

The economic contribution of the University of New South Wales

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Executive Summary

Universities play a vital role in the Australian economy – supporting economic growth and productivity through their operations, educating skilled graduates, and through the translation and commercialisation of academic research, to unlock a breadth of economic and social benefits.

In 2021, the University of New South Wales (the University, UNSW) awarded degrees to 8,000 graduates of undergraduate programs, and 4,200 graduates of postgraduate programs.

Equipped with new skills to meet the needs of industry, these graduates will play a major role in supporting Australia's productivity growth in a period of economic recovery.

Reflecting the wage increases attributable to workers' higher qualifications, the higher tax revenues associated with these earnings and the productivity spillovers of employing higher skilled workers, the University's 12,200 graduates in 2021 are expected to generate \$473 million in public and private benefits each year of their working lives.

The University's economic contribution is also realised through research, discovery, translation and commercialisation.

This report finds that every \$1 invested in higher education research and development is linked to a \$5 return to GDP. Researchers across a diversity of disciplines undertake applied research to tackle some of Australia's and the world's most pressing social problems – from climate change to pandemic management to social inclusion and wellbeing.

Across teaching and research, the University makes an enduring contribution to the communities, precincts and industries that are its collaboration partners.

With a central campus in Sydney, smaller campuses elsewhere across Sydney and around NSW, and a major campus in Canberra, the University's operations drive local employment and economic activity across these regions. Supporting 15,800 academic and professional jobs, the University contributed \$2.8 billion in economic activity to the Australian economy in 2019.

As a public institution, the University contributes to the nation's economic resilience, connects Australia to leading global economies and generates valuable public knowledge.

These contributions are critical to support Australia's economic sophistication, its advancement as a knowledge economy and its overall maturity and resilience.

This report outlines and quantifies a diverse set of economic contributions made by the University of New South Wales, across four domains:



Economic activity and employment

The economic contribution of the University through its operations



Skilled graduates

The contribution of individual skilled graduates which the University's teaching and training enables



Research activity

The economic and social contributions of research activities supported by the University



Enabling innovation and resilience

The various means by which the University's activities support the sophistication of the national economy.

These findings focus on the economic returns to university education and research, which are substantial and important. This report acknowledges that there are also rich and diverse non-financial returns, beyond those explored as part of this research.

This report relies on the most available and recent data – which results in a variable 'reference year' (over 2019-21) across the analysis underpinning each domain.

Executive Summary

The contribution of the University includes its direct operations and activities as an employer and business, and the economic returns from building the human capital of skilled graduates



1 | UNSW's economic activity and job creation in 2019

The contribution from UNSW's operations to the national economy.

As economic entities, universities contribute to the economy through their ongoing operational activity as well as through the additional overseas students and visitors that they attract. This activity provides employment and income primarily for workers in the New South Wales higher education sector, but also in associated industries that support UNSW's operations – throughout both New South Wales and Australia.

Input-output modelling finds that:

- In 2019, the University of New South Wales contributed \$2.8 billion to the Australian economy and supported 15,800 FTE jobs. This includes \$1.5 billion in direct value added and 7,670 direct FTE jobs (including spending on tuition).
- The University's international students and their visitors contributed \$770 million in value added and supported 4,700 FTE jobs across Australia through non-tuition expenditure in 2019.



2 | UNSW's skilled graduates in 2021

Benefits for individuals and broader society are attributable to graduating from the University.

Through teaching and learning activities, universities enhance the human capital of their students – their skills, knowledge and abilities.

University graduates benefit from higher workforce participation, employment and wages – the three key labour market outcomes which ultimately result in greater lifetime earnings. Broader society benefits as the economy is supplied with more highly skilled workers.

These workers are more productive – able to produce more with the same inputs – and enable productivity spillovers to be generated across workplaces and industries. The higher wages that these workers earn is reflected in higher taxation revenues.

Econometric analysis of the wages, labour force participation and employment rates of UNSW's graduates found that:

- UNSW undergraduates earn an additional \$32,800 in wages each year compared to individuals with no university qualification, and \$10,400 more than the average Australian university undergraduate.
- UNSW postgraduates earn an additional \$18,100 each year compared to a individuals with only a bachelor degree, and \$9,900 more than the average Australian university postgraduate.
- \$3.4 billion in economic activity is generated annually from 75,000 UNSW alumni in the workforce in 2021, reflecting the private benefits (through wage premiums) and the public benefits (through productivity gains and additional taxation revenue) enabled through university qualifications.

Executive Summary

The contribution of the University also includes the returns from delivering and translating important research discoveries and a broader suite of activities that support Australia's economic resilience.



3 | UNSW's research impact in 2020

The value and returns to UNSW research and innovation.

Research supports productivity and public benefits across many sectors of Australian industry. Econometric analysis of the relationship between research, productivity and innovation finds that \$1 invested in UNSW's higher education research and development is linked to a \$5 return to GDP. This means that a public investment of \$547 million in research grants to UNSW in 2020 (in 2021 dollar terms) is expected to result in an economic impact of \$2.7 billion.

The University's contribution to Australia's innovative capability is enabled through university research projects, translation and community engagement. Three stylised case studies provide specific, quantifiable and contemporary examples of the public and private benefits of research:

- Research and translation to increase access to COVID-19 vaccine information and tailor it for culturally and linguistically diverse communities in-part enabled up to \$62 million in economic benefits where increased vaccination levels contributed to ending the NSW lockdown.
- If adopted across the Australian steel industry, Green Steel produced using polymer injection technology could produce \$34 million per year in environmental and business benefits. This technology enables a 14% reduction in coking coal inputs, a 2.5% reduction in energy use and could redirect 425,600 tyres from landfill each year.
- The Thru-Fuze™ orthopaedic device, while still in medical trial phase, could provide a less invasive alternative surgery for spinal conditions. Currently, spinal fusion surgeries are successful in less than half of all cases. If Thru-Fuze™ improved this success rate by 50%, 11,250 fewer people per year would be living without chronic back pain – reflecting a financial benefit of up to \$500 million in avoided economic and social costs.



4 | UNSW's role in Australia's economic sophistication

The University's role in supporting a more resilient and connected workforce and economy

The University enables economic benefits beyond the volume of financial returns to research and teaching activity, especially as they relate to Australia's economic resilience and maturity– including supporting workforce preparedness and capability, furthering innovative capability and forging connections to global economies.

- Reflecting the University's contribution to Australia's workforce capability, half of all UNSW students are enrolled in fields of education which map to jobs currently in critical shortage, a contribution of 6,300 graduates into these roles each year.
- Supporting the Australian workforce in its preparedness for a changing economy, the University will play a major role in softening the impact of the 'great reshuffle' on Australian employers: 15,000 Australians were enrolled in online and blended models, and 400 in short programs in 2021.
- The University enables innovation at the frontier of research and teaching, with practical and industry-embedded delivery across a suite of course offerings. Research excellence underpins the technical capabilities of graduates, with which 96% of Australian employers are satisfied.
- A rich international education portfolio across inbound and outbound programs, and global research collaborations sees the University connect Australia's economy and workforce to many of the world's most sophisticated economies – including in the ever-important Asia Pacific region. With international graduate wages \$5,300 above the NSW median, UNSW plays a key role in attracting and retaining international talent in the knowledge sector.



1 | UNSW's economic activity and job creation in 2019

The contribution from UNSW's operations to Australia's economic activity.



\$2.8b

contribution to the Australian economy in 2019

\$2bn

from University operations and expenditure



\$1.8 billion attributable to NSW



\$1.5 billion directly through its day-to-day activities such as employing staff



\$430 million indirectly through downstream contributions



26,660 international students enrolled in 2019



7,200 visiting friends and relatives (VFR) in 2019

\$770m

from expenditure by international students* and VFRs

**includes all non-tuition expenditure, such as accommodation, food and travel*

15,800 FTE

(full time equivalent) jobs supported by the University's operations and associated international visitors



3 | UNSW's research impact in 2020

The value and returns to UNSW research and innovation.

\$5 dollars for every **\$1** invested in research and development

Unlocking economic benefits of **\$2.7** billion based on research funding received in 2020

Three case studies which demonstrate this value:

COVID-19 vaccine information for linguistically diverse communities

\$62 million in economic benefits associated with faster vaccination uptake

Green Steel produced using polymer injection technology

\$34 million in potential savings for the Australian steel industry in environmental and business costs

Thru-Fuze™ orthopaedic device could provide a less invasive surgery

\$500 million in potential avoided economic and social costs if 11,250 fewer people were living without chronic back pain



2 | UNSW's skilled graduates in 2021

Benefits for individuals and broader society are attributable to graduating from the University.

