GROUP OF EIGHT AUSTRALIA

Productivity Commission 5-year Productivity Inquiry

Group of Eight Submission

THE UNIVERSITY OF WESTERN AUSTRALIA

MONASH University

Australian National University

THE UNIVERSITY of ADELAIDE

THE UNIVERSITY OF MELBOURNE

UNSW SYDNEY

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

THE UNIVERSITY OF SYDNEY

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Foreword

The Group of Eight (Go8) represents Australia's eight leading research-intensive universities. Seven of its members are ranked in the world's top 100 universities. In an increasingly competitive global research sector that is no mean feat.

The Go8 has also garnered a global reputation for the quality of its graduates whom we describe as the leaders of tomorrow. They are, and they have been for many decades. They lead their professions. Their knowledge and their commitment drive economies. The teaching and research training offered at Go8 universities is exemplary.

It is too often ignored that globally recognised high quality research-intensive universities hold the innovation key that unlocks growth in national productivity.

This foreword makes those points not out of status but out of determination to use everything within the Go8's arsenal to be, and to be seen to be, part of the solution to Australia's deleterious productivity growth position.

There's no argument from our leading economists that Australia, and indeed nations around the globe, are facing significant economic challenges. Australia's research-intensive universities are committed to being part of the economic solution. In fact, we are integral to the solution.

It is too often ignored that globally recognised high quality research-intensive universities hold the innovation key that unlocks growth in national productivity.

Foreword

We therefore owe it to every Australian to work as a team – with Government and industry – and through the Productivity Commission auspices to right that wrong.

Together we must chart a future course that delivers productivity results.

Most Australians would not have stopped to consider what drives productivity growth and why it is so critical. Nor should they have. That is our role, and our role to correct what has occurred.

Productivity is the only long-term factor driving living standards, yet Australia's productivity growth rate has slowed and is at its lowest rate since the 1970s.

Long-term productivity growth relies on innovation and human capital. Australia must invest more in knowledge creation and human capital if we are to have profitable and innovative businesses, secure high-wage employment, and address challenges such as an ageing population, climate change, and national security needs.

The recommendations within this submission are carefully considered.

They are economically robust, and they are constructive.

Most importantly they are achievable.

They have been developed in consultation with our Go8 Economic Advisory Group – leading economists from across the Group of Eight – to make an essential difference if they are implemented.

Economic impact and economic positivity are increasingly difficult to deliver in the timeframe they should be. It is hoped by the Go8 that this submission, in response to the Productivity Commission's The Key to Prosperity report is accepted and utilised.

Our research-intensive universities can and must be leaders in Australia's productivity revival.

Productivity is the only long-term factor driving living standards, yet Australia's productivity growth rate has slowed and is at its lowest rate since the 1970s.

Executive Summary

Productivity growth is critical as the only long-term factor driving Australian living standards. Yet, Australia's productivity growth rate has slowed and is at its lowest rate since the 1970s. Ultimately, reversing this damaging productivity slide will rely on prioritising innovation (i.e., doing more or better with the same inputs) and human capital (the skills to turn innovative ideas and knowledge into productive changes to goods and services) – and that means prioritising the nation's research universities.

The Group of Eight (Go8), as Australia's consistently leading research-intensive universities, carrying out some 70 per cent of Australia's university research, is therefore key to national productivity growth. The Go8 universities are ignored or sidelined in this process at the Productivity Commission's (and the nation's) economic peril.

This is not only because seven of the Go8's Universities – ranked in the world's top 100 universities – command enormous respect globally and therefore have strong economic access internationally, but because the Go8 also enrolls quality students who become quality graduates: driving quality professional employment within Australia's most crucial industry sectors.

In other words, the Go8 universities are driving both Australia's innovation and its professional human capital.

This submission seeks to shed light on the current actuality and recommend what could be achieved if policy direction was changed and/or enhanced.

Fundamentally, Australia should be investing more in knowledge creation and diffusion and human capital to lift Australia's productivity growth rate.

Executive Summary

This is the only sustainable way to concurrently have profitable and innovative businesses, secure high-wage employment in dynamic and emerging industries and occupations, as well as the means to address challenges such as an aging population, climate change, and increasing national security requirements in a world of strained geopolitics.

There are many sources of productivity enhancing knowledge creation and diffusion. One critical source is research and development (R&D) – both basic and applied research conducted by universities, industry and government.

There are significant proven economy wide returns to R&D investment in Australia, yet the degree of R&D investment has been patchy and a drag on Australia's productivity potential. The drop in overall R&D expenditure as a percentage of GDP since 2008 for Australia is almost exactly matched by a drop in business expenditure on research and development (BERD) as a percentage of GDP.

Australia's research effort is also moving away from all-important basic research. Australia performs relatively well in terms of international comparisons of expenditure on higher education R&D (HERD) as a percentage of GDP as well as, from an 'output' perspective, patent applications and industry collaboration from Australian universities.

This performance is reflected in Australia being above the OECD average for HERD **and the Go8 universities alone almost meeting the OECD average for HERD as a percentage of GDP.**

Australia's status as a small open economy and a net importer of knowledge and technologies overlooks that Australia's research-intensive universities are recognised knowledge creators at the global technological frontier. Our universities **can** be leaders in Australia's productivity revival. This is not to diminish the scale and benefits of industry linkages with overseas knowledge creation and technologies. Rather, and importantly, it is a recognition that Australia is not solely reliant on international developments for its productivity revival. Australia can be a more sovereign nation.

Expenditure on HERD in Australia is worthwhile from an economy-wide productivity perspective. A recent report estimates that for every $1 billion invested in Go8 university research, the additional in-year economic output generated across the rest of the Australian economy could be in the order of $9.2 billion. However, more support needs to be given to Australian universities for research, especially basic research.

Growth in Commonwealth funding to support universities' indirect research costs has not kept pace with growth in funding earned from government, industry, philanthropy, and other sources to deliver research. Collaborative research and development is also important to translate basic research into commercial opportunities and given the internationalisation of these activities.

Given evidence of high benefit-cost ratios to research and development by Australian higher education institutions, the more successful Australian universities are at knowledge creation and innovation through research activities and their diffusion, the greater the stock of ideas that can be applied across the Australian economy, including by businesses, to enhance productivity.

As a priority, the Australian Government must develop a *National Research Strategy* that encapsulates the recently announced national target for R&D expenditure of closer to three per cent of GDP and review of the Australian Research Council (ARC). This is because how as a nation we reach this target matters for productivity. As the International Monetary Fund (IMF) recently acknowledged, basic scientific research is a key driver of innovation and productivity and diffuses wider and for a longer time than applied research. Moreover, the IMF conclude that basic scientific research in advanced economies is underfunded.

... for every $1 billion invested in Go8 university research, the additional in-year economic output generated across the rest of the Australian economy could be in the order of $9.2 billion.

Recommendations – innovation policy and diffusion of new processes and ideas

- The Australian Government should develop a *National Research Strategy* that encapsulates its announced commitment to national R&D expenditure of closer to three per cent of GDP and review of the Australian Research Council (ARC). This is because how, as a nation, we reach the target matters for productivity.
- The *National Research Strategy* should address impediments to R&D in different sectors of the economy, including in higher education institutions and by business. The *Strategy* should encompass:
  - » Recognising, prioritising, and enhancing funding support for basic research in Australia as an essential component of Australia's economy, including through:
    - Revising the ARC's legislative mandate and programs; and
    - Better measuring the broad impacts of publicly funded Australian research.
  - » Improving the incentives for Australian universities to conduct basic research by providing secure and sustainable funding to university research programs – particularly through the ARC, National Health and Medical Research Council (NHMRC), and the Medical Research Future Fund (MRFF) – including by:
    - Reviewing ARC funding levels and programs to ensure they are fit for delivering research funding to basic research in national priority areas.
    - Adopting a full economic cost approach (i.e., addressing all research cost) rather than relying on cross-subsidisation from university discretionary funds predominantly from international student fee revenue.

Recommendations – innovation policy and diffusion of new processes and ideas *(continued)*

» Supporting further collaboration between industry and universities on R&D effort, including:
  - Amending skilled migration settings by introducing a new high potential individual (HPI) visa targeting the attraction and retaining of world leading university researchers and educators as well as enabling graduating international PhD students to remain in Australia.
  - Training research translation and commercialisation professionals.
  - Examining policies to promote co-location with universities to facilitate knowledge diffusion externalities.

» Supporting Australian university researchers access to international collaboration and funding, including:
  - Supporting Australian universities to access the *Horizon Europe* program via third country association or dedicated funding to enable participation.
  - Increased support for researcher exchanges in areas of specific need to support key national agreements such as AUKUS and broader initiatives such as Australia's space program.
  - Bilateral research funding to leverage the advantages offered by the first ever innovation chapter in the Australia-UK Free Trade Agreement.
  - Support to deepen Australia's engagement with key regional architecture nations such as ASEAN and the QUAD.

» Tightening the criteria for the business Research & Development Tax Incentive (R&DTI) to focus on encouraging the hiring of Australian PhD graduates.

» Consistent with OECD recommendations, broader taxation settings to create an environment that better supports innovation activities and human capital accumulation in Australia.

The Australian Government must also set out that it understands that knowledge creation goes hand in hand with skills, including the advanced skills taught in our universities. Moreover, rapid technological change and trade openness necessitates (and will continue to) a workforce with more skills to adopt to use new technologies.

This in turn necessitates lifelong investment in education and skills, starting with early childhood learning, through to universities that provide the teaching and learning for students to acquire these necessary advanced skills that are increasingly becoming a prerequisite in the global economy.

The value of education accrues not only to an individual but to their employer, industry, and economy more generally because of human capital 'externalities' or spillovers. That is, education and training are critical to the accumulation and sharing of knowledge and ideas, and moreover can also make other (less educated) workers in the economy more productive.

There are proven high public benefit cost ratios to skill acquisition through university education in Australia.

We also know that employment growth in occupations requiring a bachelor degree or higher is expected to account for over half of the projected total employment growth over the five years to November 2026.

This will require additional investment in our universities as the creators of human capital required to lift Australia's productivity performance.

It is simply an indisputable fact that the more successful Australian universities are at teaching students, the greater the stock of human capital available across the economy, including for businesses, to turn ideas and knowledge into innovative and productive changes to the production of goods and services.

As a priority, the Australian Government must address the funding needs of Australian universities – and this is not asking for more but a more effective allocation of the pie to ensure outcomes and return on investment – and use the upcoming *University Accord* to work with universities to redevelop an outcome focused university sector that can meet the 21st century needs for every Australian through productivity growth.

Recommendations – a skilled and educated workforce without which nothing can be achieved

The Australian Government should:

- Plan and budget for additional university student places to support workforce needs that will be dominated by occupations requiring at least a bachelor's degree. Additional places should be, in the main, tied to projected demographic changes with at least a five-year lead up to allow universities to plan for the additional places.
- Abolish the Job-ready Graduates package in favour of a simpler model for university teaching funding by having one single student contribution and a Commonwealth contribution to reflect the variability of the given qualification cost.
- Work with universities on the appropriate level of funding per student required to support progress towards equity and gender representation targets.
- Introduce the HPI visa to attract and retain world leading university researchers and educators as well as enabling graduating international PhD students to remain in Australia as permanent residents.
- In addition to the above, use the upcoming *University Accord* to review:
  - » University funding structures and the incentives they create for resource allocation between university research and teaching activities.
  - » Current industrial arrangements related to university faculty staff that want to specialise in teaching or research.
  - » Evaluation of student experience and teaching quality processes and reporting.
  - » The role and additional funding of university micro-credentials and other short-course offerings to meet specific and changing skill needs and re-training.
  - » Best practice Industry/PhD programs and how these can be scaled nationally.

Executive Summary

We are living in a digital economy where rapid technological change across all sectors of the economy has resulted in unprecedented demand for a high skilled workforce. Australia is now at a critical juncture where investment in a high technology-enabled workforce is essential to meet growing industry demand and reap productivity gains.

Australian universities have a critical role in addressing education and training so that there is a strong, reliable long-term supply of information technology and computing workforce in Australia. The Go8 universities have a central role to train people for world-leading advanced IT and computing roles that will not be addressed by the vocational education and training (VET) sector.

An increased domestic supply of university graduates with advanced IT and computing qualifications will be critical to building productive sovereign capacity in key industries such as defence and critical technologies in the national interest.

Recommendations – data policy, digital technology, and cyber security

The Australian Government should, in the **immediate term** prior to the full *University Accord* process:

- Introduce targeted funding to increase the quantum of information technology (IT) and computing related courses taught to domestic students enrolled at Australian universities.
- Fund the teaching of IT at universities at the same Commonwealth contribution rate as engineering.
- In the context of critical technologies in the national interest, provide a clear articulation to industry and universities of where it believes the national focus on IT and computing research, education, workforce recruitment and business activity should be.

Excessive and unwarranted red tape stymies productivity and limits our nation's prosperity, a fact recognised but not adequately addressed by successive governments.

A productivity-friendly business environment is just as important to Australian universities as it is to the broader economy.

Recommendations – a productivity-friendly business and research environment

The Australian Government should:

- Use the upcoming University Accord process to prioritise a review of legislative, regulatory, and reporting requirements impacting the university sector to identify and address:
  - » Duplicative and overlapping legislation, regulation, and reporting requirements.
  - » Opportunities for streamlined reporting and data collection – 'collect once, use many times'.
- Ensure that all new legislation impacting the university sector is subject to a full legislative and regulatory scan by the sponsoring Minister's agency to identify areas of overlap, duplication, redundancy.
- Ensure that there is cross-portfolio collaboration between departments when designing regulation – with the purpose of eliminating duplication, overlap and redundancy.

1 Introduction

As the Productivity Commission has noted in its *The Key to Prosperity* report, productivity ***is*** the only long-term factor driving living standards, yet Australia's productivity growth rate has slowed and is at its lowest rate since the 1970s Productivity Commission (2022a). The need for reform is evident by the foregone gains in living standards each year there is weak productivity growth in Australia.

Australia's status as a small open economy and net importer of knowledge and technologies overlooks the fact that Australia's research intensive universities are knowledge creators at the global technological frontier as well as highly effective diffusors of knowledge both domestically and internationally. With further reforms outlined in this submission, Australia's research-intensive universities can be partners and leaders in Australia's productivity revival.

The elusive quest for productivity growth has resulted in a wide range of drivers or enablers being postulated – everything from physical infrastructure investment, new technologies, the business 'environment', trade openness and diversity, the changing industry structure of the economy, the quality of institutions, the 'digital' economy broadly defined, and even geography.

Long-term productivity growth relies on innovation (i.e., doing more or better with the same inputs) and human capital (the skills to turn innovative ideas and knowledge into productive changes to goods and services). In other words, the more you invest in knowledge creation and human capital together, the larger the economy-wide productivity return. This is recognised by the Productivity Commission (2022a) itself: *"While economic growth based solely on physical inputs cannot go on forever, human ingenuity is inexhaustible"*.

Ultimately, the rate of long-term productivity growth relies on innovation – the creation of ideas and knowledge combined with human capital (people with skills) to turn knowledge and innovative ideas into improved production of goods and services in the economy. Fundamentally, Australia should be investing more in knowledge creation and innovation and human capital to reap increasing returns to scale and lift the growth rate of productivity in Australia. This is the only sustainable way as a society to concurrently have profitable and innovative businesses, secure high-wage employment in dynamic and emerging industries and occupations, as well as the means to address challenges such as an aging population, climate change, and national security needs.

There are many sources of productivity enhancing knowledge creation and innovation, but a critical source is research and development – both basic and applied – which is diffused through the economy.

Research is conducted by individuals in solving problems, by businesses looking to expand and become more profitable, and governments and not-for-profits trying to deal with public policy issues. Research is also conducted and diffused in a systematic way by organisations specially designed for such activities – namely universities and associated research institutes and in Australia **the bulk of university-based research is undertaken across the Go8.** Through our research, we diffuse knowledge through publications in leading peer-reviewed journals, by engaging with industry and government, and by teaching students who are our future leaders. Labour productivity growth in Australia's higher education sector between 2008–09 and 2018–19 has outpaced labour productivity growth of market sector industries.

Fundamentally, Australia should be investing more in knowledge creation and innovation and human capital to reap increasing returns to scale and lift the growth rate of productivity in Australia.

Introduction

Given high benefit-cost ratios to research and development by Australian higher education institutions (see section 2), the more successful our universities are at research activities, the greater the stock of knowledge and innovative ideas that can be applied across the economy, including by businesses, to enhance productivity.

Investing in skills in the face of rapid technological change is a lifelong investment starting with early childhood learning, right through to university education that provides the necessary advanced skills that are increasingly becoming a prerequisite in the global economy.

Australia, like most of the global economy, has been subject to rapid technological change over the past 50 years and these technologies require people to have more skills to apply them. This trend has resulted in a greater skill intensity of jobs in the economy. Investing in skills in the face of rapid technological change is a lifelong investment starting with early childhood learning, right through to university education that provides the necessary advanced skills that are increasingly becoming a prerequisite in the global economy.

Given evidence of high public benefit-cost ratios to skill acquisition through university education in Australia (see section 3), the more successful our universities are at providing high quality teaching, the greater the stock of human capital available across the economy, including for businesses, to turn ideas and knowledge into innovative and productive changes to the production of goods and services.

2 Innovation policy and diffusion of new processes and ideas

2.1 Introduction

Fundamentally, ideas or knowledge creation that underpins innovation is the key to prosperity. Research, whether basic or applied, is the process of creating ideas or knowledge and is conducted by individuals in solving problems, by industry and businesses looking to expand and become more profitable, and by governments and not-for-profits trying to deal with public policy issues.

> ***Economic growth arises from people creating ideas***
>
> Bloom et al., 2020, p. 1104

Research and development (R&D) expenditure and knowledge spillovers contribute to innovation and productivity in several ways. For example, firms use external knowledge to become more productive. Second, R&D expenditure creates and raises the returns to knowledge spillovers that leads to innovation. Moreover, R&D can create new collaboration between sectors. As the IMF (2021, p. 67) notes "research increases knowledge, knowledge enhances productivity, and productivity determines how much final output is generated from real inputs."

The Go8 research intensive universities are Australia's bedrock for basic research.

Innovation policy and diffusion of new processes and ideas

While Australia and its economy focused on in-ground resources during the mining boom, other nations were developing their intellectual resources and building substantial research infrastructures that promise major economic benefits. This is a model Australia must emulate. Our universities have remained competitive in research by careful use of government support and by finding research funding from other sources. Much of the infrastructure and expertise required is in place: the government needs to nurture the discovery-application research pipeline leading to economic benefit by protecting and enhancing research funding.

While Australia and its economy focused on in-ground resources during the mining boom, other nations were developing their intellectual resources and building substantial research infrastructures that promise major economic benefits. This is a model Australia must emulate.

Doing so will lift our productivity.

It is not enough to remain a net importer of knowledge and technologies and in doing so we ignore the fact that our research intensive universities are both creators and diffusors of knowledge at the global technological frontier. With the reforms outlined in this submission, our universities can and will be partners and leaders in Australia's productivity revival. This is not to diminish the scale and benefits of linkages with overseas knowledge creation and technologies, it is a recognition that Australia can be a world leader.

The more successful our universities are at creating knowledge through research, the greater the stock of ideas and knowledge that can be applied across the Australian economy to enhance productivity, including by businesses. Wages, secure employment, incomes, and a low inflationary environment depend on productivity growth. Hence engagement with world leading research is critical for Australia's future as a high-income economy. It is also critical to our national security which is now a communications/data/space race.

2.2 Public returns to research and development expenditure in Australia

The Productivity Commission acknowledge that productivity growth has been linked to innovation and research, and that this has become a rationale and basis of funding of public research (Productivity Commission, 2007). The Australian Government, recognising the importance of R&D, has also committed to raising Australia's expenditure on R&D closer to three per cent of GDP (from the current level of 1.8 per cent of GDP).

