Deloitte Access Economics

The importance of universities to Australia's prosperity

A report prepared for Universities Australia

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Deloitte.

Contents

Glossary iv

Preface v

Approach v

This report v

Executive Summary vi

1 How universities enhance Australia's prosperity 12

1.1 Overview 12

1.2 Universities build human and social capital through teaching and learning activities 13

1.3 Universities drive technological progress and economic growth through research discovery and adoption 15

1.4 Universities enrich society through community service activities 16

1.5 Universities will support the 'next wave' of economic prosperity through international education exports 16

1.6 Universities will support Australia's future 'knowledge economy' 17

2 Measures of the economic and social benefits 18

2.1 Categorising the benefits arising from university activities 18

2.2 Teaching and learning 21

2.3 Research discovery and adoption 30

2.4 Community service 36

3 Universities supporting Australia's future prosperity 41

3.1 International higher education – Australia's advantage 41

3.2 Australian universities supporting the 21st century 'knowledge economy' 43

3.3 The productivity imperative 48

4 Conclusions 50

References 55

Appendix A: Measuring the contribution of the sector's operations 62

Appendix B: Categorising the accrual of benefits 65

Appendix C: Macroeconomic modelling approach and results 68

Appendix D: Measuring the benefits of teaching and learning 73

Appendix E: Measuring the benefits of university research 81

Appendix F: University funding – the Australian context 86

Limitation of our work 88

Charts

Chart i: Average Australian annual national income growth per capita xi

Chart 1.1: Higher education attainment and per capita income across countries ($US 2010 PPP `000s) 14

Chart 1.2: University research and per capita income across countries ($US 2010 PPP `000s) . 15

Chart 3.1: Education related personal education exports, calendar year estimates 41

Chart 3.2: Projections of total demand for undergraduate and postgraduate qualifications 2015–2025 44

Chart 3.3: Projection of the proportion of the working age population with a university higher education qualification 2015–2025 45

Chart 3.4: Five industries with demand for new university qualifications 46

Chart 3.5: Impact of computerisation across occupations 47

Chart 3.6: Average Australian annual national income growth per capita 48

Chart D.1: Tertiary education attainment, 2000–2012 73

Chart D.2: Recent growth in university enrolments, 2001–2013 74

Chart D.3: Total Australian university enrolments by field of study, 2013 75

Chart E.1: Volume of university research publications, 2001–2013 81

Chart E.2: Australian universities at or above world standard by ERA rating 83

Chart E.3: University research expenditure as a proportion of national GDP, (constant 2010 US$ millions, constant PPP) 84

Chart F.1: Expenditure on tertiary educational institutions as a percentage of GDP, selected countries, by source of funds, 2011 87

Tables

Table 2.1: Returns to higher education in Australia, 2012 24

Table C.1: Countries 70

Table C.2: Data sources 70

Table C.3: Modelling results 70

Table C.4: Implied share of income per capita 71

Table D.1: Overview of university students, 2013 74

Table D.2: Returns to higher education in Australia, 2012 77

Table D.3: Earnings and employment outcomes by educational qualification level, 2011 (2014 dollars) 78

Table D.4: Earnings and employment outcomes without the effect of university higher education qualifications (counterfactual scenario), 2011 (2014 dollars) 79

Table E.1: Australia's top 20 areas of research strength 83

Figures

Figure 2.1: Core university activities – conceptual benefits framework..... 19

Figure 3.1: Australia's current, next and future waves of growth, 2013–2033 42

Figure 3.2: International student flows to Australia, 2012 43

Glossary

ABS	Australian Bureau of Statistics
ACER	Australian Council for Educational Research
ACU	Australian Catholic University
AUCEA	Australian Universities Community Engagement Alliance
CGE	Computable General Equilibrium
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEEWR	Department of Education, Employment and Workplace Relations
FTE	Fulltime equivalent
GDP	Gross Domestic Product
GFC	Great Financial Crisis
GWS	Greater Western Sydney
HILDA	Household, Income and Labour Dynamics in Australia
IAC	Industry Assistance Commission
KPI	Key performance indicator
MFP	Multi-factor productivity
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
RMIT	Royal Melbourne Institute of Technology
RUN	Regional University Network
UNESCO	United Nations Educational, Scientific and Cultural Organization
USC	University of the Sunshine Coast
USQ	University of Southern Queensland
WSU	Western Sydney University

Preface

Universities Australia commissioned Deloitte Access Economics to analyse the contribution that universities make to Australia's economic and social prosperity. This work was undertaken to inform the development of Universities Australia's *Keep it Clever—Policy Statement 2016*.

This report seeks to present a comprehensive and coherent framework of benefits generated by universities. This includes examination of the conceptual role of universities in Australian society and how they contribute to the success of the nation, as well as a more detailed analysis of the benefits directly attributable to universities. The scope of the analysis does not include a detailed examination of the economic activity generated by university operations, but rather examines the contribution made to the productive capacity of the economy through universities' teaching and learning, research discovery and adoption, and community service activities.

Approach

In undertaking this analysis, the project focussed on establishing a comprehensive framework of the benefits attributable to higher education. In doing this, the project has synthesised existing literature from Australia and internationally on the benefits of universities, as well as undertaken original analysis to establish estimates of some of the current benefits generated by universities in Australia. To achieve this, the project has involved:

1. a literature review to support the development of a conceptual framework which captures the many ways in which universities generate benefits for society;
2. data collection, analysis and modelling, drawing on Universities Australia and publicly available sources, to identify quantitative and qualitative evidence of the benefits;
3. synthesis of the evidence and reflections for funding; and
4. reporting and presenting the findings of the analysis.

This report

This report presents a summary of the analysis and is structured as follows:

- Section 1 conceptually outlines the mechanisms and nature by which universities contribute to Australian prosperity.
- Section 2 presents evidence, and where possible estimations, of the benefits generated by universities in Australia.
- Section 3 outlines the role that Australian universities will play in the future, supporting Australia's income growth and progress towards a new 'knowledge-economy' by providing the workforce, innovation and knowledge required to drive future prosperity.
- Section 4 presents the conclusions from the analysis and reflections on university funding.

Executive Summary

As institutions, universities embody social, economic and intellectual resources which combine to generate benefits on a local, national and global scale. They equip students with the knowledge and skills that allow them to make greater contributions to society; they generate and disseminate knowledge which enhances productivity and improves living standards; and they provide a myriad of broader community benefits.

This report canvasses and examines the various ways in which universities contribute to our economic and social prosperity and how, given the economic imperatives confronting Australia, the sector's role is likely to evolve and grow over time.

Universities' operations make significant contributions to Australia's economic output

Australia's university sector directly employs over 120,000 staff and supports the delivery of education to over one million students. The operations of the university sector generate significant contributions to Australia's economic output and national income.

- The sector contributed around $25 billion to the Australian economy both directly and indirectly in 2013, accounting for over 1.5% of Australia's GDP and 160,000 fulltime equivalent (FTE) jobs.
- In 2014–15, education related exports accounted for 5.7% of Australia's total exports, representing the largest service export and the third largest export category overall. Higher education is the single biggest contributor to this, representing around two-thirds of the total value.

A thriving university sector is synonymous with a prosperous economy

The role that universities play in contributing to the socio-economic prosperity of nations transcends the contribution of their operations to GDP and employment, as significant as these contributions are in their own right.

International evidence demonstrates that strong university sectors are associated with stronger economies and higher standards of living. Countries with higher levels of higher education attainment and higher levels of investment in higher education research and development are consistently shown to have higher levels of per capita income.

The empirical analysis conducted to inform this report reinforces the widely held view that Australian universities generate and embed skills and knowledge in society through their teaching and learning, research discovery and adoption, and community service activities. Moreover, it demonstrates that this activity is a direct and significant driver of growth in incomes, output and employment across the Australian economy. The resulting socio-economic benefits accrue both to those directly engaging in university-led activities and to society at large. In some cases, and in research especially, it is broader society that is by far the greatest beneficiary.

University education increases the nation's productive capacity and, with it, the nation's living standards

It is well established that university graduates achieve higher labour force outcomes than those with lower order qualifications—employment rates are higher, average hours worked are higher and, most significantly, lifetime earnings are higher. Although part of this is due to a student's innate ability, a large part of this is due to formal education, including from Australian universities.

- The value that university education adds to the productive capacity of the nation is estimated at $140 billion in GDP in 2014.
    - That is, Australia's GDP is 8.5% higher because of the impact that a university education has had on the productivity of the 28% of the workforce with a university qualification.
- At least $24 billion of these benefits are estimated to accrue in annual earnings premiums to students themselves each year.
    - The broader societal benefits—that is, the positive spillovers associated with the contribution of university graduates to the workforce—are evidently significant. For example, as just one indicator of the positive spillovers from university education, the wage of those without a tertiary qualification has been estimated to be 1.6–1.9% higher as a result of a 1 percentage point increase in the number of workers with a university higher education degree.
- Beyond the benefits generated from incrementally higher labour force outcomes, a university education has been empirically demonstrated to be positively associated with improved health outcomes, quality of life and a range of other social indicators.
    - Recent international analysis has shown the monetary value of these benefits may be equivalent in magnitude to the more readily observable impacts such as labour force outcomes.

University research drives innovation, productivity and, ultimately, economic growth

University research is the causeway between the world of pure and unapplied knowledge and the world of real economic impacts. University research contributes to technological progress through improved productivity, innovation and entrepreneurialism, and the generation of knowledge spillovers and spin-off technologies and companies.

Indeed, it has been estimated that the existing stock of all knowledge generated by university research is estimated to account for almost $160 billion in 2014, equivalent to approximately 10% of Australian GDP.

In further recognition of the vital role that university research plays in driving economic growth and prosperity, investment in university research has grown, in real terms, by $9 billion over the past 30 years, at an average growth rate of 6% a year.

- As this investment has increased, so too have the benefits to society. Indeed, increasing investments in university research over the past 30 years are estimated to have added almost $10 billion to GDP each year (in 2014 dollars) over this same period, primarily through gains to national productivity.
  - The benefits of this improved productivity are equivalent to almost a third of the average living standards growth experienced over this 30 year period in Australia.
  - The majority of these benefits accrue to the public, as universities predominately draw upon grant funding to support their research and activity and, on the whole, the mode of dissemination of research discovery is open and public.
- These estimated effects are large, and there are some empirical limitations that should be borne in mind in their interpretation. Nonetheless, the effect sizes are consistent with results from other studies, both in Australia and overseas, and point to significant positive spillovers from university research expenditure.

Universities are also major contributors to society through their community service activities

By drawing on university resources embodied in staff, students and facilities, universities share knowledge, expertise and amenities to enrich communities on a local, national and even international level.

While it is not possible to quantify the scale of benefits generated by community service activities, through a number of representative university case studies, it is apparent that there are many and varied ways that Australian universities contribute through community service. These additional activities can include:

- contributing to regional governance and planning;
- community capacity building;
- providing cultural facilities and programs;
- hosting community forums, events and festivals;
- opening up university facilities to the community; and
- student-led community initiatives.

As the global economy changes, the role and contribution of the university sector will expand and evolve

As has been evident throughout history, the global economy is always changing. The nature of the changes taking place over the coming decades is particularly profound. When coupled with other macro trends—such as the disruptive impacts of technology—the changes suggest both a big opportunity for the Australian university sector and a critical imperative in supporting continued growth in the nation's living standards.

The demand for international education is burgeoning and the associated economic opportunity confronting Australia is a sizeable one

The middle class of emerging Asia is burgeoning. In less than two decades' time, some two thirds of the world's middle class will reside in the Asia Pacific region and demand for services such as education will grow rapidly. Deloitte Access Economics projects international education to be among the fastest growing sectors of the global economy over the next two decades.

This, coupled with the Australia's competitive strengths in education and training, saw international education identified as among the five most significant sectoral drivers of the next wave of Australia's economic growth and prosperity in the Deloitte Access Economics (2014a) report *Building the Lucky Country #3, Positioning for prosperity? Catching the next wave*.

Already Australia's largest service export, the scope for international education providers like universities to grow the nation's incomes through the provision of education to a new wave of international students is vast.

The Australian economy's demand for university graduates is increasing and so too is the calibre of education they require in the 21st century knowledge economy

Australian universities will play an important role in meeting future skill demands, and ensuring a strong and growing stock of intellectual capital is made available for an increasingly high-skilled labour force. Indeed, on current trends, the demand for higher education qualifications will increase by 34% by the year 2025, equivalent to 2.1 million more university qualifications compared to current levels.

In net terms, this means that Australia will require an additional 3.8 million university qualifications by 2025, which will result in an increase in the proportion of the working age population with a higher education qualification from 23% in 2015 to over 26% in 2025. The top five industries projected to need the largest increases in skilled graduates over the next 10 years include education and training, health care and social assistance; professional, scientific and technical services; public administration and safety; and financial and insurance services. Each of these industries will require additional workers with over 100,000 new university qualifications over the period 2015—2025, representing a growth in demand for university qualifications of 30% or more.

Throughout history, Australia's prevailing industrial economic context has been inexorably linked to the considerable and expanding contribution and impact that universities have made to the economy and broader society.

As digital technology changes the way we communicate and interact, and computerisation alters the skills required of workers, the Australian economy of the future will not just require workers with traditional 'higher skills', rather we will require a workforce of **creative, innovative and highly adaptable knowledge-workers**.

By virtue of their unique position in society, Australia's universities can support this pluralism of intellectual and human capital that will be demanded over the coming decades.

Indeed, digitalisation and computerisation, as well as other forms of scientific and technological progress, often originate from the research undertaken within universities. Via the nexus of teaching and research, universities are uniquely positioned to define the skills and attributes of Australia's future workforce.

Universities will play an essential role in responding to the changing skills demand of the knowledge economy, but will also help to shape and define the industry and jobs of the future, acting as a gateway for Australia's future prosperity.

The continued growth of living standards in Australia will rely almost exclusively on higher levels of productivity and the university sector stands to be at the forefront of this challenge.

It is widely acknowledged that Australia faces a significant challenge over the coming decades if it is to maintain growth in national income and living standards as commodity prices fall and the sizeable returns from the decade long mining boom recede. This challenge is compounded by Australia's ageing population, which will see rates of workforce participation decline as more Australian workers enter retirement. With both participation and the terms of trade acting as a drag on the nation's living standards, it will fall almost exclusively to productivity growth to propel national incomes higher.

The university sector, and the skilled workforce it produces, has a major role to play in addressing the productivity imperative Australia confronts. Indeed, recent estimates suggest that one-third of Australia's historical labour productivity growth may be attributable to the accumulation of university higher education.

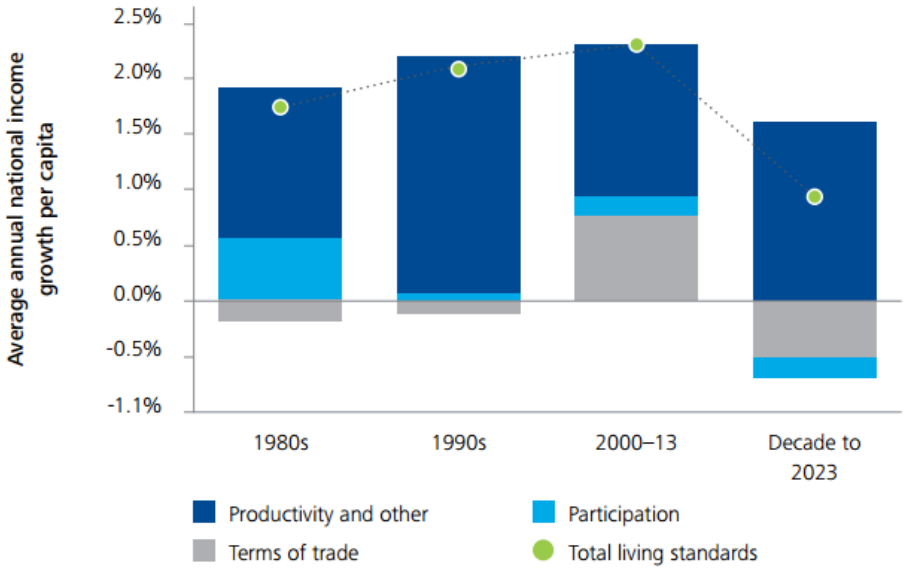
Successfully evolving to provide not only the graduates that the changing Australian economy needs, but the skills and intellectual resources that the future knowledge economy requires, will see the university sector continue to be among the most significant drivers of growth in living standards over the decades ahead.

The results from this study suggest that a permanent 10% increase in the tertiary education attainment rate in Australia would increase labour productivity in Australia by 1.5–2.0 percentage points, representing around half of the required rate of productivity growth required to maintain our growth in living standards over the coming decade.

University research too will play an important role in supporting growth in multi-factor productivity (MFP)[1] over the coming decades. Indeed, recent published estimates show that a 10% increase in the stock of publicly supported higher education research can increase Australia's MFP by 3.6 percentage points over the long-term.

[1] The amount produced given the number of hours worked and capital employed in production

Chart i: Average Australian annual national income growth per capita



Source: Dr Martin Parkinson, Secretary to the Treasury, *The 2014–15 Budget and sustaining broad-based growth in living standard* speech, 20 May 2014; Deloitte Access Economics

Concluding observations

Australia's university sector has evolved considerably over the past 165 years since the first university was founded in 1850. Throughout this period universities have strived to meet the skills demands of an emergent economy and champion progress in terms of technology, culture and society.

Over the coming decades creative and innovative embodied human capital will become central to the strength of the Australian economy, while at the same time, university research will continue to be an indispensable driver of technological progress. Should Australian universities realise this enormous potential, and adapt to meet the demands of the future knowledge economy, the value of their economic contribution to society can only be expected to grow.

Deloitte Access Economics

1 How universities enhance Australia's prosperity

Universities contribute to economic and social prosperity in broad and varied ways. These contributions are linked to the unique role universities play in society. In broad terms, this section outlines the position of universities in Australian society, and how they strengthen the economic and social fabric of Australia at a local, national and global scale.

1.1 Overview

Universities embody major concentrations of social, economic, intellectual and communicative resources which combine to provide a key driving force behind economic and social prosperity. They reach freely across populations and borders, sustain large networks and connect to government, industry, NGOs and community organisations (Marginson, 2012).

Universities represent **large sectors of national economies**, providing significant value to **economic output and national income**, as well as providing **job opportunities** for their national and local communities directly through their operations, and indirectly through the students and researchers that they attract to their local regions. Indeed, Australian universities currently employ more than **120,000 staff** and enrol almost 1.3 **million students**.

The university sector is also a major earner of export income through attracting students from abroad. In Australia in 2014–15, education-related exports account for 5.7% of Australia's total exports, representing the largest services export and the third largest export overall. Building on this past performance, the sector is also seen as one of the key drivers of the 'next wave' of prosperity in Australia, on the back of a broader dependence on service industries and the winding back of the long mining boom.

It is possible to estimate the share of current economic activity that is contributed by the university sector through the use of an 'Input-Output' model of the Australian economy. This model captures the share of total industry value-added (measured in terms of Gross Domestic Product (GDP)) attributable to the university sector directly, through payments to labour and returns on physical capital, and indirectly, through the intermediate inputs provided by other businesses to the university sector.

Building upon the results from this standard approach for universities in Australia, as set out in Appendix A, Deloitte Access Economics estimates that the Australian university sector contributed around **$25 billion** to the Australian economy in 2013, accounting for over **1.5% of Australia's GDP** and **160,000 fulltime equivalent (FTE) jobs**.[2]

[2] The number of FTE jobs contributed by the university sector in Australia exceeds the number of FTE persons directly employed by universities as a result of the indirect economic contributions made to related industries from which universities purchase intermediate inputs.

While this measure demonstrates the significant size of the sector in relation to the total size of the Australian economy, it does not fully capture the impact that universities' activities have on national prosperity or economic growth.

Indeed, Australian universities have played a critical role in **supporting economic growth in Australia** and the construction of a democratic, socially cohesive society.

The broad remit of universities includes many factors all associated with the **creation and dissemination of knowledge**. This supply of knowledge and intellectual resources has considerable impacts on the economy, namely through:

- supporting economic growth and national prosperity by generating human and social capital through teaching and learning activities;
- driving technological progress and economic growth through research discovery and adoption; and
- enriching society through broader community service activities.

Measures of these benefits, associated with the core activities undertaken by Australian universities, are outlined in section 2 of this report.

The totality of these effects is evidenced by the clear relationship between the strength of a nation's university sector and economic growth and prosperity (Elnasri and Fox, 2014; Holland et al., 2013; Veugelers and Del Rey, 2014).

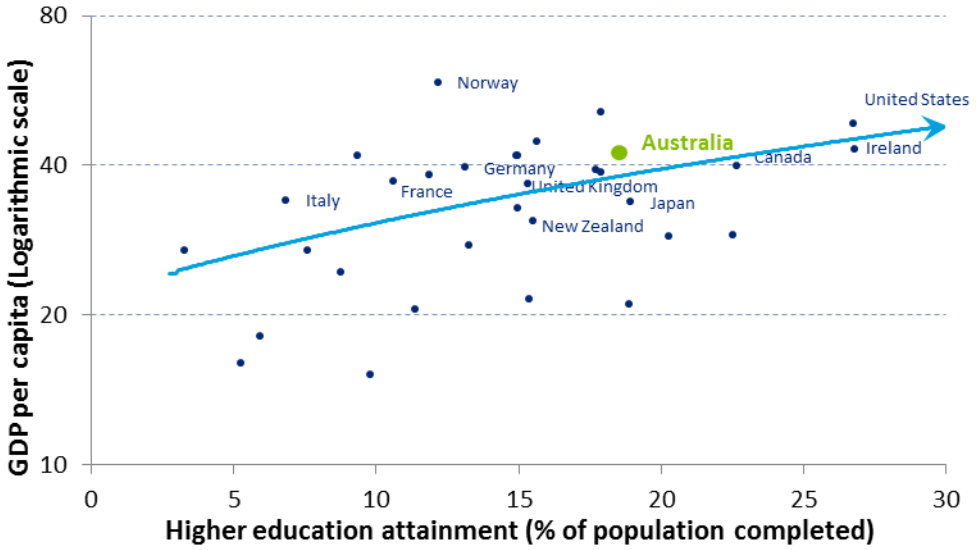
Looking forward, and as outlined in section 3 of this report, universities will play an important role in shaping Australia's future economic and social prosperity through:

- driving Australia's 'next waves' of economic prosperity through the provision of international education exports; and
- supporting the skills needs of the future 'knowledge economy' through world leading higher education and research.