\$3.4 b in public and private benefits from 75,000 UNSW employed alumni in the workforce.

Includes \$2.1 billion in public benefits for broader society, stemming from:

- Productivity spillovers to other economic inputs
- Additional taxation revenue

Undergraduates

+\$32,800 average yearly wage premium compared to school leavers (before tax)

+\$1.5 million more over a lifetime (\$260,000 in present values)

Postgraduates

+\$18,100 average yearly wage premium compared to those with an undergraduate degree (before tax)

+\$830,000 more over a lifetime (\$190,000 in present values)

The UNSW specific premium

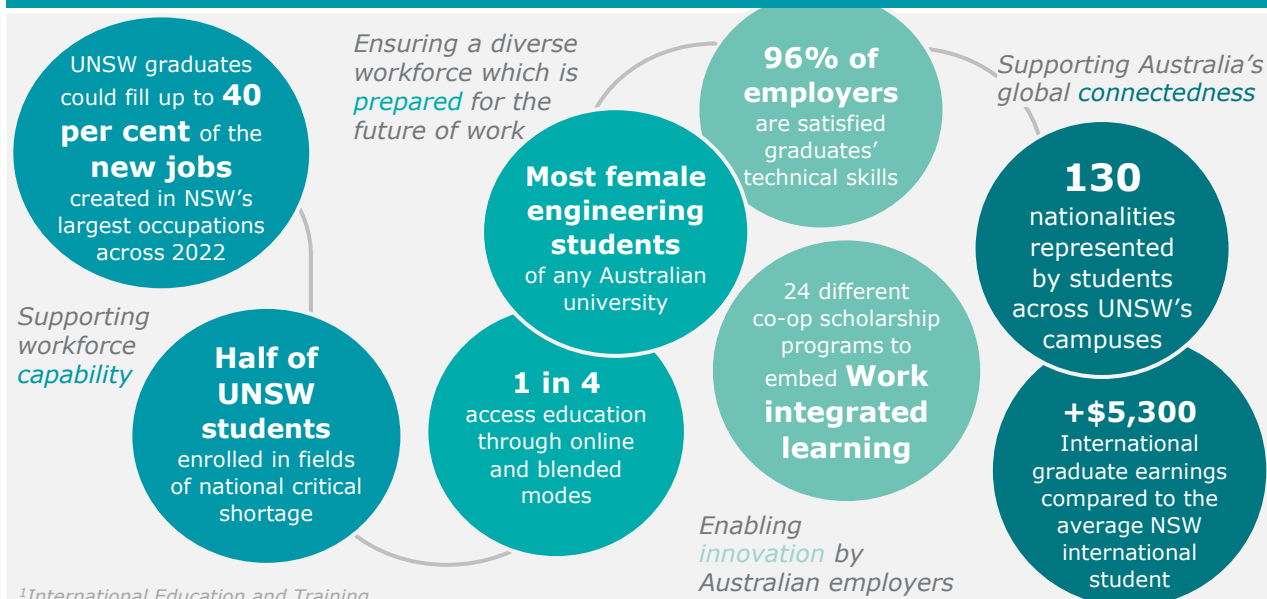
+10% higher than the average undergraduate from any Australian university

+9% higher than the average postgraduate from any Australian university



4 | UNSW's role in Australia's economic sophistication

The University's role in supporting a more resilient and connected economy



Context and purpose

Introduction and purpose

Universities play a vital role in the Australian economy, supporting economic growth and productivity.

By delivering training to skill the future workforce and through research discovery, translation and commercialisation, the University of New South Wales (UNSW, the University) makes a significant economic contribution to the national economy and workforce capability.

Equipped with new skills to meet the needs of industry, these graduates will play a major role in supporting the Australia's productivity growth in a period of economic recovery.

The University's economic and social contribution is also realised through research discovery, translation and commercialisation.

The impact of Universities is maximised by combining the frontier thinking of university researchers and graduates with the influence and reach of businesses. Researchers across a diversity of fields undertake applied research to tackle some of the world's most pressing social problems, from climate change to pandemic management to social inclusion and wellbeing.

Through their operations as employers and as a destination for local and international students, the University also makes an enduring contribution to the communities, precincts and industries that are their collaboration partners.

With a main campus in Sydney, smaller campuses elsewhere in Sydney and around NSW, and a campus in Canberra, the University's operations drive local employment and economic activity across these regions.

Universities have significant capacity to support Australia's recovery from the pandemic, though this role extends to strengthening Australia's economic sophistication, resilience and adaptability.

Public institutions also make broader contributions to the nation's economic resilience, connect Australia to leading global economies and support the generation of public knowledge. These contributions are critical to support Australia's economic sophistication and its transition to a knowledge economy.

Against this context, the University of New South Wales engaged Deloitte Access Economics to undertake research and analysis on the economic and social contributions of the University across its operations, teaching and research activities.

This draft report presents the key empirical and numerical findings across four domains of economic and social contribution:



1 | The University's operations and international students

The University's economic contribution through its day-to-day operations, including the volume of national economic activity and employment supported by UNSW.



2 | The University's skilled graduates

The public and private benefits associated with skilled graduates who enter the workforce with greater productive capabilities.



3 | The University's research impact

Econometric analysis to demonstrate the relationship between research, productivity and innovation, accompanied by specific, contemporary case studies to demonstrate the contribution made through the application of research and innovation.



4 | The University's contribution to Australia's economic resilience

Analysis to articulate and quantify the economic benefits beyond the volume of financial returns to research and teaching activity, as they relate to Australia's economic sophistication and maturity – including supporting workforce preparedness and capability, furthering innovative capability and forging connections to global economies.



1 | The University's operations and international students

The University's operations and international students in 2019

In 2019, UNSW contributed \$2.8 billion and supported 15,800 jobs through ongoing operations and the expenditure from international students and visitors.

As economic entities, universities contribute to the economy through their **ongoing operational activity as well as through the additional overseas students and visitors that universities attract**. This activity provides employment and income primarily for workers in the New South Wales higher education sector, but also in associated industries throughout Australia that support UNSW's operations.

In economic contribution studies, this impact is measured in terms of the 'value added', where the sum of value added across all entities in the economy (plus net tax on production) is equal to Gross State or Domestic Product (GSP and GDP, the most common measures of economic output). This impact can also be measured in terms of the contribution to employment in the labour force, expressed as full-time equivalent (FTE) jobs (overpage for further detail).

This report measures the contribution of UNSW in 2019. This recognises that the economic flows between sectors in the economy were likely disrupted over 2020-21 due to the COVID-19 pandemic, and key ABS data on how these flows changed are not yet available. 2019 also represents the latest representative year for the University's operations and students.

In 2019, the University of New South Wales contributed \$2.8 billion to the Australian economy, and supported almost 16,000 FTE jobs.

- UNSW contributed \$2 billion in value added, and 11,100 full time jobs, through the immediate (*direct* contributions) and downstream (*indirect* contributions) impact of the University's ongoing operations.
- Due to the location of campuses, the majority of this contribution (\$1.8 billion and 10,000 jobs) is concentrated within the New South Wales economy, although UNSW's supply chains extend \$0.2 billion across the other Australian states.
- In addition, international students attending UNSW - approximately 26,000 in 2019 - as well as friends and relatives that visited those students, contributed a further \$770 million through expenditure on non-tuition items such as accommodation (excluding campus accommodation), food and travel. This expenditure supported another 4,700 jobs to the national economy.

\$2 billion

contribution to Australia's economy in 2019

through the University of New South Wales' operations across Australia, of which **\$1.8 billion** contributed to the NSW economy.

11,100

full time equivalent jobs

supported through the operations of the University of New South Wales in 2019, of which **10,000** were supported within NSW.

+

\$770 million

additional contribution via international student and visitor expenditure

from the **26,000** international students enrolled at the University in 2019, and the friends and family that visited.

4,700

full time equivalent jobs

supported through additional expenditure from overseas visitors.