Table 1 shows recent estimates from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) on the public returns to R&D investment in Australia (CSIRO Futures, 2021). Specifically, the CSIRO quantifies the relationship between domestic gross expenditure on R&D and Australian GDP per capita growth to estimate the return on investment (ROI) to innovation. These estimates assume a lag of 10 years between the research activity and the economic returns as well as allowing for R&D embodied in physical capital. The benefit-cost ratio of 3.5 suggests R&D investment has a worthwhile return to Australia.

Table 1: Estimated public returns to R&D investment in Australia

Average benefit-cost ratio	Average rate of return (per cent)
3.5	10

Source: CSIRO Futures (2021).

Innovation policy and diffusion of new processes and ideas

> ***Productivity is the set of non-rival ideas that tell us how to combine rival inputs (capital, labor) to produce GDP.***
>
> ***The non-rivalry is why productivity is capable of driving growth in GDP per person even when rival inputs (capital, labor) are not.***
>
> Vollrath, 2022

What underpins these estimates is the very nature of knowledge as largely being 'non-rival' (use by one person does not preclude use by another person) which provides the basis for increasing returns to scale when used together with labour. This is a feature other traditional inputs such as physical capital do not exhibit.[1]

In other words, investment in R&D adds to the stock of ideas that can provide productivity 'spillovers' that increase the growth rate of productivity and is not limited to creating step 'level' effects on productivity growth. Hence public (or 'social') returns to R&D tend to often be larger than 'private' returns to R&D. As the OECD (2015a) notes *"Social rates of return to R&D generally prove to be significantly larger than private returns, the average (median) social return to R&D amounting to roughly 1.2 (0.8). On average, spillover benefits make up for approximately 61% (median 67%) of the social return to R&D"*.

Examining specifically ***the contribution of Australian universities to the R&D productivity spillovers***, Australian research by Elnasri & Fox (2017) indicates strong evidence of productivity benefits from higher education R&D (HERD) amongst four classes of public funding for research and innovation.

1 This approach to understanding economic growth is known as 'endogenous growth theory' as developed by Paul Romer for which he won a Nobel prize in Economics. See Romer (1990).

In particular, the elasticity of multifactor productivity (MFP) with respect to public funding of higher education R&D is 0.175, which means an increase of 1 per cent in public funding of higher education R&D can increase MFP by 0.175 per cent. Moreover, Elnasri & Fox find that there are also significant spillovers to productivity from public sector R&D spending on research agencies but no evidence of spillovers from indirect public funding for the business enterprise sector, civil sector, or defence related R&D.

Through conducting R&D, Australian universities are knowledge creators that underpin public innovation and productivity growth. There is also a geographic proximity to this – international evidence points to innovation precincts from university research (Anselin et al., 1997). Hence the 'high-technology' clustering of businesses including start-ups in proximity to universities (Audretsch, 1998). More broadly, industries in which knowledge spillovers are more common through more intense use of R&D, university research and skilled labour have a greater likelihood to cluster (Audretsch & Feldman, 1996). Evidence for Australia from Bakhtiari & Breunig (2017) also suggest positive local R&D spillovers and that R&D expenditure specifically by academia, has a positive impact on a firm's own R&D expenditure within the same Australian jurisdiction.

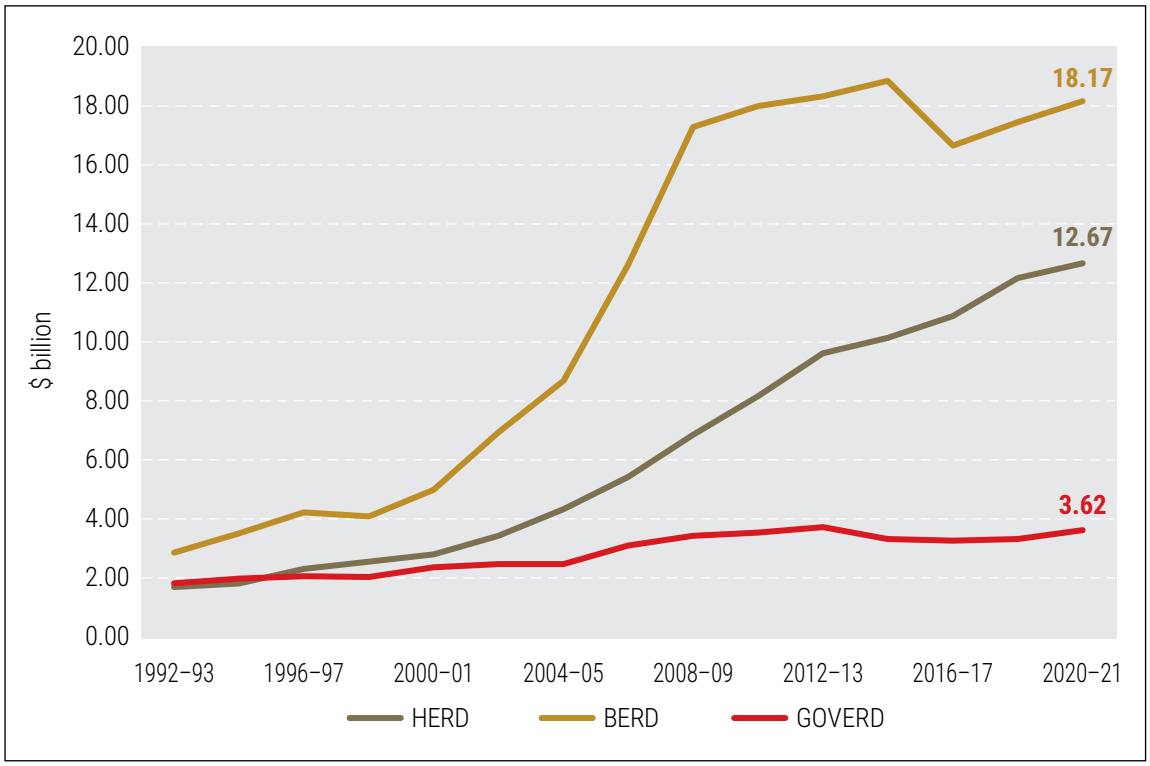
Australian research and development, particularly by Australian universities, has high public returns and significant benefit-cost ratios

2.3 Australia's R&D performance and productivity

Aggregate R&D expenditure

In dollar terms, business sector R&D expenditure (BERD) is much larger than government (combined Commonwealth and State/Territory) R&D expenditure (GOVERD) and R&D expenditure by higher education institutions (HERD). This is evident by Chart 1 which shows R&D expenditure by each sector. BERD was $18.2 billion in 2019–20, while HERD was $12.7 billion and GOVERD $3.6 billion. We can see from Chart 1 there has been a levelling off in the growth in BERD from around 2008–09, post the global financial crisis (GFC).

Chart 1: Research and development expenditure in Australia by sector (a)



(a) Data for BERD and GOVERD are on a financial year basis. Source (2022b), (2022c) and (2022d).

Despite the significant economy wide returns to R&D investment in Australia, the degree of R&D investment has been patchy and a drag on Australia's productivity potential.

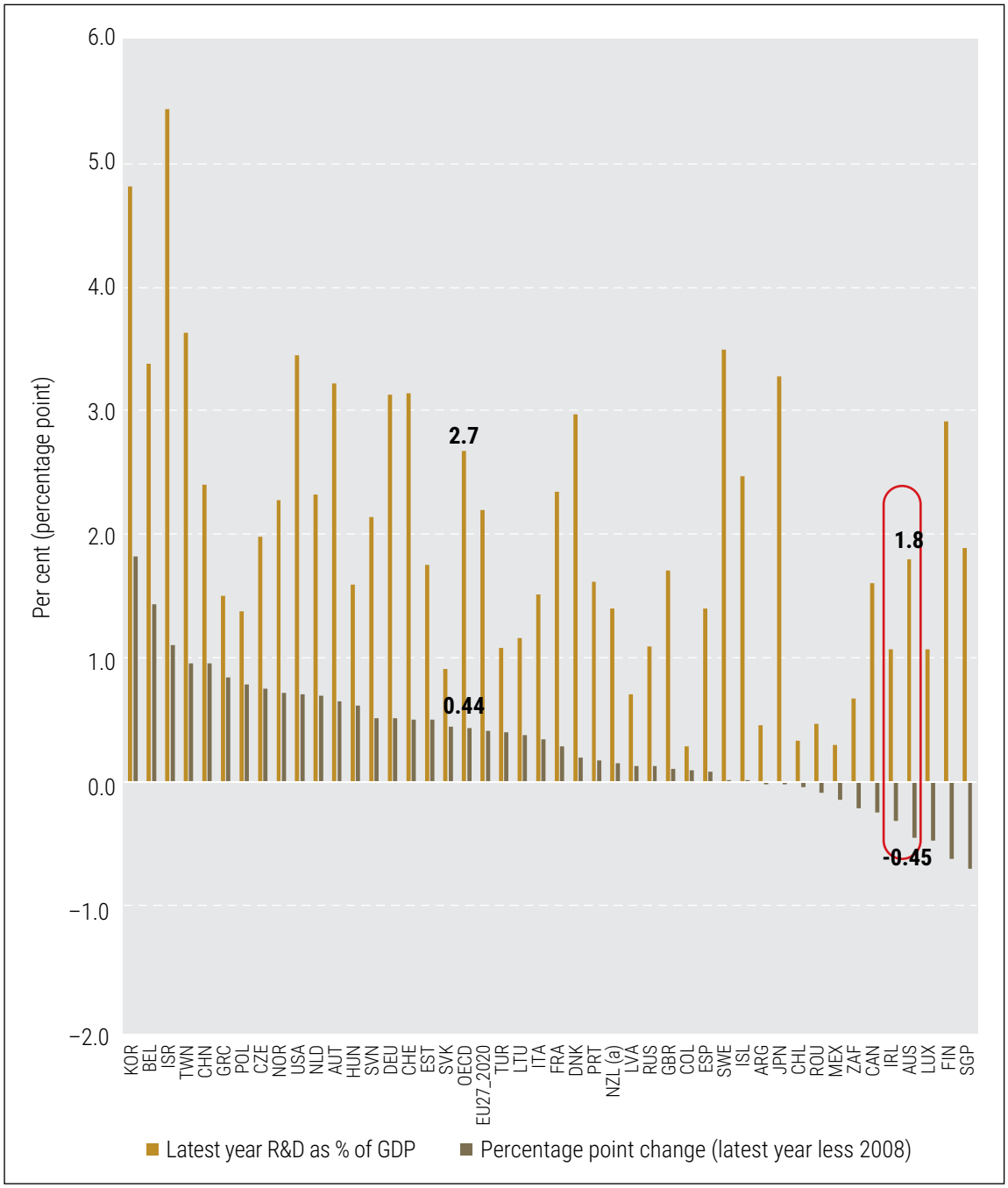
Despite the significant economy wide returns to R&D investment in Australia discussed earlier, the degree of R&D investment has been patchy, suggestive that the productivity 'spillovers' of R&D are not fully considered by business and industry in making decisions about whether to invest in R&D and/or there are impediments to further R&D investment, both of which mean potentially less than socially optimal levels of R&D may occur.

Australia's expenditure on R&D as a percentage of GDP stands at 1.8, well below the OECD average of 2.7 per cent and significantly behind innovative nations such as Japan – 3.3 per cent, the US – 3.5 per cent, Korea – 4.8 per cent, and Israel – 5.4 per cent (Chart 2).

Australia's expenditure on R&D as a per cent of GDP has declined by 0.45 percentage points since 2008 when it stood at 2.25 per cent – in line with the then OECD average of 2.24 per cent. This is in contrast with the OECD average which increased 0.44 percentage points since 2008, and countries such as Korea where its increase in R&D expenditure as a percentage of GDP has risen 1.83 percentage points since 2008.

Australia's expenditure on R&D as a percentage of GDP stands at 1.8, well below the OECD average of 2.7 per cent ...

Chart 2: Gross domestic spending on total R&D, per cent of GDP, 2020 or latest available and percentage point change since 2008



(a) New Zealand (NZL) figure is for 2009. Source: OECD (2022a).

Expenditure on basic and applied R&D

Basic research that adds to the stock of knowledge (and does not necessarily immediately lead to tangible products or services) is critical because basic research can deliver the pipeline of ideas, technologies and processes that be built upon in the future. Often without basic research, applied research is not feasible, basic research can be a necessary precursor to applied research and/or commercialisation.

The Go8 conducts almost two-thirds of basic research conducted in Australian universities and 72 per cent of all pure basic – or truly blue sky – research. In 2018 this was an investment of almost $3.3 billion in basic research – including in the Go8's biggest research areas of Medical, Health and Biological Sciences, and Engineering, Computing Sciences and Technology.

This is despite funding from the Australian Research Council – the principal funder of non-medical basic research – having been in decline in real terms for the last decade with a cumulative shortfall of $1.25 billion against funding levels in 2012–13.

Improving the incentives and funding for Australian universities to conduct basic research is important.

Complex products and processes — whether highly useful (smartphones) or absolutely essential (lifesaving cancer drugs) — frequently begin with basic research in a university, before being commercially adopted for development. The smartphone market is dominated by two giants, Samsung and Apple, but almost all the key elements — processors, lithium-ion batteries, touch screens, GPS tracking — owe their existence to government-funded university research.

The Go8 conducts almost two-thirds of basic research conducted in Australian universities and 72 per cent of all pure basic – or truly blue sky – research.

Innovation policy and diffusion of new processes and ideas

The human papillomavirus vaccine Gardasil, widely used in protection against cervical cancer in women and HPV-related cancers in men, began life in 1991 at the University of Queensland, when a research team led by scientists Jian Zhou and Ian Frazer found a way to make "virus-like particles" that could activate the immune system and form the basis of an HPV vaccine.

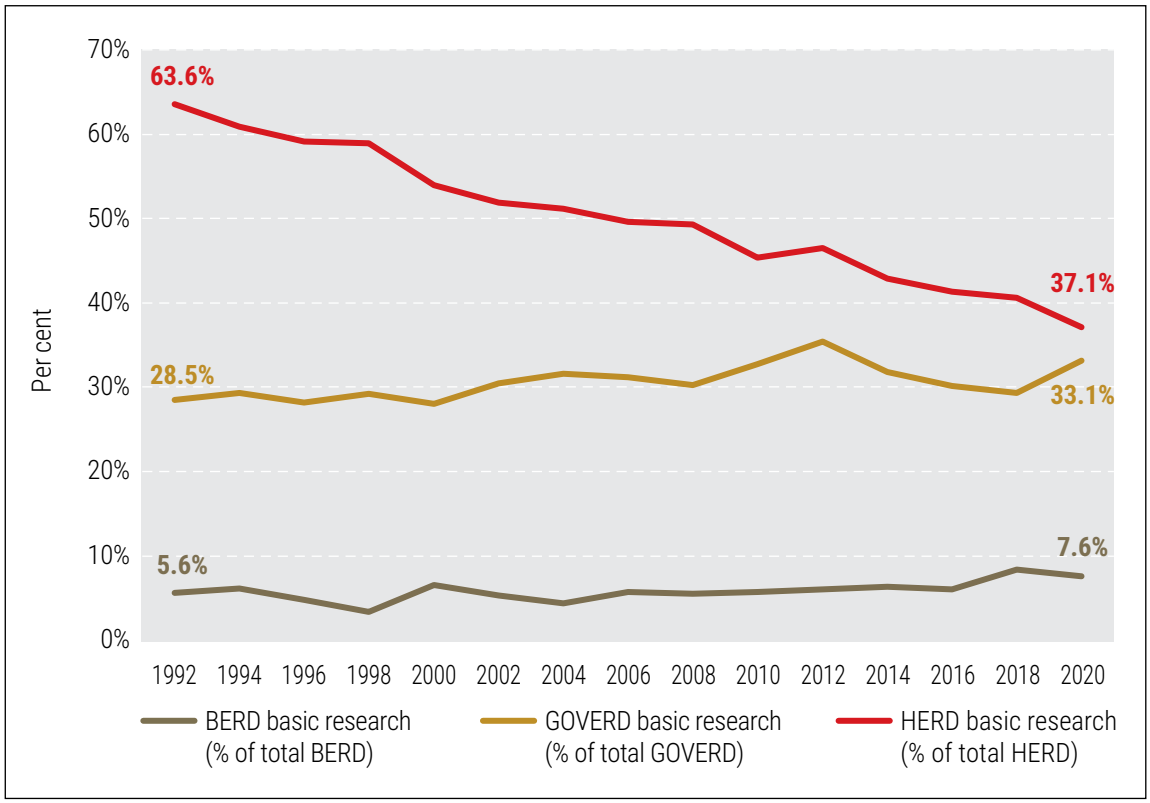
Further research at UQ and at Georgetown University, the University of Rochester and the National Cancer Institute in the US led to a vaccine used by millions today and credited with saving thousands of lives.

Two lessons emerge here: that government funding of basic research to drive the pipeline from discovery to application can lead to human benefits and economic growth disproportionate to the initial investment, and that the alternative — "wait and see what others do" — is not a policy so much as a recipe for economic decline.

At a time that the OECD (2015b) suggests *"We need to keep pushing out the global innovation frontier. This requires significantly more public investment in basic research to support the continued emergence of breakthrough innovations"*, Australia's research effort is largely moving away from all-important basic research.

This is evident in Chart 3 which shows the relative decline in Australia of basic research in total R&D expenditure as a percentage of total HERD from 63.6 per cent of total HERD in 1992 to 37.1 per cent in 2020. The share of total GOVERD on basic research has risen marginally, from 28.5 per cent in the early 1990s to 33.1 per cent in 2020–21, while the business sector does not have much of a focus on basic research – the share of BERD on basic research hardly changed over three decades.

Chart 3: Basic research shares of total R&D expenditure (a)



Source: ABS (2022b), ABS (2022c) and ABS (2022d). (a) Basic research includes pure basic research and strategic basic research as defined by the ABS. Data for BERD and GOVERD are on a financial year basis.

Australia's research effort is moving away from all-important basic research. More support needs to be given to Australian universities for basic research.

Innovation policy and diffusion of new processes and ideas

Sectoral shares of aggregate R&D expenditure

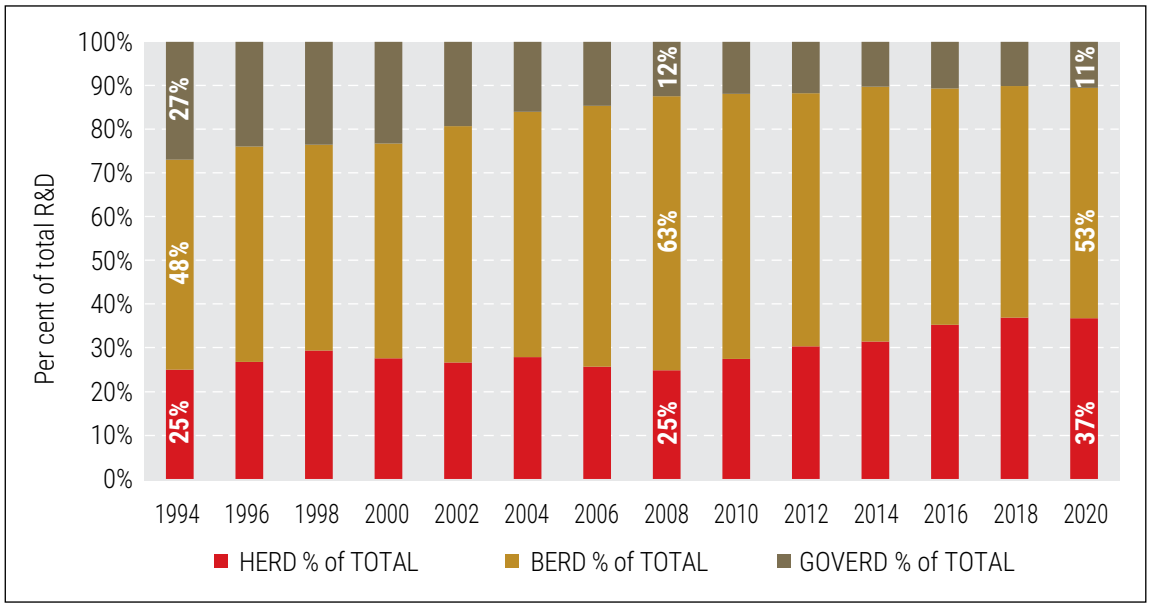
The sectoral share of aggregate R&D expenditure in Australia has shifted over time, especially since the global financial crisis (GFC) period around 2008. Chart 4 shows GOVERD's share of total R&D has been in decline since the mid 1990's.[2] This decline has been accompanied by BERD's share of total R&D also declining since 2008, falling 10 percentage points by 2020 to 53 per cent of total R&D expenditure. Australia's R&D investment performance has increasingly become reliant on HERD, its share of total R&D rising by 12 percentage points since 2008 to 37 per cent of total R&D expenditure in 2020. **The research intensive Go8 universities contributed around 60 per cent of the total HERD in 2018.**

The national drop in R&D expenditure as a percentage of GDP since 2008 of 0.46 percentage points is almost matched by a drop in BERD of 0.45 percentage points – from 1.37 per cent of GDP to 0.90 per cent, so that by 2020 it is less than half the OECD average of 1.92 per cent of GDP. The national decline in BERD as a per cent of GDP and the associated drop in Australia's productivity performance over the past decade is illustrated in Chart 5. BERD is further discussed in the next section.