1.2 Universities build human and social capital through teaching and learning activities

University higher education, provided through its **teaching and learning activities,** increases the knowledge and skills of workers, which in turn improves employment, labour force participation and productivity in the workforce. As such, it plays a key role in supporting productivity growth for all nations, which is the primary driver of improved living standards over time. Indeed, there is a strong positive relationship between higher education attainment and national income across countries, as shown by Chart 1.1.

Chart 1.1: Higher education attainment and per capita income across countries ($US 2010 PPP `000s)



Source: Deloitte Access Economics 2015, based on the Barro and Lee (2010) dataset.

Because of their contribution to economic growth and productivity and the relative demand for skilled labour, university graduates earn higher wages over the course of their lifetime than they would otherwise earn without a university degree (McMahon, 2009; Daley et al., 2015).

Further, this rising demand for highly skilled labour affects not only the wages paid to those graduates but also increases their employment opportunities, causes greater workforce participation, longer working lives and lower levels of unemployment (Leigh, 2008; Wilkins, 2015).

The benefits from the increased human capital embodied by skilled graduates also spill over to other businesses and workers in the economy, through their impact on total factor productivity (Moretti, 2004).

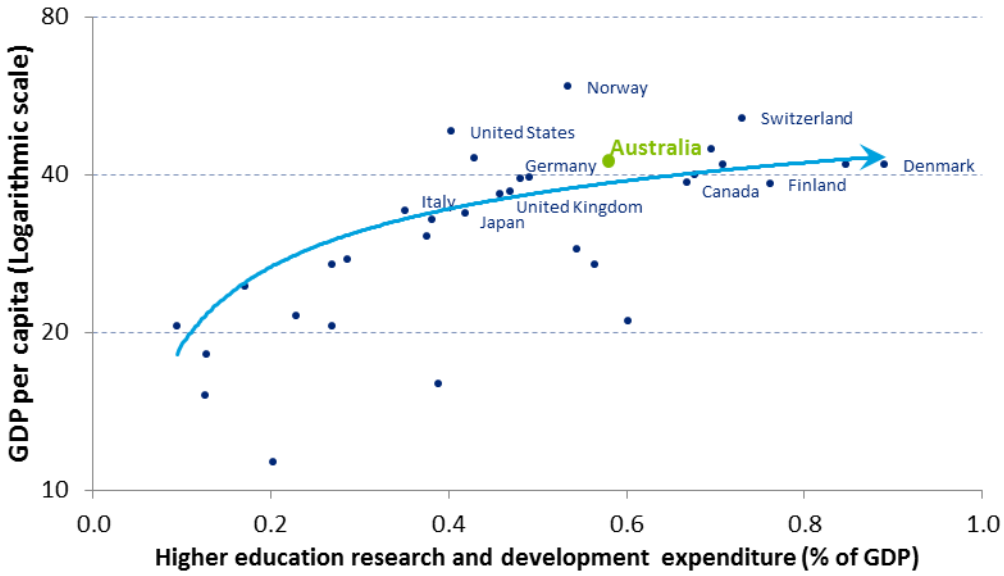
This enhanced human capital does not just result from the skills and content learned as part of a university education, but also from the improved capacity to learn and think analytically throughout an individual's working life. University education helps foster a philosophy of lifelong learning among graduates, facilitated by an ongoing connection to the university academic community, further contributing to the ability for graduates to accumulate human capital over time.

In addition to improving average incomes and living standards, increased attainment of higher education goes some way in improving equity in the distribution of income and wealth in society. For example, recent research has found that students from social groups under-represented in higher education realise the largest benefits, relative to those who do not participate (Brand and Xie, 2010). There are also well established relationships between higher education and wellbeing both personally and in broader society, such as in terms of health, social cohesion, crime and justice outcomes (McMahon, 2009).

1.3 Universities drive technological progress and economic growth through research discovery and adoption

Universities' **academic and research activities**, both in terms of knowledge discovery and adoption, provide crucial support for the national innovation system. These activities contribute to technological progress through innovation and entrepreneurialism, generating considerable contributions through knowledge spillovers and the creation of spin-off technologies and companies. This strong relationship between public university research and economic prosperity is further demonstrated in Chart 1.2, which shows that countries with higher expenditure on higher education research tend to experience higher GDP per capita.

Chart 1.2: University research and per capita income across countries ($US 2010 PPP `000s)



Source: Deloitte Access Economics 2015, based on the Barro and Lee (2010) dataset.

University research—defined here as **research discovery and adoption**—includes the broad scope of research undertaken at universities, from pure and basic to experimental and applied. Research activity relates not only to the discovery and creation of new knowledge but also the costs and effort associated with research dissemination and research adoption. This is because the benefits of university research activity are linked both to the nature of the research and the extent to which it is used and adopted in broader society (i.e. factors relating to research *impact*).[3]

[3] To be more explicit: innovation, in and of itself, will not necessarily translate into economic activity. Rather, it is the application of that technology and its introduction into the marketplace that results in economic growth.

Principally, the economic benefits of university research activity result from improved levels of productivity in industry, as well as the value of innovation and entrepreneurship flowing from research discoveries and applications, which leads to the production of new spin-off technologies, products and corporations.

Research and innovation more broadly is widely agreed to be a major driving force behind long-term productivity and economic growth (Bassanini and Scarpetta, 2001). It is now well recognised that the productivity benefits from research and successful innovations are not fully absorbed by the innovating entities; rather, they diffuse through the rest of the economy leading to positive externalities in growth and the productivity performance of the other using entities (Bloom et al., 2014; Leyden and Link, 2013; Acs et al., 2009). This is particularly true of universities, whose social remit ensures the wide and varied creation and dissemination of knowledge throughout society.

Beyond these economic impacts, university research plays a broader role in supporting individuals in the economy to change their preferences and decision-making around issues of culture or politics which are difficult to quantify economically. In short, university research results in other important non-market returns that need to be carefully considered alongside its economic returns.

1.4 Universities enrich society through community service activities

University **community service activities** include those additional community engagement activities undertaken by universities that are not explicitly captured in their teaching and learning or research activities. This entails universities working outside of the academic community to share resources and expertise. It typically includes educational outreach, voluntary work and consulting, public lectures and information dissemination, and access to performances and art and leisure facilities. Through these activities, universities can further affect the broader social fabric of their local community and even the nation.

Most Australian universities actively engage in community service, benefiting communities at a local, national and international level. The benefits, which may not always be easily identifiable, primarily accrue to the community broadly, contributing to enhanced civic engagement and community networks.

1.5 Universities will support the 'next wave' of economic prosperity through international education exports

As the middle class of emerging Asia burgeons, demand for services such as education will grow rapidly. Indeed, given that in less than two decades' time, some two thirds of the world's middle class will reside in the Asia Pacific region and demand for services such as education will grow rapidly, Deloitte Access Economics projects international education to be among the fastest growing sectors of the global economy over the next two decades.

This, coupled with the Australia's competitive strengths in education and training, saw international education identified as among the five most significant sectoral drivers of the next wave of Australia's economic growth and prosperity in the Deloitte Access Economics (2014a) report *Building the Lucky Country #3, Positioning for prosperity? Catching the next wav*e.

Already Australia's largest service export, the scope for international education providers like universities to grow the nation's incomes through the provision of education to a new wave of international students is vast.

1.6 Universities will support Australia's future 'knowledge economy'

It is widely acknowledged that Australia faces a significant challenge over the coming decades if it is to maintain growth in national income and living standards as commodity prices fall and the sizeable returns from the decade long mining boom recede. This challenge is compounded by Australia's ageing population, which will see rates of workforce participation decline as more Australian workers enter retirement. With both participation and the terms of trade acting as a drag on the nation's living standards, it will fall almost exclusively to productivity growth to propel national incomes higher.

The university sector, and the human capital it generates, has a major role to play in addressing the productivity imperative Australia confronts. University research too will play an important role in supporting growth in livings standards over the coming decades.

Australia, like other developed nations, is fast transforming into a 'knowledge economy' where knowledge is being used to generate value for industry. More than ever before, Australia's economic potential is dependent on the production, distribution and application of intellectual capital. Core to the knowledge economy are workers who have embodied knowledge in the form of greater levels of human capital. These 'knowledge workers' are the managers, administrators, professionals, designers and innovators that will drive the future economy and be highly demanded by the labour market.

Australian universities will play a key role in meeting the future demand for knowledge workers by producing both undergraduates and postgraduates that have the capabilities to develop and transform knowledge to create economic value.

2 Measures of the economic and social benefits

To further specify and quantify the benefits generated by Australian universities, this section first establishes a framework for categorising the benefits arising from university activities, and then provides a detailed analysis of the estimated benefits.

2.1 Categorising the benefits arising from university activities

The benefits that arise from Australian universities' core activities can be categorised along several themes, relating to whom the benefit accrues and the nature of the benefit itself. An explanation of this categorisation is set out below to support the subsequent analysis and estimation of the benefits of universities in Australia.

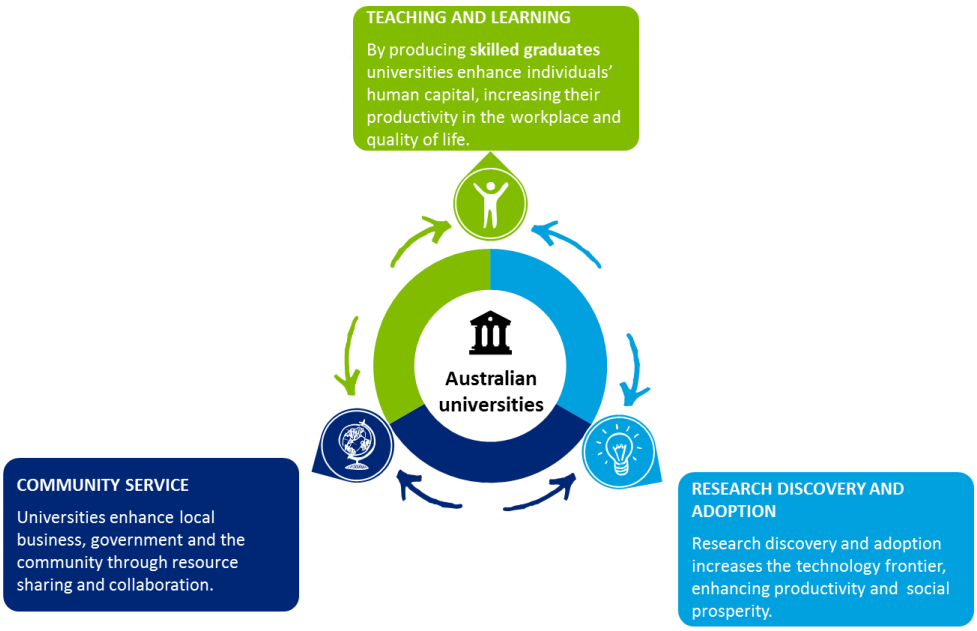
2.1.1 Core university activities

The broad remit of universities includes many factors all associated with the **creation and dissemination of knowledge**. Specifically, the most defining core activities of universities that support this, as outlined in section 1, are:

- teaching and learning;
- research discovery and adoption; and
- broader community service activities.

These three component activities, the core undertakings of universities, form the basis of the conceptual framework of the measurable benefits of universities to the economy and broader society, illustrated in Figure 2.1.

Figure 2.1: Core university activities – conceptual benefits framework



2.1.2 To whom benefits accrue

On the whole, universities create and disseminate knowledge through their core activities, generating benefits that can accrue to particular individuals and the economy and society more broadly.

To conceptualise and subsequently measure the benefits associated with each component activity, benefits can be described **in terms of to whom the benefit manifests and their relationship to the activity itself**. Such a taxonomy is informed by principles of public economic theory (Rosen and Gayer, 2010; MacMahon, 2009; Marginson, 2012) which is set out in detail in Appendix B.

Using this taxonomy, a distinction is made between benefits that accrue to individuals directly involved in acquiring the good or service. In many cases this includes the university itself (including its staff) as well as the university's clients—**students and other entities**. In economic terms, these benefits can be referred to as 'private benefits'.

In addition to these direct benefits, there are **'spillover' benefits** to third parties who are external to the production and consumption of the good or service, for example government, tax payers, employers and local community members. In economic theory, such benefits are often defined as 'positive externalities' or 'public benefits' (Rosen and Gayer, 2010).

As an example, consider teaching and learning activities. A university's students receive considerable benefits from completing their degree programs which, among other things, comes in the form of higher lifetime earnings (Chapman and Lounkaew, 2011). In addition to this, and as a result of the students' increased lifetime earnings, the government receives greater taxation revenue. This additional benefit accrues as a 'spillover' to third parties, namely the Commonwealth Government and ultimately, taxpayers.

The total social benefit from university activities is the sum of all of these benefits (IAC, 1995; McMahon, 2009). In this sense, the categorization presented here seeks to be exhaustive in its treatment of the total benefits to society from specific university activities.

In some instances it is possible to independently and empirically estimate the benefits that accrue to different types of individuals/entities (McMahon, 2009; OECD, 2014). In other circumstances, it is more feasible to estimate the **total economic returns accrued to society** (that is, the combined benefits). Further still, some benefits cannot be quantified in any reliable manner and are at best canvassed in more qualitative terms.

2.1.3 The nature of the benefit

The benefits created by university activities arise in many and varied forms. Based on McMahon (2009), the analysis in this report has adopted a classification of **'market' or 'non-market' benefits**, where benefits are categorised dependent upon whether the benefits are measurable in the form of market output and income, or external to market quantification.

Market benefits are observable from a market transaction and are monetisable, for example higher earnings for graduates. In contrast, further non-market benefits for graduates are the social interactions and connections they make from attending university. The value of these interactions cannot be estimated in monetary terms, but they are nonetheless a result of the 'market' interaction of the activity of teaching and learning (McMahon, 2009). Another example of a non-market benefit that accrues more broadly is the civilising impact of higher education (Dee, 2004).

While non-market benefits are not practically monetised nor directly expressed in financial terms, in many cases they can be estimated using economic techniques to enable an indicative comparison with market benefits (for example, through dollar value estimates of 'consumer surplus').

2.2 Teaching and learning

Key findings:

- The value that university education adds to the productive capacity of the nation is estimated at $140 billion in GDP in 2014, equivalent to 8.5% of GDP.
  - That is, Australia's GDP is 8.5% higher because of the impact that a university education has had on the productivity of the 28% of the workforce with a university qualification.
- This reflects the market benefits that students accrue through higher earnings, which are estimated to be at least $24 billion annually (in 2014 dollars), as well as substantial spillover benefits to the broader economy.
- In addition, there are sizable non-market benefits to both students—in the form of improved health, wellbeing, knowledge and family life—and to society more broadly through the creation of more efficient labour markets, and a secure and vibrant civic society.

Economists have long been interested in the labour market benefits of higher education, and there has correspondingly been a great deal of research attempting to quantify these benefits (see, for example, Ashenfelter et al., 1999; and Card, 1999).

However, irrefutable evidence on the benefits of education has proved somewhat elusive; reflecting the fundamental problem that social scientists and economists cannot observe what an educated person would have experienced had they not obtained their education. Nevertheless, current evidence points to the conclusion that significant benefit is more highly likely to be present than not, particularly for education in early years (Gould et al., 2003; Chetty et al., 2011).

Human capital theory is perhaps the most widely accepted model used to analyse the contribution that higher education makes to individuals' earnings and productivity, and subsequently to economic and social prosperity (McMahon, 2009; Leigh, 2008). Human capital is essentially the skills and abilities that individuals apply to the workplace or to their personal lives more generally. These skills and abilities are in part explained by an individual's *innate* ability, but they are also acquired through experience and formal education (Borjas, 2010). The human capital theory posits that skilled graduates embody greater human capital as a result of their university education, which increases their productivity in the workplace (reflected in the form of higher wages) and quality of life more broadly.

2.2.1 Total benefits to the economy

The human capital theory of higher education postulates that university education increases the knowledge and skills of workers, which in turn improves productivity in the workforce, labour force participation and employment. As such, it plays a key role in supporting productivity growth for all nations, the primary driver of improved living standards over time (Mankiw et al., 1992).

Improvements in educational outcomes have been widely recognised as a fundamental element in enhancing economic growth. In a seminal paper, Mankiw et al. (1992) used average schooling duration to measure human capital and showed its strong correlation with per capita output across countries. Their neo-classical approach sparked the development of influential macroeconomic literature which focuses on how education, as a measure of human capital, can generally sustain economic growth both in the form of benefits to individuals and social returns at the macroeconomic level (for example, see reviews by Caselli, 2005 and Sianesi and Van Reenen, 2003).

Growth accounting analysis in the UK has indicated that the ongoing accumulation of skilled university graduates contributed to around 20% of all GDP growth in the UK from 1982–2005, a highly significant contribution. This same analysis found that a 1% increase in the share of the workforce with a university degree raises long run productivity by 0.2–0.5%. This means that at least one third of the 34% increase in the labour productivity growth that occurred between 1994 and 2005 can be attributed to the accumulation of skilled university graduates in the labour force (Holland et al., 2013).

The overall finding, of the significant contribution of university higher education to productivity growth, is consistent for most OECD countries including Australia. Indeed, there is newly emerging theoretical evidence that these more traditional approaches to estimating the contribution of human capital accumulation to income growth and living standards at best present *a lower bound* of the total contribution of formal (university) education (Jones, 2014).

These observable benefits to economic growth, national per capita income and living standards are market in nature (i.e. monetisable) and accrue both privately to the individuals who embody the enhanced human capital, and more broadly to other workers and business owners in the economy who benefit from the overall improvement in labour productivity (McMahon, 2009).

Total economic contribution of higher education human capital

To provide a measure of the total economic contribution of university higher education to the Australian economy, Deloitte Access Economics has developed a cross-country macro-econometric model of economic growth that extends upon the neo-classical Solow growth model adopted by Mankiw et al. (1992) (see: Deloitte Access Economics, 2015, for more detail). The model includes observations of economic growth and higher education attainment for 37 countries between 1980 to 2010 and estimates the impact higher education attainment has on a Australia's productive capacity. The empirical results from this model are consistent with other results found in similar studies conducted on this topic. Further detail of the modelling approach and estimated results is included in Appendix C of this report.

Applying the results of this model to measures of output in the Australian economy, as set out in Appendix D of this report, Deloitte Access Economics estimates that the value that university teaching and learning adds to the productive capacity of the nation, through the development of the stock of higher education human capital, is estimated to **$140 billion in GDP in 2014**.

That is, Australia's GDP is **8.5% higher** because of the impact that university education has had on the productivity of the 28% of the workforce with a university qualification.

2.2.2 Benefits to students

Students gain a variety of skills over the course of their degrees, resulting in the development of human capital. These skilled graduates are then equipped with the knowledge necessary to contribute successfully in their chosen fields and will experience market benefits relating to income and earnings over the course of their career.

Graduates also receive non-market benefits beyond those related to income due to their time at university such as an improved quality of life outside of a working environment. While these benefits are more difficult to measure, as they do not tend to be valued in the marketplace, this report provides an overview of the accepted methodologies at present.

Society more broadly also benefits from the increased skill level of graduates attained at university. These benefits generally relate to the impact of additional skills and higher earnings in the economy as the productivity gains achieved by students spillover to other individuals and businesses in the economy.

2.2.2.1 Market benefits

There is considerable evidence demonstrating that higher education contributes to higher wages for skilled graduates (Card, 1999). The wealth of international research on this topic is not reproduced here.

In Australia, there is a small but growing body of evidence that shows that individuals with university higher education receive higher wages, are more likely to be employed and commit more hours to the labour force than individuals without a higher education degree (Wilkins, 2015). Estimates show that an individual completing a bachelor degree in Australia

could expect an average private rate of return of 15.3% for males and 17.3% for females, compared to someone who had finished Year 12 (Leigh, 2008).

A recent study of Household, Income and Labour Dynamics in Australia (HILDA) Survey found that individuals receive significant returns from higher education in Australia in the form of an increased likelihood of being employed fulltime and higher weekly income. Importantly, these results are determined after controlling for demographic factors and cognitive ability which 'arguably provides a stronger basis for interpreting estimates for education variables as 'causal', on the grounds that this controls for the higher innate ability of the more-educated that would suggest they would have better labour market outcomes even without the additional education' (Wilkins, 2015, pp. 70–71).

The results from this analysis are included in Table 2.1 below. Income returns from each level of higher education are measured relative to the average income of individuals with education levels equivalent to year 11 or below. Employment effects are measured in percentage points of the probability of employment (or fulltime employment) attributable to each higher education qualification level.