University operations

International students & visitors

Input-output modelling

UNSW contributes to the economy directly through its ongoing operations, and indirectly through the industries that provide intermediary goods and services

Input-output (IO) modelling attempts to estimate an entity's economic contribution through recognised, well-defined and quantifiable economic measures, namely value-added and employment. In the case of a university, this is typically estimated through measuring the university's operations (primarily tuition and associated expenditure) and additional international expenditure that occurs as a result of the university (international students and visitors).

Despite efforts to use well defined economic measures, IO models are assumption-driven and, as such, economic contributions can easily be misrepresented. To mitigate this risk, this report used conservative, data driven assumptions and has limited the estimation to only the quantifiable direct and indirect contributions (see below) in line with best practice.^(a) Additional descriptions of analytical decisions and standard practice for the Deloitte Access Economics Regional Input Output Model (DAE-RIOM) can be found in Appendix A.

In IO modelling, the economic contribution of an entity can be defined one of two ways; in terms of value added or employment.

- **Value added** measures the value of goods and services generated by the activity associated with the entity's operations.
- **Employment** measures the number of FTE jobs that the entity supports.

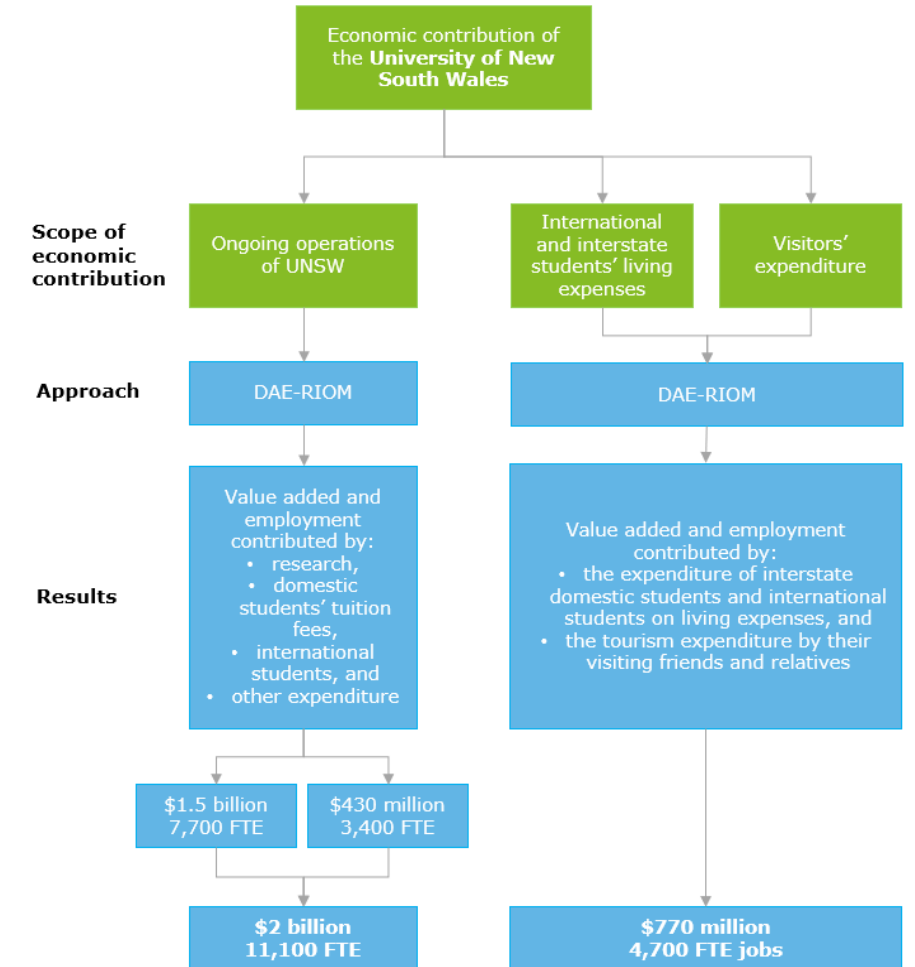
Within both value added and employment, there is an additional distinction between the entity's *direct* or *indirect* contribution.

- The **direct** economic contribution is the value added created by the entity's day-to-day operations. In the case of UNSW, this involves the activities undertaken as part of UNSW's function as a university (such as tuition).
- The **indirect** contribution is a measure of the demand for goods and services produced in other sectors of the economy as a result of the activities of the entity being measured. These are often thought of as the 'flow on' effects, for example, UNSW demands electricity and other utilities to power the campus.

The total economic contribution is the sum of the direct and indirect economic contributions. For more information on the economic contribution methodology, refer to Appendix A.

(a) Induced effects (also known as 'Type-2' analysis) can be thought of as spending by those who have received income from the industry (i.e. University staff spending their wages). This report does not consider induced effects since value added is measured using an income approach (activity that goes into production) rather than the inverse expenditure approach. Inclusion of 'Type-2' analysis would result in instances of double counting.

Figure 1.1: Overview of economic contribution framework for UNSW



Source: Deloitte Access Economics.

Direct economic contribution

The day-to-day operations of UNSW directly contribute more than \$1.5 billion to the Australian economy as well as 7,700 FTE jobs.

The primary way in which UNSW contributes to the economy is through its day-to-day activities and ongoing operations. For a university, this activity predominantly involves tuition of students and research, however may also include additional commercial activities and functions, such as student accommodation and recreation.

This contribution is referred to as the *direct economic contribution* and is measured in terms of university employees and value added, the sum of the returns to the primary factors of production (capital and labour).

The components of value added are outlined in Figure 1.2 and expressed as the total labour expense (wages) and gross operating surplus (GOS).^(a) Within GOS, the model also considers taxes on production that accrue to the government as a result of the entities operations.

Using these metrics, UNSW contributed \$1.5 billion in value added to the Australian economy in 2019. As higher education is a relatively more labour intensive industry, the larger share of value add was attributable to the return on labour. Another way of looking at this contribution is through the impact to the labour market. Over 2019, UNSW supported 7,670 FTE roles (Table 1.1).

With a main campus in Sydney, with smaller campuses elsewhere in Sydney and around NSW, and a campus in Canberra, the University's operations drive local employment and economic activity across these regions. The bulk of the University's direct economic contribution is attributable to New South Wales.

- This report has measured UNSW's contribution to New South Wales as \$1.46 billion in value added, and 7,200 FTE jobs.
- The remainder of UNSW's value added occurs in the ACT, as UNSW operates the Australian Defence Force Academy (ADFA) (approximately 5% of total revenue).
- In total, UNSW's contribution to Australia is \$1.51 billion in value added and 7,670 FTE jobs.
- The University's indirect economic contribution is felt more broadly across Australia through supply chains and associated industrial activity (discussed overleaf).

(a) In 2019, UNSW spent approximately \$160 million on capital expenditure, although this is not explicitly included in the economic contribution. Contribution studies capture the returns to existing capital stock as measured by GOS which includes an allowance for depreciation (capital expenditure as is it 'used' over time). For further explanation of the treatment of capital expenditure refer to the Appendix.

Figure 1.2: Components of contribution



Source: Deloitte Access Economics.

Note: The contribution of expenditure on intermediate inputs (indirect contribution) is estimated overleaf.

Table 1.1: Direct contribution of UNSW's ongoing operations to Australia and NSW, 2019

Direct economic contribution	AUS	NSW
Value added (\$m)	1,514	1,464
Wages (\$m)	1,291	1,224
GOS (\$m)	253	240
Employment (FTE)	7,670	7,201

Source: Deloitte Access Economics. Discrepancies may occur in total due to rounding.

Note: Australia figure also includes direct contribution from ADFA.

Indirect economic contribution

UNSW's expenditure on goods and services contributes \$430 million and 3,400 jobs to the Australian economy through associated industries.

In addition to the direct contribution of the University's ongoing operations, UNSW generates activity in associated industries through expenditure on intermediate goods and services. This is referred to as UNSW's *indirect contribution* and is obtained from detailed expenditure data from UNSW's disaggregated financial statements. UNSW's expenditure generated \$430 million in value added in 2019, as well as 3,422 FTE jobs across Australia (Table 1.2).