The drop in overall R&D expenditure as a percentage of GDP since 2008 for Australia is exactly matched by a drop in BERD as a percentage of GDP.

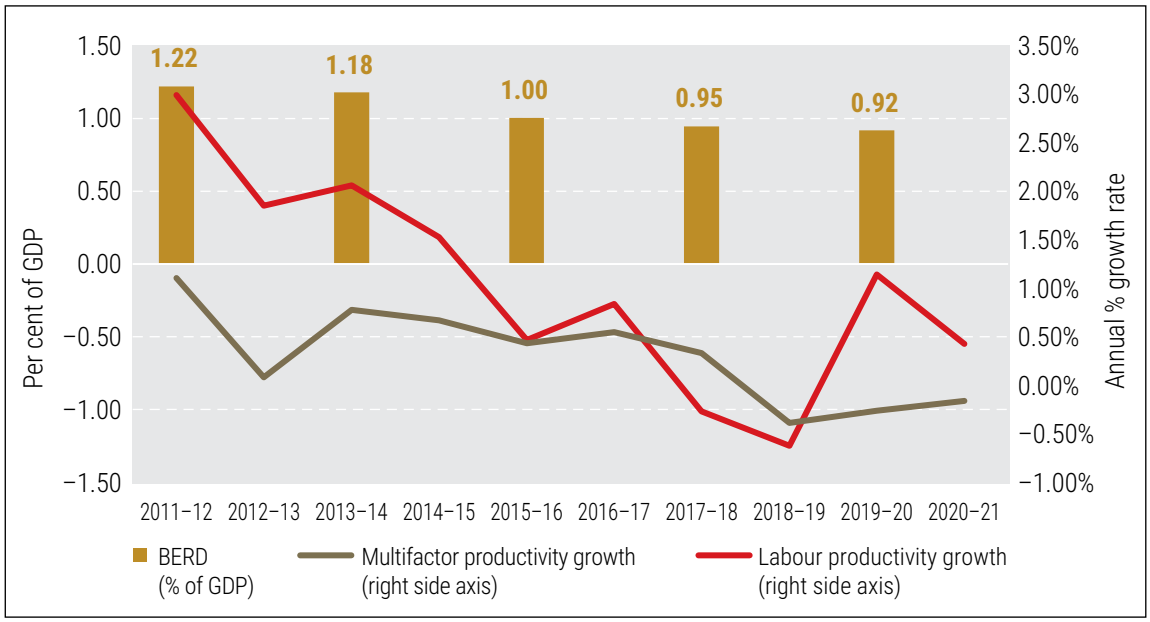
2 GOVERD as measured by the ABS also includes R&D expenditure by private non-profit organisations.

Chart 4: Share of total R&D expenditure in Australia by sector



Source: ABS (2022b); ABS (2022c); and ABS (2022d).

Chart 5: Australia's BERD as a per cent of GDP and productivity growth



Source: OECD (2022a) and ABS (2022a).

Business research and development expenditure

One significant reason behind the relatively low level of BERD is the structure of the Australian economy that has 99.5 per cent of employing Australian businesses as SMEs and 69.0 per cent employing between one and four staff (Australian Bureau of Statistics, 2022e). This means there is limited economy wide absorptive capacity for industry in Australia to understand and adopt research into businesses. Another potential driver of the weakening R&D performance of the business sector is that with industries such as automotive manufacturing having moved offshore, so have some of their R&D activities.

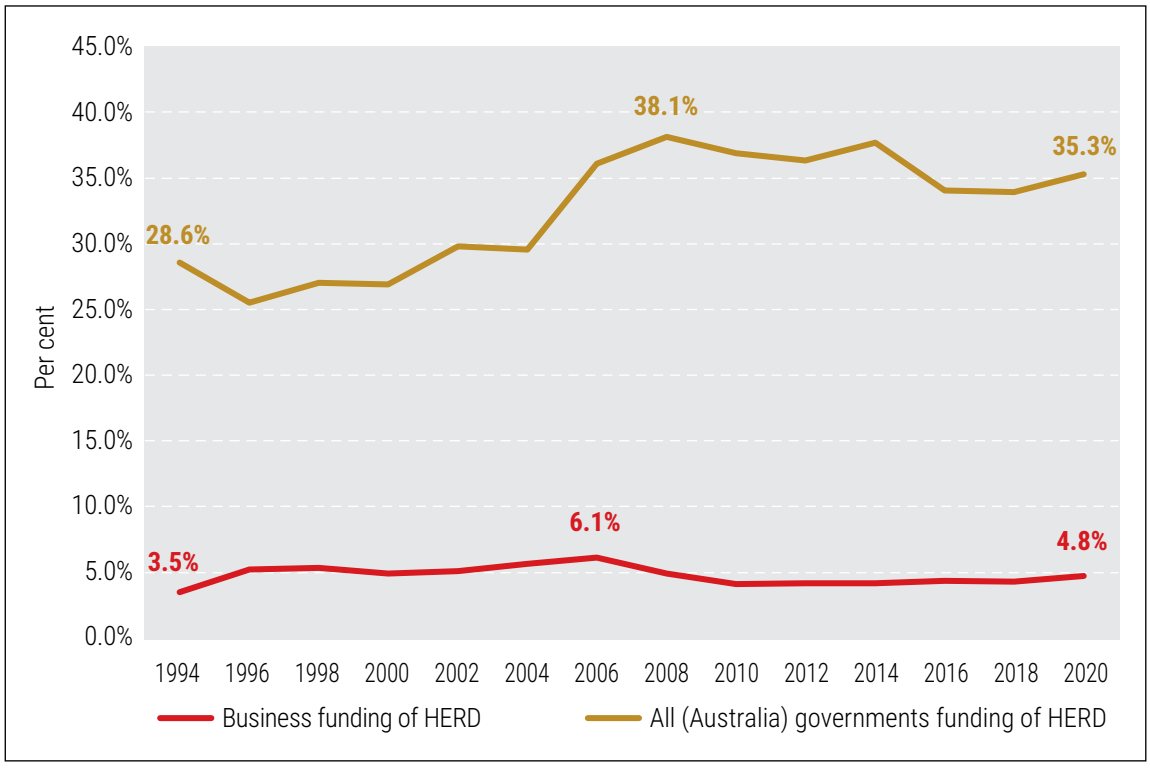
Another factor is that businesses may underinvest in R&D if they do not fully consider the public returns relative to private returns. This contrasts to HERD where publicly funded researchers may be considering the broader public returns to R&D in addition to the private returns. The Productivity Commission (2007) additionally notes that positive spillovers are only a relevant rationale for public support of commercially oriented research when subsidies change the marginal (private) decision about whether to proceed.

There is also a procyclical nature to BERD. As the OECD (2021b) has pointed out, internationally, BERD has followed economic activity – slowing during economic downturns. This is evident for Australia in the slowdown of BERD immediately post the GFC presented in Chart 1. The longer-term impact of the COVID-19 economic downturn on BERD in Australia is yet to be seen.

One significant reason behind the relatively low level of BERD is the structure of the Australian economy that has 99.5 per cent of employing Australian businesses as SMEs and 69.0 per cent employing between one and four staff (Australian Bureau of Statistics, 2022e).

Not only has BERD as a per cent of total R&D expenditure declined in Australia, the share of higher education institutions R&D funded by the business sector has also declined, albeit from an already low base. This is shown in Chart 6 which shows the percentage of HERD funded by the business sector declining from 6.1 per cent in the mid-2000s to 4.8 per cent in 2020. In contrast, all domestic governments (Commonwealth and State/Territory) have increased their share of HERD funding.

Chart 6: Business sector and all domestic governments funding of higher education institutions R&D (per cent of total funding sources)



Source: ABS (2022b).

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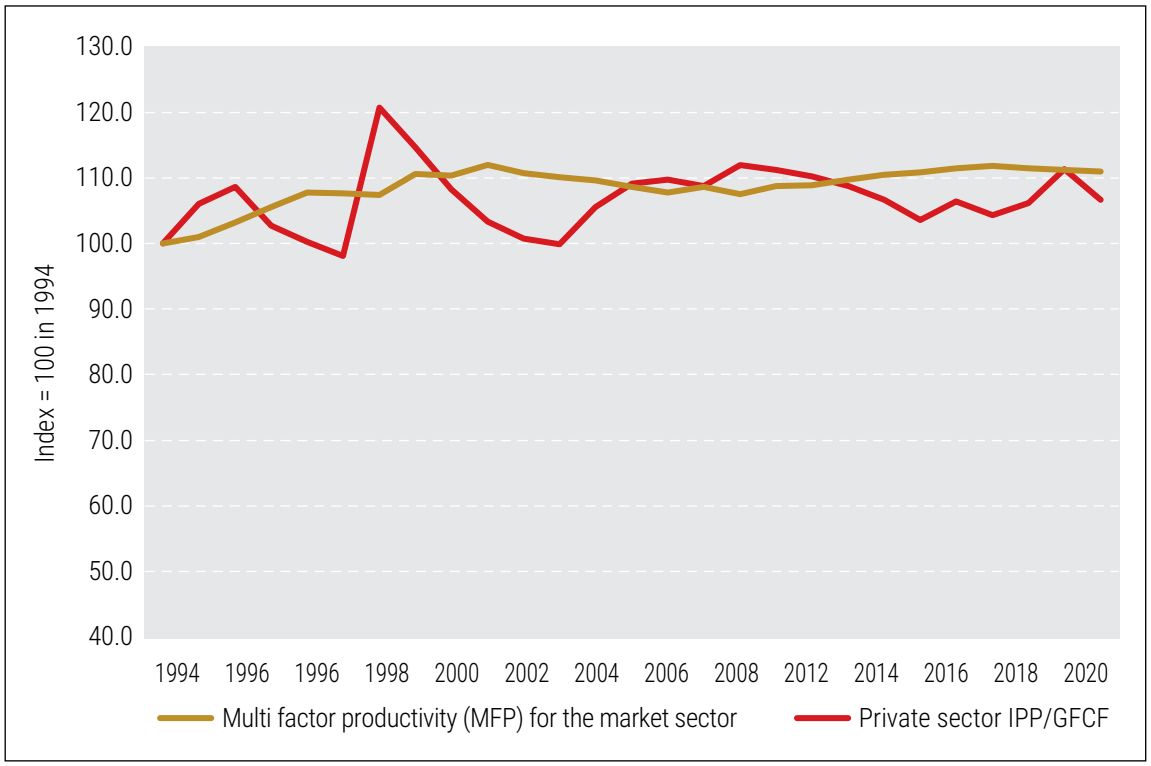
Examining a broader indicator of knowledge investment for the business sector, Chart 7 compares the growth in private sector investment in intellectual property products (IPP) as a per cent of total private sector gross fixed capital formation (GFCF) to the trend in multifactor productivity growth for Australia. IPP is a broader concept defined to include not only R&D, but also mineral exploration, software and databases, and literary and artistic originals. The knowledge investment series given by private sector IPP/GFCF closely matches the behaviour over time of multifactor productivity (MFP) for the market sector.

Chart 7: Australia private sector investment in intellectual property products relative to total private sector gross fixed capital formation; and multifactor productivity growth, market sector (index = 100 in 1994)



Source: For IPP/GFCF ratio – OECD (2022b). For MFP – ABS (2022a).

The Productivity Commission has examined the role of broader 'intangible capital', including items not captured in Chart 7, such as organisational capital, firm-specific human capital, and brand equity on productivity growth (Barnes & McClure, 2009). While they find a relatively less important role in intangible capital contributing to multifactor productivity growth, the contribution of intangible capital deepening to labour productivity growth rose from 0.29 per cent a year from 1974–75 to 1984–85, to 0.57 per cent a year from 1994–95 to 2005–06. Moreover, Elnasri & Fox (2017) find strong evidence for the positive impact of intangible capital on Australian market sector multifactor productivity – an increase of 1 per cent of intangible capital raises MFP by 0.58 per cent.

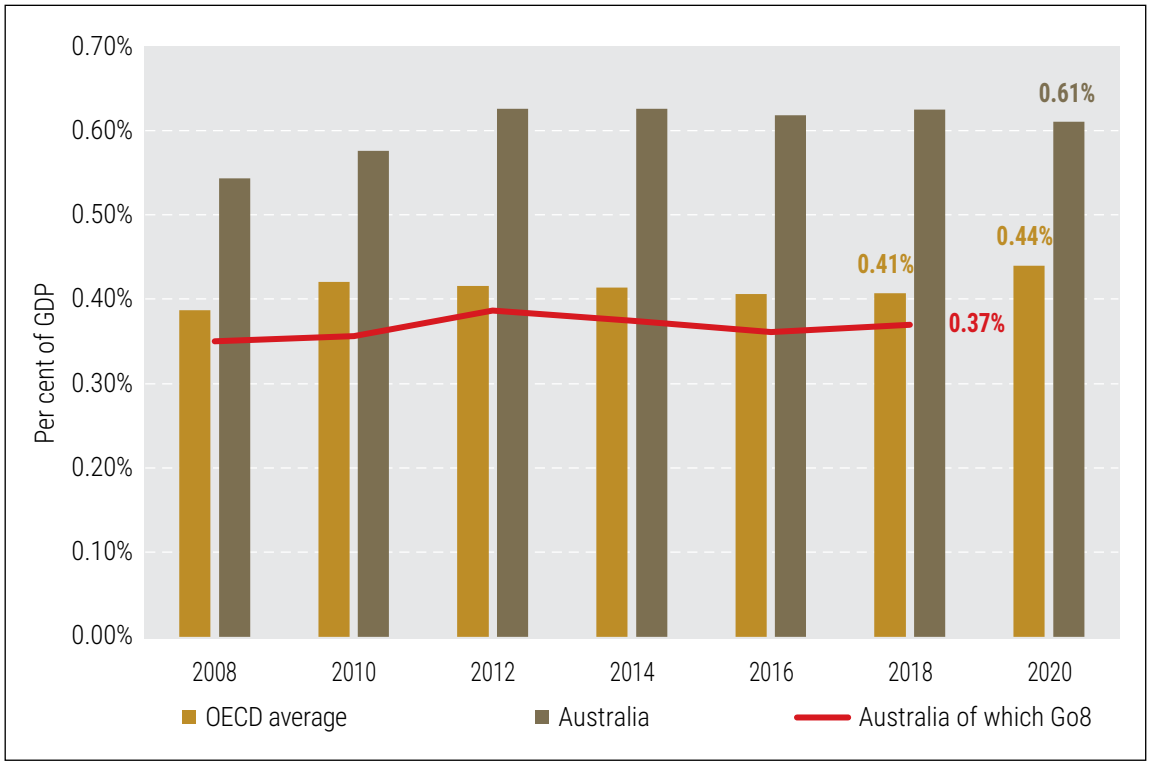
... the contribution of intangible capital deepening to labour productivity growth rose from 0.29 per cent a year from 1974–75 to 1984–85, to 0.57 per cent a year from 1994–95 to 2005–06.

Higher education research and development expenditure

In contrast to BERD, HERD as a percentage of GDP has risen from 0.54 per cent in 2008 to 0.61 per cent in the survey conducted by the ABS in 2020 – significantly higher than the OECD average of 0.44 per cent of GDP **– and with a Go8 contribution of approximately $7.2 billion in 2018.**

Comparing expenditure on HERD as a percentage of GDP across the OECD to Australia shows that Australia performs relatively well – for Australia expenditure on HERD as a percentage of GDP was 0.61 per cent in 2020, compared to 0.44 per cent on average across the OECD. The Go8 universities have contributed around 60 per cent of total expenditure on HERD in Australia since 2008 and as a percentage of GDP **the Go8 universities alone almost meet the OECD average for HERD as a per cent of GDP** (comparing the gold column and red line in Chart 8, for example in 2018, HERD as a percentage of GDP across the OECD was 0.41 per cent, and Go8 R&D was 0.37 per cent of Australia's GDP).

Chart 8: Expenditure on HERD as a per cent of GDP Australia and OECD average



Source: ABS (2022c) and OECD (2022a).

Australia performs relatively well in terms of international comparisons of expenditure on higher education research and development. Australia is above the OECD average for HERD and the Go8 universities alone almost meet the OECD average for HERD as a per cent of GDP.

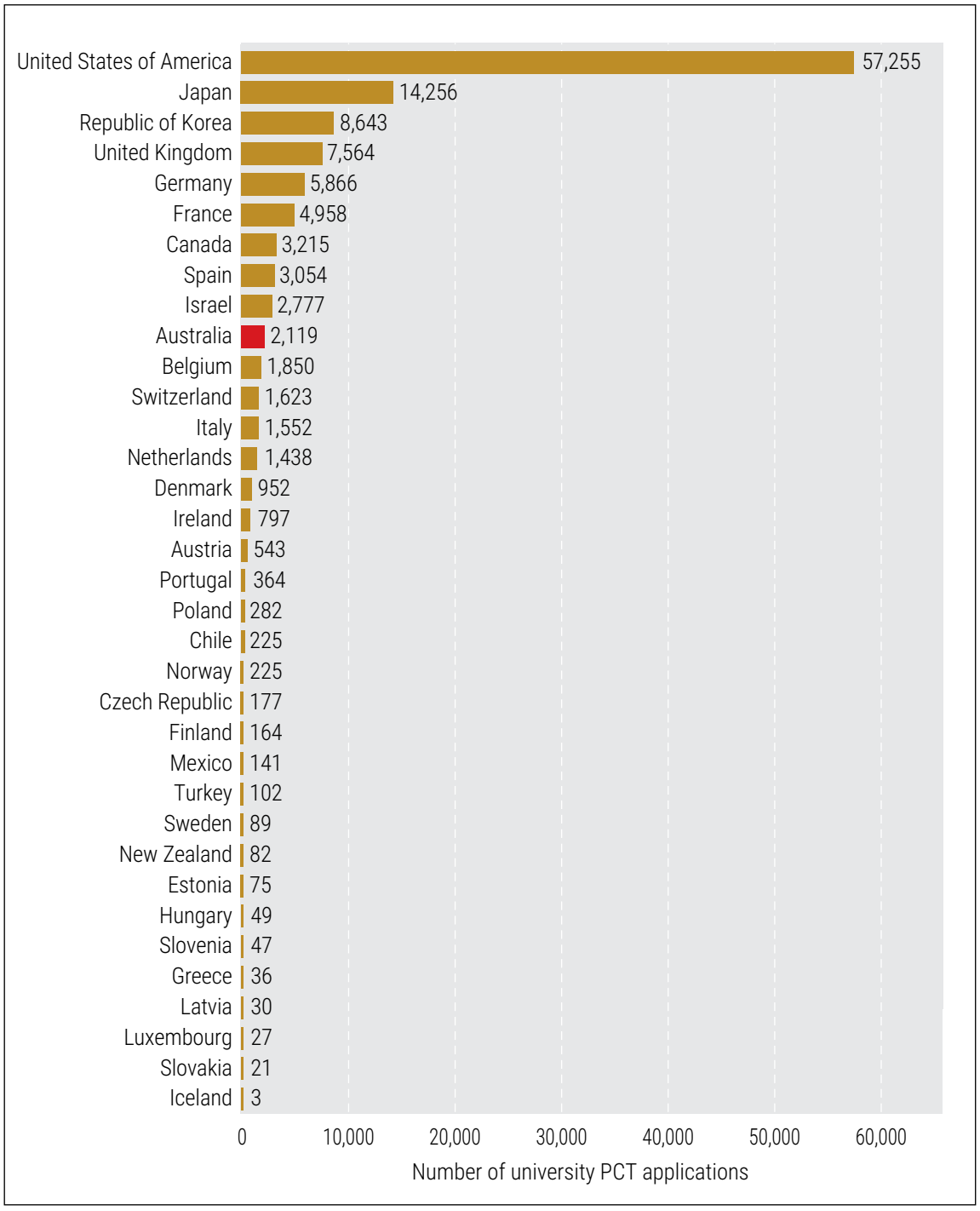
The 'productivity' and quality of Australia's research

One measure of the 'output' of higher education research and development expenditure is international patent applications. Chart 9 shows the number of patent applications filed by universities in different countries through the international Patent Cooperation Treaty (PCT) process (IP Australia, 2017). Australian universities rank in the top ten for the number of PCT applications filed by universities.