Table 2.1: Returns to higher education in Australia, 2012

	Probability of being employed		Probability of being fulltime employed		Weekly earnings premium of fulltime employees	
	Males	Females	Males	Females	Males	Females
Postgraduate Degree Level	0.04‡	0.04‡	0.09	0.08‡	49%	40%
Graduate Diploma and Graduate Certificate Level	(0.01)‡	0.06‡	0.05‡	0.05‡	45%	33%
Bachelor Degree Level	0.01‡	0.06	0.03‡	0.03‡	42%	32%
Advanced Diploma and Diploma Level	0.03‡	0.07	0.07	0.10	28%	8%
Certificate Level	0.03	0.11	0.06	0.03‡	20%	0%‡
Year 12	0.00‡	0.06	0.01‡	0.05	19%	14%

Source: Wilkins (2015) corrected version of Table 7.4. Figures marked with an ‡ are *not* statistically significant at the 10% level.

According to the 2011 ABS Census there was estimated to be over 3.2 million individuals with a higher education qualification in Australia (bachelor degree qualification or higher). Approximately 44–69% of this population were employed fulltime in 2011, and the average weekly earnings of these fulltime employed workers ranged from around $1,465 to $2,027 in 2014 dollars (depending upon individuals' educational status and gender). This is in comparison to individuals with a year 12 level of educational qualification, of whom around 35% were employed fulltime and recorded average weekly earnings of around $1,100 (in 2014 dollars). Some of this difference in wage and employment outcomes can be attributed to different levels of educational attainment, as well as the innate ability and attributes of these individuals.

Market benefits to students from university higher education

Using the estimates from Wilkins (2015) and data from the 2011 ABS Census it is possible to estimate the *causal* value of higher education qualifications in terms of wage and employment benefits to the 1.8 million fulltime employed Australian's with a higher education qualification (bachelor degree or above) in 2011. Further detail on this approach and the resulting estimates is included in Appendix D of this report.

Deloitte Access Economics estimates that the gross income benefits earned by these skilled higher education graduates exceeded **$24 billion in 2014 dollars each year**. In other words, after controlling for innate ability and other attributes, fulltime employed graduates in 2011 earned $24 billion more in 2014 due to their higher education than if they had only completed year 12.

2.2.2.2 Non-market benefits

While many students are likely to be aware of the market benefits they accrue from their time at university, few generally consider the benefits enjoyed beyond their enhanced employment and income prospects. It has been noted this may be because these benefits are poorly understood (McMahon, 2009; Norton and Cherastidtham, 2014).

Nonetheless, there have been a number of studies which have quantified these effects. In broad terms, the non-market benefits may be categorised as those relating to:

- health and longevity;
- happiness and wellbeing;
- knowledge and productivity; and
- children and education.

Given that university graduates will generally earn higher incomes than those without higher education, controlling for income when producing quantatitive estimates is necessary. This ensures that estimated benefits can be said to arise from differing education levels, and not associated increases in lifetime earnings. All the studies canvassed in this report control for income effects, unless otherwise stated.

Health and longevity

The benefits to a graduate's health due to their time at university have been well documented. As early as 1975, Grossman identified a clear relationship between education and health levels (Grossman, 1975). Today, health benefits are frequently recognised as arising from further education, and these benefits have been assessed in a variety of frameworks.

A recent report published by the OECD stated that 90% of Australian adults with tertiary education reported they were in good health, compared to 84% of those with upper- or post-secondary non-tertiary education, and 76% of those without upper secondary education (OECD, 2014). This seems to indicate a positive relationship between education levels and health, although it should be noted this study does not control for income effects.

A question may be raised as to the causality of these findings. However, further analysis conducted in other countries suggests that improvements in health follow education, and that this holds true even when other possible effects, such as income or parents' education, are controlled (McMahon, 2009).

The health benefits experienced by graduates are broad and generally relate to the choices made by graduates compared to those who have not attended university. A US study estimated that on average, an individual exercises 17 minutes more per week for each additional year in college (McMahon, 2009). Another report found evidence that those with a university education make greater use of health services than those who did not (Bowen, 1977). Fletcher and Frisvold (2009) found that attending college is associated with an increase in the likelihood of accessing preventive care. It can be seen that these choices lead to improved health outcomes. While most studies relate to data collated in other nations, it is likely the effects are similar across developed countries. Indeed, an analysis of Australian data has found that university graduates have an average Body Mass Index (BMI) 0.5 points lower than non-graduates (Savage and Norton, 2012).

The question then becomes one of measuring the actual value attributable to these health impacts. Grossman concluded that the value of education to own health is approximately 40% of value of the market benefits of education that graduates receive (Grossman, 2006). McMahon in his work *Higher Learning, Greater Good: The Private and Social Benefits of Education* estimated that the average value of health benefits was $16,800 2007 US dollars per year following the completion of a bachelor's degree, or approximately $1 million 2007 US dollars over an average lifetime. According to McMahon, the value of health benefits represents 54% of the private market benefits of a university education (McMahon, 2009).

As stated earlier, the range of health benefits experienced by graduates are likely due to the choices they make compared to those without higher education. While difficult to measure, it has been estimated that some of the effect is due to education causing graduates to value the future more highly (Becker and Mulligan, 1997). In addition, graduates tend to stay better informed about health matters.

Of course, improved health leads to longevity. Overall, it is estimated that those with university education live five to seven years longer in Western economies (Grossman, 2006). In terms of mortality, Grossman concludes that each additional year studied at college lowers the probability of death between the ages of 32 and 46 by 0.4% (Grossman, 1975). In value terms, McMahon estimates the additional longevity arising from a university education to be $484 per year of higher education in 2007 US dollars (McMahon, 2009).

These improved health outcomes not only benefit the individual graduate but lead to an overall healthier population, which benefits society more broadly.

Happiness and wellbeing

A number of studies have found a link between further education and happiness and wellbeing.

As pointed out in McMahon's work, it is likely that the increased happiness levels of university graduates is due to a combination of the income, health and employment effects that arise from education. However, even when controlling for those secondary effects,

education itself has a positive effect on happiness: a study conducted by Di Tella et al. (2003) found that a university education contributes directly to happiness. An analysis of Australian data also found greater life satisfaction in university graduates (Savage and Norton, 2012). However, given the intricate links between the factors that influence happiness, some studies have found there to be no direct contribution aside from the secondary effects (Helliwell, 2003).

Education may also contribute to overall wellbeing. A study in the UK found that individuals with university qualifications are less affected by distressing situations, measured as an average of 75% less distress than those without university qualifications (Mandemakers and Monden, 2010). However, it should be noted that income was not controlled for in that particular study.

In addition, an Australian study has established that graduates have better relationships in a variety of contexts. It was found that university is likely to cause an increase in the number of close friends a person may have. University graduates were also found to have better relationships in the workplace, feel more a part of their local community, and have higher acceptance of other religions and races than non-graduates. These relationships can have a positive effect on overall happiness, as well as benefit society via increased social cohesion and connectivity (Savage and Norton, 2012).

Knowledge and productivity

The knowledge gained at university allows graduates to enhance their productivity not just within the workplace but within their personal lives as well.

A number of studies have found that university graduates are able to make more efficient choices, saving money over the long run (McMahon, 2009). For example, Hettick (1972) found that women with college degrees are more efficient in purchasing household items, estimating a saving which raises the rate of return to a college education by 1.5%.

Studies have also found that university graduates are able to more efficiently manage financial assets compared with those who did not complete higher education. Solomon showed that those who graduated from college obtain a higher rate of return on their savings, even after controlling for income levels (Solomon, 1975).

Overall, McMahon estimates the total savings arising from the efficient choices made by university graduates to be equivalent to $856 in 2007 US dollars per year of college (McMahon, 2009).

The knowledge that university graduates obtain also encourages lifelong learning and therefore productivity over a graduate's lifetime. Mincer (1962) found that those with more education are in a better position to learn on the job and apply creative knowledge, while McMahon (2004) found that those who have higher education levels are more likely to be selected for on-the-job training. Aside from the benefits in the workplace, the tendency of and ability for graduates to continue their learning beyond university can also benefit their lives at home and in the community (McMahon, 2009).

Children and education

Higher education has a range of effects on the future family of a university graduate. Studies have shown that children with educated parents are healthier overall. Grossman (2006) found a clear relationship between the education level of the mother and the health of her adolescent children. Frank and Mustard (1994) found lower infant mortality rates are also linked with higher rates of female education at all levels, even after income effects are controlled for. It is likely these positive effects are due to the ability of university-educated individuals to seek knowledge relating to better child health. McMahon (2009) estimated that the university degree of the parent has a value of $4,340 per year in US 2007 dollars. It is clear that there is also a societal benefit here, as evidence shows that healthier children do better in adult life.

It is also recognised that the parents' level of education has a positive link with their children's levels of education (Johnston, 2004). Bynner and Egerton (2001) have shown that graduates in the UK are half as likely to see educational difficulties in their children compared with parents educated below a high school level. Graduates also tend to read more to their children, who then perform better in reading and mathematics tests compared to children of parents without higher education (Bynner et al., 2002). However, it should be noted that the two studies did not control for possible income effects. The benefits enjoyed by children of graduates can also have a broader social impact in that future generations are likely to be better educated and therefore contribute more effectively to society. McMahon (2009) estimates that the number of years of education the child receives is worth $1,246 in 2007 US dollars for each year of the mother's additional education at university.

Non-market benefits to students from university higher education

While there is considerable evidence of the non-market benefits to students from higher education both in Australia and overseas, there are no definitive studies that present the value of these benefits in quantitative terms.

Nonetheless, through a comprehensive study of the literature it is likely that the public non-market benefits from higher education in Australia **are approximately equivalent in magnitude to the market benefits that students receive**.

2.2.3 Benefits to the broader economy and society

2.2.3.1 Market benefits

In addition to the benefits to students, higher education generates significant 'spillover' benefits to the broader economy. In **market** terms, these benefits accrue to both the government, in the form of higher taxation revenue and lower income support payments, and to other individuals in the economy, through increased overall productivity resulting in improved returns to wages and physical capital.

For example, Moretti (2004) found that increasing the supply of skilled higher education graduates in regional economies can increase wages for all workers (of varying skill levels), including existing higher education graduates. In particular he found that a percentage point increase in the supply of college graduates raises high school drop-outs' wages by 1.9%, high

school graduates' wages by 1.6%, and college graduates wages by 0.4%. This effect is larger for less educated groups, as predicted by a conventional demand and supply for labour. Even for college graduates an increase in the supply of college graduates increases their wages, as predicted by a model that includes conventional demand and supply factors as well as spillovers.

To date, there are no comprehensive and robust measures of the total public market benefits resulting from higher education in Australia. Such an analysis would best be undertaken in a Computable General Equilibrium (CGE) model framework, and would consider a range of scenarios related to improvements in labour productivity and increases in labour supply associated with the production of skilled graduates.

However, using a narrow definition of these spillover benefits—namely, the net return to government finances from skilled graduates in the economy—a recent study by the OECD found that the net public returns to investment in higher education in Australia are 40% of the total market returns, or around two-thirds of the size of the private returns (OECD, 2014). This methodology does not consider the other spillover benefits that would likely occur in a general equilibrium framework of the national economy, in particular the returns to owners of capital and other workers in the economy.

A further method for estimating the public return of higher education is proposed by McMahon (2009). This involves subtracting the estimated private market benefits from higher education from the total estimated market benefits for the economy as a whole. Using this methodology it has been estimated that the public share of total (market and non-market) benefits may be as high as 60%, with a more applicable estimate for Australia being approximately equivalent to 50%. Indeed, such an approach is conceptually valid, as total wages represent a share of national economic output and are comparable to total economic returns.

Broader market benefits from university higher education

While it is not possible to directly estimate the spillover public benefits from university higher education, Deloitte Access Economics' estimates of the total contribution of higher education attainment—when compared with the private benefits to individuals' wages and employment—point to the existence of **highly significant spillover benefits** to the broader economy.

2.2.3.2 Non-market benefits

Other identified **non-market** benefits from higher education that accrue publically include more stable, cohesive and secure environments, more efficient labour markets, faster and wider diffusion of new knowledge, viable social networks and civic institutions, greater cultural tolerance and enhanced democracy.

Indeed, research in the US suggests that educational attainment has large and statistically significant effects on subsequent voter participation and support for free speech and that additional schooling appears to increase the quality of civic knowledge as measured by the frequency of newspaper readership (Dee, 2004).

Broader non-market benefits from university higher education

The broader non-market benefits from university higher education are hard to define, measure and monitor, and they tend to be underestimated or ignored in both economic research and policy. Nonetheless, seminal research by McMahon (2009) has found that the overall value of non-market goods and services that accrue both privately and publically likely exceeds that of market-derived goods, in equivalent monetary terms.

2.3 Research discovery and adoption

Key findings:

- It is estimated that the existing stock of all knowledge generated by university research is estimated to account for almost **$160 billion** in 2014, equivalent to approximately **10% of Australian GDP**. By way of comparison, the value of this 'knowledge stock' exceeds the entire value-added to GDP of Australia's mining industry.
- Investments in university research over the past 30 years have increased in real terms, by $9 billion, at an average growth rate of 6% a year. This increased investment is estimated to have added almost **$10 billion to GDP each year** (in 2014 dollars), primarily through gains to national productivity.
- The benefits of this improved productivity are equivalent to almost **a third of the average living standards growth** experienced over this 30 year period in Australia.
- The majority of these benefits **accrue to the public**, as universities predominantly draw upon grant funding to support their research and activity and, on the whole, the mode of dissemination of research discovery is open and public.
- Private investments in university research can facilitate knowledge exchange increases research impact and the benefits generated by university research more broadly. Private investment in university research, including through consultancies, commercialisation and collaboration, is **complimentary to and enhances the returns of public university research**.

University research—defined here as **research discovery and adoption**—includes the broad scope of research undertaken at universities, from pure and basic to experimental and applied. Research activity relates not only to the discovery and creation of new knowledge but also the costs and effort associated with research dissemination and, ultimately, research adoption. This is because the benefits of university research activity are linked both to the nature of the research and the extent to which it is used and adopted in broader society (i.e. factors relating to research *impact*). To be more explicit, innovation, in and of itself, will not necessarily translate into economic activity. Rather, it is the application of that technology and its introduction into the marketplace that results in economic growth.

The benefits of university research activity are as broad and varied as the nature of the research itself. Highly applied research can have clear and demonstrable impacts on productivity and economic growth, through its enhancement of technology. However, more exploratory and basic research discovery can also have significant and long-term impacts on social prosperity, through its impact on technological progress in the economy and further enhancements of the social and political discourse of a nation and its citizens.

Because of the complex nature in which university research generates social benefit and the long time-lags often associated with research development and subsequent impact on the economy and broader society, it is challenging to measure the market and non-market benefits of university research in a comprehensive and meaningful way. In particular, without in-depth examinations of the return to individual research projects (for example, through the use of case studies) it is not possible to accurately determine the extent to which these benefits accrue privately and publically. Indeed, the ultimate measures of economic and social impact will depend upon the unique nature in which a given research project or agenda is funded and disseminated throughout society.

Nonetheless, a wealth of literature exists on the returns to research and development (R&D) activity in the economy, including R&D conducted by the higher education sector. The following sections consider the estimates of the total economic benefits to this research activity to the economy and society and reflect on the extent to which these benefits accrue publically and privately. It is important to note that this dichotomy is ultimately to endogenous to the research funding system itself and the manner in which the benefits of knowledge and 'know-how' associated with the research activity are transmitted to the economy.

2.3.1 Total benefits to the economy

The effect of research on productivity may work through various channels depending on the nature of the research and the manner in which it is disseminated and adopted in the economy. For example, R&D more broadly can be performed either by the business sector, higher education institutions or public sector agencies. Each of these types of R&D performers can be a source of significant domestic technological change. R&D performed by the business sector results in new goods and services, higher quality of output, and new production processes. In comparison, R&D performed by higher education institutions enhances the stock of knowledge available for the society; it may open new opportunities for business research, which can improve productivity. Regardless of the exact relationship between the sources of R&D, it is clear that any quantitative analysis of growth must take R&D activity into account as an additional form of investment and differentiate between various types of R&D entities (Elnasri and Fox, 2014).

The accumulation of knowledge through research and its application to productive activity is at the heart of modern economic theories of growth such as Romer (1990) and Aghion and Howitt (1992). At the core of these theories, sustained economic growth comes mainly from productivity increases. There are several ways to improve productivity but knowledge capital (through new technology, skills, R&D and efficient services and production processes) is the most significant factor as new technology allows the same level of output to be produced with fewer inputs.

Further, these benefits can diffuse throughout the economy since knowledge, unlike many other economic inputs, is non-rivalrous and can often be non-excludable. This means that knowledge can result in increasing returns to scale in production and the potential for knowledge spillovers (New Zealand Treasury, 2008). Arrow (1962) notes that these R&D spillovers can be very cheaply done and generate significant benefits for those other than the primary investors. Discoveries can be copied, knowledge embodied in capital can be accessed through reverse engineering, and researchers can leave organisations, taking technical insights and expertise with them.

Research discovery and adoption conducted by Australian universities plays a major role in the growth of the economy by improving the productivity of industries, and creating new systems, materials, and products. Salter and Martin (2001) note that research projects can contribute to the economy in a number of ways, including:

- Increasing the stock of useful knowledge that firms can draw upon to increase their chances of finding and implementing productivity-improving changes.
- Generating spin-off companies which contribute to the economy.
- Stimulating new relationships between individuals and organisations in industry, government, and research institutions that can lead to the further development of economically beneficial learnings and innovations.
- Training skilled higher degree research graduates to enter into industry, bringing knowledge of recent research and useful skills such as problem-solving and research.
- Creating new scientific instrumentation and methodologies that can be used by industry.

In the overall context of research discovery and adoption, knowledge transfer extends beyond the generation and commercialisation of new research and includes the active dissemination social, cultural, and non-market benefits to groups such as industry, NGOs, and public bodies. Whereas university research generates publication, processes, materials, and other innovations, the actual channels of knowledge exchange to broader society include teaching, consultancy, networking, professional development, collaborative research and contract research.

Studies that attempt to measure the economic benefits of R&D are numerous and their results vary significantly, with the most common approach being an estimate of either R&D expenditures or the stock of accumulated R&D capital to the level of output or productivity, controlling for the contribution of other inputs such as physical capital and labour. In such approaches it must be noted that there are methodological challenges due to the complex causal pathways through which R&D affects productivity, inadequate data across time, measurement errors, varying times lags in benefits of R&D being realised, and difficulties in controlling for the other factors that influence productivity.

Nevertheless, attempts in the literature have consistently shown significant private and spillover benefits of R&D. Dowrick (2003), in a survey of the rates of return to R&D commonly found in the literature, finds gross industry-level returns of up to 40% or more, and gross economy-wide returns of 80% or more. Econtech (2006) conducted a similar survey of the R&D literature and found that many studies placed the economy-wide social rate of return on **overall publicly funded research in the order of 25 to 40% a year**. Likewise, many Australian aggregate studies confirm the existence of positive returns on domestic R&D (for example, see Connolly et al., 2004; Bodman, 1998; and Dowrick, 1994).

More specifically on Australian universities, Burgio-Ficca (2004) examined the actual performance outcomes of Australian university R&D. The results from this analysis found that **higher education R&D has more of an impact on state productivity than the private sector**. The results indicate that larger coefficients were recorded for the various types of R&D undertaken by the higher education sector compared to R&D undertaken by the private sector.

In contrast to these econometric studies of the impacts of R&D expenditure on productivity and economic growth, a number of studies have instead attempted to use various types of CGE models to estimate the impact of specific Australian research funding and research activity.

For example, using the CIE-REGIONS CGE model, the Centre for International Economics (2015) estimated that the flow-on and total impacts of advanced physical and mathematical sciences amounted to over 22% of Australian economic activity, or about $292 billion per year. Further, they estimated that 7% of total Australian employment (or 760,000 jobs) is directly related to the advanced physical and mathematical sciences.

Additionally, Econtech (2006) examined the impact of public R&D activity on the Australian economy by using the MM600+ model. They evaluated the economic impact of the *Backing Australia's Ability* (BAA) funding package and found that the productivity gains achieved through the BAA program lead to a long-term increase in real GDP of 0.12% per annum when compared to the counterfactual scenario of no BAA funding. Further, they estimated the effect of having public R&D activity versus not having public and found that R&D activity resulted in an increase in real GDP of 1.02% per annum, a highly significant return relative to the investments in the program.

Ultimately, the most meaningful and robust way to evaluate the impacts and benefits associated with university research is through individual case study evaluations of research projects. However, as the Productivity Commission (2007) noted there are only a few detailed Australian cost–benefit studies of university projects. This is because universities concentrate more on curiosity-driven research and applied social research, rather than on large mission-oriented research projects suited to analysis by cost-benefit methods. That said, there are a large number of case studies on research institutions such as CSIRO, and case studies vary in terms of the quantitative and qualitative frameworks used to present results.

As an example, ACIL Allen Consulting (2014) examined the economic impact of CSIRO's research by studying seven case studies within a cost–benefit assessment framework. They conservatively estimated that these case studies **created more than $1.03 billion per annum in value, which exceeds CSIRO's total appropriation**. Likewise, Deloitte Access Economics (2014b) conducted four CSIRO case studies. They found, for example, that the impact of CSIRO's BARLEYmax™—a nutritionally enhanced strain of barley—had total economic impacts estimated to be slightly more than $253 million per annum once higher farm prices, price premiums for cereal products, and broader health related welfare gains and reduced health system costs were calculated. While these studies are not specific to research undertaken with universities, they are representative of the returns that university research projects often achieve, which has been corroborated by other studies specific to universities (Dowrick, 2003; Salter and Martin, 2001). Indeed, the implied returns on investment from these studies are highly significant, and demonstrate the significant value of research generated by university programs.