Due to the nature of the services provided by UNSW, the composition of UNSW's expenditure and intermediate inputs is also skewed towards service industries. Based on UNSW financial statements, the industries^(a) that most materially benefit from UNSW's ongoing operations include:

- *Professional, Scientific and Technical Services*, through UNSW's expenditure on external consultants and advisory services.
- *Employment, Travel Agency and Other Administrative Services*, through UNSW's expenditure on staff recruitment, relocation fees, conferences and domestic travel.
- *Computer Systems Design and Related Services*, through UNSW's expenditure on software licenses, software infrastructure and IT contractors.

Approximately 48% of UNSW's non-capital, intermediate expenditure (over 2019) is captured by these three industries. A summarised expenditure profile for UNSW is shown (Chart 1.1).

Not all expenditure can be attributed to the Australian economy, since all industries and businesses have some amount of their intermediate goods imported from overseas, which represents a 'leakage' to the Australian economy. In the absence of relevant expense data to offshore entities, this report estimates UNSW's propensity to import based on the average for the higher education sector.^(b) On average, for every dollar spent by the University, \$0.83 flows through to domestic industrial production and services.

^(a) The industry groups referred to in report are Input Output Industry Groups (IOIG). IOIGs are defined by the Australian Bureau of Statistics and comprise of 114 individual industry groups. In some instances, such as Chart 1.1, this report uses shortened names of IOIGs for brevity.

^(b) Propensity to import for UNSW derived from the ratio of the value of imported, intermediate goods relative to the value of domestic, intermediate goods for the *Higher Education* IOIG group.

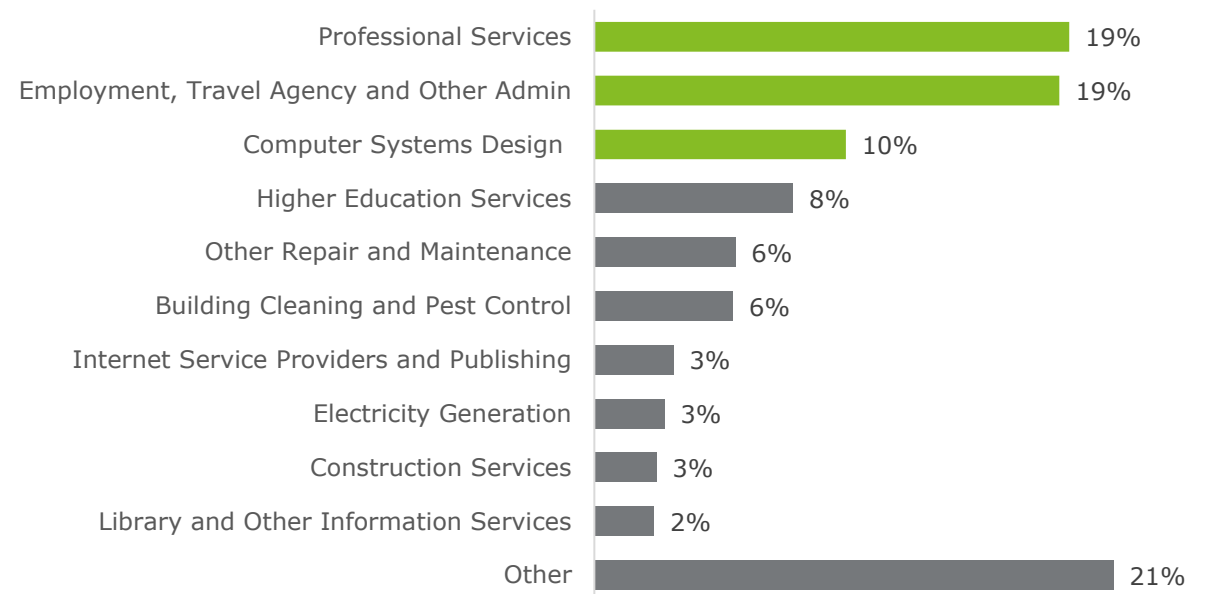
Table 1.2: Indirect contribution of UNSW's ongoing operations to Australia and NSW, 2019

Indirect economic contribution	Australia	NSW
Value added (\$m)	430	342
Wages (\$m)	270	221
GOS (\$m)	160	121
Employment (FTE)	3,422	2,750

Source: Deloitte Access Economics. Discrepancies may occur in total due to rounding.

Note: The difference between Australia and NSW represents the indirect contribution to other parts of Australia.

Chart 1.1: UNSW's intermediate expenditure by industry, 2019



The economic contribution of student and visitor expenditure

UNSW attracts thousands of international students and visitors who contributed more than \$770 million and 4,700 jobs to the Australian economy in 2019.

The direct and indirect contributions (pages 12-13) have focused on the benefits generated through UNSW's operations and expenditure. However, as one of Australia's largest universities, UNSW plays an important role in attracting interstate and international students that generate additional economic activity through expenditure on consumer goods and services (Table 1.3). Furthermore, international students often host visiting friends and relatives (VFR) that also participate in the local and national economy. This activity generated an additional \$771 million in value added and 4,700 FTE jobs for Australia in 2019 (\$762 million and 4,600 jobs in New South Wales).^(a)

In 2019, more than 25,000 international students participated in programs at UNSW (Table 1.3). This figure excludes students who participated remotely or online, since their location cannot be definitively established. Furthermore, nearly 5,000 domestic students relocated from interstate to attend UNSW in 2019. These domestic interstate students are only considered in the state (NSW) contribution.

In 2019, interstate and international higher education students spent an average of \$34,400 and \$33,200 respectively on living expenses (Table 1.3).^{1,2} Top expenditure items for both student types include accommodation and takeaways and restaurant meals. To avoid double counting, this chapter considers only non-tuition expenses and makes adjustments for the amount of international students living on campus, since this contribution is already captured through the universities operations. In the absence of data specific to UNSW students, this analysis relies on the average expenditure profile of students across all Australian higher education institutions.

On average, there are 0.28 VFR's for each international student in 2019 with each VFR spending on average \$4,000.³ For UNSW, this translates to an additional 7,300 VFR's entering Australia contributing an additional \$29 million in value added.

^(a) Interstate visitors are only considered in the state contribution to New South Wales and not the contribution to Australia.

Table 1.3: Domestic interstate and international students and average per-student living expenses, 2019

	Headcount	Per-student living expense
Domestic interstate students	4,990	\$34,449
International students	25,961	\$33,165

Source: UNSW, Deloitte Access Economics. Discrepancies may occur in total due to rounding.
Note: Enrolment breakdown provided by UNSW. Domestic interstate students refers to students who have moved to NSW in order to attend UNSW. International student number includes all in-person enrolments and does not include distance or online education since their exact location cannot be established for purposes of attribution.

Table 1.4: Economic contribution from international students and visitors facilitated by UNSW, 2019

	AUS	NSW
Contribution to value added (\$m)	771	762
Contribution to employment (FTE)	4,749	4,577

Source: UNSW, Deloitte Access Economics. Discrepancies may occur in total due to rounding.
Note: Direct contribution has not been included to remove double counting. Direct contribution in student expenditure refers to fees, which are already captured in UNSW's GOS (slide 13). The state contribution (NSW) includes domestic interstate students. Only international students are counted towards the Australian contribution.



2 | The University's skilled graduates

The University's skilled graduates in 2021

By enabling graduates to enter the labour market with greater skills and productivity, universities unlock substantial benefits for both graduates and the broader economy.

Through teaching and learning activities, universities enhance the human capital of their students – their skills, knowledge and abilities.

University graduates benefit from **higher workforce participation, employment and wages**, the three key labour market outcomes which support greater lifetime earnings and economic wellbeing.

Broader society benefits as the **economy is supplied with more highly skilled workers**. These workers are more productive – able to produce more with the same inputs – and enable productivity spillovers to be generated across workplaces and industries. The higher wages these workers earn also increase taxation revenues.

The underlying analysis relies on econometric regressions to **isolate the economic returns that can be attributed to attaining higher education**, as opposed to other demographic, contextual and cognitive ability characteristics, which might also drive higher earnings or greater productivity.

Further, these findings include **returns specific to the University of New South Wales**, where the returns for the University's graduates are found to be larger than the average Australian university graduate.

These findings focus on the economic returns to education, noting that there are also **rich and diverse non-financial returns to education which can be substantial**, but are otherwise beyond the scope of this research.

Undergraduate students

\$32,800

the average annual wages premium attributable to attaining a UNSW bachelor degree, compared to those with only a high school qualification. This is an average yearly wage of \$113,700 (pre tax) and equates to \$1.5 million more over a lifetime.