More broadly, the Australian Government Department of Industry, Sciences and Resources (2021) *Australian Innovation System Monitor* points to the 'productivity' or 'efficiency' of Australia's research. It finds:

- Australia has a significantly higher share of highly-cited publications than its share of world population – an indication the quality of Australia's research is well above the world average.
- Improvement over time in Australia's research efficiency (given by number of scientific publications per $ million invested in non-business R&D). Specifically, Australia's performance rose from 4.9 publications per $ million non-business R&D in 2006 (below the corresponding OECD average of 5.2) to 7.2 publications per $ million non-business R&D in 2017 (above the corresponding OECD average of 6.2). According to the report "This indicates that Australia's researchers have become more productive at generating scientific publications per dollar invested and clearly highlights improvements in relation to the OECD average. This suggests that Australia's research efficiency has notably improved over the period."
- In 2020, Australia produced around 3,533 publications per million population, which is above the OECD average of 2,090 and ranking Australia 6th in the OECD. **The Go8 alone is responsible for approximately 57 per cent of Australian publications – almost the same as the OECD average when calculated in terms of publications per million of population.**

Chart 9: University PCT applications, 2000–2015



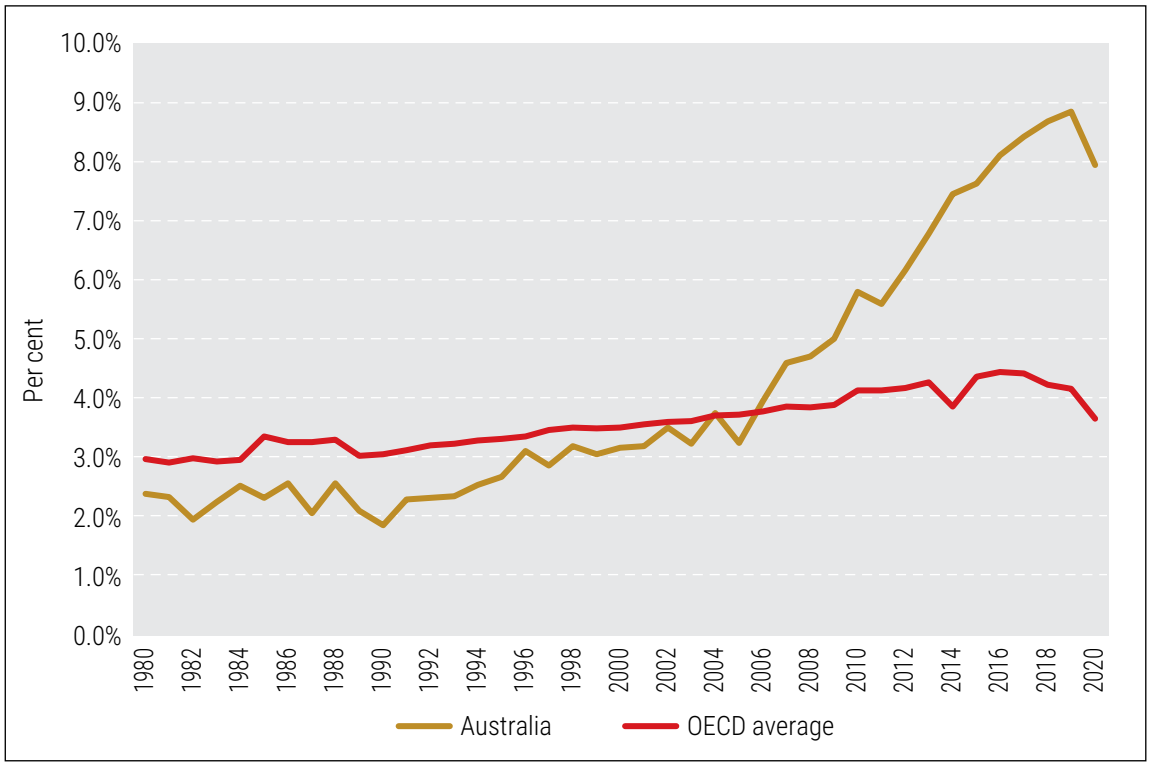
Source: IP Australia.

In terms of the 'quality' of Australian research, the Australian Government Department of Industry, Sciences and Resources (2021) finds:

"In 2020, Australian authors were credited in 7.9 per cent of the world's top 1 per cent highly cited publications and in 6.1 per cent of the world's top 10 per cent highly-cited publications for all disciplines. Further, while rates of international collaboration have risen around the world, Australia has experienced a greater increase in its publication citations involving international collaboration compared to the OECD average."

The improvement in the quality of Australian research over time is evident in Chart 10 which shows the share of top one per cent highly cited publications for Australia compared to the OECD average.

Chart 10: Share of top one per cent highly cited publications



Source: Australian Government Department of Industry, Sciences and Resources (2021).

Innovation policy and diffusion of new processes and ideas

The 'productivity' and quality of Australia's research is high by world standards and given Australia's smaller population.

There is ample evidence that research from Australian universities is worthwhile from an economy-wide productivity perspective. For a start, Go8 universities generate world-class research as reflected in the 2018 Excellence in Research for Australia (ERA) assessment conducted by the ARC which found 99 per cent of the universities' research to be at 'world standard' or higher, and 90 per cent of Go8 research was assessed to be 'above world standard' or higher (London Economics, 2022). In terms of the productive impact of this research, an estimated productivity spillover associated with Go8 universities' research of approximately 9.2 is found (Box 1) (London Economics, 2022).

Expenditure on HERD in Australia is worthwhile from an economy-wide productivity perspective. For example, **for every $1 billion invested in Go8 university research, an additional in-year economic output of $9.2 billion is generated across the rest of the Australian economy.** Significant productivity spillovers estimates suggest R&D investment has a worthwhile public return to Australia and together with the international comparisons of R&D expenditure as a per cent of GDP, suggest Australia is potentially under investing in R&D. Reforms discussed below can improve Australia's R&D performance and revitalise productivity in Australia.

Box 1: The productivity spillover benefits of R&D by Go8 universities

In 2020, Go8 universities received a total of $3.46 billion in research income.

On one measure of 'outputs' associated with this income; the Survey of Commercial Outcomes from Public Research (SCOPR) provides insights into the scale of the knowledge transfer activities undertaken by the Go8 universities. It shows that Go8 universities accounted for a significant proportion (822 out of 1,393, or 59%) of invention disclosures created by Australian research institutions in 2020. Go8 universities also led the number of new patent applications filed and new non-patented technologies approved for technology transfer amongst all Australian universities.

Using elasticity estimates of productivity spillovers for the Australian private sector arising from public investment in higher education research and development in Australia, derived by Elnasri & Fox (2017), this translates to $31.83 billion in private sector productivity spillovers.

When considering university research income, for every $1 invested in Go8 university research, an estimated additional in-year economic output of $9.2 billion is generated across the rest of the Australian economy.

Source: London Economics (2022).

2.4 Reforms to improve Australia's R&D performance

The need for a National Research Strategy

Australia's status as a small open economy and net importer of knowledge and technologies overlooks that Australia's research-intensive universities are knowledge creators at the global technological frontier and effective diffusors of knowledge both domestically and internationally. This is not to diminish the scale and benefits of industry linkages with overseas knowledge creation and technologies, it is a recognition that Australia is not solely reliant on international developments for its productivity revival. The Australian Government recognises the imperative of R&D by announcing and committing to raise R&D expenditure closer to 3 per cent of GDP. Beyond this headline commitment, the Australian Government also recognises the importance of an effective Australian Research Council (ARC) in administering the National Competitive Grants Program (NCGP), by initiating an independent review of the ARC.

The Australian Government recognises the imperative of R&D by announcing and committing to raise R&D expenditure closer to 3 per cent of GDP.

The national per cent of GDP R&D expenditure target and ARC review should form part of the development of a broader *National Research Strategy* to ensure Australia is a global leader in knowledge creation and dissemination that provides for innovation and significant public productivity returns. This is because how as a nation we reach this target matters for productivity.

The proposed *National Research Strategy* should address impediments to R&D in different sectors of the economy, including in higher

education institutions and by business. The *Strategy* should encompass:

- Recognising and enhancing support for basic research in Australia.
- Improving the incentives for Australian universities to conduct basic research by providing secure and sustainable funding to university research programs.
- Supporting further industry/ university collaboration on R&D effort.
- Supporting Australian researcher access to international collaboration and funding.
- Tightening the criteria for the Research & Development Tax Incentive (R&DTI) to focus on encouraging the hiring of Australian PhD graduates.
- Having in place broader taxation settings to create an environment that better supports innovation activities and human capital accumulation in Australia.

Each of these elements is further discussed below.

Recognising and enhancing support for basic research in Australia

The earlier discussion highlighted the relative decline in expenditure on basic research despite it being critical towards adding to the stock of knowledge and pushing the innovation frontier that is the basis for future commercialisation opportunities. International evidence suggests that policies promoting public basic research and its interaction with the private sector are significantly welfare-improving relative to uniform research subsidies that tend to result in over subsidising applied research (Akcigit, et al., 2021).

The International Monetary Fund (2021, p.66) in examining post COVID-19 pandemic strategies for boosting long-term growth highlight the critical importance of basic research: *"Basic scientific research is a key driver of innovation and productivity, and basic scientific knowledge diffuses internationally farther than applied knowledge."* Box 2 summarises the IMF findings on the importance of basic research on innovation and productivity.

Box 2: The importance of basic research to innovation and productivity

The International Monetary Fund in examining post COVID-19 pandemic strategies for boosting long-term growth state that the composition of R&D matters for growth – specifically the IMF highlight the critical importance of basic research. Innovations do not occur in a vacuum but are reliant on the stock of basic scientific research. Examples include the rapid development of COVID-19 vaccines; GPS technologies; and cardiac pacemakers, all built on waves of previous basic research.

The reason basic research is important relative to applied research, is that it diffuses internationally farther and for a longer time. The IMF find that a 10 per cent increase in domestic (foreign) basic research is estimated to lift productivity by around 0.3 (0.6) per cent on average. Moreover, the IMF conclude that basic scientific research in advanced economies is underfunded and policies that fund public basic research and subsidise private basic research will have a positive payoff. Where targeted subsidies to private firms basic research cannot be implemented (because basic research activities of private firms cannot be easily distinguished with applied research activities) more public-private partnerships may be an option.

Source: International Monetary Fund (2021).

The Productivity Commission (2007) notes three criteria to realising the spillover benefits of basic research. The first is the need for high quality governance arrangements. The second is that knowledge diffusion processes need to be efficient and the third is the requirement for research of "reasonably good quality".

Australian universities, and particularly Go8 universities, are involved in competitive grants for specific research projects that are governed through merit-based criteria. These include funding from the ARC and the National Health and Medical Research Council (NHMRC) who administer most competitive grants. The Go8 universities receive around 70 per cent of competitive grants funding and have the largest proportion of research fields rated at 4 or 5 ('above' or 'well above' world standard) in the ERA assessment administered by the ARC.

There are areas of improvement to basic research in Australia.

In relation to competitive grants funding and the ARC, since 2012–13 real funding for the ARC has been reduced by $1.25 billion.

Currently the ARC and other bodies (NHMRC, MRFF) appear to spread competitive research grants funding around, whereas a more targeted approach could result in economies of scale. For example, the remit of the ARC to fund research across wide fields of research means that research applicants in the social sciences are competing with pure sciences, whereas internationally some research funding by fields is separated. Moreover, the Go8 is also concerned that the current formulation and application of the National Interest Test for ARC applications rules out – on principle – funding pure basic research. The ARC Act and the operations and programs of the ARC should explicitly state and support the proposed *National Research Strategy* including pure basic or "blue sky" research.

Innovation policy and diffusion of new processes and ideas

There is also scope for improvements to the measurement of the broader economic, social, and environmental impacts of public funding for research, which in turn can assist in better targeting future funding. This goes beyond the existing ERA exercise which has an Engagement and Impact Assessment (EIA) component. The existing EIA scope attempts to assess how well universities are translating research into impacts beyond academia including economic, social, environmental and, cultural. However, this process will next occur in 2024 and a review in 2020 commissioned by the ARC found a range of benefits such as light touch assessment, but also areas for improvement related to weak incentives and outcomes of the evaluation (Williams et al., 2020). Evaluation of the broader socioeconomic impacts of research also occurs internationally. For example, in the United States, the STAR METRICS program introduced over a decade ago attempts to measure the impacts of public investment in science research (Box 3).

There is also scope for improvements to the measurement of the broader economic, social, and environmental impacts of public funding for research, which in turn can assist in better targeting future funding.

Box 3: The STAR METRICS program in the United States measuring the impact of public investment in science research

The Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness and Science, or STAR METRICS program, is designed to monitor the impact of federal science investments. STAR METRICS is a multi-agency venture led by the National Institutes of Health, the National Science Foundation, and the White House Office of Science and Technology Policy.

Measures of the impact of federal science investment relate to four areas:

- Economic growth – measured through indicators such as patents and business start-ups.
- Workforce outcomes – measured through indicators such as student mobility into the workforce and employment markers.
- Scientific knowledge – measured through indicators such publications and citations.
- Social outcomes – measured through indicators such as long-term health and environmental impacts.

Source: United States National Institute of Health (2010).

Measurement gaps more generally with respect to government support for business innovation such as R&D is an area the OECD (2021b) has identified as requiring more work: "the inherent difficulty of identifying the innovation scope of government support, given the overlap of innovation with other government strategic objectives, coupled with the general lack of a requirement to use innovation as a descriptor/classifier in administrative processes within many public authorities."

Apart from recognising and better measuring the impact of Australian research, recognising, and enhancing support for basic research in Australia should include:

- Reviewing whether there is an appropriate balance for publicly funded university researchers to demonstrate the immediate 'commercial' value of their research versus its intrinsic value to the stock of knowledge; and
- Addressing the need for sustainable university research funding (funding is discussed in the next section).

Secure and sustainable funding for Australian university research programs

Universities help to train and develop the innovative workforce (at all levels) and have the depth of expertise to innovate. Most businesses would not be able to afford a small R&D team whereas a single university has depth – the network of universities has an even greater depth. In the face of a relative decline in BERD, HERD has contributed an increasing share of overall R&D expenditure in Australia.

While the increased expenditure of universities on R&D is indicative of a national strength in university research, it does mask a structural vulnerability in the funding of research for the university sector. The vulnerability is that there is only partial funding by government of national research program costs. An important way to lift Australia's R&D performance is to address these research funding impediments.

Government funding for research by universities includes:

- Competitive grants for specific research projects: these include funding from the ARC and the NHMRC who administer most competitive grants. Other sources include the Medical Research Future Fund (MRFF).
- Research Block Grants (RBGs): These grants attempt to cover the indirect (or fixed) costs of research and training (including the indirect costs of research from competitive grants) and include the Research Training Program (RTP) and the Research Support Program (RSP).
- Funding to support industry engagement, including via the Cooperative Research Centre (CRC) Program.

Other sources of funding for research by universities include:

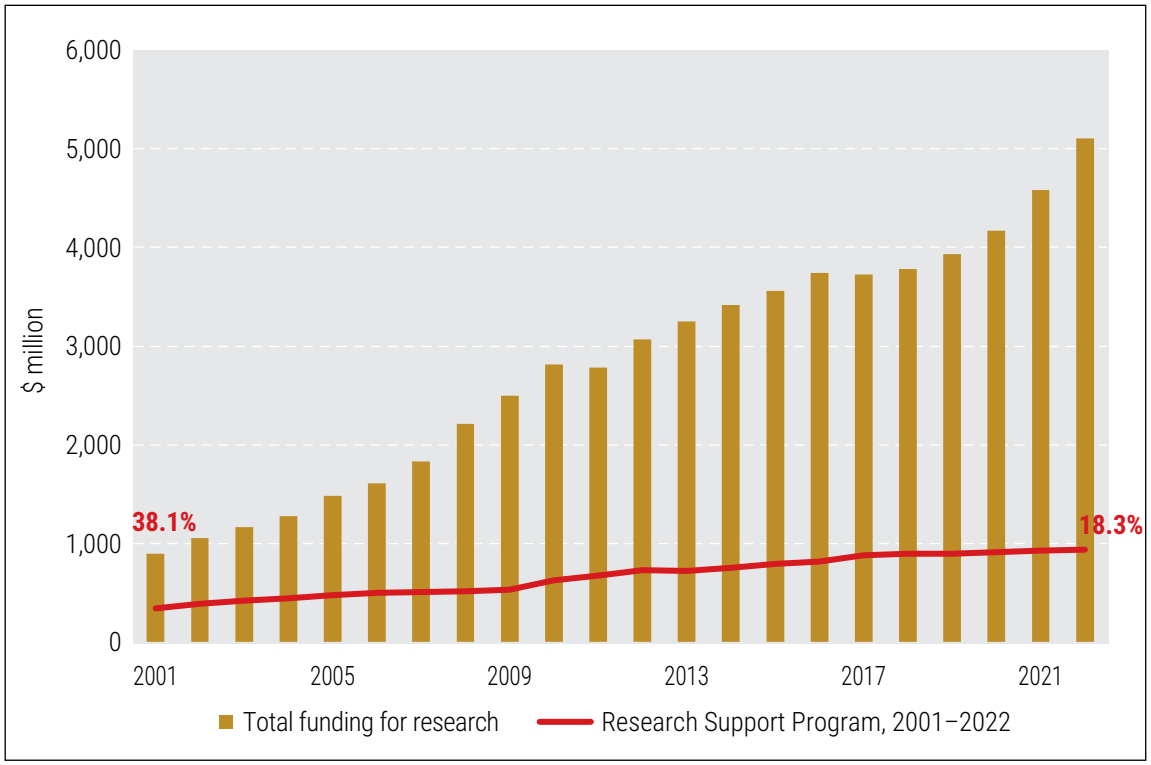
- "General University Funds" which includes student fees income.
- Income from research commissioned by government departments, and private not-for-profit organisations, such as charities and foundations.
- Philanthropic donations, endowments, and crowdfunding.

In the early 2000s, for every dollar of external funding earned for the direct costs of research, universities received approximately 38 cents in funding for indirect research costs. By 2022, that figure has fallen to 18 cents in the dollar (Chart 11).