Total economic benefits from university research

To provide a measure of the total economic contribution of university research to the Australian economy, Deloitte Access Economics has developed a cross-country macro-econometric model of economic growth which extends upon the neo-classifical Solow growth model adopted by Mankiw et al. (1992) using a similar approach to that undertaken in the literature (see: Deloitte Access Economics, 2015; Bassanini and Scarpetta, 2001 and Elnrasi and Fox, 2014).

The model includes observations of economic growth and higher education attainment for 37 countries between 1980 to 2010 and estimates the impact that university expenditure on research and development has on Australia's productivity growth and economic output. The empirical results from this model are consistent with other results found in similar studies conducted on this topic. Further detail of the modelling approach and estimated results is included in Appendix C of this report.

Through the results of this model, the existing stock of all knowledge generated by university research is estimated to account for almost **$160 billion in 2014**, equivalent to approximately 10% of Australian GDP.

Investments in university research over the past 30 years are estimated to have increased in real terms, by $9 billion, at an average growth rate of 6% a year.[4]

The estimates from this model, when applied to measures of economic output in Australia as set out in Appendix E, indicate that increasing investments in university research over the past 30 years have added almost **$10 billion to GDP each year** (in 2014 dollars), primarily through gains to national productivity.

The benefits of this improved productivity are equivalent to almost **a third of the average living standards growth** experienced over this 30 year period in Australia.

2.3.2 Beneficiaries from university research

2.3.2.1 Market benefits

It is important to recognise that the teaching, generation, and open dissemination of high quality basic research is the essential, sustaining element of a university's knowledge generation. There are often public benefits to these basic research activities. However, given that basic research often has no specific application in mind, any benefits that do accrue are often hard to identify and attribute to a particular institution or faculty. For example, the Productivity Commission (2007) argues that basic science research is usually one component of a dynamic interdependent system rather than the ultimate driver of direct application.

[4] Calculated using data from ABS Cat. No. 8111 on total R&D spending and interpolating missing years of data from 1984 to 2014 using a cubic spline interpolation formula.

It is often strategic, impact-driven, goal-orientated research that drives direct application and progresses entire industries in the broader economy. This is captured in the notion of a **"knowledge exchange"** system were universities actively disseminate knowledge with economic, social, and cultural benefits to groups such as industry, NGOs, and public bodies.[5]

The knowledge exchange framework posits that basic research generated by a university can be exchanged to other bodies through activities such as collaborative research, contract research, and consultancy by the university. This allows knowledge with a specified industry end-use to be effectively transferred from the university to users in government, industry, and broader society, which then in turn has economic effects such as creating new products, services, or jobs.

As has been noted, in general, the majority of benefits from university research activities accrue to the broader economy as, on the whole, the mode of dissemination is open and public. Exceptions to this are instances where private individuals, firms and industry groups invest directly in university research activity, with the aim of improving their own productivity and financial returns. In 2013 Australian universities received around $922 million in research funding from private individuals, firms, and industry groups, as well as other research bodies located in Australia and overseas. This investment represents around 10% of the total expenditure by the higher education sector on R&D in that year.

Beneficiaries from university research output

Due to the nature in which university research is openly disseminated and used in the economy and broader society, the majority of the benefits are expected to accrue to the broader public.

Further, while it is not possible to know what the returns to private individuals from investment in university research may be, estimates from the literature on R&D investment by private industry consistently find large spillovers from private investment. As such, it might be expected that the total private market benefits from university research activity is less than 10% of the total funding contributed by private industry, thereby implying that public market benefits likely exceed 90% of the total market benefits resulting from Australian university research.

Importantly, private investments in university research, as described above, realise knowledge exchange that can increase research impact and the total market benefits. Indeed, the value of this private income is often used as a proxy for research impact in funding systems internationally. From this it can be concluded that private investment in university research, including through commercialisation and collaboration, is complimentary to and enhances the returns of public university research.

2.3.2.2 Non-market benefits

University research often leads to the development of new, usually unanticipated, spin-off products and firms that individuals in the economy place significant value upon, above and beyond the market value of the goods and services themselves. These 'consumer-surplus'

[5] See: http://www.gla.ac.uk/media/media_148613_en.pdf

benefits are appropriately defined as non-market benefits, and form part of total welfare resulting from university research and development activity. Because these spin-offs are usually unanticipated benefits associated with technological advancements caused by universities, they generally represent a pure spillover to the broader economy.

Other non-market benefits, which by their nature are difficult to quantify, nevertheless reflect the important contributions that research can make that accrue to society at large. These may include the benefit to the general public from being informed and educated about the latest research breakthroughs, which can elicit a sense of enjoyment or fascination in 'knowledge for knowledge's sake'. The results of research could also lead individuals in the economy to change their preferences and decision-making around issues of culture or politics which are difficult to quantify economically. In short, research may have important non-market returns that need to be carefully considered alongside its economic returns. While some of these benefits may be attributed to private investors in higher education research they are more generally attributed to public society as a whole.

2.4 Community service

Key findings:

- Drawing on resources embodied in staff, students and facilities, universities share knowledge, expertise and amenities to enrich communities on a local, national and even international level.
- While it is not possible to quantify the scale of benefits generated by community service activities, it is apparent that there are many and varied ways that Australian universities contribute through community service activities. These additional activities can include:
  - contributing to regional governance and planning;
  - community capacity building;
  - providing cultural facilities and programs;
  - hosting community forums, events and festivals;
  - opening up university facilities to the community; and
  - student-led community initiatives.

It has long been recognised that beyond building human capital through the core activities outlined above, universities are expected to undertake a "third mission".[6] This reflects the longstanding interpretation that universities have a role in enhancing civic knowledge and responsibility, as summarised in the 1957 Murray report on Australian universities (Committee on Australian Universities, p. 11):

[6] There is an alternative view that community services are embedded in teaching and research and does not represent a third stream of activities (see for example, de Rassenfosse and Williams (2015)). While it is acknowledged that much community engagement occurs through channels, to provide a comprehensive analysis of the benefits of universities this section seeks to analyse those *additional* activities that do not easily fit within those activity categories as defined above.

> *… in addition to the two aims of education and research, universities have a third function. They are, or they should be, the guardians of intellectual standards, and intellectual integrity in the community.*

There has been a recent revival of the importance of a social contract between universities and the community to foster greater partnership and integration, reflected in the work of the Australian Universities Community Engagement Alliance (AUCEA) and others.

This role is commonly conceived as engaging with the community through the core activities of teaching and learning and research as well as broader activities that focus on social responsiveness (AUCEA 2006). Community service activities provide a way of enriching the quality and applicability of teaching and research. It can also entail a broader range of activities, with the specific purpose of advancing community engagement. These generally draw on the capabilities of staff and students, and other university resources, to engage and collaborate with business, government and communities, and often do not attract any explicit government funding.

Most Australian universities express a formal commitment to community engagement through their missions, policies and practices. For example Western Sydney University's mission seeks to achieve excellence through 'service to local and international communities, beginning with the people of Greater Western Sydney' (UWS 2015). Some even have an explicit legislative requirement to undertake civic engagement and benefit the local community; for example RMIT seeks to achieve 'excellence in community service' with a focus on northern Melbourne (Winter et al., 2005).

How these commitments manifest varies across institutions, reflecting diverse histories, objectives and place (Winter et al., 2005). Some have gone so far as to include community engagement in their academic reward system; for example, Victorian University and ACU in relation to research activity (Winter et al., 2005). Other universities have specific KPIs; for example, Western Sydney University monitors the recruitment of students from specific regional areas (WSU 2015).

USQ is explicit in setting 'community capacity building' goals in its strategic plan, including (USQ 2013):

- developing and implementing a contemporary Indigenous strategy within a comprehensive social justice framework;
- developing an enhanced role for USQ in supporting the cultural life of the Queensland community;
- building capacity through sustainable partnerships with our local, regional, national and international communities; and
- providing local leadership and advocacy for education in the university's home regions.

Many universities seek to engage locally as well as at broader national and international levels. Often regional universities and campuses play a prominent role in their local community and express a more explicit commitment to local engagement. The Regional University Network (RUN, 2013) suggests that regional universities' co-exist' with their local community, in closer physical and social proximity than their city counterparts. This creates additional opportunities for community service activities and the creation of networks and partnerships, generating localised benefits for the community.

2.4.1 Total benefits to the economy and society

Community engagement encompasses a diverse range of activity, which can be summarised by the following taxonomy (European Commission, 2012):

- Social consultancy – using expertise to solve problems on a voluntary basis.
- Educational outreach – running informal learning programs.
- Services and facilities – putting resources to work for society.

In a 2013 impact study of engagement by regional universities, RUN presented a more detailed breakdown of activities including:

- contributing to regional governance and planning, including the development of regional bids for new funding and infrastructure;
- community capacity building;
- providing cultural facilities and programs;
- hosting community forums, events and festivals;
- opening up university facilities to the community; and
- student-led community initiatives.

Measuring, and even cataloguing, the benefits of university community service is a recent concept, particularly in Australia, so there are few agreed measures or estimations of their impact (de Rassenfosse and Williams 2015, RUN 2013, AUCEA 2006). This largely reflects the challenges of measuring performance, often involving self-evaluation, complex measurement techniques, and/or a focus on process rather than outcomes (Hanover Research 2011).

AUCEA (2006) provides a high level summary of potential benefits—many which are common to those from other core universities activities—including enhanced human and social capital development and encouraging more active citizenry that can improve social cohesion and quality of life. They also identify improved health and wellbeing as a benefit, particularly for disadvantaged groups who otherwise may rarely interact directly with universities, and social and cultural benefits communities gain through engaging with university infrastructure, such as art and recreational facilities.

Further, in the RUN impact study (2013, p46), regional stakeholders nominated a range of positive outcomes from university community activities, including*:*

- enhanced liveability of the region, through the provision of publically accessible infrastructure and creative arts and cultural facilities, performances and events;
- providing a catalyst for innovation and positive change, as brokers and facilitators of regional partnerships and alliances, and as major contributors to regional governance; and
- promotion of reconciliation between Aboriginal and Torres Strait Islander people and the broader regional community.

Given the community focused nature of these activities, the benefits they generate largely accrue to the public, with the exception of the private benefits for those individuals and organisations who engage directly with the university (for example, local businesses, individuals receiving outreach education or using art and sporting facilities).

Reflecting the limited assessment of benefits and the quasi-public good nature of those that have been identified, this section seeks to illustrate the benefits of university community service through select case studies. It does not seek to quantify the share of market benefits or to whom benefits accrue.

2.4.2 Australian university case studies

To highlight the diverse range of ways that Australian universities engage with communities and generate social and economic benefits, three case studies are summarised below illustrating how universities:

- Support community health and wellbeing.
- Contribute to a vibrant cultural landscape.
- Share innovation and technological progress.

Support community health and wellbeing

Most Australian universities have established programs to connect students and staff to the wider community through volunteer programs that share the human capital and other resources embodied in universities. Common approaches include the delivery of legal, health, education and other outreach services to vulnerable communities and others by drawing on the skills of senior students, often in partnership with community organisations.

Case study – ACU's Beyond Today initiatives

The Beyond Tomorrow agenda of the ACU Institute for Advancing Community Engagement uses integrated community engagement to support disadvantaged and marginalised groups in Australia and overseas. As part of this initiative the Learning for Life projects in Ballarat bring together families, schools, universities, local government, non-profit organisations, businesses, and other community institutions in a range of community programs that promote lifelong learning and enhance social capital. The project involved researching innovative engagement practices and then delivering innovative engagement activities. For example, the program includes pre-service teachers and nurses working with school children and their families in a range of learning and wellbeing programs (RUN 2013, ACU 2015).

These activities generate non-market benefits through helping to reduce economic and social disadvantage in Ballarat and supporting sustainable community improvement. They are also likely to generate benefits for those families who engage with the program and consequently increase their educational engagement and attainment.

Contribute to a vibrant cultural landscape

Australian universities represent cultural hubs that foster and share creative talent among students, staff and the broader community. Many universities house museums and galleries, for example the Museum of Human Diseases at the University of New South Wales, as well as maintaining specialist archives that form an important part of the cultural landscape. Some universities host festivals and exhibitions central to the local community, such as Stonefest at the University of Canberra, the largest music festival in the city.

Case study – RMIT's art and cultural endeavours

RMIT's central location in the heart of Melbourne provides a valuable opportunity share its physical facilities and other resources with a broader audience. RMIT opens a number of gallery spaces to the public to showcase student art as well as for national and international art exhibitions. In addition, building on RMIT's successful media curriculum, the university operates a public radio station, is a founding member of the community television station Channel 31, has a student run TV production house (RMITV) and a student newspaper (Winter et al., 2005).

Through these endeavours, RMIT generates non-market benefits for the Melbourne community through creating and sharing cultural content and enriching the Melbourne arts scene.

Sharing innovation and technological progress

Universities are often at the forefront of emerging technologies and social innovation. Many universities seek to partner with the community to develop innovative, low cost and sustainable solutions to meet community needs. Initiatives often seek to share information and enable engagement among the community, but can also involve using the community to support other university endeavours. For example, the University of Tasmania's REDMAP crowdsources data on marine species in Tasmanian waters to help chart the ocean's changing ecology.

Case study – USC's Engage Research Lab

USC established the Engage Research Lab to use innovative technologies in collaborations between researchers, students and other community partners to develop solutions to social issues. In one example, a partnership between the Queensland Police, Education Queensland, the Crime and Misconduct Commission, and the Daniel Morcombe Foundation, developed a free online game called 'Being Safety Smart' (www.beingsafetysmart.com.au). The game promotes safety and anti-abduction strategies for children aged six to eight years. It has now been used by over 750 schools and community groups, and was awarded the Gold Award for Excellence in Crime Prevention from Queensland Police Service in 2009 (RUN 2013, Engage Research Lab 2015).

Developing and sharing innovation resources to address community needs, such as Being Safety Smart, create non-market benefits for the community through empowering children and improving safety. Given the initiative produces online content, the benefits it generates can accrue across the state, and even nationally.

3 Universities supporting Australia's future prosperity

The global economy is always changing and the nature of the changes taking place over the coming decades is particularly profound. When coupled with other macro trends—the disruptive impacts of technology especially—the changes suggest both a big opportunity for the Australian university sector and critical imperative in supporting continued growth in the nation's living standards.

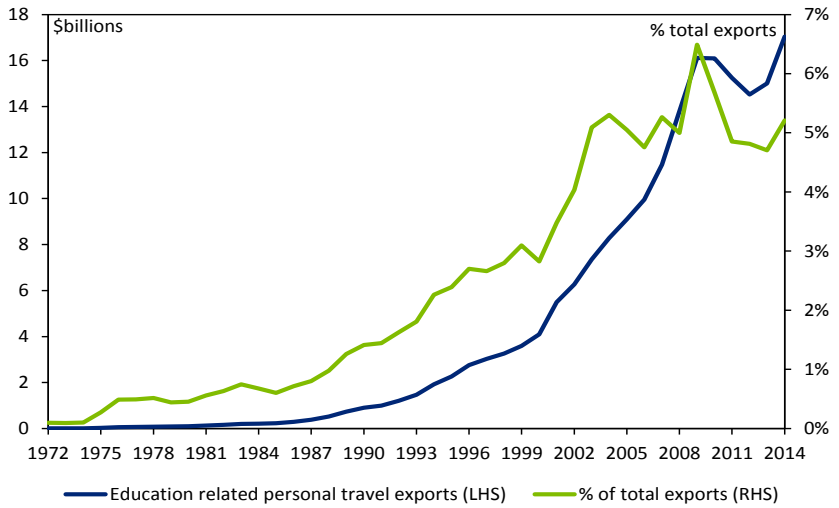
3.1 International higher education – Australia's advantage

The demand for international education is burgeoning and the associated economic opportunity confronting Australia is a sizeable one

Australia, given its strong position as a top nation for higher education, continues to educate more than its share of the world's international students, contributing significantly to the world's stock of human capital and aiding in the social and economic development of its trading partners.

As Chart 3.1 shows, the value of education exports to the Australian economy rose substantially through the 1990s and 2000s, peaking just before the onset of the global financial crisis (GFC) in September 2009. The high Australian dollar hurt the sector in the later years of the mining boom, but as the Australian dollar has fallen, education exports have recovered to be near their pre-GFC highs. University higher education accounted for around two thirds of total education exports in 2014–15 (ABS, 2015).

Chart 3.1: Education related personal education exports, calendar year estimates

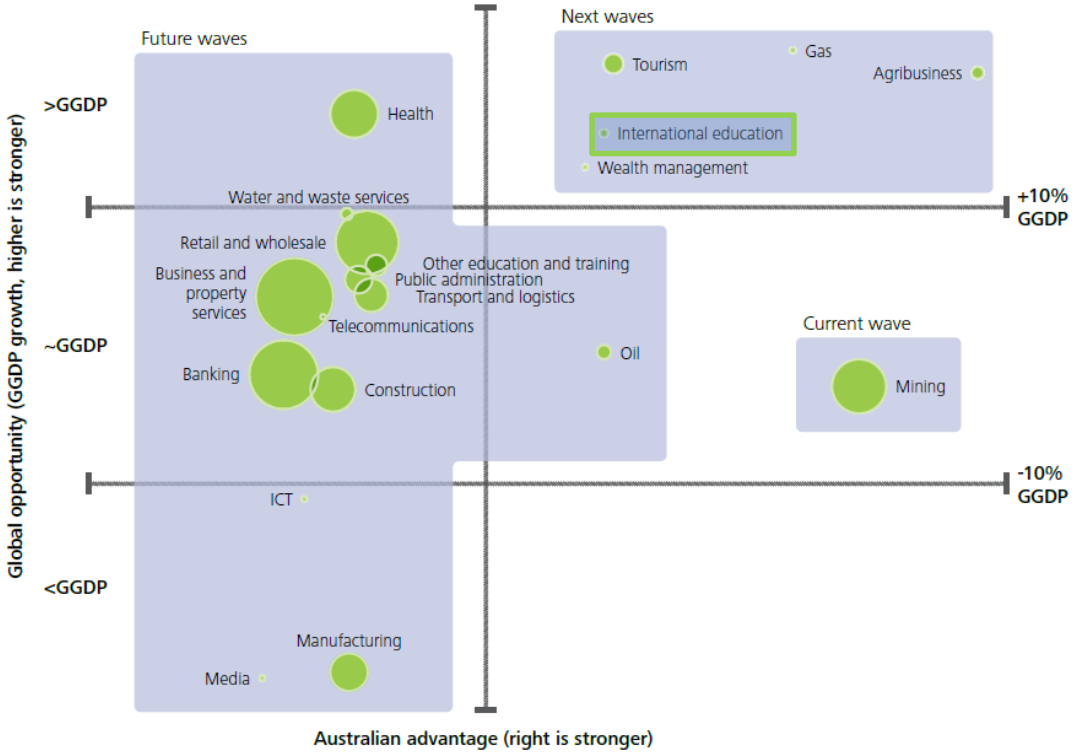


Source: Australian Bureau of Statistics (2015), *International Trade in Goods and Services, Australia, July 2015*, Cat. No. 5368.0, ABS, Canberra

As the middle class of emerging Asia burgeons—such that some two thirds of the world's middle class will reside in the Asia Pacific in less than two decades' time—demand for services like education is growing rapidly. Indeed, Deloitte Access Economics projects international education to be among the fastest growing sectors of the global economy over the next two decades.

This, coupled with Australia's competitive strengths in education and training, saw international education identified as among the five most significant sectoral drivers of the next wave of Australia's economic growth and prosperity in the Deloitte Access Economics (2014a) report '*Building the Lucky Country #3, Positioning for prosperity? Catching the next wave*', as demonstrated in Figure 3.1.

Figure 3.1: Australia's current, next and future waves of growth, 2013–2033



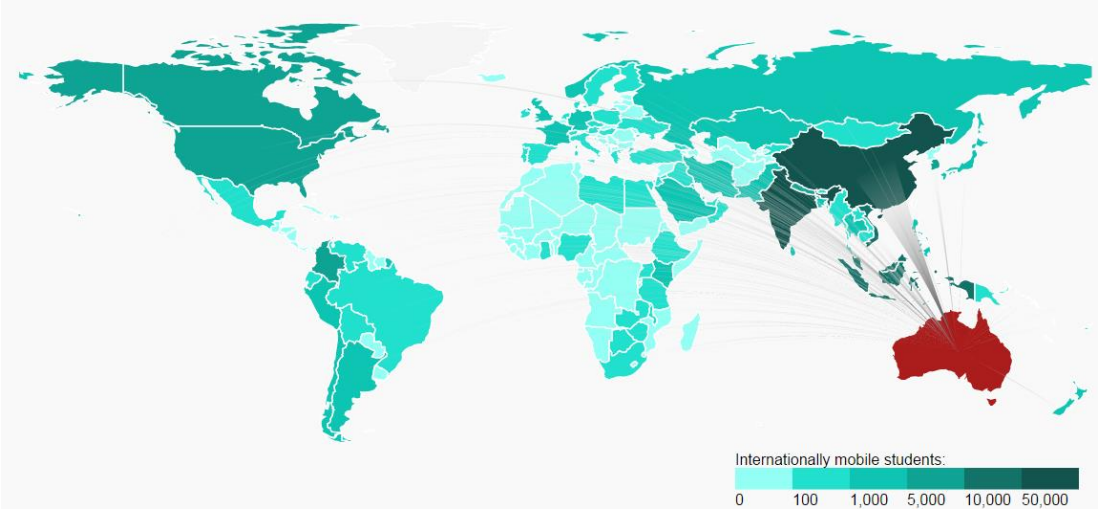
Source: Deloitte Access Economics (2014a)

Indeed, supporting these estimated trends, it has been estimated that the number of students seeking study abroad could rise to eight million by 2025, nearly three times more than today (British Council, 2012). Nearly all of this growth in demand will be from the developing world, with more than half in China and India alone.