41%

Higher lifetime wages for a UNSW graduate, compared to those with only a high school qualification. 13% higher than the average graduate from any Australian university.

Postgraduate students

\$18,100

the average annual wages premium attributable to attaining a UNSW postgraduate degree, compared to those with an undergraduate degree from any university. This is an average yearly wage of \$121,500 (pre tax) and equates to \$0.83 million more over a lifetime.

18%

Higher lifetime wages for a UNSW graduate, compared to those with an undergraduate degree. 10% higher than the average graduate from any Australian university.

Economic benefits from the UNSW alumni

\$3.4 billion

economic activity generated annually from 75,000 UNSW working alumni across Australia, reflecting both economic returns to the individual (i.e. private benefits) and returns to broader society and the economy (i.e. public returns).

This activity reflects that **each alumni unlocks \$24,600 in public benefits** for broader society, on average, reflecting the additional taxation revenue and productivity spillovers to other economic inputs attributable to increasing the supply of highly skilled labour.

Estimating public and private benefits (1 of 2)

Higher education supports greater participation, employment and wages, which together enable higher lifetime earnings. These benefits are estimated using a regression approach and modelled over an average working lifetime. The corresponding public benefits are simulated through a CGE model of the Australian economy.

The benefits of skilled graduates

In 2021, the University of New South Wales awarded 8,000 undergraduate degrees and 4,200 postgraduate degrees. Equipped with new skills to meet the needs of industry, these graduates will have a different experience in the workforce than their peers without the same level of post-schooling study.

It is well-established that the attainment of post-schooling education supports greater economic outcomes for both individuals and their communities.¹ The benefits quantified in this report are organised by:

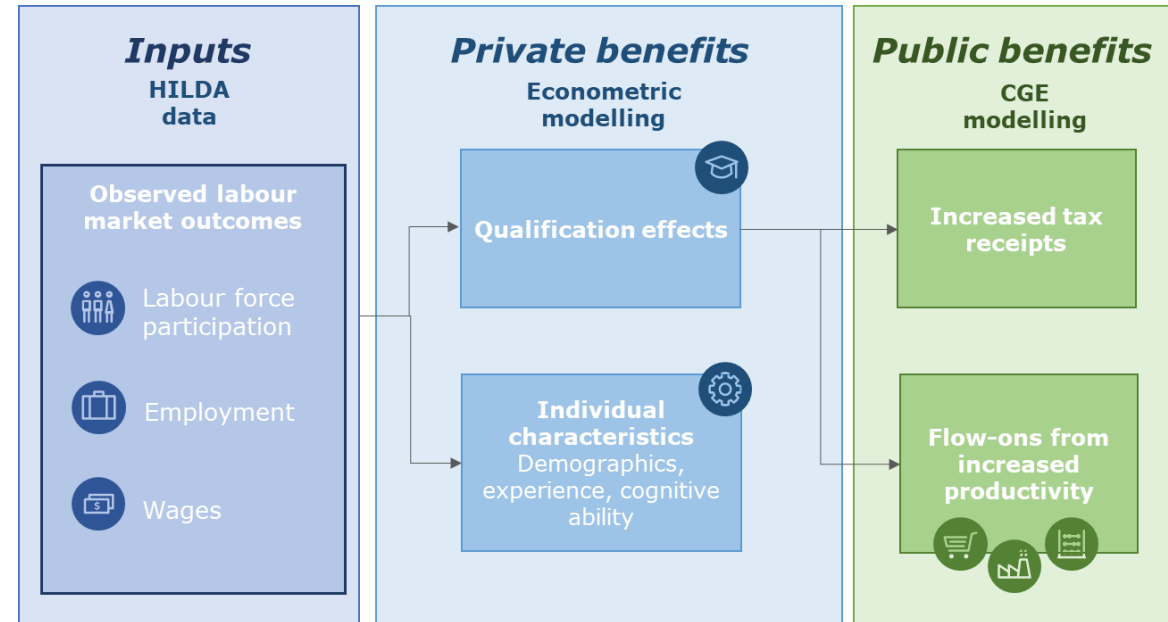
- the **private benefits** that accrue directly to individuals with university qualifications in the form of higher earnings
- the **public benefits** that accrue to the broader economy and society, in the form of productivity benefits and increased taxation revenue from higher-earning degree-holders.

Figure 2.1 (over page) illustrates the approach to quantifying these benefits.

This analysis focuses on the market benefits realised from higher education – which tend to be more consistently and rigorously measured in the literature, with established empirical techniques to quantify outcomes.

These results, which revolve around pecuniary values, are also more readily comparable to other benefits and studies. Of course, there are a range of non-market benefits associated with individuals gaining a higher education qualification – such as improved wellbeing and social relationships and higher likelihood to participate in volunteering activities – which can be substantial, and would imply that the benefits quantified here are a conservative measure of the total impact of graduates' contributions.²

Figure 2.1: Overview of approach



Source: Deloitte Access Economics (2022)

Estimating public and private benefits (2 of 2)

Private benefits reflect the wage premiums for degree holders, while public benefits comprise the flow-on benefits for productivity and additional taxation associated with higher educational attainment.

Quantifying the private benefits

On average, university graduates enjoy higher lifetime earnings compared to those with no post-school qualifications. These higher earnings reflect the combined impact of a qualification on an individual's labour force participation levels, their likelihood of employment and their wage.

An individual's labour market outcomes are determined by an array of personal characteristics – including cognitive ability, work experience and demographic characteristics – and those that participate in university study may have different characteristics to those that do not study. Therefore, it is critical to separate out the effects of these different characteristics to identify the benefits which are attributable to higher education (as opposed to other factors).

An econometric regression approach is used to isolate the relationship between an individual's attainment of a university qualification and their labour market outcomes. This allows for the 'qualification effect' to be disentangled from other confounding effects. These qualification effects are estimated using separate regressions for each of participation, employment and wages.

A lifetime earnings model uses these inputs to estimate the average private benefits to the individual. This model accounts for:

- the qualification effects across the three labour market outcomes: participation, employment and wages
- wages being conditional on participation and employment (i.e. only workers receive wages)
- lower wages and participation during years of study, and trends in student employment
- higher income taxation on higher wages (including higher marginal rates), and
- projected wage growth over time (based on macroeconomic forecasts).

The model's final output is an estimate of the lifetime earnings premium for an individual with a university qualification, relative to an individual with no post-school qualification.

Quantifying the public benefits

The public benefits of higher education attainment are measured in terms of the impact on workers' productivity and the higher taxation revenue associated with their higher earnings.

The effects of labour productivity work their way through the economy, spurring investment and economic activity in ways that ultimately increase the economy's overall productivity and output. To estimate this, the earnings premium (private benefit) is used as an input to a model which simulates how the economy would respond to an increase in workforce productivity.

To estimate the public market benefits associated with this, Deloitte Access Economics' in-house computable general equilibrium model (DAE-RGEM) is used. The model projects changes in macroeconomic aggregates such as Gross National Product (GNP), employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The utilisation of a CGE model allows the broader economic impacts of higher education to be simulated. This analysis relies on the same CGE modelling framework from previous Deloitte Access Economics' higher education public benefit studies, with adjustments made to key parameters (such as tax receipts) to account for the larger private benefits estimates for UNSW-specific graduates.

Data sources

HILDA data provides the best available longitudinal data to understand the study pathways and labour market outcomes of graduates from the University of New South Wales.

Informing average private benefits

This analysis primarily uses data from the Household Income, Labour Dynamics in Australia (HILDA) survey data to understand the effect of university qualifications on labour market outcomes.

HILDA is a detailed longitudinal dataset, which includes detailed labour market information and individual characteristics (e.g. cognitive ability, qualification and demographic information) and is commonly used to assess educational outcomes across the academic literature. HILDA has been collected annually since 2001, and follows the lives of more than 17,000 Australians each year.

Detailed characteristic information allows for more robust and rigorous analysis of graduate outcomes, compared to other datasets that only report outcomes, i.e. without accounting for systematic differences in cohorts (e.g. QILT and CompareED).

Labour market outcome data from the ABS Census 2016 and Deloitte Access Economics macroforecasting models – such as wages, labour force participation rate and employment rate – are used to model the average baseline outcomes for individuals, i.e. school qualification only compared to undergraduates, and undergraduates compared to postgraduates.

