Xero SBI, AlphaBeta analysis.

Exhibit 41

Faster growing Xero firms are more likely to use apps irrespective of business size



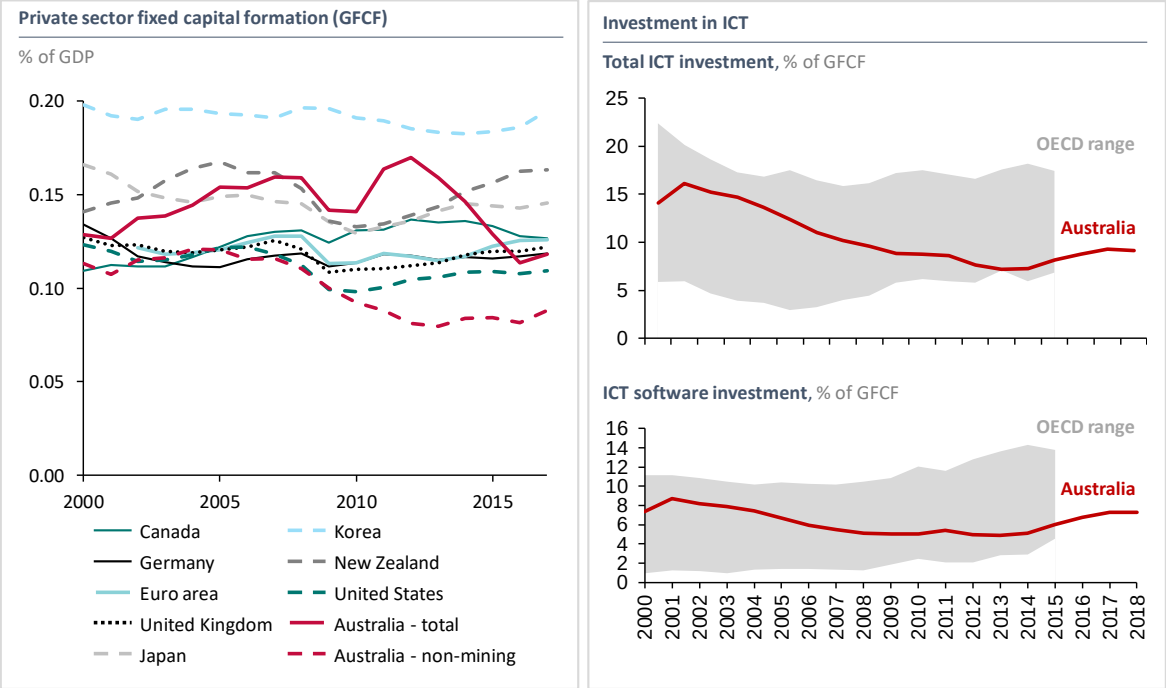
Source: Xero SBI, AlphaBeta analysis.

APPENDIX C – BUSINESS INVESTMENT IN ICT AND INTANGIBLES

Australian's businesses have a different pattern of investment to their global peers. Australian Private Gross Fixed Capital Formation (GFCF) as a share of GDP has been higher than the OECD average for many years, though it has converged towards average OECD levels in the last few years. However, ICT investment, and its software component are both declining as a share of GFCF in Australia, while increasing in OECD peer economies, which is of concern as many recent innovations are delivered by ICT, or embodied in it (Exhibit 42).