Many of the fastest growing outbound mobile student flows over the next decade are expected to be from nations in the Asia-Pacific Region (British Council, 2012). In fact, two of the five the fastest growing bilateral mobile student flows over the next decade are expected to involve Australia with over 17,000 and 11,000 students from China and India respectively expected to undertake higher education study in Australia each year by 2025 (British Council, 2012).

While the majority of international students come from China and India, significant numbers also come from other countries in the Asia-Pacific region, including Vietnam, Thailand and Nepal, as well as other parts of the world, including the US and Brazil, as shown in Figure 3.2.

Figure 3.2: International student flows to Australia, 2012



Source: UNESCO Institute for Statistics, http://www.uis.unesco.org/Education/Pages/international-student-flow-viz.aspx

There are additional benefits that higher education exports bring to the Australian economy. People who study at Australian institutions often settle in Australia after completing their degree. This provides a potential stream of skilled and educated migrants to Australia which benefits the Australian economy overall.

International students who return to their home country or move elsewhere overseas for work nonetheless maintain a strong connection with Australia. This helps to develop and maintain academic, economic and social links between Australia and other nations.

Indeed, as a conduit for these linkages, universities in Australia themselves play a key role in strengthening our links with strategic economic partners in Asia by facilitating academic and industry networks and linkages, through cross-country collaboration, including through publications, seminars and so on.

3.2 Australian universities supporting the 21st century 'knowledge economy'

The Australian economy's demand for university graduates is increasing and so too is the calibre of education they require in the 21st century knowledge economy

Australia, like other developed nations, is fast transforming into a 'knowledge economy' where knowledge is being used to generate value for industry. More than ever before, Australia's economic potential is dependent on the production, distribution and application of intellectual capital.

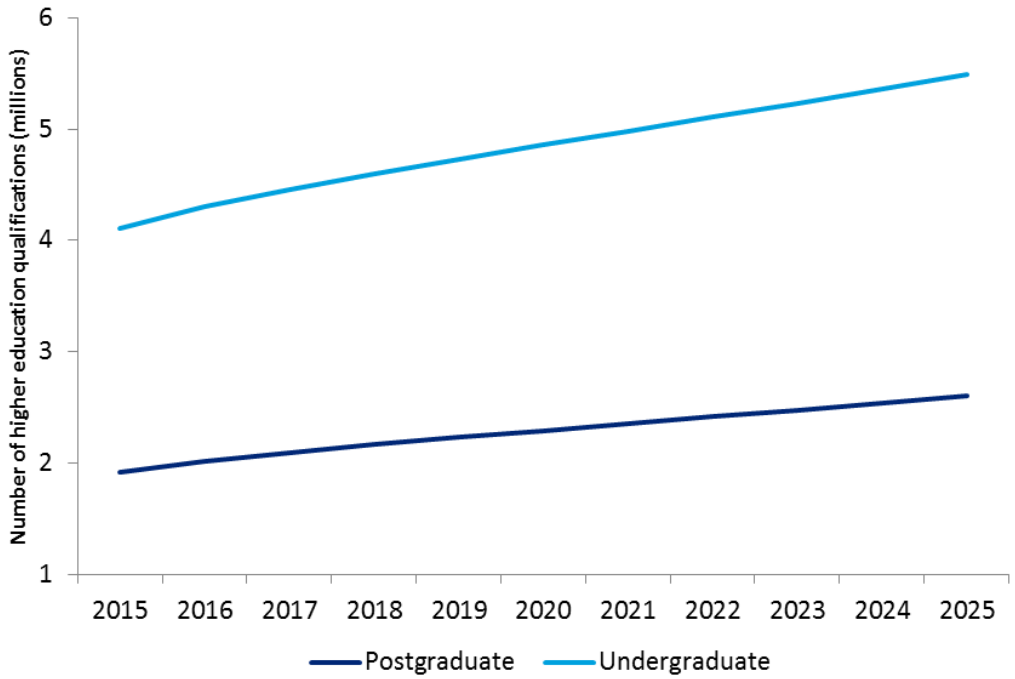
Core to the knowledge economy are workers who have embodied knowledge in the form of greater levels of human capital. These 'knowledge workers' are the managers, administrators, professionals, designers and innovators that will drive the future economy and be highly demanded by the labour market.

Our universities play a key role in meeting the future demand for knowledge workers by producing both undergraduates and postgraduates that have the capabilities to develop and transform knowledge in order to create economic value.

As shown in Chart 3.2, over the next 10 years it is estimated that the economy will require approximately **2.1 million more university qualifications** (for both undergraduates and postgraduates) than it needed in 2015. This represents a projected overall growth in demand for university qualifications of **34%** for the period 2015–2025.

This means that over this period, the Australian economy will need approximately **1.4 million more undergraduate university qualifications and 0.7 million more postgraduate university qualifications** than currently exist.[7]

Chart 3.2: Projections of total demand for undergraduate and postgraduate qualifications 2015–2025



Source: Deloitte Access Economics (2015)

The number of additional qualifications that need to enter the economy to support this demand is higher again, as qualifications are demanded by the labour force each year to replace those held by skilled workers who leave the labour force as the current population ages.

[7] It should be noted that these are forecasts of the economy's demand for total university qualifications, not total *persons* with a university qualification. That is, one person may be able to supply multiple university qualifications to the economy (for example, a PhD graduate who also has a bachelor's degree).

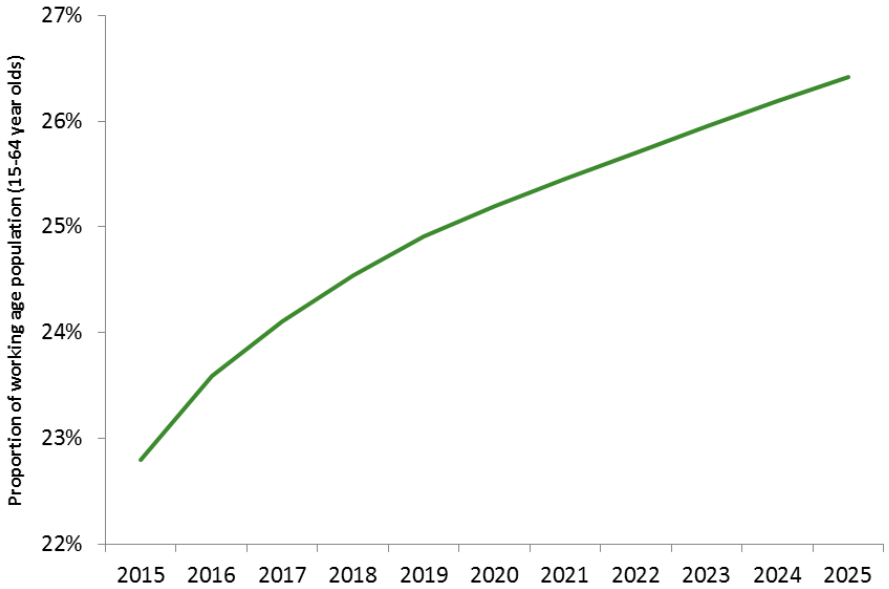
In total, around **3.8 million new university qualifications** (2.5 million new undergraduate qualifications and 1.3 million new postgraduate qualifications) will need to enter Australia's knowledge economy over the period 2015–2025 to meet this demand. This means that on average, Australia will need approximately **227,000 new undergraduate qualifications** and **115,000 new postgraduate qualifications** each year over this period.

By way of comparison, in 2014, a total of 136,700 domestic undergraduates and 78,600 domestic postgraduates graduated from Australian universities, significantly less than this projected demand. In part this reflects the fact that many skilled workers enter Australia having gained their qualifications overseas; nonetheless, it also indicates that Australian universities will have a crucial role to play in increasing the output of new qualifications for Australian residents in order to meet the needs of the economy.

It is also important to recognise that workers with undergraduate and postgraduate qualifications are becoming an increasingly important component of the overall working age population. In addition to demand for more university qualifications, the total number of skilled graduates needed over the coming years will increase significantly as a proportion of the projected working age population (15 to 64 year olds), from 23% in 2015 to over 26% in 2025, as shown in Chart 3.3.[8]

This strongly suggests that the working age population of Australia will need to increase their level of human capital through higher education to keep up with labour demand of the knowledge economy. Australian universities will be central to meeting this challenge.

Chart 3.3: Projection of the proportion of the working age population with a university higher education qualification 2015–2025



Source: Deloitte Access Economics (2015)

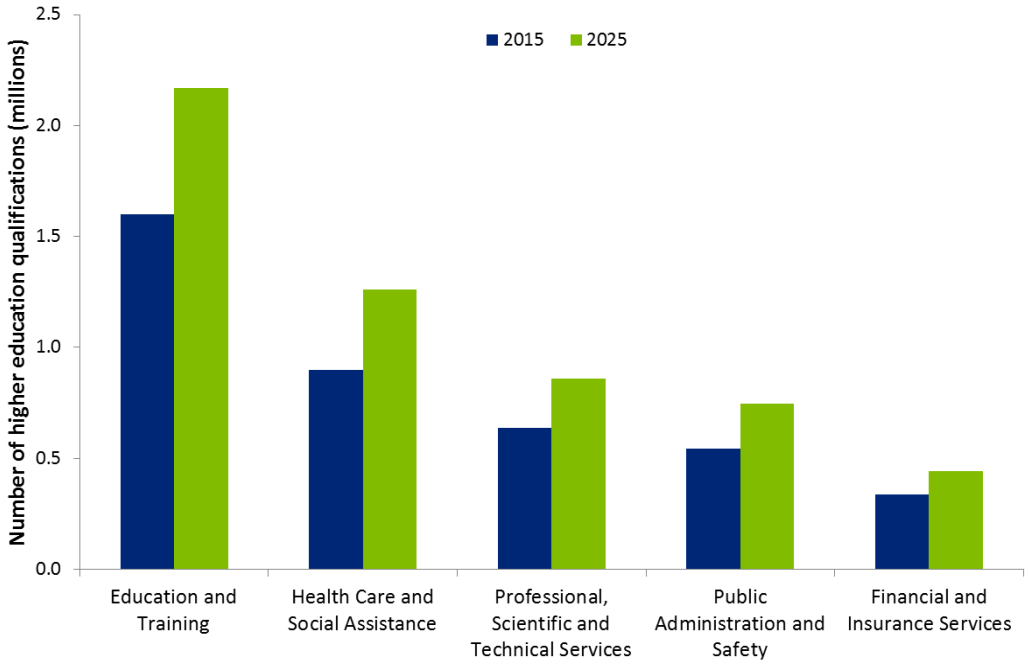
[8] These figures will be larger in terms of the active workforce as labour force participation rates for workers with higher levels of education tend to be higher. In particular it should be noted that this fact accounts for the difference between the estimated 28% of the current workforce with a university qualification referenced earlier in this report and the figures presented here.

The top five industries projected to need the largest increases in skilled graduates over the next 10 years are:

- education and training;
- health care and social assistance;
- professional, scientific and technical services;
- public administration and safety; and
- financial and insurance services.

Each of these industries will require additional workers with over 100,000 new university qualifications over the period 2015–2025, representing a growth in demand for university qualifications of 30% or more. For example, by 2025, health care and social assistance will need the largest proportional increase in university qualifications, with demand for knowledge workers increasing by 41% from current levels. Similarly, by 2025, education and training will need the largest absolute increase in skilled graduates, with 570,000 new university qualifications needed in the sector, as shown in Chart 3.4. This trend towards a more highly skilled workforce is, in part, a continuation of a trend that has prevailed throughout Australia's industrial history.

Chart 3.4: Five industries with demand for new university qualifications



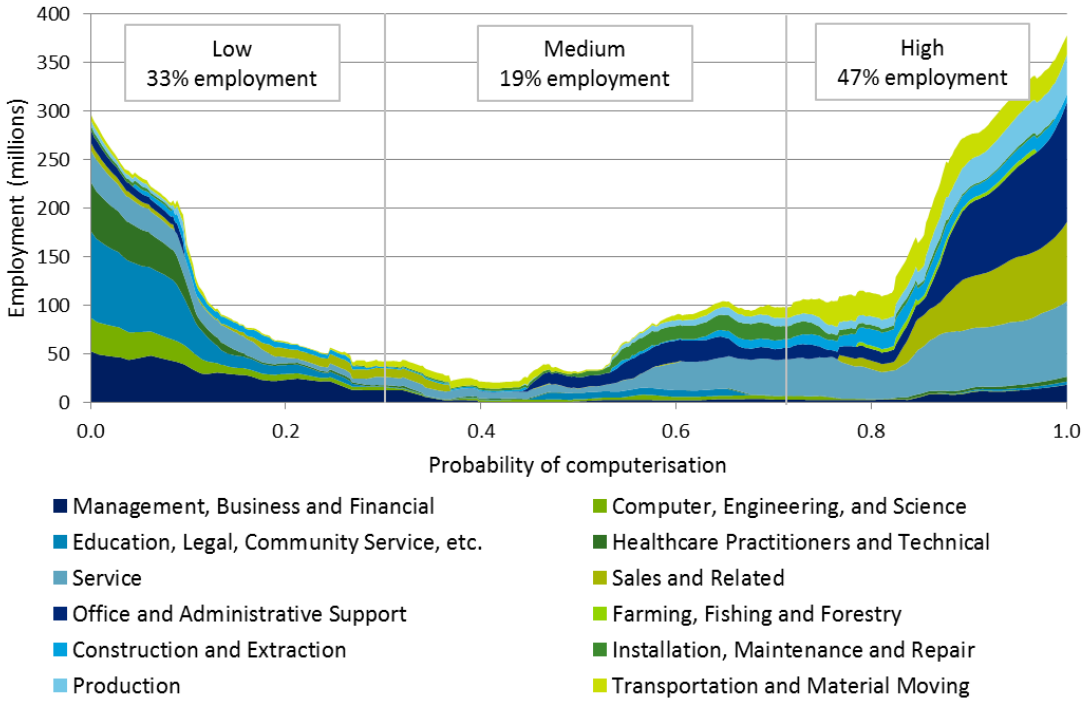
Source: Deloitte Access Economics, 2015

However, significant disruptive forces to the modern economy will profoundly affect the contributions of Australian universities over the coming years, above and beyond these longer term trends.

As digital technology changes the way we communicate and interact, and computerisation alters the skills required of workers, the Australian economy of the future will not just require

workers with traditional 'higher skills'; rather we will require a workforce of **creative, innovative and highly adaptable knowledge-workers**. To illustrate just how profound these changes might be, Chart 3.5 demonstrates the impact that computerisation might have on the occupational structure of our workforce, affecting both traditionally high and low skilled occupations.

Chart 3.5: Impact of computerisation across occupations



Source: Frey and Osborne (2013)

Importantly however, digitisation and computerisation originated from the research laboratories of universities. There is no greater contemporary example of the power of basic research to change the way we live. Basic research undertaken in Australian universities will continue to explore how best to deploy these powerful forces and how to manage their impact on people, the economy and society.

Via the nexus of teaching and research, universities are uniquely positioned to define the skills and attributes of Australia's future workforce.

Australia's universities are already perceiving and adapting to these emerging forces. They are innovating in the ways they deliver teaching and learning, disrupting the traditional lecture hall and transforming university campuses into centres of social, intellectual and entrepreneurial activity.

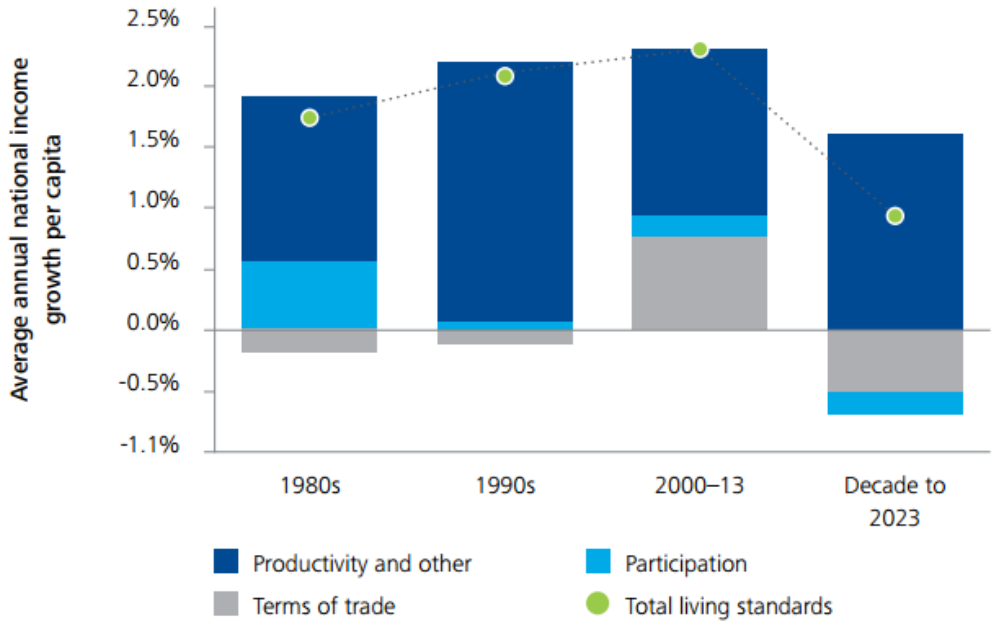
3.3 The productivity imperative

The continued growth of living standards in Australia will rely almost exclusively on higher levels of productivity and the university sector will be at the forefront of this challenge

It is widely acknowledged that Australia faces a significant challenge over the coming decades if it is to maintain growth in national income and living standards as commodity prices fall and the sizeable returns from the decade long mining boom recede. This challenge is compounded by Australia's ageing population, which will see rates of workforce participation decline as more Australian workers enter retirement (see Chart 3.6). With both participation and the terms of trade acting as a drag on the nation's living standards, it will fall almost exclusively to productivity growth to propel national incomes higher. As noted by Krugman (1994, p. 11):

> *Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker.*

Chart 3.6: Average Australian annual national income growth per capita



Source: Dr Martin Parkinson, Secretary to the Treasury, *The 2014–15 Budget and sustaining broad-based growth in living standards* speech, 20 May 2014; Deloitte Access Economics

The university sector, and the skilled workforce it produces, has a major role to play in addressing the productivity imperative Australia confronts. Indeed, recent estimates suggest that one-third of Australia's historical labour productivity growth may be attributable to the accumulation of university higher education since the early 1980s (Holland et al., 2013).

Successfully evolving to provide not only the graduates that the changing Australian economy needs, but the skills and intellectual resources that the future knowledge economy requires will see the university sector continue to be among the most significant drivers of growth in living standards over the decades ahead.

University research too will play an important role in supporting growth in multi-factor productivity (MFP)[9] over the coming decades. This report has found that the benefits of improved productivity from increased investments in university research were equivalent to almost a third of the average living standards growth experienced over the past 30 years.

Recent analysis conducted by Deloitte Access Economics (2015) and the Commonwealth Treasury (as shown in Chart 3.6) has shown that, for growth in national income over the next decade to remain at the level experienced from 2001 to 2013, labour productivity will need to increase by almost 3% annually from 2014 to 2023, around twice the level of productivity growth experienced between 2001 and 2013.

The results from this study[10] suggest that a permanent 10% increase in the tertiary education attainment rate in Australia would increase labour productivity in Australia by 1.5–2.0 percentage points, representing around half of the required rate of productivity growth required to maintain our growth in living standards over the coming decade.

Further to this, recent published estimates show that a 10% increase in the stock of publicly supported higher education research in Australia can increase our MFP by 3.6 percentage points over the long-term, a highly significant figure when compared to estimates of MFP growth and labour productivity growth experienced over the past few decades (Elnasri and Fox, 2014; Deloitte Access Economics, 2015).

[9] The amount produced given the number of hours worked and capital employed in production

[10] See section 2.2.1 and Appendix C of this report.

4 Conclusions

This report demonstrates how Australian universities play an important role in supporting growth in economic and social prosperity.

Clear evidence of a substantial contribution to prosperity

Australia's university sector directly employs over 120,000 fulltime equivalent staff and supports the delivery of education to over almost 1.3 million students. The operations of the university sector generate significant contributions to Australia's economic output, national income and employment.

Both directly and indirectly, the sector was estimated to account for over 1.5% of Australia's GDP and 160,000 fulltime-equivalent jobs in 2013.

Further, through its related educational exports the Australian university sector contributes significantly to our national income. In 2014–15 education exports accounted for 5.7% of Australia's total exports, representing the largest service export and the third largest export category overall (ABS, 2015). At around two thirds of the total value, higher education is the single biggest contributor.

Nonetheless, the role that universities play in contributing to the socio-economic prosperity of nations transcends the contribution of their operations and exports to GDP and employment. The core activities that universities undertake are known to produce significant contributions to national productivity, living standards and social prosperity in their own right.

Evidence from throughout the world demonstrates that strong university sectors are associated with stronger economies and higher standards of living. Countries with higher levels of higher education attainment and higher levels of investment in higher education research and development are consistently shown to have higher levels of per capita income.

Through their teaching and learning activities Australian universities build human and social capital. This higher education increases the nation's productivity capacity and, with it, the nation's living standards.

It has been estimated that the value that university education adds to the productive capacity of the nation was equivalent to around $140 billion in GDP in 2014. That is, Australia's GDP is 8.5% higher because of the impact that a university education has had on the productivity of the 28% of the workforce with a university qualification.

It is well established that university graduates achieve higher labour force outcomes than those with lower order qualifications—employment rates are higher, average hours worked are higher and, most significantly, lifetime earnings are higher. Although part of this reflects a student's innate ability, a large part of it owes to formal education, including from Australian universities.