The analytical outputs from HILDA are then modelled alongside the baseline outcomes from above to develop the average labour market outcome trajectories for individuals with different qualifications.

Informing UNSW-specific private benefits

Different waves (i.e. years) of HILDA collect information on 'special questions', in addition to the 'regular questions'. Wave 16 of HILDA included questions relating to the 'institution of highest qualification obtained'. This question allows for UNSW graduates to be identified and compared to non-UNSW graduates (i.e. from any other Australian university).

Wave 16 is used to calculate the UNSW-specific labour market outcomes, i.e. the returns above and beyond the average returns to graduates from any Australian university. Almost 7,800 relevant individuals were identified in Wave 16, where 155 graduated from UNSW.

Notwithstanding that the results are statistically significant, given the relatively smaller sample size of UNSW graduates in wave 16, the results in the analysis should be read in conjunction with other reporting.

Accordingly, the results in this report are presented alongside other data reported by CompareED (an initiative between the Australian Tax Office and the Department of Education, Skills and Employment), which provides external validation to these results (see analysis on page 22).

The private benefits of a UNSW bachelors degree

UNSW graduates earn \$32,800 more on average each year, compared to workers with no post-school qualification. This equates to \$1.5 million in additional wages over their lifetime.

The average UNSW graduate with a bachelor's degree earns a wage premium of **\$32,800 per year** compared to an individual with no post-school qualification. This is equivalent to **\$1.5 million** over the average working life.

All results discussed in this chapter are derived through an econometric approach. They can be interpreted as the impact of qualification on wages, after controlling for differences in key demographic, cognitive ability and contextual characteristics between degree and non-degree holders.

Wage premium

The average wages for individuals are modelled over an average working lifetime (from ages 19 to 64 year old). This wage profile is presented in Chart 2.1.

The baseline wage (for individuals with no post-schooling qualification), gradually increases before declining as older workers tend to work fewer hours and/or exit the labour force.

The wages for undergraduates is initially lower during years of study, where students typically work for lower wages and for fewer hours, but then immediately increases in the year after graduation – earning \$61,400 on average per year, compared to \$42,600. The wage premium (i.e. the gap between the two wage lines) then increases over time.

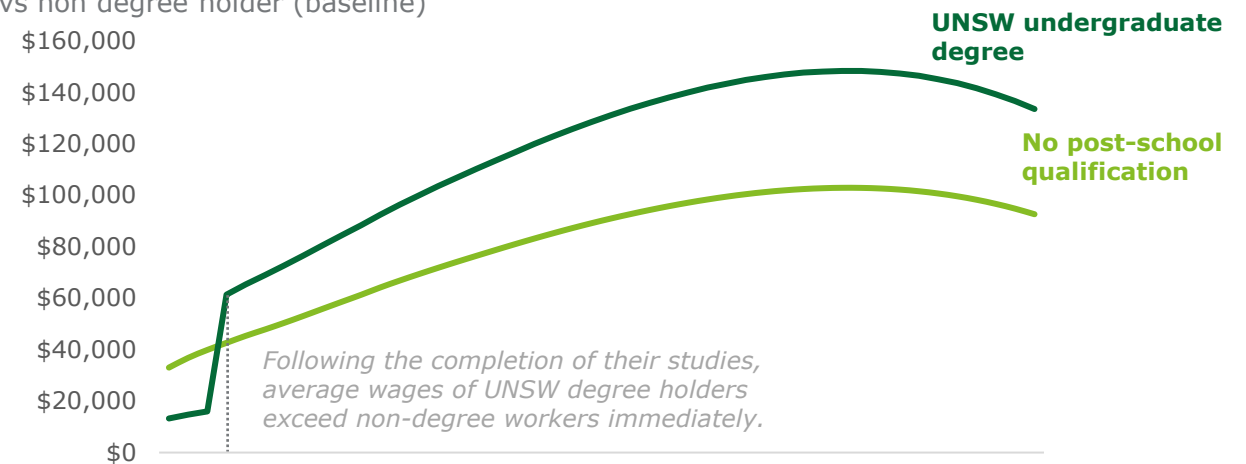
The wage premium attributable to a UNSW qualification aggregates to a total value of \$1.5 million over the working life. This is equivalent to a premium of \$262,000 in present value terms.¹

Labour force participation

This analysis finds that the average labour force participation for UNSW graduates is 78%, which is **10% higher** than the participation rate among individuals with no post-school qualifications.

Higher participation supports accessing wages and wage premiums, and supports higher labour force productivity by increasing the supply of labour.

Chart 2.1: Wages (pre-tax) for average worker over the lifetime, UNSW degree holder vs non degree holder (baseline)



Source: Deloitte Access Economics analysis using HILDA data (2021). Notes: The model assumes three years of study in an undergraduate degree, and 43 years of work on average, between the ages of 19-64.

Employment rate

This analysis finds an employment rate among UNSW graduates of 88%, a figure 3% lower than for individuals with no post-school qualifications. While surprising if taken alone, this likely reflects in-part the significantly higher labour force participation rates among UNSW graduates.

The UNSW-specific results also rely on a smaller sample of individuals from the HILDA data. High levels of employment and lower sample sizes mean that a relatively small number of unemployed graduates can skew the results. These graduates could be between jobs or be willing to wait for the 'right' job offer.

This result could also reflect higher rates of unemployment in disciplines in which UNSW specialises in. For instance, UNSW has a higher share of graduates in business (86% graduate employment overall) and science and mathematics (82%), and a lower share in nursing, where employment rates are higher (89%).

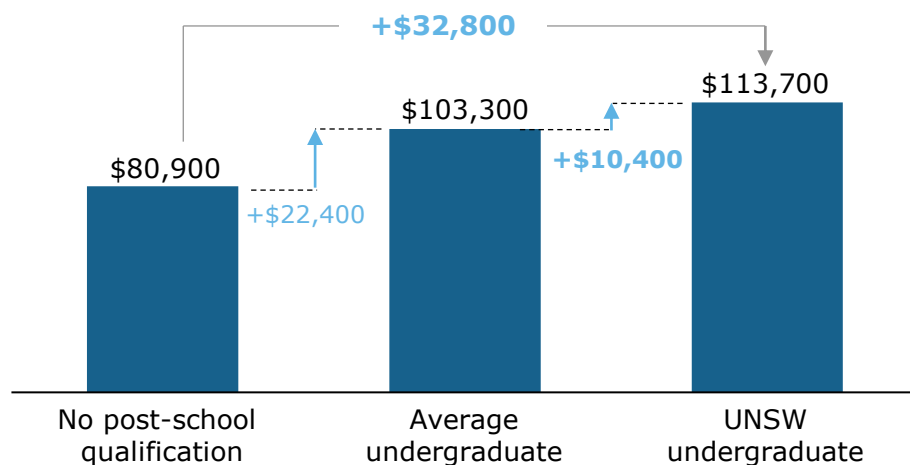
The private benefits specific to a UNSW degree

UNSW graduates earn, on average, \$10,400 more each year than the average graduate from any Australian university – a lifetime wages premium of \$480,000.

As a leading university in Australia, UNSW’s graduates benefit from better labour market outcomes on average relative to the average bachelor degree holder from an Australian university. This results in higher wages premium for workers with UNSW degrees (41% higher than workers with no post-school qualification) compared to the average bachelor degree (28%). This is equivalent to **\$10,400 more in additional wages each** year on average, and a total of \$480,000 over a lifetime (Chart 2.2).

A smaller sample size is used to estimate UNSW-specific premium (as explained earlier, see ‘Approach’), and while the estimated premiums are statistically significant, they are also less precise. Subsequently, the results of this analysis comparing UNSW with other universities is further examined and validated using other reporting (see over page).

Chart 2.2: Components of the earnings premium, UNSW degree holders vs average university degree holders



Source: Deloitte Access Economics analysis using HILDA data (2021).
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Key results

- The average annual wage of an employed UNSW graduate is \$113,700. This is 10% (\$10,400) higher than the average wage reported among workers with any bachelor level qualification.
- Among UNSW graduates, average labour force participation rate is 78%, 2% higher than the average participation rate among graduates from all other Australian universities.
- The employment rate among UNSW graduates is 88%, which is 5% lower than for individuals with a bachelor level qualification from other Australian universities.