In procurement terms, the **Australian Government is commissioning national research services from universities while paying for less than half the costs, requiring universities (primarily the Go8) to support the national research effort through contingent funding sources, mainly international student fees revenue.**

The cross-subsidy of university research by international student revenue applies directly to government funded research through the ARC, the NHMRC and the MRFF which support only direct project costs.

Chart 11: Research funding support for indirect research costs in universities (a)



Source: Pettigrew & Payne (2022). (a) Total funding for research includes Category 1: Australian Competitive Grant Research Income; Category 2: Other Public Sector Research Funding; Category 3: Industry and other Funding for Research; and Category 4: Cooperative Research Centre (CRC) Funding.

Growth in Commonwealth funding to support universities' indirect research costs has not kept pace with growth in funding earned from government, industry, philanthropy, and other sources to deliver research.

Amend the Commonwealth base funding to fully cover universities' costs to delivering research

The trend of relying on international student fee income has been exacerbated by the recent Job-ready Graduates (JRG) package where Commonwealth funding for universities now only reflects universities' costs of teaching and scholarship. Commonwealth 'base funding' no longer includes an implied component to help cover the costs of delivering the minimum level of research required for registration as a university. This means, for example, that the cost of covering the generally accepted 40 per cent of a typical academic's time allocated for research – is no longer recognised in Commonwealth 'base funding' for universities (Pettigrew & Payne, 2022).

The impact of this significant cross-subsidisation was seen in the ABS survey of Higher Education R&D for the first COVID-19 impacted year of 2020 in which university finances were significantly constrained, including an 8 per cent decrease in international student revenue. The ABS HERD data released in May 2022 indicate that, for the first time since 2014, universities have reduced their spending on basic research and the overall research workforce has reduced for the first time since at least 1992 (ABS, 2022c).

The trend of relying on cross subsidies from teaching (international) students to fund HERD is a constraint on the growth of R&D and, in turn, the innovation and knowledge creation potential of the Australian economy, because it is not necessarily the case that international student growth will continue strongly and indefinitely.

Innovation policy and diffusion of new processes and ideas

One approach to recognise and address the full cost of research in universities and reduce the reliance on cross subsidies from student fee income is to strategically concentrate Commonwealth Government funding through a Full Economic Costing (FEC) approach. The FEC approach has been applied to funding university research in the United Kingdom (see Box 4). The Australian Government should ensure that research funding is linked to the full costs of the research. It should be determined using a full economic cost model that precisely and transparently determines the funding required to undertake the research. Under current funding arrangements, the Government should reduce its stated, or implied, expectation that universities can afford to co-invest in research projects part-funded by Commonwealth grants.

Adopting an approach that ensures the full (direct and indirect costs) of university research are identified and funded in a transparent way, rather than relying from cross subsidisation from student fee incomes, would put university R&D on a sustainable basis and remove constraints to growth in knowledge creation and innovation that lead to productivity in Australia.

Under current funding arrangements, the Government should reduce its stated, or implied, expectation that universities can afford to co-invest in research projects part-funded by Commonwealth grants.

Box 4: Full Economic Costing (FEC) approach to university research in the United Kingdom

The Full Economic Costing (FEC) method has been implemented in the United Kingdom. It is part of a broader Transparent Approach to Costing (TRAC) methodology developed with the higher education sector to help cost research and teaching activities.

TRAC involves activity-based costing for higher education providers including teaching, research and other activities. These costs include:

- Direct costs (e.g., staff costs and equipment).
- Support costs (e.g., IT, library, and central costs).
- Adjustments (e.g., a margin for sustainability and investment).

The FEC method for research projects was part of the UK's reform of support arrangements for public funding of research, including funding from UK Research Councils. The FEC approach is now also the only accepted basis for costing research bids to the UK Research Councils.

Source: TRAC Support Unit (2022).

Attracting and retaining academic talent

Another potential handbrake on university research capacity and therefore Australia's innovation potential is attracting and retaining academic talent, especially in emerging and high demand fields where there is so much competition, including from high paying industries. This includes technology/commercialisation professionals.

This could be achieved, in part, by amending skilled migration settings through introducing a targeted high potential individual (HPI) visa open to all Australian universities to attract and retain world leading university researchers and educators as well as enabling graduating international PhD students to remain in Australia.

Collaboration between business and universities could focus on retaining researchers within the higher education sector, recognising their importance in industry engagement and the translation and commercialisation pathways.

The Productivity Commission (2022e) highlights that migration enables the inflow of skills, ideas and innovation, all of which contribute to productivity. Attracting and retaining researchers within Australia's university sector, recognising their importance in industry engagement and the translation and commercialisation pathways are essential to building a more sovereign nation. This could be achieved, in part, by amending skilled migration settings through introducing a targeted high potential individual (HPI) visa open to all Australian universities to attract and retain world leading university researchers and educators as well as enabling graduating international PhD students to remain in Australia. For example, the Productivity Commission (2022e, p. 19) notes the UK has recently implemented a *High Potential Individual* visa program to attract highly skilled migrants.

Supporting further industry/ university collaboration on R&D effort

One way knowledge diffusion or transfer can better occur is through further industry/university collaboration on R&D effort. Having linkages among innovating organisations (whether industry, universities, public laboratories) is an important component of an innovation system (Sheehan, 2002).

source of funding is a relatively low component of overall funding for higher education institutions and has further declined since 2008. Under the Research and Development Tax Incentive (R&DTI) there is a Research Service Provider arrangement whereby businesses can engage universities to perform research and development on their behalf. Other formal research collaboration arrangements include the Linkage Program under the ARC that

Intersectoral research and development collaboration is important to translate basic research into commercial opportunities.

Collaboration between businesses and universities can occur through informal and formal channels such as, for example, funding, contract research, internships, research secondments, and proof of concept/ use of facilities arrangements (New South Wales Innovation and Productivity Council, 2021).

As discussed earlier, businesses do fund R&D conducted by higher education universities, although that

supports research alliances between higher education organisations and industry and other research end-users (Australian Research Council, 2022). Under this umbrella, the ARC has in place Industry Fellowships that include *Industry Laureate Fellowships* aiming to facilitate senior researchers to gain opportunities in both industry and academia for research collaboration, translation, and commercialisation.

Innovation policy and diffusion of new processes and ideas

As noted earlier, Australia also has Cooperative Research Centres with grants providing funding for medium to long-term, industry-led research collaboration.

In February 2022, the Australian Government announced the *University Research Commercialisation Action Plan*, a $2.2 billion investment to enhance university innovation and industry collaboration. The plan includes "Australia's Economic Accelerator" (funding for translation and commercialisation in national priority areas); introduction of a National Industry PhD Program; expanding CSIRO's Main Sequence Ventures program and funding a CSIRO Research Translation Start Program; establishment of the Trailblazer Universities Program; and a commitment for a new streamlined IP framework for intended to promote greater uptake of Australian research outputs by industry (Australian Government Department of Education, 2022b).

Academic consulting

The Productivity Commission (2022b) suggest that given the importance of knowledge transfer to businesses, consulting by academics may be a more relevant form of transfer for some businesses and industries. The Commission (2022b, p. 52) poses the question: *"Can Australia's current level of academic consulting to private industry be increased?"* The Commission highlights various policies at different universities which it sees as barriers to academic consulting to business.

Various Go8 experts currently provide advisory, collaboration and consulting type services to industry, government and others. Examples include Monash University which has Vice-Chancellor's Professorial Fellows and Practice Professors that encourage collaboration with university researchers and industry partners. University academics also are members of scientific advisory boards, and in a private capacity provide consulting services.

It appears the Commission is suggesting business consulting by academics on a much bigger scale, and this would require consideration of the opportunity costs which include the foregone university research and teaching activities (which, as discussed, have high public returns).

While consulting activities linked to university research can be approved under certain circumstances, consulting is not in itself research, which is typically provided through commissioned research projects, and funding for which feeds into ultimately research block grants funding. Moreover, while the Commission points to university policies as potential barriers, there are also wider factors beyond a given university's individual policies – such as industrial/employment laws regarding rights and entitlements academics have accrued through their previous employment in moving between sectors.

This is not to say that university-industry collaboration and knowledge transfer is not important. What is needed is a recognition of the broader regulations regarding movement between sectors, the relative scarcity of researchers, and a need to consider relative research priorities through the development of a proposed *National Research Strategy*. Moreover, collaboration in the form of supporting university graduates transition to employment is discussed in Section 3 of this submission.

It appears the Commission is suggesting business consulting by academics on a much bigger scale, and this would require consideration of the opportunity costs which include the foregone university research and teaching activities (which, as discussed, have high public returns).

Innovation policy and diffusion of new processes and ideas

Industry-relevant research experience

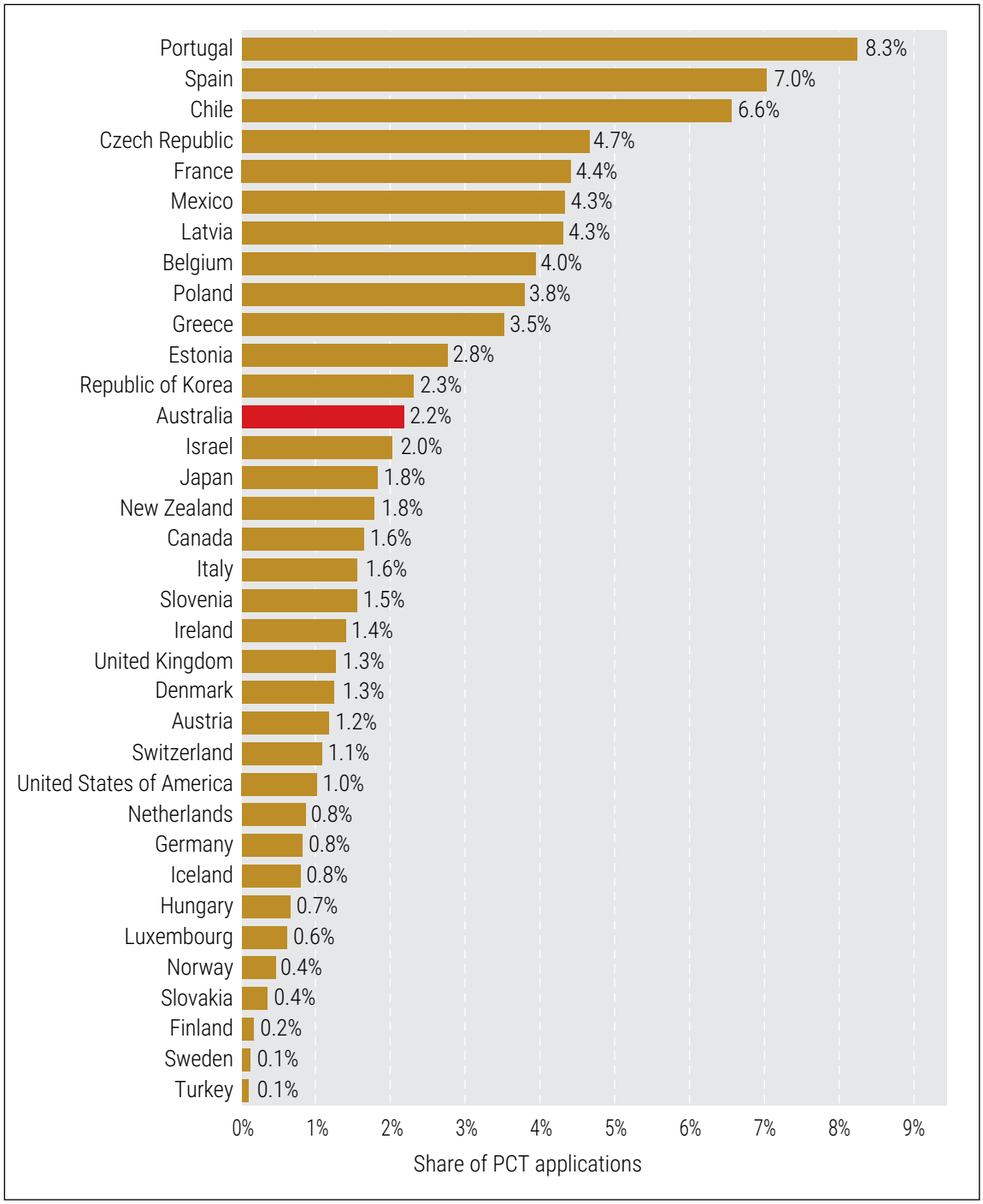
The Productivity Commission (2022b) ask whether a lack of industry-relevant research experience in universities poses a significant constraint to firms is developing an in-house research capacity. There is no strong evidence that this is a significant issue. In fact, IP Australia find that Australian universities rank relatively high on collaboration with industry as co-applicants on patents, ahead of other OECD countries such as the United States, the United Kingdom and Germany (Chart 12). Possibly the decline in BERD intensity post the GFC may reflect a lack of business internal capacity to develop and conduct in-house research and in-source financial consultants. Some challenges for firms seeking to maintain in-house R&D capabilities is the external economic market environment in which they are operating. Sustaining an R&D capability is a significant cost to a firm's budget, and this tends to be an area where cost cutting occurs when profitability deteriorates.

Research Hubs and Innovation precincts

There is a need for governments in Australia to further consider facilitation of co-location of creators and users of research – industry, business and universities. Much of this co-location may occur 'organically' but perhaps not optimally. While the Productivity Commission (2022b) suggest that because university research programs tend to focus on highly novel innovators, "place-based innovation policies are unlikely to yield a significant and wide-reaching diffusion dividend", it is still worth considering how such programs could be extended to facilitate greater collaboration. The Commission for example suggests a 'cluster' itself may need additional mechanisms to have scale, such as collaboration with an Industry Growth Centre.

Go8 members are partners in many research precincts including the University of Melbourne and Monash University in the Melbourne Biomedical Precinct which also includes corporate, hospital and medical research institute presence and is one of the top concentrations of biomedical researchers in the world.

Chart 12: University-industry collaboration 2000–2015, as a share of all PCT applications originating in an OECD country



Source: IP Australia.

Supporting Australian university researcher access to international collaboration and funding

Increasingly, research is undertaken through global research partnerships to take advantage of scale (e.g., gravity wave detection) as well as funding source opportunities internationally, particularly in science where scale is important. Australia needs to be at the forefront of this to engage with world leaders in our like-minded, values aligned partners for reasons of not only productivity, but national security. Global partnerships and collaboration is an area of future promise for research and development and productivity.

It is also much-needed insurance to ensure that, whatever challenge is next on the horizon … we have the knowledge and expertise necessary to secure effective and evidence-based solutions.

Government investment in Australian researchers to participate in global research programs and exchanges is an investment in Australia's future prosperity.

It is also much-needed insurance to ensure that, whatever challenge is next on the horizon – be it antibiotic resistance, cyber threats, food or water security, extreme climate events, or another global pandemic – we have the knowledge and expertise necessary to secure effective and evidence-based solutions. A high quality, highly trained, globally engaged network of researchers should be considered a fundamental part of Australia's essential infrastructure. A prosperous, competitive, and successful future cannot be attained without that.

There are various avenues where Australian university researcher access to international collaboration and funding could be further developed. These include supporting Australian universities to access the *Horizon Europe* program via third country association or dedicated funding to enable participation; bilateral research funding opportunities through Free

Trade Agreements and existing multilateral arrangements such ASEAN and the QUAD.

Tightening the criteria for the Research & Development Tax Incentive (R&DTI)

The Productivity Commission (2022b) canvasses the potential to tighten the criteria for the Research & Development Tax Incentive (R&DTI) to focus on personnel costs to stimulate additional absorptive capacity by bringing additional researchers into firms. The Go8 supports this reform direction as well as considering the Ferris et al. (2016) recommendations regarding a 'collaboration premium rate' on the non-refundable tax offset for companies that partner with public research organisations, including for the cost of employing new PhDs for the first three years after graduation. The introduction of such measures would complement the Industry PhD and Fellowship program by providing demand-side incentives for firms to engage with universities in higher degree by research (HDR) training, and the recruitment of graduate researchers.

Taxation settings

As illustrated earlier, BERD in Australia has been in relative decline with Australian sourced knowledge and innovation growth increasingly dependent on HERD. The OECD (2021b) notes, "how governments incentivise and influence research and innovation in firms can have major implications for our future and is a badly needed element of injecting resilience into the economy and society". Australia like many other countries has public support for R&D – predominantly through indirect support such as tax incentives rather than directly through grants.

... "how governments incentivise and influence research and innovation in firms can have major implications for our future and is a badly needed element of injecting resilience into the economy and society".

Innovation policy and diffusion of new processes and ideas

Internationally, the move towards indirect support has been partly due to international trade and competition rules that limit support to specific firms or industries and the prevailing view that governments should not be in the business of 'picking winners' (OECD, 2021). The key for public support for BERD is to induce 'additionality' (the extent to which funding induces additional R&D). However, government funded tax incentives for BERD suffer from asymmetric information notwithstanding the setting and use of eligibility and other criteria for the R&DTI, which may mean that public funding for business research and development may not be optimising additional research and development. Moreover, Acemoglu et al. (2018) develop a model of incumbent and entrant firms hiring skilled labor to perform R&D. The authors consider allocation of R&D inputs decisions (reallocation and misallocation) in economic growth and conduct various counterfactual policy experiments. They find subsidies to the R&D of incumbents do not achieve substantial improvement in economic growth because they encourage the survival and expansion of low-innovative firms. These findings highlight the need to ensure Australian Government support for business research and development is well-targeted and monitored.

A wider approach is to have broader taxation settings to create an environment that better supports innovation activities and human capital accumulation in Australia (OECD, 2021c). Taxation reform should be a complement to the other elements of the proposed National Research Strategy, because as the Tax Foundation (2021) notes in examining tax support for R&D expenditure across the OECD, *"governments should create an environment that is favorable to innovation that reaches beyond tax, with support for academic institutions, basic research,…"*.

2.5 Recommendations: innovation policy and diffusion of new processes and ideas

Innovation policy and diffusion of new processes and ideas

- The Australian Government should develop a *National Research Strategy* that encapsulates its announced commitment to national R&D expenditure of closer to three per cent of GDP and review of the Australian Research Council (ARC). This is because how as a nation we reach the target matters for productivity.
- The *National Research Strategy* should address impediments to R&D in different sectors of the economy, including in higher education institutions and by business. The *Strategy* should encompass:
  - » Recognising, prioritising, and enhancing funding support for basic research in Australia as an essential component of Australia's economy, including through:
    - Revising the ARC's legislative mandate and programs; and
    - Better measuring the broad impacts of publicly funded Australian research.
  - » Improving the incentives for Australian universities to conduct basic research by providing secure and sustainable funding to university research programs – particularly through the ARC, National Health and Medical Research Council (NHMRC), and the Medical Research Future Fund (MRFF) – including by:
    - Reviewing ARC funding levels and programs to ensure they are fit for delivering research funding to basic research in national priority areas.
    - Adopting a full economic cost approach (i.e., addressing all research cost) rather than relying on cross-subsidisation from university discretionary funds predominantly from international student fee revenue.

Innovation policy and diffusion of new processes and ideas

- Supporting further collaboration between industry and universities on R&D effort, including:
  - Amending skilled migration settings by introducing a new high potential individual (HPI) visa targeting the attraction and retaining of world leading university researchers and educators as well as enabling graduating international PhD students to remain in Australia.
  - Training research translation and commercialisation professionals.
  - Examining policies to promote co-location with universities to facilitate knowledge diffusion externalities.
- Supporting Australian university researchers access to international collaboration and funding, including:
  - Supporting Australian universities to access the *Horizon Europe* program via third country association or dedicated funding to enable participation.
  - Increased support for researcher exchanges in areas of specific need to support key national agreements such as AUKUS and broader initiatives such as Australia's space program.
  - Bilateral research funding to leverage the advantages offered by the first ever innovation chapter in the Australia-UK Free Trade Agreement.
  - Support to deepen Australia's engagement with key regional architecture nations such as ASEAN and the QUAD.
- Tightening the criteria for the business Research & Development Tax Incentive (R&DTI) to focus on encouraging the hiring of Australian PhD graduates.
- Consistent with OECD recommendations, broader taxation settings to create an environment that better supports innovation activities and human capital accumulation in Australia.