In fact, results from econometric studies of the benefits from higher education imply that at least $24 billion of total benefits to the economy from human capital accumulation in 2014 are estimated to accrue in annual earnings premiums to students themselves.

The broader societal benefits from university higher—that is, the positive externalities associated with the contribution of university graduates to the workforce—are evidently significant.

However, above and beyond these market benefits generated from incrementally higher labour force outcomes, a university education has been empirically demonstrated to be positively associated with improved health outcomes, quality of life and a range of other social indicators. In fact, recent international analysis has shown the monetary value of these benefits may be equivalent in magnitude to the more readily observable impacts such as labour force outcomes.

In addition to the contributions made by teaching and learning activities, university research makes considerable contributions to technological progress through improved productivity, innovation and entrepreneurialism, and the generation of knowledge spillovers and spin-off technologies and companies.

The estimated relationship between university research expenditure and economic output demonstrates that increasing investments in university research over the past 30 years have added almost $10 billion to GDP each year (in 2014 dollars) over this same period, primarily through gains to national productivity**.** The benefits of this improved productivity are equivalent to almost a third of the average living standards growth experienced over this 30 year period in Australia

The majority of these benefits accrue to the public, as universities predominantly draw upon grant funding to support their research and activity and—on the whole—the mode of dissemination of research discovery is open and public.

Above and beyond the impacts generated by their teaching and learning and research activities, universities draw on resources embodied in staff, students and facilities, universities share knowledge, expertise and amenities to enrich communities on a local, national and even international level. These community service activities come in many and varied forms, from providing cultural facilities and programs to local community groups, to hosting community forums, events and festivals.

The role of government, student, industry and the community is to invest in Australian universities

Throughout the world, nations make considerable investments in their university sectors, reflective of their significant contributions to productivity growth and social prosperity. Due to variations in the way that different nations structure and define their higher education (and research and innovation systems), as well as more nuanced variations in political ideologies, it is not possible to make direct comparisons about the level, share and efficacy of funding for Australia's university system with other nations.

Nonetheless, the most reliable evidence from the OECD shows that the total of public and private investment in higher education and research in Australia, as a share of total economic output, comprises around 1.6% of GDP. This is roughly in line with the OECD average (1.6%) and higher than the UK (1.2%), but below other comparable nations like Canada (2.8%) and the US (2.7%). Of this total expenditure in Australia, around 60% is attributed to core education services, with the remaining attributable to expenditure on research and development, as outlined in Appendix F of this report.

This expenditure reflects the contribution of universities as large sectors in the national economies of advanced nations. It is also indicative of the importance these societies place on the impact that universities' activities have on economic and social prosperity. Significant investments in our university system over past decades, in terms of both higher education and research funding, are shown to have made considerable impacts on our prosperity today.

Across the world, universities fund their activities from a range of sources, including from private sources (tuition fees, industry investments, bequests and donations) and government (through tuition subsidies, grants for research and other specific purpose payments). As outlined in Appendix F of this report, the share of tertiary education institution expenditure contributed by public funding sources is estimated to be around 46% for Australia, compared to an average of 69% for the OECD as a whole.

The significant spillover benefits from university higher education demonstrate a role for government to support teaching and learning activities at Australian universities. At the same time, students' tuition contributions are reflective of the significant private benefits earned by students.

While it is not possible to comment on the efficacy of the rates of government and student contributions in Australia, it should be noted that the principles of public finance suggest government should contribute up to the value of the social marginal benefits that 'spillover' from university higher education, while students necessarily contribute up to the remaining costs (on average) for the supply of university teaching and learning services.

As a proportion of GDP, the amount of spending on university research in Australia has doubled from around 0.3% in the early 1990s to over 0.6% in 2012. This increase has exceeded the rate of investment undertaken by similar countries, including in the UK and the US, as demonstrated in Appendix E and Appendix F.

Finally, evidence from other countries demonstrates that research funding systems that focus on research impact can better ensure high returns to public investments are realised. Industry investment in higher education research plays a key role in ensuring knowledge exchange, dissemination and ultimately, economic impacts are realised. By growing the prevalence of industry, government and community collaboration with the university system, universities and policy makers can ensure that this profound impact only continues to grow.

Looking forward, universities are key to Australia's economic and social prosperity

The global economic landscape is constantly changing. The nature of the changes taking place over coming decades is particularly profound. When coupled with other macro trends —the disruptive impacts of technology especially—the changes suggest both a big opportunity for the Australian university sector and a critical imperative in supporting continued growth in the nation's living standards.

As the middle class of emerging Asia burgeons, such that some two thirds of the world's middle class will reside in the Asia Pacific in less than two decades' time, demand for services like education is growing rapidly. Deloitte Access Economics projects international education to be among the fastest growing sectors of the global economy over the next two decades. This means Australian universities will realise considerable benefits for the nation's economic prosperity.

As the structure of the Australian economy changes, our universities will play an important role in meeting future skill demands and ensuring a strong and growing stock of intellectual capital is made available for an increasingly high-skilled labour force. On current trends, the demand for higher education qualifications will increase by 34% by the year 2025, equivalent to 2.1 million additional university qualifications compared to current levels.

As digital technology changes the way we communicate and interact, and computerisation alters the skills required of workers, the Australian economy of the future will not just require workers with traditional 'higher skills'; rather it will require a workforce of creative, innovative and highly adaptable knowledge-workers.

By virtue of their unique position in society, Australia's universities can support this pluralism of intellectual and human capital that will be demanded over the coming decades.

Digitalisation and computerisation as well as other forms of scientific and technological progress often originate from the research undertaken within universities. Via the nexus of teaching and research, universities are uniquely positioned to define the skills and attributes of Australia's future workforce.

Universities will play an essential role in responding to the changing skills demand of the knowledge economy and will also help to shape and define the industry and jobs of the future, acting as a gateway for Australia's future prosperity.

The continued growth of living standards in Australia will rely almost exclusively on higher levels of productivity, and the university sector stands to be at the forefront of this challenge.

It is widely acknowledged that Australia faces a significant challenge over the coming decades if it is to maintain growth in national income and living standards, as commodity prices fall and the sizeable returns from the decade long mining boom recede. This challenge is compounded by Australia's ageing population, which will see rates of workforce participation decline as more Australian workers enter retirement. With both participation and the terms of trade acting as a drag on the nation's living standards, it will fall almost exclusively to productivity growth to propel national incomes higher.

The university sector, and the skilled workforce it produces, has a major role to play in addressing the productivity imperative Australia confronts. Recent estimates suggest that one-third of Australia's historical labour productivity growth may be attributable to the accumulation of university higher education.

Successfully evolving to provide not only the graduates that the changing Australian economy needs, but the skills and intellectual resources that the future knowledge economy requires, will see the university sector continue to be among the most significant drivers of growth in living standards over the decades ahead.

Concluding observations

Australia's university sector has evolved considerably over the past 165 years since the first university was founded in 1850. Throughout this period universities have strived to meet the skills demands of an emergent economy and champion progress, in terms of technology, culture and society.

Over the coming decades creative and innovative embodied human capital will become central to the strength of the Australian economy, while at the same time, university research will continue to be an indispensable driver of technological progress. Should Australian universities realise this enormous potential, and adapt to meet the demands of the future knowledge economy, the value of their economic contribution to society can only be expected to grow.

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Appendix A: Measuring the contribution of the sector's operations

Background

Australian universities support regional economic development by employing local residents and attracting students and business to the local region, enhancing the economic diversity and social fabric of local communities.

As an example, a study by Deloitte Access Economics (2014c) found that in 2013, the total economic contribution of Deakin University's Geelong Waterfront and Waurn ponds campuses' ongoing operations and student expenditure in the Greater Geelong local government area was $426 million of value added. This economic contribution represented 5.3% of the Geelong economy in 2012–2013, which was equivalent to approximately 3,124 fulltime equivalent (FTE) jobs for the region (Deloitte Access Economics, 2014c).

A similar study for Western Sydney University (WSU) found that the contribution of WSU to the Greater Western Sydney (GWS) region was equal to $845 million value-add to gross regional product, equivalent to a total employment contribution of 8,805 FTE jobs for the local region. The study found the provision of higher education to be essential to the future economic growth and development of the GWS region.

As the economy of GWS changes, with manufacturing—the largest industry by output and employment—losing ground to service sectors (such as finance and insurance, health care and social assistance, education and professional, scientific and technical services) higher education in the local region plays a key role in delivering higher-paid jobs to the local residents of GWS by ensuring that an influx of workers with higher education qualifications is available to meet the changing demands of industry (Deloitte Access Economics, 2012).

Estimates for this report

Economic contribution studies quantify measures such as value added, gross output and employment associated with a given industry or firm, in a historical reference year. The economic contribution is a measure of the value of production by a firm or industry. Economic contributions of a number of universities in Australia have been quantified using Deloitte Access Economics' in-house integrated regional input-output model (known as DAE-IRIOM).[11]

The primary measure of this contribution is 'value added', which measures the value added to intermediate inputs by the application of capital and labour. 'Value added' is the sum of three elements:

[11] See: Deloitte Access Economics (2012; 2014c; and 2015) among others.

- **Payments to labour**: This represents the value of output generated by the university sector's direct labour inputs, as measured by the income to labour.
- **Payments to capital, measured by gross operating surplus (GOS)**: GOS represents the value of income generated by universities' direct capital inputs, generally measured as the earnings before interest, tax, depreciation and amortisation (EBITDA).
- **Tax on production less subsidy provided for production**: This generally includes company taxes and taxes on employment.

The share of total industry value-added (measured in terms of Gross Domestic Product (GDP)) attributable to the university sector is measured directly, through payments to labour and returns on physical capital made by the universities themselves, and indirectly, through the value-added by the intermediate inputs provided by other businesses to the university sector.

For this report an approximate estimate of the economic contribution of the Australian university sector has been determined, drawing on the results of previous analysis undertaken by Deloitte Access Economics. Employing this approach, together with published financial data from the Commonwealth Department of Education and Training, it is estimated that the *direct* industry value-added by the university sector in 2013 was around $18.5 billion. This comprises around $13.5 billion in employee related expenses (payments to labour), around $4.3 billion in estimated Gross Operating Surplus, and around $700 million in production taxes (payroll taxes).[12;13]

To calculate the *indirect* industry value-added by the university sector it is possible to apply a multiplier that relates the direct gross output of universities to their indirect industry value-add. The total gross output of the university sector in 2013 is estimated to be around $26.3 billion, based on the total revenues from continuing operations for the sector as a whole.[14] Modelling using the DAE-IRIOM from previous economic contribution studies of Australian universities shows that the multiplier between direct gross output (revenue) and *indirect* industry value-added is around 0.23. This implies that the industry value-added contributed *indirectly* by the university sector was around $6 billion in 2013.

Combining these results, it is estimated that the university sector as a whole contributed around $25 billion to the Australian economy in 2013, accounting for over 1.5% of Australia's GDP.[15]

It is also possible to express the contribution with respect to total employment, measured using full time equivalent (FTE) workers. While the university sector itself, in 2013, is

[12] Data sourced from: http://docs.education.gov.au/system/files/doc/other/finance_publication_-_tables_0.xlsx

[13] GOS earnings are calculated before net returns on investment (these comprise an interest payment to the sector when they have a positive net financial asset position). GOS earnings are also calculated before Payments for Scholarships, Grants and Prizes, as these are not deemed to represent operational costs (i.e. they are a transfer of surplus).

[14] Data sourced from: http://docs.education.gov.au/system/files/doc/other/finance_publication_-_tables_0.xlsx

[15] This figure does not explicitly account for payments made by universities which go overseas. The magnitude of these payments is expected to be small, and their (countervailing) effect on the value-added contribution made by the sector is likely to be minor. Nonetheless it should be noted that, as a result, this total contribution figure may in fact represent an overestimate of the total contribution of the university sector.

estimated to have employed over 100,000 FTE staff[16], the sector also contributes to employment indirectly through the intermediate goods and services they purchase from other businesses. Estimates of the direct and indirect value-added contribution per FTE worker for Australian universities have been derived from previous economic contribution studies that use the DAE-IRIOM. Using these results and reported FTE figures from the Commonwealth Department of Education and Training it is estimated that the Australian university sector's total economic contribution is approximately equivalent to 160,000 fulltime equivalent (FTE) jobs.[17]

A number of economic contribution studies of Australian universities also include the contribution made by the expenditures of students and their families that are incidental to their education expenses (i.e. accommodation, food, etc.). These contributions are not canvassed in this report as the benefits would only be additional to the economy with respect to international students, and this economic contribution is already captured within the share that educational exports contribute to Australia's total service exports. As noted in the body of this report, in 2014–15 education related exports accounted for 5.7% of Australia's total exports, representing the largest service export and the third largest export category overall. At around two thirds of the total value, higher education is the single biggest contributor.

[16] Source: http://docs.education.gov.au/system/files/doc/other/2013_staff_full-time_equivalence_0.xls

[17] It should be noted that this figure represents the average of a sensitivity analysis which included scenarios whose total estimates range from 155,000 to around 170,000 FTE workers. These sensitivities arise from the variance between implied FTE figures from the results of the DAE-IRIOM model and observed FTE estimates from the Department of Education and Training available (see above reference for the exact data source).

Appendix B: Categorising the accrual of benefits

In Australia, most universities are public institutions established by state and national legislation. These universities operate as non-profit public institutions whose roles and obligations are set out by legislation. The activities that universities undertake are ultimately intended to serve the public good by creating and disseminating knowledge or 'know-how' throughout society. However the core activities that universities undertake have benefits that manifest themselves both privately and publically.

In economic theory, *pure* public goods are defined as being non-rivalrous and non-excludable in their consumption, in particular this means:

- once the good is provided, the additional resource cost of another person consuming the good is zero; and
- preventing anyone from consuming the good is either very expensive or impossible (Rosen and Gayer, 2010).

Certainly, public knowledge or 'know-how' has this defining attribute, as it is readily obtained and reproduced, and consumed by any number of people without being depleted (Stiglitz, 1999).

In conceptual and practical terms, universities do not (exclusively) operate in a marketplace (public or otherwise) that directly generates and disseminates *pure* knowledge and 'know-how'. Rather, universities create and disseminate knowledge through their core activities of teaching, research and broader community service, which have their own defining attributes as goods and services, in and of themselves. So, in this sense, it can be seen that universities' core activities facilitate the creation of a pure public good—knowledge—but do so only indirectly.

For example, in the case of teaching, the knowledge content of curriculum can be non-rivalrous and non-excludable if it is provided in open, online community lectures or forums (Marginson, 2012). For research discovery, when disseminated freely and widely to the public, associated knowledge or 'know-how' cannot be depleted or competed over (Stiglitz, 1999). The benefits of community services too, depending upon their form, can be non-rivalrous and non-excludable, for example, exhibitions of university collections.

However, these core activities undertaken by universities (and the goods and services they produce *directly*) do not always satisfy the definition of a pure public good. For example, when university research produces new knowledge, it can be confined to its creator and, through the use of intellectual property laws, licensed for private commercial return. Access to teaching and learning too is often confined to those who pass admission requirements for limited academic places, and one of the most distinguishing benefits of higher education—returns to educated individuals in the form of higher lifetime earnings—is a private benefit confined to the individual student.

From this it can be concluded that a strict categorisation of activities undertaken by universities (i.e. where goods are strictly defined as either public or private in nature) fails to capture the different ways in which these activities may be undertaken and the varied ways in which the benefits may manifest themselves (Marginson, 2007). Indeed, the activities undertaken by universities generate benefits that are both private and public in nature, and *importantly* benefits of both forms may be present for all instances of activity that a university undertakes (McMahon, 2009; Marginson, 2012).

Nonetheless, to conceptualise and subsequently measure the public and private benefits associated with each component of universities' core activities, a taxonomy of benefits can be defined which apportions benefits as being either public or private, **depending upon the individuals to whom the benefit manifests and their relationship to the activity itself**. Such a taxonomy is informed by principles of public economic theory (Rosen and Gayer, 2010; MacMahon, 2009; Marginson, 2012; Elnasri and Fox, 2014).

In this taxonomy the defining nature of benefits that are public are those that 'spillover' to third parties who are external to the production and consumption of the good or service (or in other words, those that are external to the market mechanism that produces the good or service). In economic theory, such benefits are often defined as 'positive externalities' (Rosen and Gayer, 2010).

Subsequently, private benefits are those that accrue to the individuals directly involved in the market mechanism that produces the good or service. In many cases this includes the university itself (and its academic staff) as well as the university's students and firms that directly support the development and dissemination of university research. Oftentimes the individuals to whom private benefits accrue pay the university directly for the good or service from which they benefit directly, though this need not necessarily be the case in general (McMahon, 2009).

The total social benefit from university activities is the sum of the private and public benefits as defined by this taxonomy (IAC, 1995; McMahon, 2009). In this sense, the categorization presented here seeks to be exhaustive in its treatment of the total benefits to society from specific university activities.

As a motivating example, consider teaching and learning activities at university. The university's students receive considerable benefits from completing their degree programs which, among other things, come in the form of higher (after-tax) lifetime earnings (Chapman and Lounkaew, 2011). This is a **private benefit** to the student as a result of their 'consumption' of higher education, that is their direct market interaction with the university. In addition to this, and as a result of the students' increased lifetime earnings, the government receives greater taxation revenue than they otherwise would have received. This additional benefit, clearly the result of the university's teaching and learning activity, accrues as a 'spillover' benefit to a third party, namely the Commonwealth Government. As such it is considered a **public benefit**.

As a further example, university research may provide direct commercial returns to the university as a result of patents, licensing, consultancy or contracting related to technological innovation developed for industry. This is reflective of the **private benefits** accrued to the firms who pay for access to the innovation (which may also extend above and beyond the value of the license itself). Additionally, the knowledge of this technological innovation may

spillover to other firms and industries, without a direct market interaction between these businesses and the university, leading to the development of a new, unanticipated, spin-off good or service, which provides **public benefits** to both firms and consumers external to the original research activity (Salter and Martin, 2001; World Bank, 2002; Guthrie et al., 2013; Shanks and Zheng, 2006). Importantly, it should be noted that where the government is the direct funder of university research, and therefore considered to be the direct agent in this taxonomy, any benefits they derive should be considered as public. This includes any payments to universities and the government from the commercialisation of research.

The relationship between private and public benefits can vary, depending upon the nature of the activity and the respective benefits therein. In some instances private benefits are directly related to public benefits; that is, the presence of private benefits is sufficient for public returns to also occur (for example, taxation returns to government). In other instances private returns may help to enhance the quanta of public benefit (e.g. through university–industry research collaboration), but private benefits themselves may not be necessary for public benefits to be present (e.g., the benefits of pure basic research disseminated through journal publications).

In some instances (i.e. with certain benefit types) it is possible to independently and empirically estimate both the private and public benefits of university activities (McMahon, 2009; OECD, 2014). In other circumstances, it is only possible to estimate the **total economic returns accrued to society** (that is, private and public returns combined) and consider private and public shares of this contribution only indirectly through a circumspect application of the taxonomy described here (Moretti, 2004; Elnasri and Fox, 2014).[18] Further still, some benefits cannot be quantified in any reliable manner and are at best canvassed in more qualitative terms.

[18] In fact, the total economic contribution to teaching and learning and research discovery and adoption are explicitly measured in section 3 of this report.

Appendix C: Macroeconomic modelling approach and results

In line with a large body of economic development literature, Deloitte Access Economics has developed a cross-country model of economic growth which seeks to diffuse effects of human capital and higher education research and development (R&D) on national income. (See: Deloitte Access Economics, 2015, for greater detail). This model uses a neo-classical production function; the formal framework is first set out by Mankiw, et al. (1992) and its augmented-form implemented by OECD (2001), among others. Deloitte Access Economics' model adheres closely to existing literature, with modifications provided to accommodate the focus on tertiary human capital and higher education R&D. The standard neo-classical growth model is derived from constant returns to scale production function with three inputs (capital, labour and human capital) that are paid their marginal products. Production (output) at time t is given by:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} \big(A(t)L(t)\big)^{1-\alpha-\beta}$$

Where Y, K, H and L are respectively output, physical capital, human capital and labour, α is the partial elasticity of output with respect to physical capital, β is the partial elasticity of output with respect to human capital and $A(t)$ is a measure of technological progress and economic efficiency, where:

$$A(t) = I(t)\Omega(t)$$

This research incorporates higher education R&D along with other R&D activities and exposure to international trade as key determinants of economic efficiency $I(t)$, such that:

$$\ln I(t) = p_0 + \textstyle\sum_j p_j \ln V_j(t) \qquad \text{or alternatively:}$$

$$\ln I(t) = \ p_0 + p_1 Higher\ Education\ R\&D\ + p_2 Other\ R\&D + p_3 Exposure\ to\ trade$$

Technological progress is assumed to be exogenous and grows at rate $g(t)$; that is:

$$\dot{\Omega}(\mathrm{t}) \ = g(t)\Omega(t)$$

Substituting the steady-state values of physical capital and human capital yields the intensive form of steady-state output as a function of h^*.[19]

$$\ln(y^*) = \ln \Omega(t) + p_0 + \sum_j p_j \ln V_j(t) + \frac{\alpha}{1-\alpha} \ln s_k(t) + \frac{\beta}{1-\alpha} \ln h^*(t) - \alpha(1-\alpha) \ln(g(t) + n(t) + d)$$ [20]

[19] The steady-state stock of human capital h^* is not observed, but it can be expressed as a function of actual human capital: $\ln h^*(t) = \ln h(t) + \frac{1-\psi}{\psi} \Delta \ln\left(\frac{h(t)}{A(t)}\right)$

[20] Where y^* is the steady-state output per capita, s_k is the investment rate in physical capital, $n(t)$ is the population growth rate, and d is the rate of depreciation.