Table 2.1: Components of the undergraduate earnings premium

	No post-school qualifications	Average undergraduate	UNSW undergraduate
Wages <i>Relative to no post-school qualifications</i>			
Average annual wages	\$80,900	\$103,300 +\$22,400	\$113,700 +\$32,800
Lifetime wages	\$3.72 m	\$4.75 m +\$1.03 m	\$5.23 m +\$1.51 m
Lifetime wages (discounted)	\$0.86 m	\$1.02 m +\$0.16 m	\$1.12 m +\$0.26 m
Other labour market outcomes <i>Relative to no post-school qualifications</i>			
Participation rate	68%	76% +8%	78% +10%
Employment rate	91%	93% +2%	88% -3%

Source: Deloitte Access Economics analysis using HILDA data (2021).

Note: The UNSW undergraduate results rely on a smaller sample of HILDA, as only one ‘wave’ of individuals were asked about which university they attended. While the results are ‘statistically significant’, the confidence intervals are wider, such that these results are less precise than for the ‘average undergraduate’.

Comparison with public wages data

Tax data on graduate wages provides a means to validate the analysis, showing that on average, nine years after graduation, the UNSW earnings premium is in-line with modelled results.

In 2021, the Department of Education, Skills and Employment released a new database, CompareD³, reporting average incomes for VET and higher education graduates by field of study, using ATO tax returns from FY2017-18.

This database shows that on average (across all fields of study, without weighting by enrolments), **UNSW graduates earn a wage of \$92,800 in their ninth year after graduation, an amount \$9,800 higher than the average graduate from any Australian university.**

Further, the CompareD database reveals an 11.8% wage premium for UNSW graduates relative to the average graduate from any Australian university, which is in line with the 10.1% lifetime wages premium estimated using the econometric analysis.

These premiums are consistent with the results presented in this report, with small discrepancies. There are three possible explanations behind these differences, where the CompareD wages:

- Reflect estimates at a point in time (i.e. 9 years post graduation), whereas the results in this report reflect an average lifetime estimate.
- Do not control for other non-educational characteristics, while this study controls for a range of variables to isolate the qualification effect.
- Are calculated as simple averages (aggregating across fields of education), while results presented in this report are weighted by UNSW's enrolment across different fields.

Chart 2.3: Median wages by field of study (9 years post-study)

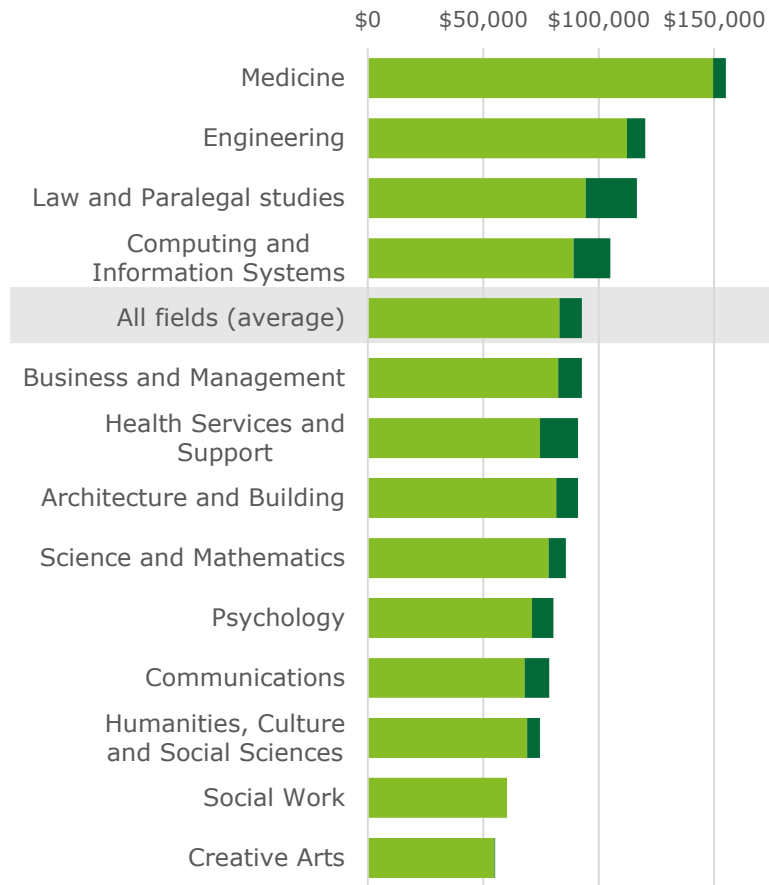
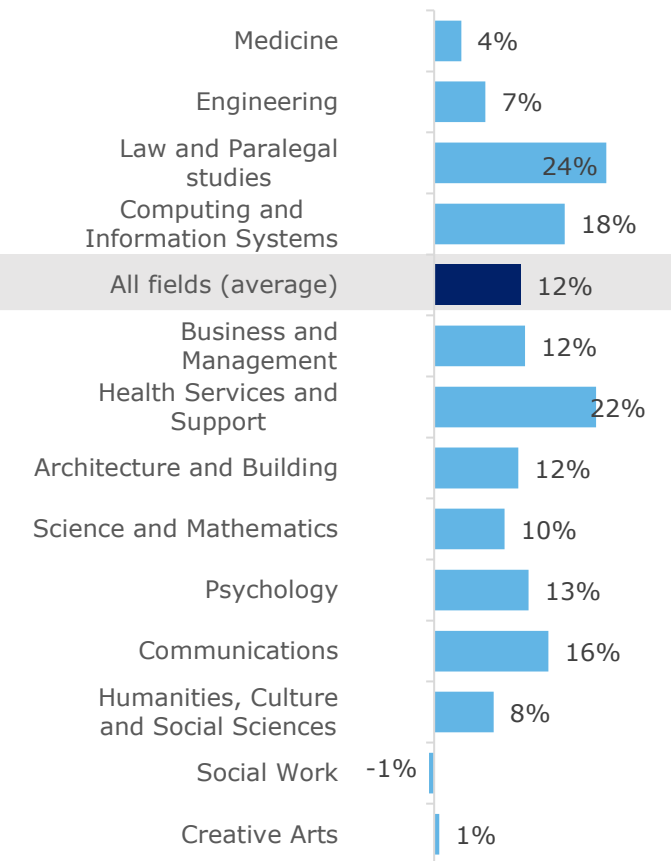


Chart 2.4: UNSW wage premium, relative to the average university graduate (9 years post-study)



■ All university graduates ■ UNSW graduates

The private benefits of a UNSW postgraduate degree

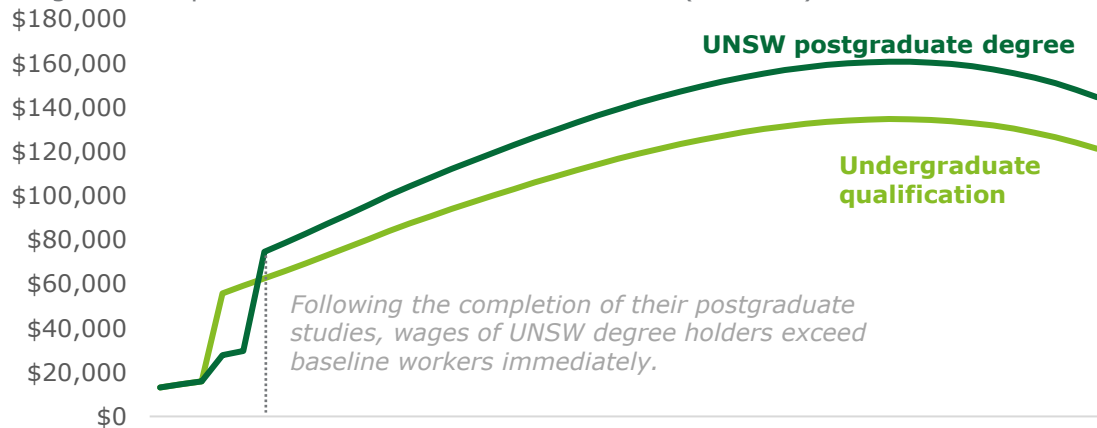
With a postgraduate degree, UNSW graduates earn, on average, \$18,100 more than workers with bachelor level qualification. This equates to \$834,000 over a lifetime.