3 A skilled and educated workforce

3.1 Introduction

We are all aware that education is important for people to participate in society. For students, universities represent opportunity and growth from both an economic and intellectual perspective. Students gain economically as they acquire added training/skills/insights that lead to good employment and long-term earnings growth, but students also gain intellectually. Students' horizons expand, they engage with leading research and development and this experience positions them to contribute more to society. Intellectual growth and critical thinking skills taught at universities lead to innovative people who are more productive.

> ***And education is our most powerful weapon against disadvantage, the best long-term generator of economic growth and productivity***
>
> *Albanese, 2022*

As Wei (2016) notes for Australia, investment in university bachelor's degrees is the most important form of human capital formation by post-school education. This is because the value of education accrues not only to the individual but to their employer, industry, and economy more generally through 'human capital externalities'. For example, education and training are critical to the accumulation and sharing of knowledge and ideas that can make other (less educated) workers in the economy more productive (Kolesnikova, 2010).

As Chapman & Lounkaew (2015, p. 767) note *"An important point related to the complexity of the nature of higher education externalities is that the process is considered to contribute to research and development (R&D), innovation and technical change, which in turn are the major factors contributing to productivity increase and thus to the society's economic wellbeing"*.

The Productivity Commission (2022b) highlight how human capital can facilitate technological diffusion across the economy through providing industry with research capacity, technical and tacit knowledge, frontier knowledge and/or organisational capital. This is because knowledge creation and diffusion go hand in hand with skilled people, including advanced skills taught in universities. Moreover, rapid technological change and increased trade openness over the past fifty years globally has necessitated advanced skills to use new technologies.

3.2 The importance of human capital in Australia

The research on the private and public (societal) returns to investment in education generally point to significant benefits although estimates vary widely depending on methodology and setting (Card, 1999). A global review of 1,120 estimates in 139 countries concludes the private rate of return to one extra year of schooling is about 9 per cent a year and very stable over decades while the private returns to higher education have increased over time. Moreover, the public returns to schooling remain high, above 10 per cent at the secondary and higher education levels (Psacharopoulos & Patrinos, 2018). These returns reflect human capital externalities that create benefits over and above the direct benefits to the recipient of the education.

Examining rates of return to university education in Australia, using Census data as far back as 1981, Wei (2016) finds, depending on the methodology, expected after-tax lifetime rates of return for male cohorts of a university degree relative to upper secondary education in the range of 13.1 per cent to 25.3 per cent. For females, the return was in the range of 18 per cent to 28.8 per cent. Leigh (2008) uses Household, Income and Labour Dynamics in Australia (HILDA) survey data and after accounting for ability bias, he finds that each year of a bachelor degree raises returns by about 15 per cent and these largely reflect productivity gains from skills acquired through additional education. Chapman & Lounkaew (2015) acknowledge the difficulties in measuring externalities from higher education and therefore estimate a range in present values terms of around $10,635 and $15,952 in 2014 dollars for each year of an average university education in Australia. Carroll et al. (2019) also point to evidence of a small Go8 universities wage premia.

The significance of university education to individual prosperity (private returns) as well as public returns for Australia is evident in OECD (2022d) estimates of the relative returns to education by level of qualification (Table 2) and the net public benefit to attaining tertiary education (Table 3). When comparing full-time, full-year earners, the OECD estimate having a bachelor's degree or equivalent education is associated with earnings around 37 per cent higher, relative to only having upper secondary school education. Having a master's, doctoral or equivalent education results in an estimated 49.6 per cent higher earnings relative to only upper secondary education.

... each year of a bachelor degree raises returns by about 15 per cent and these largely reflect productivity gains from skills acquired through additional education.

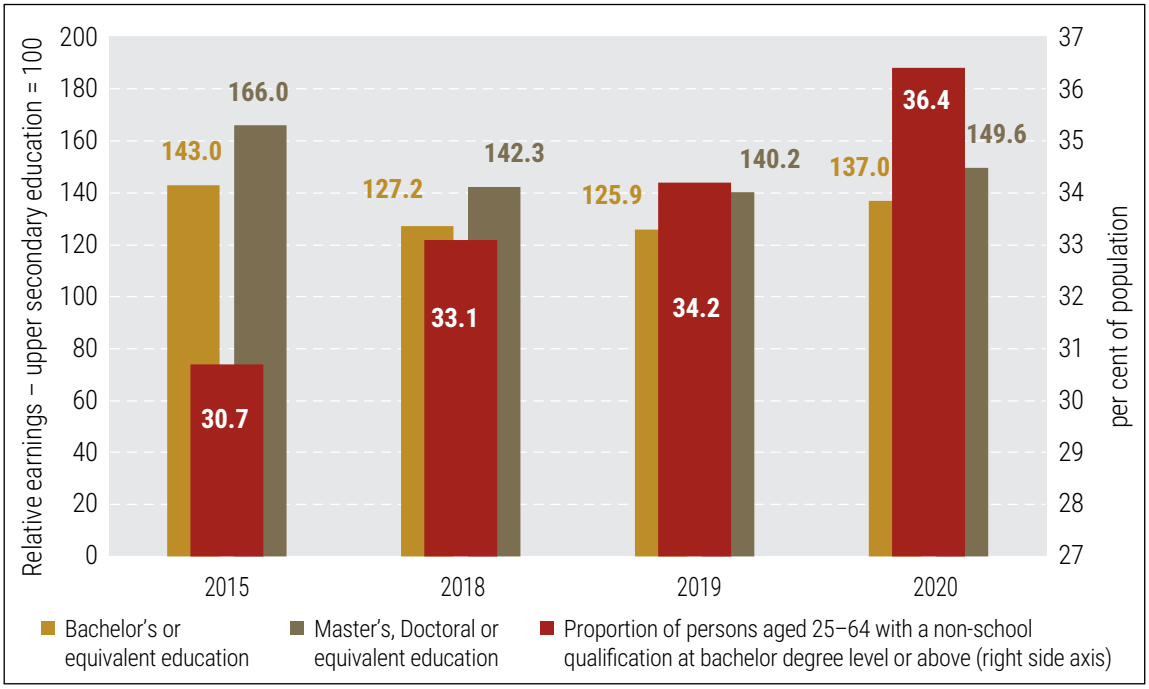
Table 2: Relative earnings – Australia (2020, 25–64 year olds, relative to upper secondary education = 100) (a)

Education level	Relative earnings
Bachelor's or equivalent education	137.0
Master's, Doctoral or equivalent education	149.6

(a) Full-time, full-year earners. Source: OECD (2022d).

The changes over time in relative earnings and the associated increased supply of university educated people is illustrated in Chart 13.

Chart 13: Relative earnings over time Australia (25–64-year-olds, relative to upper secondary education = 100) (a) and increased supply of university educated population



(a) Full-time, full-year earners. Source: OECD (2022d) and Australian Bureau of Statistics (2021b).

From a public policy perspective, what matters is not necessarily the private returns to a given level of education, but the net public returns to additional education after accounting for subsidies provided by governments for individuals to invest in higher education. Table 3 shows the estimated public net benefits for Australia of attaining tertiary education (OECD, 2021a). The figures show benefits of around 10 per cent based on an internal rate of return, with benefit-cost ratios of around 4.

Investment in human capital, together with knowledge and innovation creating R&D discussed earlier are the key for Australia to revitalise its productivity performance.

Table 3: Net public benefits to attaining tertiary education – Australia (2018) (a)

	Internal rate of return (per cent)	Public benefit cost ratio
Male	9.5	4.2
Female	10.5	4.0

(a) As compared to a male or female attaining upper secondary education, in equivalent USD converted using PPPs for GDP; future costs and benefits are discounted at a rate of 2 per cent. Source: OECD (2021a).

There are high and persistent private and public returns to investment in university education in Australia.

3.3 Skill biased technological change and higher education

Australia, like most of the global economy, has been the subject to rapid technological change over the past 50 years. Technologies (broadly defined to include any means by which inputs are used to produce outputs) have become more sophisticated, whether they are scientific knowledge, physical machinery and equipment, or increasingly 'intangible' capital (such as intellectual property, software, and research).

They require people to have more formal and advanced skills to understand, use and master these technologies for productive ends.

Technology-skill complementarity and trade openness are postulated as a cause of skill biased technological change (Krusell, et al., 2000; Burstein and Vogel, 2017) and in turn the existence of a skill 'wage premium' – that is, higher earnings for people with higher skills/education relative to the earnings of people that have lesser levels of education (Autor et al., 2020; Tsai et al., 2022). Moreover, Edmond & Mongey (2021) develop a theoretical model to show how, in the context of the United States, as occupations become more heterogenous in skill requirements, workers with comparative advantage in intensively used skills earn more. Box 5 discussed the issue of automation and employment and productivity.

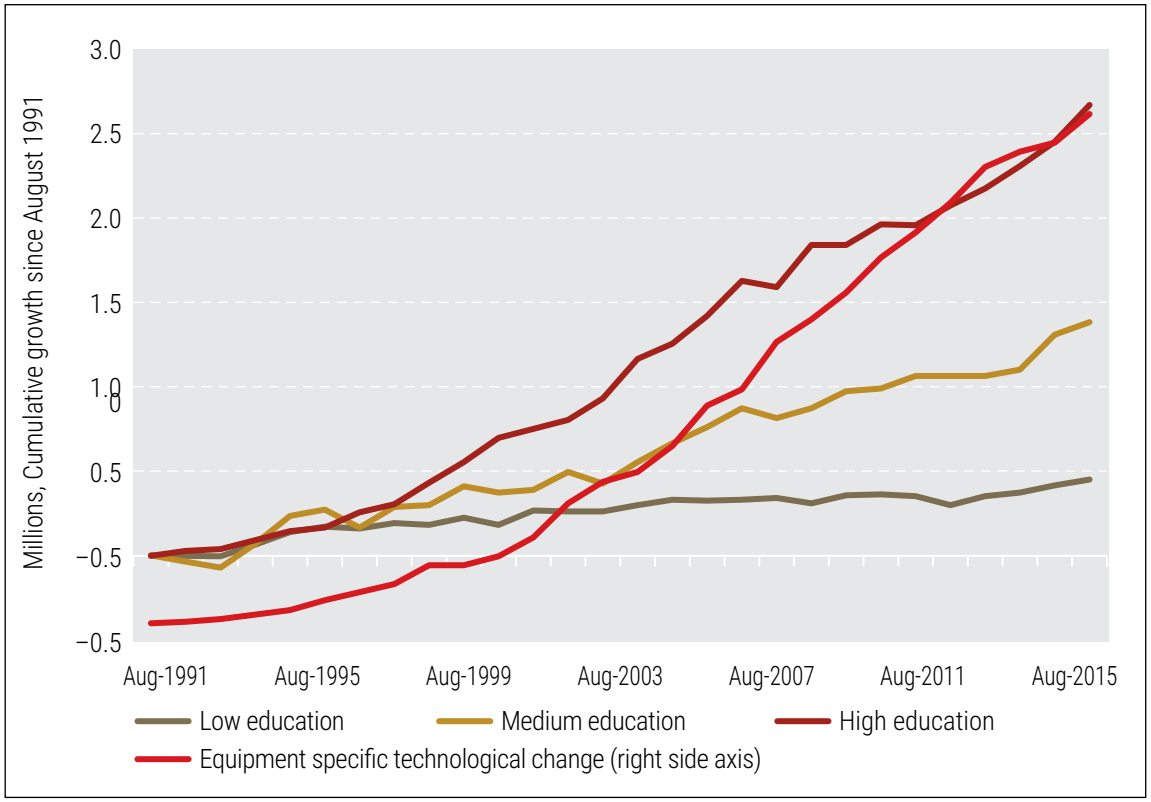
Rapid technological change has necessitated a workforce with more and different skills to adopt and use new technologies.

New technological equipment can be more complementary to more skilled labour in several different ways. For example, the relative decline in the price of computers and other advanced equipment since the 1990s has accelerated its adoption in production, and this rapid adoption has resulted in relatively higher demand for more skilled workers and hence higher relative earnings. Alternatively, as adoption of information technologies create a reorganisation of work tasks, skilled workers are more adept at adopting to the new technology. Finally, people with the general skills to perform non-routine tasks benefit relatively more from the change in work induced by technological change (Violante, 2008). For example, compare a typical office in the 1970s with perhaps one shared mainframe computer and a typing 'pool' to today where everyone independently has access to more sophisticated computing power and may be performing relatively unique tasks.

Chart 14 shows the growth in technological change is associated with relatively stronger growth in employment that requires skill levels commensurate with high levels of education. For Australia, skill biased technological change has been recognised by the Productivity Commission as pervasive across industries and "the existence of a technical change bias in the use of skilled workers is found regardless of existing relative labour use (ie skilled or less skilled intensive industries)" (Laplagne et al., 2001).

For Australia, skill biased technological change has been recognised by the Productivity Commission as pervasive across industries and "the existence of a technical change bias in the use of skilled workers is found regardless of existing relative labour use ..."

Chart 14: Equipment specific technological change (index, right axis) and growth in employment by qualification level (millions, cumulative growth since August 1991)



Source: For growth in employment by education requirement – Heath (2020) and Group of Eight (2019a). For equipment specific technological change – Go8 calculations using ABS (2022f) national accounts data.

It is not only technology change that has resulted in relatively stronger demand for higher skilled people. Australia is a small open economy and has undergone a long period of trade barrier reductions that has opened the economy to the forces of comparative advantage. Research by Burstein and Vogel (2017) highlight that reductions in trade costs reallocate factors of production such as labour to sectors of the economy that have a comparative advantage.

increasing the supply of people with skills may ignore the dynamic effects of income growth on the skill premium. That is, higher income may mean consumption of higher quality goods, and higher quality goods require even more skills to produce, causing the demand for these skills and the associated premium to grow.

The implications of skill biased technological change for Australia is the need for lifelong investment

Human capital investments need to increasingly focus on advanced skills which are acquired through teaching and learning at universities.

This increases the skill premium in economies with a comparative advantage in skill intensive sectors as well as reallocating resources toward more productive and skill-intensive firms. Moreover, Jaimovich et al. (2020) show that simply attempting to address the skill premium by

in education and skills starting with early childhood learning, right through to university education that provides for people to acquire the necessary advanced skills that are increasingly becoming a prerequisite in the global economy.

Box 5: Automation, employment, and productivity

Rapid technological change has resulted in the automation of tasks and occupations. With artificial intelligence, computer learning and advanced robotics, there is a debate about whether automation will result in substitution of people with machines in occupations at different skill levels or may additionally create new 'human centered' tasks and employment opportunities not easily replicated by machines (Acemoglu & Restrepo, 2019).

Hötte et al. (2022) review the empirical literature from the past four decades of technological change and find the labour-displacing effect of technology appears to be more than offset by compensating mechanisms that create or reinstate labour. Nevertheless, the authors conclude "low-skill, production, and manufacturing workers have been adversely affected by technological change, and effective up- and reskilling strategies should remain at the forefront of policy making along with targeted social support systems".

Atkinson (2019) also finds that "Robot adoption will likely be a critical determinant of productivity growth and has the potential to reshape global supply chains" but that "When industrial robots are shown to have reduced the hours worked, this has applied primarily to low-skilled workers; the declines are less pronounced for workers with mid-level skills".

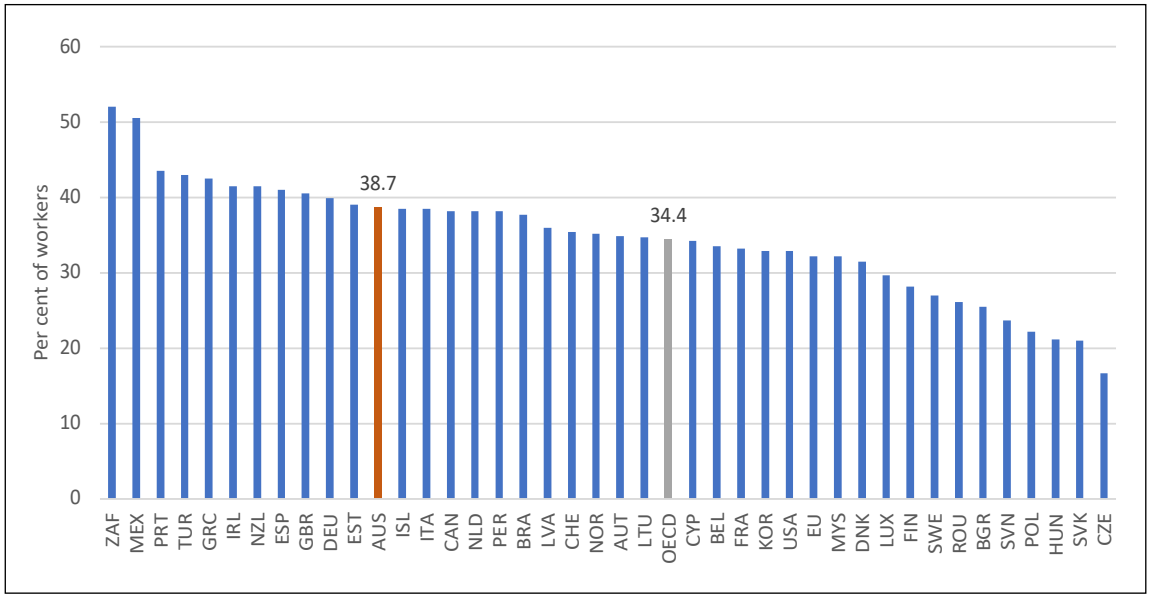
These literature reviews point to the continuing importance of education, especially higher education for roles that are not easily automated and require human centric skills. As Brown & Keep (2018) point out, whether automation and robots will be complementary to human capital or substitute for it, there is a need for educational reform and a greater focus on lifelong learning.

Matching skills to needs

Matching skills to needs is a critical element of promoting productivity. The OECD (2022e) use ABS labour force data to compare workers qualifications or their fields-of-study to their current job requirements and arrive at an average percentage of workers that have a qualification or field-of-study that do not match their job requirements. The comparative results for Australia are presented in Chart 15. According to the OECD, Australia has 38.7 per cent of workers in a qualifications mismatch, slightly above the OECD average of 34.4 per cent. However, these results should not be interpreted as 'overskilling' or 'overeducation' because they may reflect transaction costs in labour market job search and matching (National Skills Commission, 2021).

The Go8 believe that reforms (discussed further below) can improve supporting transition to employment of students and improving matching skills to needs in the Australian economy.

Chart 15: OECD estimates of qualifications mismatch by country (per cent of workers)



Source: OECD (2022e).

3.4 Universities contribution to human capital in Australia

As new technologies such as quantum computing and artificial intelligence emerge, further skill biased changes to the labour market will require Australia to further invest in human capital, including university education. This trend is partly reflected in the National Skills Commission (NSC) finding that occupations usually requiring a bachelor degree or higher are expected to account for over half of the projected total employment growth over the five years to November 2026.

The NSC suggest employment in science, technology, engineering, and mathematics (STEM) is projected to grow by 12.9 per cent and more than double the growth in non-STEM based occupations (6.2 percent) (NSC, 2021). More broadly, the NSC summarise the skills needed for the future as the four C's: care, computing, cognitive abilities, and communication.

Our research-intensive universities are crucial to human capital development in Australia that underpins Australia's productivity potential. Universities lead to international prominence and expertise and that leads to the ability to attract strong/prominent researchers plus also a strong student base. For example, all Go8 universities are in the QS World University Rankings top 100 for subjects in engineering and technology, life sciences and medicine, natural sciences, and management (Group of Eight, 2022c).

Occupations usually requiring a bachelor degree or higher are expected to account for over half of the projected total employment growth over the five years to November 2026 (National Skills Commission, 2022)

Australian universities are creators of human capital in Australia – both quantity and quality of human capital needed to lift Australia's productivity performance.