The above is valid in empirical cross-country analysis only if countries are in their steady states or if deviations from steady state are independent and identically distributed. If observed growth rates include out-of-steady-state dynamics, then the transitional dynamics have to be modelled explicitly (Bassanini and Scarpetta, 2001). A linear approximation of the transitional dynamics can be expressed as follows (Mankiw et al., 1992):

$$\begin{aligned}\Delta \ln y(t) = &-\phi(\lambda)\ln y(t-1) + \phi(\lambda)\left(\frac{\alpha}{1-\alpha}\right)\ln s_k(t) + \phi(\lambda)\left(\frac{\beta}{1-\alpha}\right)\ln h(t)\\ &+ \sum_j p_j \phi(\lambda)\ln V_j(t) + \frac{1-\psi}{\psi}\left(\frac{\beta}{1-\alpha}\right)\Delta \ln h(t)\\ &- \phi(\lambda)\left(\frac{\alpha}{1-\alpha}\right)\ln(g(t)+n(t)+d) + \left(1-\frac{\phi(\lambda)}{\psi}\right)g(t)\\ &+ \phi(\lambda)(p_0 + \ln \Omega(0)) + \phi(\lambda)g(t)t\end{aligned}$$

This equation represents the generic functional form that has been empirically estimated in this research. Further, the coefficient estimate $\phi(\lambda)$ represents the convergence parameter. The convergence parameter underlines the speed in which countries converge to their steady-state output.

In addition to estimating the stead state solutions, we also estimate another functional form, adding short-term dynamics in the model to help isolate dynamic cyclical effects. This augmentation is advantageous as it relaxes the assumption that countries are in their steady states and that deviations from the steady state are independent and identically distributed. Its functional form can be expressed as follows:

$$\begin{aligned}\Delta \ln y(t) = a_0 - \phi \ln y(t-1) + a_1 \ln s_k(t) + a_2 \ln h(t) - a_3 n(t) + a_4 t + \sum_{j=1}^{3} a_{j+4}\ln V_j\\ + b_1 \Delta \ln s_k(t) + b_2 \Delta \ln h(t) + b_3 \Delta \ln n(t) + \sum_{j=1}^{3} b_{j+3}\Delta \ln V_j\end{aligned}$$

Similar to specifications used in OECD (2001), our analysis uses a sample of 37 countries between 1980 and 2010 (Table C.1). Where appropriate, data is converted to constant 2010 US dollars using constant Purchasing Power Parity, consistent with OECD standards.

Table C.1: Countries

Country list				
Australia	Denmark	Iceland	Mexico	Slovak Republic
Austria	Estonia	Ireland	Netherlands	Slovenia
Belgium	Finland	Israel	New Zealand	South Africa
Canada	France	Italy	Norway	Spain
Chile	Germany	Japan	Poland	Sweden
China	Greece	Korea	Portugal	Switzerland
Czech Republic	Hungary	Luxembourg	Russia	Turkey
United Kingdom	United States			

Table C.2 outlines the parameters used in the estimation procedure.

Table C.2: Data sources

Parameter	Variable	Source
$y(t)$	Gross domestic product per capita	OECD
$h(t)$	Tertiary education attainment (% of 15+ population)	Barro-Lee (2010)
$n(t)$	Total population growth	OECD
$s_k(t)$	Gross capital formation (% of GDP)	OECD
$V_1(H\ R\&D)$	Expenditure on Higher education R&D per capita	OECD
$V_2(O\ R\&D)$	Expenditure on Other R&D per capita	OECD
$V_3(Trade)$	Exports and Imports of goods and services (% of GDP)	World Bank
t	Time trend	-

Table C.3 outlines the modelling results.

Table C.3: Modelling results

Parameter	Model I: Steady State	Model II: Short term dynamics
$\ln y(t-1)$	-0.204**	-0.149**
$\ln s_k(t)$	0.819***	0.454***
$\ln h(t)$	0.152*	0.233**
$n(t)$	-12.1*	-7.621
$V_1(H\ R\&D)$	0.175*	0.184***
$V_2(O\ R\&D)$	0.139*	0.150*
$V_3(Trade)$	0.123	0.128
$\Delta \ln s_k(t)$	-	0.162***
$\Delta \ln h(t)$	-	-0.0864
$\Delta n(t)$	-	0.265
$V_1(H\ R\&D)$	-	0.0731***
$V_2(O\ R\&D)$	-	0.174***
$\Delta V_3(Trade)$	-	-0.0425

Note: * p<0.05, ** p<0.01, *** p<0.001. Reported coefficients are transformed to exclude the convergence term per their functional form.

Production parameters

Estimates of steady state coefficients as well as parameters of the production function can be retrieved based on the estimated coefficients presented above. For example, according to the functional form of the linear approximation given by Mankiw et al. (1992), the share of physical capital in steady-state output (α) is given by the coefficient estimate of the physical capital investment rate (s_k) and the convergence term (ϕ):

$$a_1 = \phi\left(\frac{\alpha}{1-\alpha}\right)$$

Table C.4 outlines the implied input shares of the estimated production function.

Table C.4: Implied share of income per capita

Implied share	Model I	Model II
Physical capital share (α)	45.02%	31.22%
Tertiary human capital share (β)	8.36%	16.02%
Residual share ($1-\alpha-\beta$)	46.62%	52.75%

Our results indicate the average share of tertiary human capital is around 12%, that is, around 12% of steady-state output can be attributed to tertiary human capital inputs.

Elasticities

The estimated coefficients can be interpreted as an elasticity on steady-state GDP. For example, the steady-state effect of higher education R&D has the functional form of ϕp_j where ϕ is the estimated coefficient for $\ln y(t-1)$. p_j then represents the elasticity of higher education R&D on steady-state output, estimated to be around 0.175 under model I and 0.184 under model II. This implies that a 10% increase in higher education R&D per capita will increase steady-state output by around 1.8%.

Furthermore, the results from our modelling also imply that a persistent 1.9 percentage point increase in the tertiary education completion rate (a 10% increase from the 2010 level in Australia) among Australia's population would lead to an average increase in steady state output per capita (GDP per capita) of 1.5% to 2.3%. A permanent 10% increase in the tertiary education attainment rate in Australia would increase labour productivity in Australia by 1.5-2.0 percentage points. Because GDP per capita can be interpreted as the labour productivity of the nation, this implies that a permanent 10% increase in the tertiary education attainment rate would generate half of the required rate of productivity growth required to maintain our growth in living standards over the coming decade, as noted in section 3.3 of this report.

Convergence

The convergence parameter ϕ plays an important role in explaining the modelling results. In all specifications the convergence parameter is significant, suggesting a (conditional) process of convergence as countries move towards their steady-state output levels. For example, under model II, the convergence term is estimated to be 0.149, this indicate that the economies will close 14.9% of the gap between their current level of output and their steady-

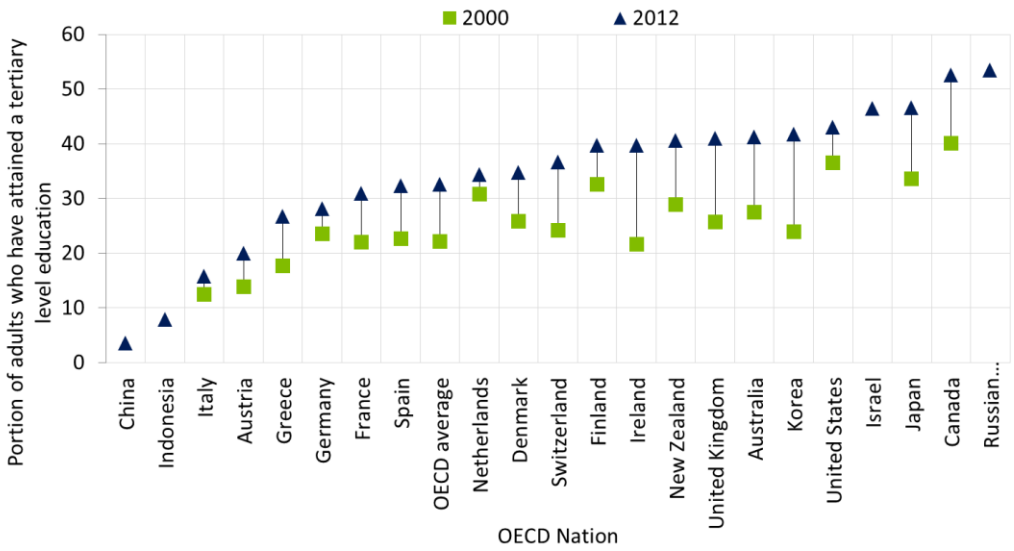
state output each year. The convergence process is asymptotic, meaning that countries will never truly reach their steady-state levels but rather move very close to it.

Appendix D: Measuring the benefits of teaching and learning

Background

As a result of the expansion of the university sector in the recent past Australia has recorded the 7th highest level of tertiary educational attainment in the OECD, roughly the same as the United Kingdom, as shown in Chart D.1.

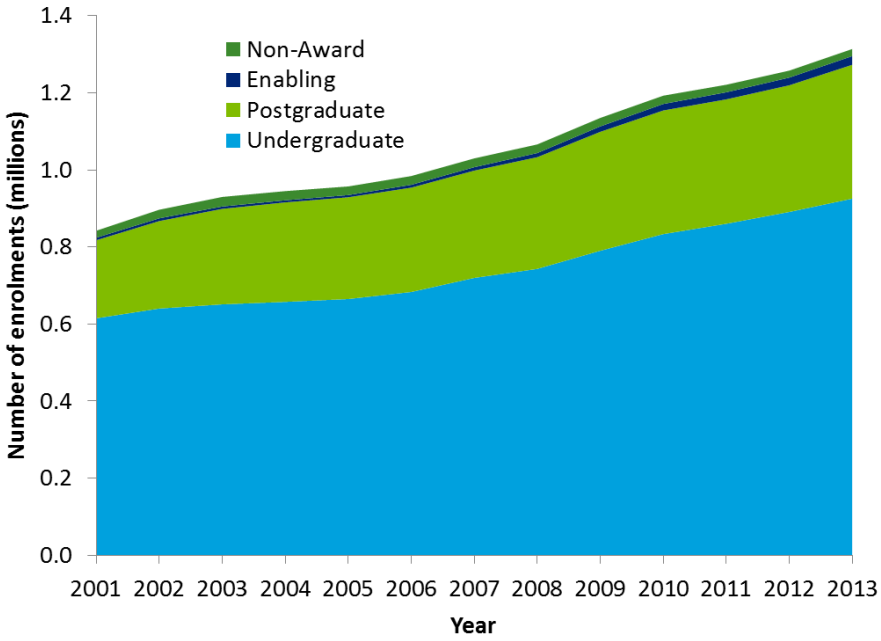
Chart D.1: Tertiary education attainment, 2000–2012



Source: OECD Education at a Glance (2014)

In 2013 there were a total of almost 1.3 million students enrolled in higher education nationally, up from around 0.9 million students a decade earlier. Of these students, 70% were studying towards an undergraduate degree program, including bachelor's degrees, diplomas and advanced diplomas. Postgraduate students, comprising both course work and higher degree research students, made up 26% of total enrolments in that same year. The remaining 4% of students were enrolled in non-award or enabling programs (Chart D.2).

Chart D.2: Recent growth in university enrolments, 2001–2013



Source: Department of Education and Training - Higher Education Statistics Data Cube (uCube)

Australia has, proportionally, one of the highest rates of international student enrolments globally (UNESCO, 2013). In 2013, 25% of enrolled higher education students were from overseas, the majority of which study on-campus and fulltime, as shown in Table D.1. Comparatively, domestic students are more likely to study part-time and off-campus (e.g. through degree programs offered online).

Table D.1: Overview of university students, 2013

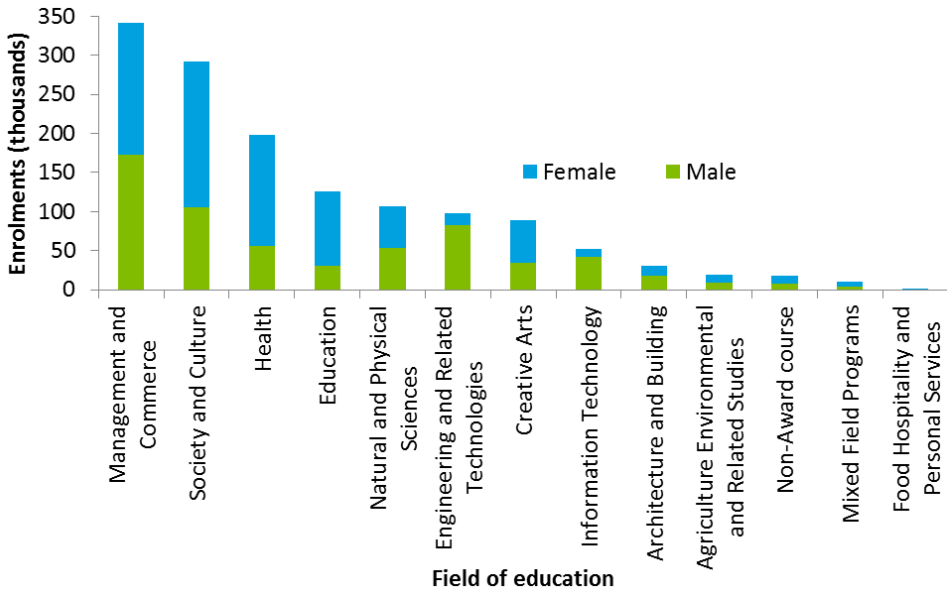
		Domestic	International	Total
Fulltime	**On-campus**	529,189	254,700	783,889
	Off-campus	45,736	3,333	49,069
	Mixed-mode	77,164	14,723	91,887
	Total	652,089	272,756	924,845
Part-time	**On-campus**	181,074	46,647	227,721
	Off-campus	130,376	6,834	137,210
	Mixed-mode	21,578	2,422	24,000
	Total	333,028	55,903	388,931
Total		985,117	328,659	1,313,776

Source: Department of Education and Training - Higher Education Statistics Data Cube (uCube)

Of the total number of higher education students enrolled in Australia in 2013, 56% were female, up from around 50% in the mid-1980s (Norton and Cherastidtham, 2014). The most common fields of education studies by Australian university students are Management and Commerce, Society and Culture, Health and Education (Chart D.3). For Australian domestic students, the field of education that has experienced the most growth over the past decade was Health, in particular the allied health disciplines, whereas management and commerce

and IT experienced the greatest proportional fall in enrolments over this same period (Norton and Cherastidtham, 2014).

Chart D.3: Total Australian university enrolments by field of study, 2013



Source: Department of Education and Training - Higher Education Statistics Data Cube (uCube) – includes international and domestic students

Total economic benefits

The results from Deloitte Access Economics' model of cross-country economic growth (set out in Appendix C of this report) suggest a significant impact of tertiary human capital on output per capita across countries and over time. Using the results from this model it is estimated that the share of human capital to output per capita is between 8.4% and 16.0%. For Australia this translates to between $136 billion and $261 billion of total GDP in 2014, or an average of almost $200 billion. In other words, the value that tertiary human capital adds to the productive capacity of the nation is estimated to be around $200 billion, or around 12.2% of the nation's GDP.

This estimate includes the contribution made by all tertiary education qualifications included in the International Standard Classification of Education (ISCED) levels 5–8, i.e. higher education diplomas and above. As not all of these qualifications are obtained through the university system in Australia, the estimate likely overstates the total share of the contribution of university higher education human capital stock to economic output.

In 2013, around 70% of tertiary education attainment in Australia was in higher education qualifications at a bachelor level and above (AQF levels 7-10), which are predominately undertaken at university.[21] This implies that a conservative value of the contribution made by university higher education to GDP in 2014 is 70% of $200 billion, or approximately $140 billion.[22]

It is therefore estimated that university education added $140 billion to GDP in 2014, by raising the productivity of the workforce. That is, Australia's GDP is 8.5% higher because of the impact that a university education has had on the productivity of the 28% of the workforce with a university qualification.

Benefits to students

Students gain a variety of skills over the course of their degrees, resulting in the development of human capital. The private market benefits are measured in the marketplace through increased wage earnings from higher education qualifications. Indeed, payments to employees as a result of their accumulated human capital comprise part of the total economic value generated by higher education attainment.

As noted in section 2.2.2 of this report, a recent study of Household, Income and Labour Dynamics in Australia (HILDA) Survey found that individuals receive significant returns from higher education in Australia in the form of an increased likelihood of being employed fulltime and receiving higher weekly income. These results are determined after controlling for demographic factors and cognitive ability (Wilkins, 2015, pp. 70–71).

> *The addition of these controls arguably provides a stronger basis for interpreting estimates for education variables as 'causal', on the grounds that this controls for the higher innate ability of the more-educated that would suggest they would have better labour market outcomes even without the additional education. Nonetheless, the estimates should at best be regarded as tentative evidence of the causal effects of education.*

The results from this analysis are outlined in Table 2.1 of this report and are also replicated below in Table D.2.[23] Income returns from each level of higher education are measured relative to the average income of individuals with education levels equivalent to year 11 or below. Employment effects are measured in terms of the percentage point effect on the probability of fulltime employment attributable to each higher education qualification level. For example, women with a bachelor degree are 6 percentage points more likely to be employed than those with education levels equivalent to year 11 or below.

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[21] Source: UNESCO educational attainment data by ISCED category, 2013. http://data.uis.unesco.org/ More specifically, AQF levels 7–10 include bachelor degrees, graduate certificates and diplomas, masters degrees and doctoral programs. While some of these programs (in particular, graduate certificates and diplomas) are delivered outside the university system, the majority are delivered within Australian universities.

[22] The total impact from higher level educational qualifications is likely to be greater than that for lower level qualifications. So applying the estimated 70% of total tertiary educational attainment which is defined as higher education may understate the contribution of these qualifications.

[23] It should be noted that these results are obtained from a corrected version of the original Wilkins (2015) report (Table 7.4). This change was communicated in an erratum statement on 16 September 2015 http://www.melbourneinstitute.com/downloads/hilda/Annual_Report/Erratum-HILDA%20Report%202015_table7_4.pdf

Table D.2: Returns to higher education in Australia, 2012

	Probability of being employed		Probability of being fulltime employed		Weekly earnings premium of fulltime employees	
	Males	Females	Males	Females	Males	Females
Postgraduate Degree Level	0.04‡	0.04‡	0.09	0.08‡	49%	40%
Graduate Diploma and Graduate Certificate Level	(0.01)‡	0.06‡	0.05‡	0.05‡	45%	33%
Bachelor Degree Level	0.01‡	0.06	0.03‡	0.03‡	42%	32%
Advanced Diploma and Diploma Level	0.03‡	0.07	0.07	0.10	28%	8%
Certificate Level	0.03	0.11	0.06	0.03‡	20%	0%‡
Year 12 (and no post-schooling)	0.00‡	0.06	0.01‡	0.05	19%	14%

Source: Wilkins' (2015) corrected version of Table 7.4. Figures marked with an ‡ are *not* statistically significant at the 10% level.

Using the results presented above it is possible to estimate the causal impact of higher education on earning for skilled graduates in Australia. This is achieved by applying these estimates to the observed earnings and employment levels of the population of workers in Australia by level of educational qualification, drawn from the ABS 2011 Census.

To achieve this, total Personal Income (weekly) (INCP) data is used to calculate average weekly earnings.[24] While this is an imperfect measure of earnings (as it includes both wage and non-wage income) it is the most detailed and comparable estimate of earnings available that is relatively comparable to the data used in the HILDA survey to estimate the effects of education outlined above.[25]

As shown below in Table D.3, higher levels of educational qualification are associated with higher levels of employment and wages, for both males and females. For simplicity, the probability of fulltime employment working age adults (persons over 15 years of age) is estimated by calculating the proportion of adults employed fulltime at the time of the census.[26] Earnings estimates are converted to 2014 dollars based on the average wage price index for all industries in Australia.[27]

Overall, in 2011, the total annual earnings of fulltime employed workers with a bachelor level degree qualification or higher is estimated to be around $162 billion (in 2014 dollars).

[24] Average wages for different groups are calculated using imputed median incomes provided by the ABS. See: http://www.abs.gov.au/websitedbs/censushome.nsf/home/factsheetsuid?opendocument&navpos=450

[25] Because the effects of higher education are measured in relative terms, the effect of using income rather than wage data will likely be small, particularly as there is little discrepancy between these series on average.

[26] It should be noted that this calculation will not exactly match the probability estimates obtained by Wilkins (2015) using the HILDA data set and are therefore only approximate in nature with respect to application of the effects of higher education estimated by Wilkins (2015).

[27] Calculated using ABS Cat. No. 6345.0 Quarterly Wage Price Index; Total hourly rates of pay including bonuses; Australia; Private and Public; All industries; June 2011 (108.2) to June 2014 (118.2).