Exhibit 42

Australian business investment has been high overall but has shifted away from ICT



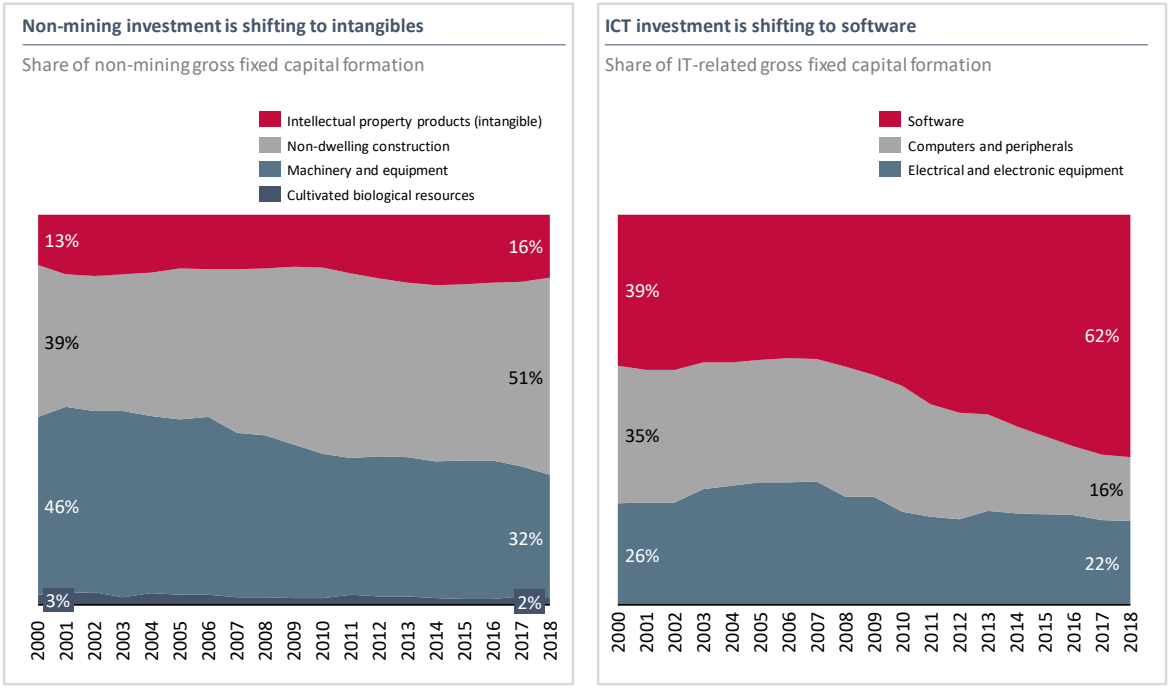
Source: World Bank (2019), GFCF; ABS (2019) 5204.0 (Table 2 and Table 52); OECD (2019), National Accounts at a Glance, Expenditure, GFCF – Corporations (per cent of total GFCF). Australian series excludes ownership of dwellings and ownership transfer costs.

Australian businesses are just as intangibles-intense as their peers, adjusting for industry mix (see Section 3.6), and the intangibles share of Australian business investment is increasing.[39] Non-mining investment is shifting to intangibles, while ICT investment in dollar terms is shifting from computers & peripherals, and electrical & electronic equipment, to software (Exhibit 43).

[39] Amani Elnasri and Kevin Fox, 2014, "The contribution of research and innovation to productivity and economic growth" (UNSW Australian School of Business Research Paper No. 2014-08) reviews cross country studies using different methodologies that together suggest that Australian private investment in a broad set of intangibles is lower than in many peer economies.

Exhibit 43

Australian business investment has shifted towards intangibles



Source: ABS 5204.0 National Accounts. All values are at current prices and so comprise shares of expenditure. On the left panel, the total excludes weapons systems, dwellings, ownership transfer costs, and artistic originals; excludes mining industry.

GLOSSARY

ANBERD	Analytical Business Enterprise Research and Development
ANZSIC	Australian and New Zealand Standard Industry Classification
ATO	Australian Taxation Office
BERD	Business Expenditure on Research and Development
BCS	Business Characteristics Survey
GFCF	Gross Fixed Capital Formation
GVA	Gross Value Added
MFP	Multifactor Productivity
OECD	Organisation for Economic Co-operation and Development
OCE	Office of the Chief Economist
RDTI	Research and Development Tax Incentive
SME	Small to Medium Enterprise