The Go8 educates 425,000 students – more than a quarter of all higher education students in Australia. Go8 universities educate more than half of Australia's doctors, dentists and vets and provide some 54 per cent of Australia's science graduates and more than 40 per cent of Australia's engineering graduates.

We are also at the forefront of the transition of the economy and labour market because of climate change. For example, two Go8 universities, the University of Melbourne, and the University of Queensland, are partnering with Princeton University and Nous Group to measure the impact of a transitioned green economy on Australia's labour market. Preliminary findings from this *Net Zero* project suggest that Australia will need 1 million new jobs if we are to meet our net zero emissions target by 2050. To put that into perspective, it is anticipated that the clean energy workforce will need to be as big as the current health workforce.

Go8 universities educate more than half of Australia's doctors, dentists and vets and provide some 54 per cent of Australia's science graduates and more than 40 per cent of Australia's engineering graduates.

Quality of university teaching

Given the importance of human capital to Australia's productivity, the quality of teaching at all levels of education is important. In Australia, the Tertiary Education Quality and Standards Agency (TEQSA) is the statutory agency for national quality assurance and regulation for higher education, tasked with, amongst several roles, registering entities as higher education providers, accrediting courses of study, and conducting compliance and quality assessments (Australian Government, Tertiary Education Quality and Standards Agency, 2022).

Further, in 2019, 86.6 per cent of postgraduate coursework graduates were in full-time employment four to six months after completing their course. Three years later in 2022 that proportion was 94.8 per cent.

Quality of university education can be measured in various ways – directly using student surveys of their learning experience during and after graduation and employer surveys of the quality of graduates they engage, and more indirectly through measuring the contribution of university graduates to the labour force and economy post university education. The Australian Government fund the Quality Indicators for Learning and Teaching (QILT) surveys which aim to make available robust, nationally consistent performance data for Australian higher education (QILT, 2022a). These surveys shed light on the value and quality of higher education teaching.

Findings from the QILT surveys indicate that the quality of Australian university education is high. For example, the QILT (2022b) *2022 Graduate Outcomes Survey – Longitudinal (GOS-L)* suggests that undergraduate medium-term employment rates have remained high in the post COVID-19 lockdowns period, as illustrated in Table 4.

Further, in 2019, 86.6 per cent of postgraduate coursework graduates were in full-time employment four to six months after completing their course. Three years later in 2022 that proportion was 94.8 per cent. Similarly for postgraduate research graduates the proportion by 2022 had also increased.

More importantly is whether graduates are utilising their skills taught at Australian universities.

The QILT (2022b) survey shows that an increasing proportion of university students find work in managerial and professional occupations which are defined by the ABS as being commensurate with requiring bachelor level or higher qualifications. As we can see in Table 4, the proportion of employed undergraduates working in the 'Managers' occupational group rose to 6.9 in 2022 and the proportion working in the 'Professionals' occupation groups rose to 66.8 per cent in 2022.

Table 4: Findings of Graduate Outcomes Survey – Longitudinal (GOS-L), 2022

	2019	2022
Undergraduates in full-time employment (a)	90.1	91.5
Postgraduate coursework graduates in full-time employment (a)	86.6	94.8
Postgraduate research graduates in full-time employment (a)	81.4	91.5
Percentage of employed undergraduates working in Managers occupational group	5.7	6.9
Percentage of employed undergraduates working in Professionals occupational group	54.3	66.8

(a) As a percentage of those available for full-time work.

Finally, in terms of measuring any underutilisation of graduate skills – the QILT survey results indicate that immediately following graduation 40.5 per cent of employed undergraduates in 2019 reported their skills and qualifications were not fully utilised. However, after three years this proportion declined to 26.5 per cent. Moreover, this is slightly lower than 27.3 per cent in 2021 and 26.7 per cent in 2020.

A key issue for the university sector will be the response to these structural changes in teaching that have been accelerated by COVID-19.

Notwithstanding the evidence suggesting university teaching is of high quality, advances in technology, including some accelerated during the COVID-19 period such as online teaching and the use of micro-credentials, are changing the nature of university teaching and student learning. A key issue for the university sector will be the response to these structural changes in teaching that have been accelerated by COVID-19. Ultimately the quality of student learning and the quality of graduate outcomes are closely tied to the individual and collective professionalism of the people who teach in higher education and the resources they have. Professionalism refers to the knowledge and skills in designing curricula, planning, and implementing teaching and learning experiences, supporting students, and assessing student progress and outcomes.

Challenges faced by universities in teaching include the tension for funding resources between research and teaching. Research rankings are increasingly a driver of international standings for universities and a driver of attracting students and world class researchers as university staff.

The complementarity of research and teaching – already strongly evident at Go8 universities – could be enhanced if overall university funding is made sustainable and industrial relations handbrakes that create a tension between the two areas of

activity are removed. Students would increasingly benefit from learning in an environment where there is world leading research being conducted. The impact of the research-intensive universities would also increase with more time spent by academics teaching frontier research to students who will become the academic and industry leaders of the future – increasing the absorptive capacity of industry for cutting-edge research.

3.5 Reforms to improve Australia's human capital

Notwithstanding the already significant contribution to human capital made to date by Australian universities, human capital will increasingly be an important driver of Australia's productivity level and growth rate as demand for skills will continue to grow strongly. The Productivity Commission (2022b) identify lack of skills (and management capabilities) as a barrier to diffusion of innovation and hence productivity. Further reforms can improve Australia's human capital.

Additional university student places to support workforce needs

The Go8 welcomes the 2022–23 Budget announcement for an additional 20,000 university places. The distribution of the 20,000 additional university places is directed to workforce needs (and equity considerations) but does not strategically target specific industry workforce pipeline needs such as engineering and nursing. Moreover, there appears to be a false dichotomy between employment and vocational skills – any overemphasis on vocational skills risks setting Australia up for unemployment in the future with skills mismatch, as the nature of work changes towards occupations requiring at least a bachelor's degree. It is imperative for students to have broad generic skills, logical thinking, reasoning and STEM skills. This is exactly what a university education provides – Go8 universities prepare student for a life-long careers requiring advanced skills.

In targeting the workforce for specific industries or occupations, scholarships are an option to additional university places but it is also important to acknowledge that many of the pull factors to particular industries and retention in the industry are the responsibility of employers and not universities. In general, additional places should, in the main, be tied to projected demographic changes with at least a five-year lead up to allow universities to plan for the additional places.

The same review found only four per cent of the students who commenced their studies at Go8 universities in 2016 were additional students. People dropping out before completing their courses is problematic because it does not address skills shortages.

The Productivity Commission (2022d) is considering a recommendation to expand the number of places in tertiary education to better support future workforce needs. We know from the National Skills Commission (2022) that projected employment growth in skill level one occupations – those usually requiring a bachelor degree or higher – is expected to account for over half of the projected total employment growth over the five years to November 2026. Hence, expanding the number of places in tertiary education should predominantly focus on additional university places.

This is not just about quantity of university graduates, but quality. The Productivity Commission's own review of the demand driven university system (2019) found that the expansion was primarily among people who typically had lower literacy, numeracy, and ATAR results, and tended to drop out at much higher rates.

The same review found only four per cent of the students who commenced

their studies at Go8 universities in 2016 were additional students. People dropping out before completing their courses is problematic because it does not address skills shortages. Data from the Australian Government to 2021 suggests the likelihood of an applicant with a low ATAR receiving a university offer has increased and there has been a significant increase in the proportion of non-year 12 applicants and offers – suggesting an increasing number of students who will require more assistance to successfully complete their university courses (Australian Government Department of Education, Skills and Employment, 2021). Any consideration of a demand-driven system for university needs to be cognisant of the need for mechanisms to support students, minimise non-completions and ensure quality as much as quantity.

The Australian Government should work with universities on the appropriate level of funding per student required to support progress towards equity and gender representation targets.

Improving funding models for teaching at universities

The Productivity Commission (2022d) is considering a recommendation to change qualification subsidy rates across tertiary education to attempt to improve the effectiveness of government investment and access for people. This includes two potential options with respect to setting course subsidy rates: providing lower public subsidies where the expected (future) private benefits by field of education are higher, or, having a flat subsidy or a common subsidy rate applied to an efficient course cost and moving away from requiring any assessment of private or public benefits.

The Go8 notes there are pros and cons to either option canvassed by the Productivity Commission and more detail is required before in principal support to either option can be provided. Moreover, public investment in higher education remains inadequate and should be reviewed as part of the upcoming University Accord.

The first option of providing lower public subsidies where the expected (future) private benefits by field of education are higher is not straightforward. In a changing labour market with rapid technological change where graduates need to have the necessary skills to move between roles through their careers (including in new roles that may not yet exist), it is not necessarily the case that a given student that graduates in a field with higher private benefits will work their entire career in that field. Similarly, a graduate from a field with lower private benefits may over the course of their career move into roles with more substantial private benefits.

The second option attempts to improve allocative efficiency by establishing, through costing exercises, what the underlying efficient costs of individual courses are and then applying a subsidy rate. The Go8 does not accept there is a unique efficient price for the delivery of a given course. All courses and degrees are not identical so an efficient price for teaching is a theoretical concept. There is potentially a 'curve' of efficiency versus quality that is complex. For example, it is not clear how differing costs driven primarily because of where a university is located will be addressed. Also, using an average or

The Go8 does not accept there is a unique efficient price for the delivery of a given course. All courses and degrees are not identical so an efficient price for teaching is a theoretical concept.

median estimate will not necessarily improve allocative efficiency – as the Commission (2022d, p. 65) acknowledges, there are very wide differences in the estimated costs of delivery, only some of which will reflect differences in efficiency. Using an average or median estimate would make delivering some courses (for instance in engineering) financially unsustainable and also would stifle diversity in offerings.

The Go8 recommends the abolishment of the Job-ready Graduates package in favour of a simpler model for university teaching funding by having one single student contribution irrespective of qualification and a Commonwealth contribution to reflect the variability of the given qualification cost.[3] Courses that have a higher private benefit financially will be progressively taxed by the income tax system as students enter the workforce. Other degrees have a private benefit that might not be financial – that is where Australia's Income Contingent Loan (ICL) system is important.

The Productivity Commission (2022d) highlight the recent JRG package which involved changes to university subsidy allocations including changes to both the student contribution and Commonwealth contribution to course costs. It is the Go8's position that one of the impediments to further skills creation by Australian universities is the inadvertent disincentives for universities created by the JRG package, particularly in relation to STEM related courses. The JRG package changes do not support the importance of STEM in revitalising Australia's National Science and Research Priorities. Areas of STEM with widespread skills shortages and need for attention are engineering and IT/computing. For example, there is widespread recognition and concern that Australia's engineering workforce is in crisis (Group of Eight, 2022a).

3 With the possibility of a limited number of exceptions, for instance medicine, where the Government currently caps the number of Commonwealth Supported Places.

A skilled and educated workforce

The JRG package intent was to invest in higher education in areas of national priority by providing better funding arrangements for universities, a better integrated tertiary system and improving transparency and accountability, quality, and standards (Australian Government Department of Education, 2022a).

Moreover, JRG changes to student contribution amounts, Commonwealth contribution amounts, and total funding amounts per commencing Commonwealth Supported Places has resulted in some STEM related fields of education experiencing funding losses, creating a disincentive for universities. For example, internal Go8

The Job-ready Graduates package should be abolished a in favour of a simpler model for university teaching funding by having a fixed student contribution and a Commonwealth contribution to reflect the variability of qualification costs.

Yet Go8 modelling indicates that by 2024 (when the JRG transition arrangements end), Go8 universities will be expected to teach an additional load of approximately 5,000 EFTSL with a decrease in base funding of $97 million or 2.7 per cent over the current arrangements. This will affect the quality of education for domestic students (Group of Eight, 2020).

estimates suggest funding for the broad field of engineering, science, and surveying has been effectively reduced by 16 per cent. There is also skill mismatch experienced by STEM graduates. Many of these graduates end up in the finance sector where their quantitative skills are sought for. A new model for funding university education in STEM is needed that addresses necessary recurrent per student funding, research costs, and infrastructure and equipment costs.

Attracting all talented people

The Australian Government should work with universities on the appropriate level of funding per student required to support progress towards equity and gender representation targets.

The Australian Government's recent announcement that it will increase the duration of post study work rights of international students from, for example, two years to four years for select bachelor's degrees and four years to six years for select PhDs (Clare & O'Neil, 2022) is a step in the right direction. In addition, the Australian Government should introduce the HPI visa to attract and retain world leading university researchers and educators as well as enabling graduating international PhD students to remain in Australia as permanent residents.

Funding allocations & competition

The Commission notes that competition for funding and students vary across the tertiary sector and suggests that "Funding that follows the student (rather than being allocated directly to providers) might allow for greater flexibility for students to move between providers and the two sectors, as well as enhancing competition across the tertiary sector as a whole" (Productivity Commission, 2022d, p. 63). A voucher style entitlement provided to students redeemable once they enrolled in a course is suggested by the Commission as one potential option.

There already exists a level of competition between universities in Australia which drives innovation and incentives to improve quality.

A voucher style entitlement provided to students redeemable once they enrolled in a course is suggested by the Commission as one potential option.

For example, universities do not only compete for competitive funding grants for research, there is also a smaller performance-based funding (PBF) component of the Commonwealth Grant Scheme (CGS) for universities. Universities compete to attract and retain both domestic and international students based on teaching and research performance and quality. For example, the Australian National University (ANU) attracts and recruits students across the whole of Australia and this creates competitiveness across the university sector.

As long as all institutions are non-profits and costs are contained, expanding access to income-contingent loans to students for different types of tertiary education, such as VET courses, is potentially a more effective way to promote greater competition than a voucher style entitlement.

As long as all institutions are non-profits and costs are contained, expanding access to income-contingent loans to students for different types of tertiary education, such as VET courses, is potentially a more effective way to promote greater competition than a voucher style entitlement. The Go8 supports students choosing their higher education – the market mechanism should be trusted for students to decide what is best for them. Yet a new voucher system would potentially mimic what already occurs. Commonwealth Grant Scheme funding already follows students – it is effectively a voucher because if a student enrols in, or transfers to, a particular university, the CGS funding follows them.

A voucher style entitlement provided to students would also potentially create a whole new set of issues and costs related to managing such a scheme – including how it would actually work for higher education institutions who need lead times to plan for and manage student loads and teaching allocations. From a

student perspective, a voucher style system may not be effectual for all students when geographic location and non-tuition cost factors play a more important role in deciding which higher education institution to attend.

In addition to addressing access to income-contingent loans to students for different types of tertiary education, another measure to further promote competition is to improve the availability and awareness of information for students. This is an area canvassed by the Productivity Commission (2022d, p. 85). One avenue is to expand on the previously discussed QILT surveys. Existing publicly available rankings systems disaggregated to the level of course subject also currently provide students with information to compare universities. Moreover, expanding access to income contingent loans to students should also be coupled with efforts to improve student literacy regarding income contingent loans so that all students can make more informed decisions about their education and career choices.

University Colleges

The Go8 supports diversity in the sector and notes the Commission mentions the role and recent reforms to the Provider Category Standards (PCS) whereby teaching-only institutions called a "University College" have been introduced. The Go8 suggests University Colleges focussed on teaching can potentially provide a further source of teaching quality, especially for higher education institutions that have less of a focus on research. However, expanding University Colleges would need to be accompanied by a discussion on differential funding for research active institutions – acknowledging that the Job-ready Graduates package has almost completely eroded any research premium in the Commonwealth Grants Scheme funding.

Enhancing the quality of university teaching

In the area of quality of teaching in higher education, as the Commission (2022d, p. 88) notes, under the PBF scheme, universities already have competitive incentives to improve their teaching quality and to support completion because graduate outcomes and student satisfaction with teaching quality are considered in the PBF. Moreover, the Commission discusses the potential to support the establishment of both a centre for teaching excellence to support external review of teaching quality as well "a single combined measure of higher education course quality".

Regarding "a single combined measure of higher education course quality", as discussed earlier, all courses and degrees are not identical so arriving at one measure would be problematic.

The Go8 notes that evaluation of student experience and teaching quality already occurs through QILT. In addition, TEQSA is responsible for several facets of quality in higher education, including conducting compliance and quality assessments and also providing advice to the Minister relating to the quality and regulation of higher education providers (Australian Government, 2022). TEQSA already administers a Higher Education Standards Framework that includes teaching including course design, staffing, and learning resources and educational support.

Regarding "a single combined measure of higher education course quality", as discussed earlier, all courses and degrees are not identical so arriving at one measure would be problematic. Nonetheless, the previously discussed QILT surveys which allow comparisons between universities could be expanded and complement existing publicly available rankings systems to provide students with information to compare universities.

Upcoming University Accord

University research and teaching can be complements if overall university funding is made sustainable and not create a tension between the two. For example, if universities had sustainable funding so that income from international students were not required to cross subsidise research activities, then this income could increasingly be targeted to improving teaching quality. One area funding could be utilised is to improve pathways for faculty staff that want to specialise in teaching.

For example, if universities had sustainable funding so that income from international students were not required to cross subsidise research activities, then this income could increasingly be targeted to improving teaching quality.

In addition to the previous recommendations, the upcoming University Accord announced by the Australian Government is an opportunity to review the balance of funding between research and teaching at Australian universities with an objective to improve their complementarity. The Accord should also examine:

- University funding structures and the incentives they create for resource allocation between university research and teaching activities.
- Current industrial arrangements related to university faculty staff that want to specialise in teaching or research.
- Evaluation of student experience and teaching quality processes and reporting.
- The role and additional funding of university micro-credentials and other short-course offerings to meet specific and changing skill needs and re-training.
- Best practice Industry/PhD programs and how these can be scaled nationally.

A skilled and educated workforce

Ensuring that mismatch of skills with jobs is minimised can potentially improve productivity, as recognised by the Productivity Commission "the efficiency of the supply and matching of skills and jobs in the labour market is critical for productivity growth" (Productivity Commission, 2022e, p. 1). An important component in skills matching is improving graduates' transition between higher education and the labour market, with a role for universities to better assist and promote graduates' skill match on the labour market (including in emerging occupations related to clean energy, creative industries).

Go8 universities are already attempting to improve the transition of students into employment, including enabling students to have experience working with industry and government, such as through the University of Sydney's Industry and Community Project Units program (Box 6).

Another example is Monash University's Graduate Research Industry Partnerships (GRIPs). The GRIP program involves PhD students working with industry partners and supervision from both Monash University academics and industry specialists.

There are many other examples of these types of programs run by universities, businesses, and in collaboration, as well as programs run by peak bodies. However, what is missing from this is scale. There is an opportunity to examine the many industry engagement programs that are currently operational, find what is working well and build scale. Moreover, there is also a role for the greater mobility of staff between universities and industry to increase knowledge diffusion. This includes the absorptive capacity of industry for cutting edge technologies – including research – and mentoring new university graduates.

Box 6: University of Sydney's Industry and Community Project Units (ICPU)

Through the University of Sydney's ICPU teaching program, the university has partnered with more than 70 business, government, and community organisations in Australia and globally to give undergraduate students the opportunity to work on real-world projects. Partners include Accenture, Adobe, ANZ Bank, EY, IBM, KPMG, Westpac and many more firms, predominantly in the services sectors. Partner firms use these arrangements to recruit participating students into paid internships and graduate roles.

Graduates of the program that are recruited into partner firms, or other firms, are becoming advocates for the program – with new projects being spawned in existing partner companies and with new companies.

Source: University of Sydney (2022).

National Industry PhD program

The previously mentioned National Industry PhD program as part of the *University Research Commercialisation Action Plan* has the intent of facilitating PhD researchers to work in both industry and university environments. Joint appointments between industry and universities are also a potential mechanism to increase the quality of academic workforce available to teach. The new industry PhDs and fellowships will assist with familiarising industry of the benefits of working with university researchers. Anecdotally the Go8 have seen some firms choosing to move to an outsourcing model and reduce their in-house capacity because they prefer working with an R&D partner such as a university.