Table D.3: Earnings and employment outcomes by educational qualification level, 2011 (2014 dollars)

	Probability of being fulltime employed		Weekly earnings of fulltime employees		Fulltime employed population		Total working age population	
	Males	Females	Males	Females	Males	Females	Males	Females
Postgraduate Degree Level	69%	50%	$2,027	$1,741	234,416	147,673	338,442	292,679
Graduate Diplomas and Certificates	68%	45%	$1,946	$1,626	74,406	84,733	108,753	188,529
Bachelor Degree Level	68%	44%	$1,825	$1,465	695,994	570,878	1,031,089	1,309,422
Advanced Diplomas and Diplomas	60%	36%	$1,582	$1,199	359,136	285,938	594,896	798,153
Certificate level	60%	33%	$1,321	$966	1,228,289	363,925	2,031,540	1,103,370
Year 12 (and no post schooling qual)	46%	25%	$1,205	$1,008	584,199	352,829	1,260,076	1,385,636
Year 11 and below (and no post schooling qual)	34%	14%	$1,088	$924	741,851	392,459	2,157,354	2,729,411

Source: ABS Census, 2011

By applying the causal estimates from Wilkins (2015) it is possible to estimate what the total wage income of these skilled graduates would be had they not obtained their higher education qualification, and just attained a year 12 level of education (for persons with a bachelor level degree or higher).[28] This is achieved subtracting the percentage point differences in fulltime employment probabilities and earnings premiums between individuals with a year 12 or bachelor education and those with bachelor or higher level degree qualifications, respectively.[29] The results of this counterfactual scenario are detailed in Table D.4 below.[30]

[28] The benefits from Graduate Diplomas and Certificates have been included as they are frequently provided by the university sector (though not exclusively). However, the benefits from Diplomas and Advanced Diplomas have been excluded. This approach is to ensure consistency with the total economic contribution analysis.

[29] It should be noted that the empirical estimates for wage premiums estimated by Wilkins (2015) are relative to those with only a year 11 level (or below) of educational qualification. As such, and as an example, the formula for calculating the counterfactual level of wages without a bachelor degree and only a year 12 level education qualification for females is:
observed_bachelor_earnings ($1,465) – observed_year11_ earnings ($924)[effect_of_bachelor_degree(32%)-effect_of_year12(14%)] = counterfactual_ earnings ($1,300).*

[30] It should be noted that this approach differs slightly from the modelling presented in Deloitte Access Economics (2015), where the benefits from postgraduate education are assessed relative to a counterfactual scenario where a bachelor level of educational qualification would have been earned.

Table D.4: Earnings and employment outcomes without the effect of university higher education qualifications (counterfactual scenario), 2011 (2014 dollars)

	Probability of being fulltime employed		Weekly earnings of fulltime employees		Fulltime employed population	
	Males	Females	Males	Females	Males	Females
Postgraduate Degree Level	62%	47%	$1,696	$1,501	208,356	138,015
Graduate Diplomas and Certificates	65%	45%	$1,664	$1,449	70,817	84,544
Bachelor Degree Level	66%	46%	$1,576	$1,300	680,528	602,304

Source: ABS Census, 2011; Deloitte Access Economics estimates from Wilkins (2015)

As demonstrated by these results, around half of the observed difference in earnings (on average) between those individuals with year 12 and those with a higher degree level of education is explained by the contribution of the qualification itself, with over half explained by other factors, such as age, experience, demographic characteristics (such as parental education and occupation) and innate cognitive ability.

In this counterfactual scenario, the total gross income per year earned by fulltime employed persons with a higher education degree (at a bachelor level and above) is estimated to be approximately $138 billion (in 2014 dollars). Subtracting this from the original $162 billion of earnings results in an estimated annual gross earnings and employment benefits in the order of $24 billion annually (in 2014 dollars).

These estimates, like those for the total economic contribution of skilled graduates, are representative of the average annual returns accrued to these skilled graduates over the course of their lives. Further, they represent the gross earnings benefits from higher education, that is, they do not account for the additional tax paid as a result of higher average income which would not be captured by as a benefit to the student but rather as additional income to the government.[31] Neither do they account for the opportunity cost of obtaining the higher education degree qualification, both in terms of tuition fees and forgone earnings while studying. Nonetheless, these estimates demonstrate highly favourable returns to investments in higher education on average, similar to those found by Corliss et al. (2013) and Leigh (2008).

It should also be noted that these estimates rely on ABS Census data from 2011 and only include the benefits for fulltime employed persons. This means that the effects of higher education on fulltime employment (in the counterfactual analysis) are overstated in the total income benefits estimated here, because these workers would likely continue earning some level of income even when they are not working fulltime. A further limitation which may lead these results to be an overestimated arises from the reliance of statistically insignificant effects for fulltime employment for some educational levels for males and females.

However, the analysis ignores the earning benefits gained by those persons who work casually, or part-time, or are self-employed. Further, because the total number of persons with a higher education qualification has grown since 2011 the total income benefits estimated here (while measured in 2014 dollars) will have grown in 2014.

[31] Estimates using marginal income rates for workers (including the Medicare levy) imply that around one-third of these approximately $24 billion in earnings benefits will be paid to the government in the form of income tax.

These limitations and biases lead to some ambiguity as to whether this figure of around $24 billion represents an over- or under-estimate of the total earnings benefits from higher education. However, on balance, it is perhaps more likely to represent an underestimate of the total returns.

Appendix E: Measuring the benefits of university research

Background

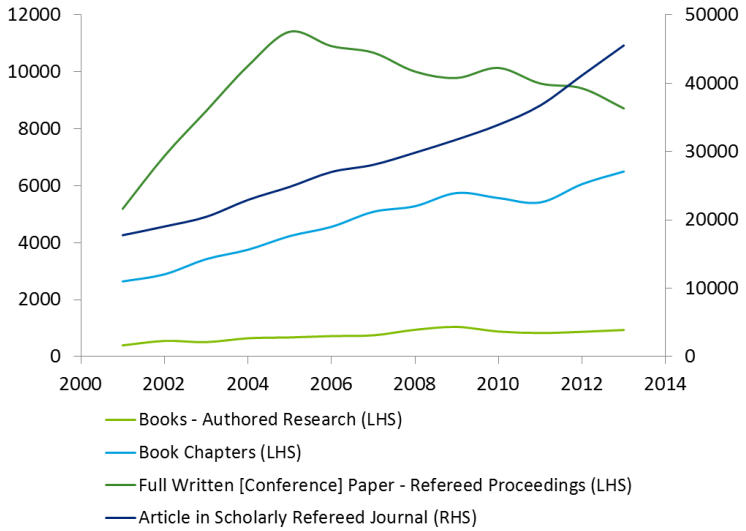
Australia's universities outperform much of the world in both the scale and quality of its research output.

Indeed, data from Thomson Reuters in 2014 shows that:

- Australia ranked ninth in the world for number of Web of Science publications, producing 3.9% of the world's approximately 2 million scientific publications in that year; and
- the quality of Australia's research publications, measured in terms of citation impact scores (normalised and in raw terms), far exceeded of the global average.[32]

The level of quality research output from Australia's universities continues to grow over time. In 2013 Australian universities published over 45,500 articles in scholarly refereed journals, more than double the volume of such articles produced in the previous ten years. Australian universities also produce a significant number of books and book chapters as well as refereed proceedings of academic conferences, as shown in Chart E.1.[33]

Chart E.1: Volume of university research publications, 2001–2013



Source: HERDC historical publication data, obtained through the Universities Australia website

[32] Data supplied from Universities Australia and sourced from the Thomson Reuters international InCites database.

[33] The number of refereed proceedings produced by universities has declined in recent years, primarily due to changes in the formula for university block grant funding.

In terms of total research activity (and associated expenditure), university research is often defined using the categories of:

- pure basic research;
- strategic basic research;
- applied research; or
- experimental development.[34]

Basic research is defined as experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. In this context, it can be thought of as the acquisition of knowledge and adding to knowledge stock without any specific purpose.

Strategic basic research can be defined as applied research which is in a subject area which has not yet advanced to the stage where eventual applications can be clearly specified.

Applied research is defined as original investigation undertaken in order to acquire new knowledge that is directed primarily towards a specific practical aim or objective.

Experimental development research is defined as systematic experimental research that draws on existing knowledge gained from research and practical experience. It is generally directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those processes already produced or installed.

In Australia, over the past two decades there has been a significant increase in the proportion of university R&D that is defined as applied research, reflecting in part the increasing need for university researchers to focus on research projects with an applied focus and identifiable economic and social impact. Nonetheless, over time, the value of research expenditure across all four definitions of research has increased.

Australian research covers a broad range of disciplines and fields. The top 20 areas of research strength in Australia include fields of study from geology to nursing to law, as shown in Table E.1.

Excellence in Research for Australia (ERA) measures Australian university research performance across different disciplines across different universities. In the ERA measures provided in 2012, 80 per cent of the units assessed were rated at world standard or above, as outlined in Chart E.2.

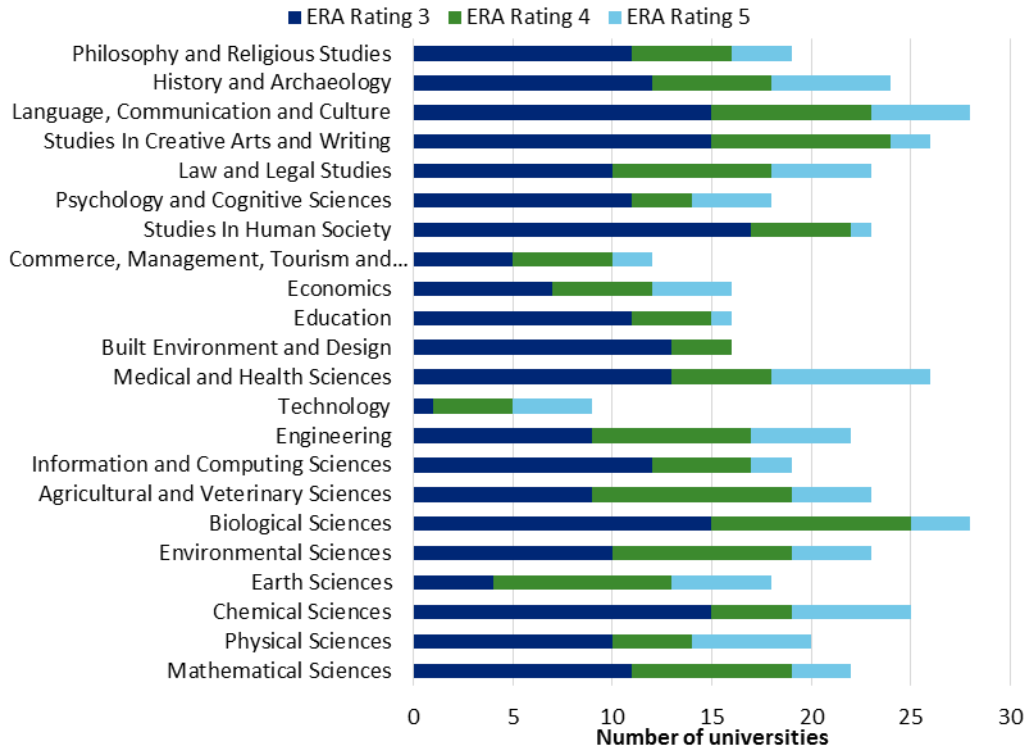
[34] See: http://www.oecdbookshop.org/get-it.php?REF=5LMQCR2K61JJ&TYPE=browse

Table E.1: Australia's top 20 areas of research strength

1.	Astronomical and space sciences	7.	Evolutionary biology	14.	Materials engineering
2.	Clinical sciences	8.	Geology	15.	Medical microbiology
3.	Cultural studies	9.	Historical studies	16.	Medical physiology
4.	Ecology	10.	Human movement and sports sciences	17.	Nursing
5.	Electrical and electronic engineering	11.	Immunology	18.	Pharmacology and pharmaceutical sciences
6.	Environmental science and management	12.	Law	19.	Plant biology
		13.	Macromolecular and materials chemistry	20.	Psychology

Source: Universities Australia, 2015

Chart E.2: Australian universities at or above world standard by ERA rating

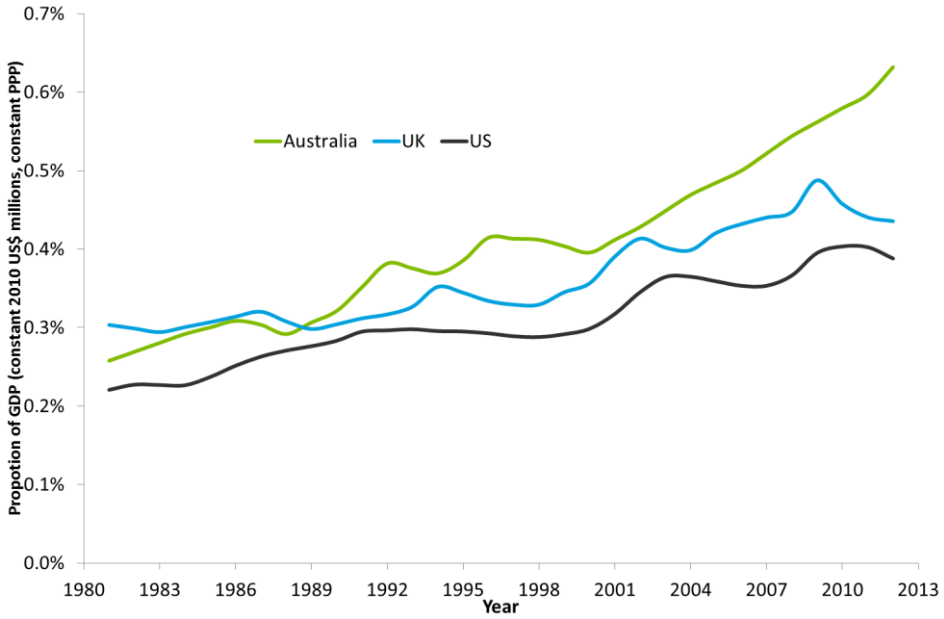


Source: Universities Australia, 2015

As a proportion of GDP, the amount of spending on university research in Australia has doubled from around 0.3% in the early 1990s to over 0.6% in 2012. This increase has exceeded the rate of investment undertaken by similar countries, including in the UK and the US, as shown in Chart E.3.

Notwithstanding the historical support for university research in Australia, ongoing government expenditure on higher education research continues to be put under pressure by other demands on government finances. Recent governments have decreased the value of research funding available as part of some university research funding schemes, including the Australian Research Council (ARC) (Norton and Cherastidtham, 2014).

Chart E.3: University research expenditure as a proportion of national GDP, (constant 2010 US$ millions, constant PPP)



Source: OECD research and development expenditure measures based on sector of performance; Deloitte Access Economics, 2015

Note: Missing data points for some years have been interpolated using a cubic spline method of approximation

Total economic benefits from university research

The modelling undertaken by Deloitte Access Economics (outlined in Appendix C) supports previous evidence that suggests a significant effect of research activity on economic growth. In particular, this analysis implies an elasticity effect on higher education research per capita to output per capita of between 0.175 to 0.184. That is, a *persistent* 10% increase in Australia's university R&D spending per capita would have a long-run effect of about 1.75% to 1.84% higher output per capita.

The estimates produced by this model can be used to estimate the long-run contribution of the stock of knowledge generated by Australian universities to the economy. Based on the results outlined in Appendix C, this share of output attributable to university research activity is estimated to be around 10% of GDP in the economy's steady state, which is equivalent to around $160 billion in 2014 (Deloitte Access Economics, 2015).[35]

This represents the contribution of historical investments in research made by Australian universities. It can be interpreted as the implied value of the stock of knowledge accumulated by university research over time to the 'production technology' of the Australian economy.

[35] This estimate of a 10% share of output in the steady state is obtained by multiplying the estimated elasticity of university R&D (18.40%) from the full dynamic growth model outlined in Appendix C (model II) by the estimated share of output attributed to technology augmented labour in the economy's production function (52.75%) from the same model.

By way of comparison, the value of this 'knowledge stock' exceeds the entire value of Australia's mining industry.

Based on data from the ABS and the OECD, university research expenditure per capita in Australia is estimated to have grown by 4.7% per year on average from 1984 to 2013. More recently, this rate of growth has moderated slightly, with average annual growth from 2009-2013 estimated to be 4.3%. These annual increases in expenditure generate positive effects on economic growth over the long-term, as demonstrated by the elasticity estimates generated from the modelling undertaken by Deloitte Access Economics which relate increases in research expenditure per capita to output per capita in the economy's steady state.

The impact of increased investments in university research take place over time, as the impact of the new technology and 'know-how' affects productivity in the economy and as the economy responds by accumulating greater stocks of capital inputs. The latter of these lag effects may be represented by the estimated convergence term which measures how quickly countries narrow the gap between current and increased steady-state levels of economic output. Based on the model develop by Deloitte Access Economics, the value of this convergence term is estimated to range between 0.149 and 0.204, this indicates that the economy will close 14.9% to 20.4% of the gap between their current level of output and their steady-state output each year (as noted in Appendix C).

By applying the estimated range of elasticities relating research expenditure growth to economic output each year from 1984 to 2014, and by using the estimated rate of convergence to track the value of these impacts over time, it is possible to estimate the cumulative impact that increases in the level of investment in university research over the past 30 years has had on GDP. Indeed, by applying this method, it is estimated that up to $10 billion in additional GDP each year was generated by increased levels of investment in university research (measured in 2014 dollars).

Appendix F: University funding – the Australian context

Universities fund their activities from a range of sources. They attract government funding for the services they provide, as well as receiving funding privately from students (in the form of tuition fees), from firms (in the form of funding for research activity in various forms) and from other benefactors (in the form of donations, endowments, bequests etc.).

Government funding, in broad terms, can come in the form of:

- block grants (for either or both of teaching and research activity);
- tuition fee subsidies; or
- competitive research grants.

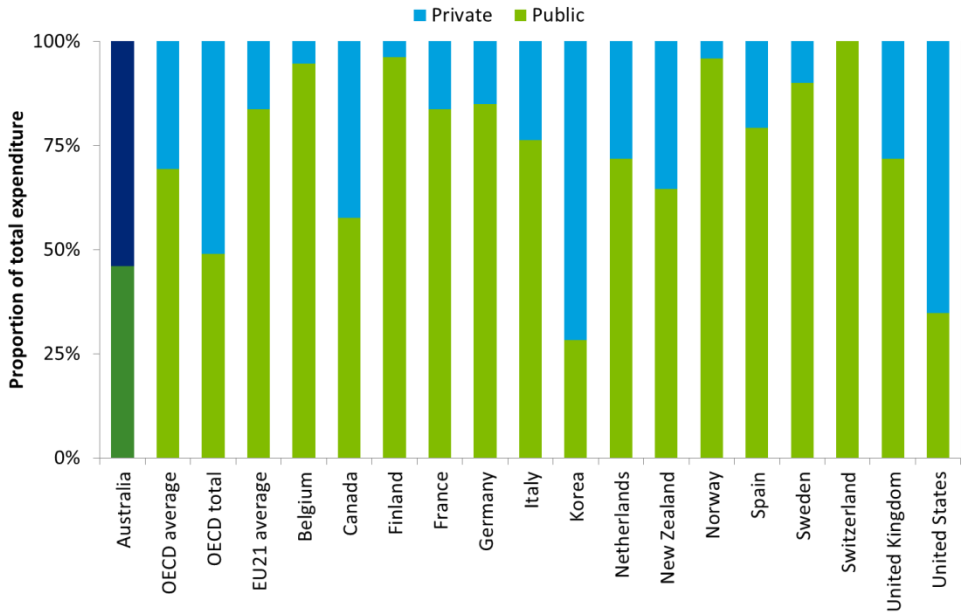
The details of university funding systems around the world vary considerably in their architecture and design. Internationally, an irrefutable and up-to-date reference that collates and compares these funding systems across nations has not been identified.

Nonetheless, OECD Education at Glance (2014) presents the most reliable and contemporary data on higher education finances across countries available. Figures from 2011 included in this report show that Australia's total expenditure on tertiary education institutions (which includes public and private contributions) is 1.6% of GDP, roughly in line with the OECD average (1.59%), but significantly below comparable nations like Canada (2.79%) and the US (2.70%), though more than the UK (1.23%).

The OECD considers the proportion of expenditure on tertiary education (teaching and research) that comes from private sources and public sources, respectively. Overall, the share of tertiary education institution expenditure contributed by public funding sources is estimated to be around 46% for Australia, compared to an average of 69% for the OECD as a whole. However, the share of private and public contributions varies greatly across countries, with private individuals in the US accounting for 65% of the expenditure on tertiary education intuitions in 2011 compared to only 28% in the UK for the same year, as shown in Chart F.1.

Of this total expenditure in Australia, around 60% (0.94% of GDP) is attributed to core education services, with the remaining 40% allocated to research and development. This is in comparison with the OECD average, where proportionally more is spent on core education services (70%) than research and development (30%).

Chart F.1: Expenditure on tertiary educational institutions as a percentage of GDP, selected countries, by source of funds, 2011



Source: OECD Education at a Glance, 2014

Across the OECD, the share of private expenditure on tertiary education institutions has increased gradually over time, with a 5 percentage point difference recorded between the year 2000 and 2011. Australia's trend in proportional private expenditure was very similar over this period of time, as was the case in the US. In contrast, as result of significant reforms to the higher education sector in the UK over the past decade, the change in proportion of private expenditure between 2000 and 2011 exceed 35 percentage points (OECD, 2014).

While the OECD 'Education at a Glance' represents the most contemporary and reliable source of evidence comparing higher education funding systems internationally, it is not without its limitations. It has been generally noted that the data on public funding provided by the OECD may understate the magnitude of public financial support as it excludes the costs to government from maintaining loan subsidies as part of tuition loan schemes like the HECS-HELP system.

Analysis by Deloitte Access Economics of the detailed guidelines published by the OECD indicates that the direct value of HECS–HELP loans are counted as private contributions, as they are considered a form of private final expenditure. It appears that this treatment is unique for Australia, as government loans are generally included in the estimates of public contributions made by other nations (as they are far less prevalent, on the whole). Further it has been confirmed that while the subsidies for up-front payments of student debts are treated as a public expenditure by the OECD, the cost of doubtful debts and interest subsidies are not included. As such, it is possible that the public share of expenditure on tertiary education in Australia is underestimated relative to other nations.

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