Lifelong learning

The Go8 supports lifelong learning. Australian universities are a place of lifelong learning, as evidenced by postgraduate enrolments and graduations as well as provision of executive education and community outreach programs and more recently the offering of 'micro credentials'.

We agree that there should be consideration for greater public investment in lifelong learning, but this should not be a 'rebalancing' of public funding exercise away from existing postgraduate courses.

We are likely to need more and a broader range of postgraduate training options to both make the most of the workforce we have, and possibly keep people in the workforce for longer. This will range from career-switching qualifications which could require much longer periods of study (e.g., postgraduate bachelor level qualifications), to micro credentials for one-off skill acquisition. It is important for long-term productivity to assess ways to accommodate reskilling and retraining of 'mature-aged' students and the role of professional course programs offered by universities given people will have several jobs in their careers and may even completely change occupations.

We agree that there should be consideration for greater public investment in lifelong learning, but this should not be a 'rebalancing' of public funding exercise away from existing postgraduate courses. This is a point the Go8 has previously made in the consultation on the reallocation of Commonwealth supported places

for enabling, sub-bachelor, and postgraduate courses issued by the Department of Education and Training in late 2018 (Group of Eight, 2019b). Instead, there should be a recognition that *additional* public funding is necessary to support lifelong learning. The need is evident by, for example, skill biased technological change discussed earlier, that necessitates ongoing investment in new skills.

The approach to lifelong learning will require a suite of different funding approaches, in line with the different types of offering. Commonwealth Supported Places (CSPs) may be part of the solution, but also potentially incentives for industry to partner with universities or training providers on bespoke programs, or executive training, and further tax-incentives for individuals funding self-study. The role and additional funding of micro-credentials and other short-course offerings to meet specific and changing skill needs and re-training should be considered as part of the University Accord.

3.6 Recommendations: a skilled and educated workforce

A skilled and educated workforce without which nothing can be achieved

The Australian Government should:

- Plan and budget for additional university student places to support workforce needs that will be dominated by occupations requiring at least a bachelor's degree. Additional places should be, in the main, tied to projected demographic changes with at least a five-year lead up to allow universities to plan for the additional places.
- Abolish the Job-ready Graduates package in favour of a simpler model for university teaching funding by having one single student contribution and a Commonwealth contribution to reflect the variability of the given qualification cost.

A skilled and educated workforce

- Work with universities on the appropriate level of funding per student required to support progress towards equity and gender representation targets.
- Introduce the HPI visa to attract and retain world leading university researchers and educators as well as enabling graduating international PhD students to remain in Australia as permanent residents.
- In addition to the above, use the upcoming *University Accord* to review:
  - » University funding structures and the incentives they create for resource allocation between university research and teaching activities.
  - » Current industrial arrangements related to university faculty staff that want to specialise in teaching or research.
  - » Evaluation of student experience and teaching quality processes and reporting.
  - » The role and additional funding of university micro-credentials and other short-course offerings to meet specific and changing skill needs and re-training.
  - » Best practice Industry/PhD programs and how these can be scaled nationally.

4 Data policy, digital technology, and cyber security

4.1 Introduction

The Australian economy is an open, largely tertiary based services economy that rapidly adopts new and leading technologies including intangible capital (such as intellectual property, software, and research). Information technologies and computing includes but is not limited to the specific field of computer science. It also encapsulates broader and related fields, skills, and technologies such as data analytics, artificial intelligence, and machine learning.

> ***Investment in research data infrastructures needs to be matched by long-term investment in human resources, including data stewards, software engineers and data analysts***
>
> *OECD, 2021b, p. 78*

Over recent decades, these technologies have changed the way knowledge and information is produced and disseminated, the way businesses and government function, the size and growth of the Australian economy, and the nature of individuals' participation in the economy as both consumers and participants in the workforce. Consequently, the nature of work and skills needed to be economically competitive has also dramatically changed – for example, automation has substituted for some occupations, changed the scope of others, and induced demand for new tasks and occupations (such as 'data engineers').

4.2 Importance of digital technologies to productivity

Our capacity to exploit information and computing technologies is directly linked to Australia's economic prosperity. The 'technology sector' broadly defined is equivalent to Australia's sixth largest industry, contributing $122 billion each year to gross domestic product (GDP) and providing an estimated $44 billion a year in economic value to consumers (AlphaBeta, 2019).

According to the TCA, labour productivity of Australia's technology sector expanded by 3.8 per cent annually over the past two decades, double the growth rate for the whole economy. The technology sector

Information technologies and computing have changed the nature of work and industry.

For Australia to be competitive, almost all businesses will need to pursue digital transformation strategies for their business operations – many are already well advanced in doing so. To accomplish this, they require a balance of teams that have staff with deep IT and computing knowledge and digital literacy. IT platforms, the use of data in decision making, and digital communications necessary for business success are rapidly evolving and so must the skills of the workforce. For example, according to the National Skills Commission (NSC), since 2015 demand for software related skills has grown almost 30 times and according to the Tech Council of Australia (TCA), more software programmers are employed in other industries than within technology sector businesses.

employs around 860,000 people (or 1 in 16 people are employed in technology jobs) and technology sector jobs pay 64 per cent higher than the economy average (Tech Council of Australia, 2022). Moreover, earlier analysis by Bean (2000) at a time when Australia's multifactor productivity (MFP) performance was much stronger, suggested that increased spending in Australia on ICT contributed to a MFP acceleration.

Critical technologies

In November 2021, the Department of Prime Minister and Cabinet released the *Action Plan for Critical Technologies* (Critical Technologies Policy Coordination Office, 2021). The Action Plan identifies a list of 63 technologies in eight categories that are either critical for Australia today or are expected to become critical within the next ten years. From this list an interim short list of nine technology areas have been prioritised including 23 specific critical technologies each with identified research areas (Critical Technologies Policy Coordination Office, 2021).[4]

According to the Action Plan, approximately half the research areas underpinning Australia's priority critical technologies are in information and computing sciences, and engineering. This includes not only areas such as artificial intelligence and machine learning but capability across a dozen broad areas of IT and computing research (Critical Technologies Policy Coordination Office, 2021).

The technology sector employs around 860,000 people (or 1 in 16 people are employed in technology jobs) and technology sector jobs pay 64 per cent higher than the economy average

4 These comprise critical minerals extraction and processing; advanced communications; Artificial Intelligence (AI); cyber security technologies; genomics and genetic engineering; novel antibiotics, antivirals and vaccines; low emission alternative fuels; quantum technologies; and autonomous vehicles, drones, swarming and collaborative robotics.

An increased supply of domestic university graduates with advanced IT and computing qualifications will be critical to building productive sovereign capacity in key industries such as defence and critical technologies in the national interest.

Workforce demand outstripping supply

In 2020, the Go8 universities contributed around 26 per cent to both the total number of commencing university students in the broad field of information technology and to the total number of award course completions. Over the period from 2016, the annual growth rate of commencing university students in Go8 universities in the broad field of information technology was 19 per cent compared to 12 per cent for all universities, while the annual growth rate of award course completions in Go8 universities was 30 per cent, well above 21 per cent achieved by all universities in Australia. Yet demand continues to outstrip supply, putting a constraint on the workforce number needed in this high productivity sector of the Australian economy.

In 2020, 417 students completed a postgraduate research qualification in IT at Australian universities (the majority of these PhDs) with over a third at Go8 universities. This number of completions has not changed significantly over the five-year period 2016–2020, although the share of international student completions has risen from half in 2016 to approximately 56 per cent in 2020. In other words, more needs to be done to grow the domestic workforce specialising in advanced and critical areas of IT and computing.

4.3 Reforms to improve use of digital technologies to boost productivity

The disparity between workforce demand and supply is particularly relevant to the higher skilled elements of the information and computing technologies workforce where university qualifications and training are essential – in particular, research training. The Australian Government has also endorsed an industry target of achieving 1.2 million 'technology' jobs in Australia by 2030 (Husic, 2022).

While measures such as a proposal for a new digital apprenticeship scheme will go part way to addressing the workforce skills needs, it will not address the priority demand for higher skilled workers that require undergraduate or post graduate university qualifications. Universities and the Go8 universities in particular, have a critical role in addressing education and training so that there is a strong, reliable long-term supply of information technology and computing workforce in Australia for roles that are increasingly high-skilled and that will not be addressed by the vocational education and training (VET) sector.

To deliver this expanded and more effective workforce, we must embrace diversity and change our understanding of what constitutes the IT and computing workforce. This change must include rather than exclude people and focus on both creativity and technical proficiency. In doing so, it will drive a diversity in critical thinking and "critical doing" skills and force people out of historical homogenous comfort zones to become more innovative.

To deliver this expanded and more effective workforce, we must embrace diversity and change our understanding of what constitutes the IT and computing workforce.

By doing this, we will enable a diverse workforce from all backgrounds. Included in this diversity is greater retention of international students in the Australian workforce and fast-tracked migration of international talent into Australia, including to teach courses in advanced technologies in our universities.

Trouble sourcing university staff to teach advanced courses in IT and computing, including partly due to Australia's slow and cumbersome visa regime for high-end international talent, and the international competition with industry for world-leading staff.

Impediments to universities delivering the increased pipeline of graduates and Australia leading in the 'digital economy' include:

- Under the Job-ready Graduates package, inadequate funding for universities to teach IT courses because JRG does not adequately recognise the infrastructure required for modern IT and computing – such as specialist labs for cyber security courses.
- Trouble sourcing university staff to teach advanced courses in IT and computing, including partly due to Australia's slow and cumbersome visa regime for high-end international talent, and the international competition with industry for world-leading staff.
- Existing support underpinned by the ARC which is neither attractive to international talent, nor – through schemes such as Linkage Grants – necessarily attractive to Australian industry.

- The need to scale up successful training models that facilitate university-industry research engagement and the need for new models to encourage a more entrepreneurial attitude from higher degree research graduates. Universities and industry must also implement collaborative models of education such as paid internships, co-design of curriculum, degree apprenticeships, business mentoring, micro-credentials, and joint PhDs.
- Clear articulation of national priorities related to critical technologies. Through the current review of the *List of critical technologies in the national interest* and the implementation of the *National Reconstruction Fund*, the Australian Government can signal to industry and universities where it believes the national focus on IT and computing research, education, workforce recruitment and business activity should be in the national interest.

4.4 Recommendations: data policy, digital technology, and cyber security

Data policy, digital technology, and cyber security

The Australian Government should, in the **immediate term** prior to the full *University Accord* process:

- Introduce targeted funding to increase the quantum of information technology (IT) and computing related courses taught to domestic students enrolled at Australian universities.
- Fund the teaching of IT at universities at the same Commonwealth contribution rate as engineering.
- In the context of critical technologies in the national interest, provide a clear articulation to industry and universities of where it believes the national focus on IT and computing research, education, workforce recruitment and business activity should be.

5 A productivity-friendly business and research environment

5.1 Introduction

Excessive and unwarranted regulation that creates red tape stymies productivity and limits our nation's prosperity, a fact recognised but not adequately addressed by successive governments. A productivity-friendly business environment is just as important to Australian universities as it is to the broader economy. This is because universities also contribute to productivity, whether directly (through for example education exports) or through their engagement and collaboration with industry.

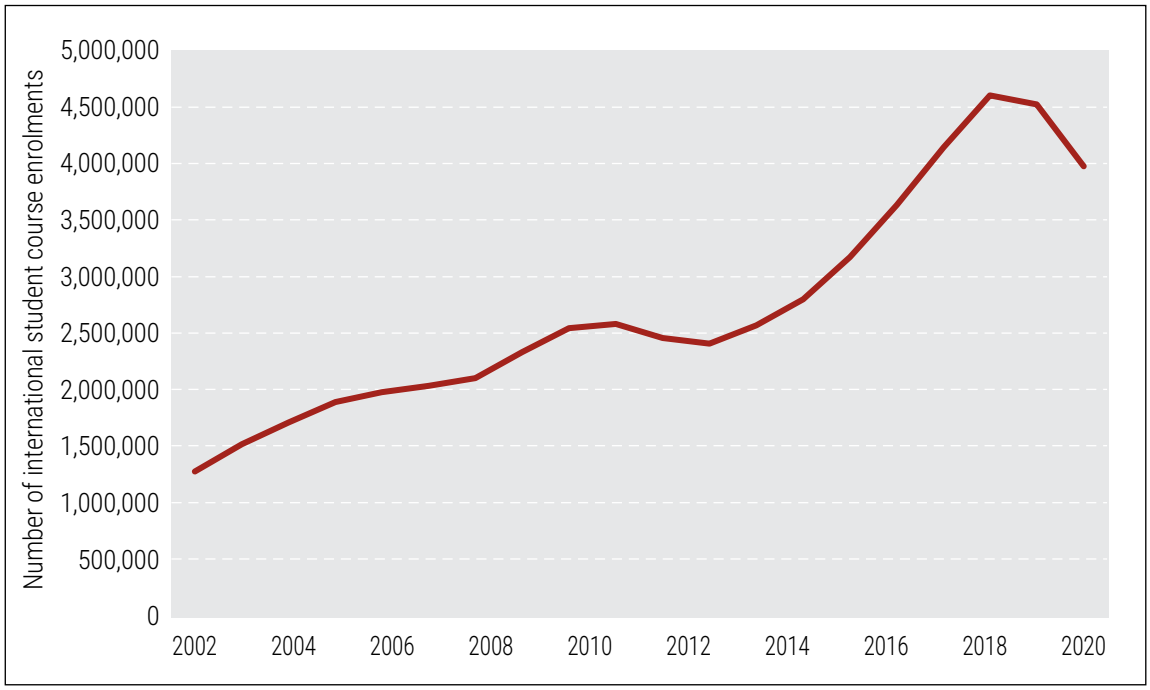
> ***Poorly regulated markets can create perverse incentives that reduce productivity***
>
> *Syverson, 2011, p.354*

The Australian Bureau of Statistics (2021a) has found that "between 2008–09 and 2018–19, higher education labour productivity grew on average by 1.2% per annum. This growth is similar to the average growth of market sector industries (around 1.1%)." For higher education labour productivity to continue to outpace the market sector, attention needs to be given to the regulatory settings facing higher education.

5.2 Importance of a productivity-friendly business environment

The Productivity Commission (2022c) recognise that "Trade in services is likely to be increasingly significant for productivity". Australian universities are one of the biggest services export earners for Australia. Pre-COVID-19, international education was Australia's largest services export and fourth largest export overall. ABS data confirms that export revenue has almost halved over the course of the pandemic – from $40.3 billion in 2019 to $22.5 billion in 2021. In volume terms we can see the growth of higher education exports and the impact of the COVID-19 pandemic in Chart 16 which shows the number of Australian higher education international student course enrolments over time.

Chart 16: Australian higher education international student course enrolments (number)



Source: Australian Government Department of Education (2022d).

A productivity-friendly business and research environment

The Go8 universities are also at the forefront of tackling climate change and managing the climate transition (Box 7).

Box 7: University research addressing the climate transition

As the Productivity Commission report notes, there will be an ongoing role for government to support research and development into new sustainable energy technologies that reduce Australia's emissions. The Go8 universities have, and will be, significant contributors to addressing the environmental challenges associated with climate change. Go8 basic and applied research supports the identification and adoption of more sustainable ways to use resources and lower emissions.

The Go8 universities are at the forefront of research in innovative renewable energy technologies, receiving almost $700 million in ARC grants alone. Go8 research covers renewable technologies in wind, solar, hydroelectricity, hydrogen, bioenergy and more recently, electric vehicles. Just eight universities are undertaking more than 65 per cent of all university-based research in these renewable energy technologies. Go8 research in renewables is not only leading the nation, but we can increasingly point to technologies that are leading the world.

For example, UNSW engineers hold the world record for conversion efficiency for silicon solar cells. This technology has been used by major international companies such as Samsung, Suntech Power and BP, underscoring the impressive footprint Go8 research has on global energy industries.

Getting the regulatory environment right for Australian universities is therefore critical to their scope to contribute to Australia's export performance as well work with industry and governments to tackle challenges such as climate change.

Box 7: University research addressing the climate transition *(continued)*

The University of Sydney's Professor Thomas Maschmeyer (a catalytic chemist) has been recognised internationally for his work and inventions that convert plastics and renewable wastes into high-value distillable liquids, as well as the development of zinc-bromide batteries intended to make renewable energy cheaper. Both inventions, will enhance Australia's capacity to build jobs in renewables and domestic manufacturing sectors.

In addition, researchers at the University of Melbourne have found a new approach to direct air capture that can run on zero emission renewable energy. This innovation is making use of engineered 'nanocatalysts' to capture carbon dioxide and regenerate at a lower temperature, paving the way for the use of renewable energy sources such as solar hot water.

As these examples illustrate, the Go8 are undertaking cutting-edge research in frontier renewable energy technologies. Importantly, Go8 universities are conducting this research despite the current handbrake on research funding in Australia. If Australia is to meet its net zero emissions target by 2050, the Australian Government should increase funding for research in renewable energy technologies.

The Australian Government announced commitment to achieving an overall R&D target of 3 per cent of GDP is a start. However, the reliance on cross-subsidisation of research through international student fees is untenable and will constrain Australia's transition to a clean energy economy.

5.3 Reforms to improve Australia's productivity-friendly business environment

The capacity of Australian universities to maximise their economic and research-led impact on our nation's prosperity is curtailed by legislative and regulatory regimes that do not necessarily consider the regulatory impost (Group of Eight, 2022b). This happens without government taking the time to review existing regimes and therefore happens without government eliminating the countless instances of overlap in purpose and reporting. This results in a heavy additional regulatory load for the higher education sector. Successive Australian Governments have pledged to rid the higher education sector of unnecessary red-tape and regulation.

The independently conducted *Review of Reporting Requirements for Universities* (PhillipsKPA, 2012) identified the need for reform related to:

- Duplication and a lack of coordination of reporting requirements.
- Tendency of reporting requirements to accumulate over time.
- Issues relating to definition and documentation.
- Issues relating to scale and proportionality.
- Frequent changes of reporting requirements and inadequate planning for change.
- Concerns regarding universities' access to useful and timely information.

The Australian Government at the time accepted all the Review's recommendations and committed to take action – so that Australia's universities could focus their resources on their core business. There was initial work undertaken to refine data collection, a move welcomed by universities. But this is an unfinished process.

There is scope for further work to reduce the regulatory burden on universities and allow them to focus on world class research and teaching that underpins Australia's productivity.

5.4 Recommendations a productivity-friendly business and research environment

A productivity-friendly business and research environment

The Australian Government should:

- Use the upcoming University Accord process to prioritise a review of legislative, regulatory, and reporting requirements impacting the university sector to identify and address:
  - » Duplicative and overlapping legislation, regulation, and reporting requirements.
  - » Opportunities for streamlined reporting and data collection – 'collect once, use many times'.
- Ensure that all new legislation impacting the university sector is subject to a full legislative and regulatory scan by the sponsoring Minister's agency to identify areas of overlap, duplication, redundancy.
- Ensure that there is cross-portfolio collaboration between departments when designing regulation – with the purpose of eliminating duplication, overlap and redundancy.

6 Conclusion

Australian universities produce and diffuse both knowledge/innovation and human capital – that is their core functions, that in turn underpin broad public returns to productivity. Universities are an eco-system that requires all parts to function effectively for productivity outcomes to be enhanced. The Group of Eight has outlined in this submission mission critical reforms needed to revitalise Australia's productivity performance.

In some cases, investment in both university research and development as well as education can have immediate positive impacts on measured productivity, and sometimes these investments need longer lead times to reap the high public benefits outlined in this submission. Policy makers need to take a long-term strategic approach to recognising and supporting Australian universities, recognising that like compound interest, incremental improvements to universities create significant long-term productivity returns.

Universities are an eco-system that requires all parts to function effectively for productivity outcomes to be enhanced.

If Australia is serious about revitalising productivity growth, reforms to further enhance the ability of Australian universities to create and diffuse knowledge and innovation and to teach students to acquire productive life-long skills, will be paramount.

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