For the average graduate with a UNSW postgraduate degree, the estimated wage premium is \$18,100, compared to the average individual with a bachelor level qualification. This is equivalent to a **lifetime wage premium of \$834,000**.

Key results

- Average annual wage of a UNSW postgraduate (among those who are employed) is **\$121,500** (Chart 2.5). This is 18% or \$18,100 higher than the average wage reported among individuals with only an undergraduate degree (from any Australian institution).
- The average labour force participation rate is 80%, **4% higher** than the participation rate among bachelor-degree holders.
- The average employment rate for UNSW postgraduate holders is 89%, **4% lower** than individuals with a bachelor degree from all Australian universities.

Chart 2.5: Wages (pre-tax) for average worker over the lifetime, UNSW postgraduate qualification vs bachelor level holder (baseline)



Source: Deloitte Access Economics analysis using HILDA data (2021). Notes: The model assumes three years of study for an undergraduate degree and two years of study for a postgraduate degree, and 43 years of work on average, between the ages of 19-64.

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UNSW's postgraduate degree holders also benefit from better labour market outcomes than the average postgraduate degree holder.

On average, UNSW postgraduate degree holders earn an annual wage of \$121,500 compared to \$111,500 for postgraduate degree holder from other universities (Table 2.2). Further, UNSW graduates also have higher (2%) labour participation rate.

Similar to the discussion of results for graduates with a bachelor's degree, a smaller sample size is used to estimate UNSW-specific premiums, which remain statistically significant, but less precisely estimated. Similarly, lower employment rates may reflect a small number of unemployed persons in the sample biasing results, as well as higher participation rates and/or systematic variation by fields of education.

Table 2.2: Components of the postgraduate earnings premium

	Average Undergraduate	Average Postgraduate	UNSW Postgraduate
Wages <i>Relative to average undergraduate</i>			
Average annual wages	\$103,300	\$111,500 +\$8,200	\$121,500 +\$18,100
Lifetime wages	\$4.75 m	\$5.13 m +\$0.38 m	\$5.59 m +\$0.83 m
Lifetime wages (discounted)	\$1.02 m	\$1.07 m +\$0.04 m	\$1.21 m +\$0.19 m
Other labour market outcomes <i>Relative to average undergraduate</i>			
Participation rate	76%	78% +2%	80% +4%
Employment rate	93%	93% +0%	89% -4%

Source: Deloitte Access Economics analysis using HILDA data (2021).

The effective lifetime earnings premium of a UNSW degree

The effective lifetime earnings premiums of UNSW undergraduate and postgraduate degree are \$859,000 and \$414,500, respectively.

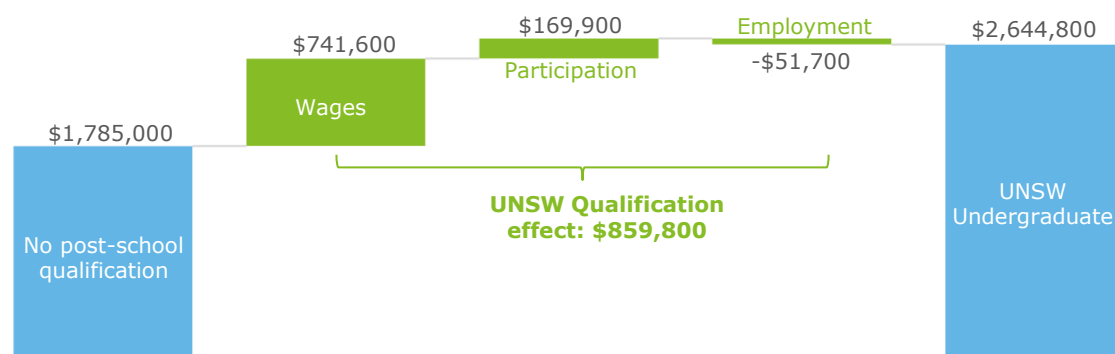
Effective lifetime earnings reflect the **combined impacts of all three labour outcomes** from attaining a qualification – that is, an individual’s labour force participation levels, their likelihood of employment, and their wage. Effective earnings are smaller than wages, as they account for graduates who do not enter the workforce or achieve employment (and are assumed to receive zero wages). These estimates are used to inform the public benefits calculations (over page).

Effective earnings premium for UNSW undergraduate degree holders

For the average UNSW graduate with a bachelor’s degree, the lifetime net ‘private benefit’ – that is, their additional effective lifetime earnings (post-tax) – is estimated at **\$859,800**.

While 86% (\$741,600) of the additional lifetime earnings from a UNSW undergraduate degree is driven by the wage effect (Chart 2.6), there is also a material impact from workforce participation, accounting for 15% of the earnings premium (equivalent to \$170,000 in lifetime benefit). Lower employment rates have a relatively small effect on final earnings.

Chart 2.6: Components of effective lifetime earnings, UNSW undergraduate vs non degree



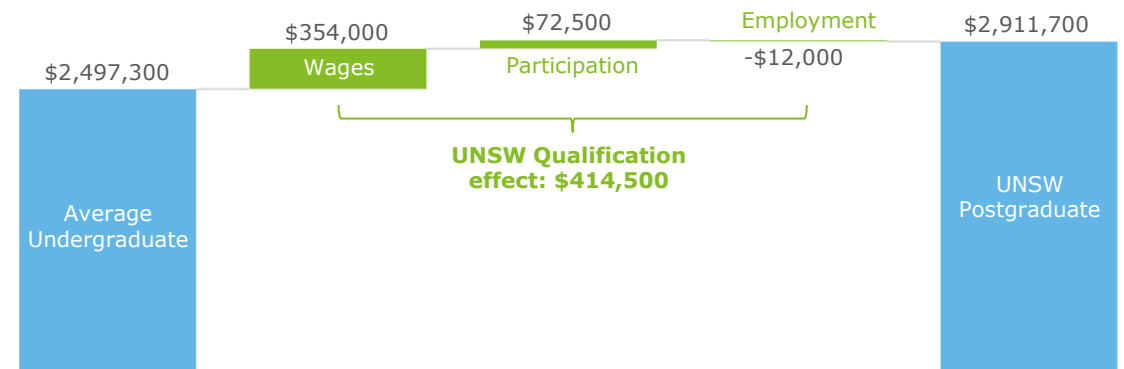
Source: Deloitte Access Economics analysis using HILDA data (2021).

Effective earnings premium for UNSW postgraduate degree holders

For the average UNSW graduate with a postgraduate degree, the effective lifetime earnings premium is **\$414,500**, compared to an individual with a bachelor level qualification (from any university).

Similarly, the wage effect is the primary driver supporting higher earnings, where \$354,000 or 85% of the greater lifetime earnings is due to the wages effect (Chart 2.7). This is followed by a higher participation level, contributing to \$72,500 in additional earnings. A slightly lower employment rate among workers with UNSW postgraduate degrees leads to a loss in earnings (-3%).

Chart 2.7: Components of effective lifetime earnings, UNSW postgraduate vs average undergraduate



Source: Deloitte Access Economics analysis using HILDA data (2021).

Note: The lifetime wages premium (slide 20) refers to the earnings of only those individual who attain employment. The effective earnings accounts for individuals who are unemployed or do not enter the labour force. Accordingly, these effective earnings values are smaller than the lifetime wages estimates.

The economic benefits of the UNSW alumni

The University's 75,000 working alumni will generate \$3.4 billion in economic activity for Australia in 2021, reflecting both their private returns and the public returns from supporting Australia's productivity and additional tax contributions.

The increased attainment of higher education principally supports broader public economic benefits through two drivers: (1) increased economic productivity, via productivity spillovers from increasing the supply of more highly skilled labour, and (2) increased tax receipts associated with higher earnings. This analysis relies on a CGE modelling approach from previous studies that examine the public benefits of education on the Australian economy.^{1,2} Adjustments are made to these existing results and modelling to account for higher earnings (and then higher taxes) for UNSW graduates.

Calculating the number of UNSW alumni

We estimate that there are approximately 75,000 UNSW alumni in employment in the Australian labour force. This calculations starts with the working age population of Australians with a higher education qualification (from the ABS Census)⁴, and then adjusts for:

- Identifying those born overseas and applying an average proportion of 32% who obtained their qualification in Australia (versus outside of Australia).⁵
- Applying a UNSW share of graduates of 3.9%.⁶
- Splitting this group in undergraduate and postgraduate holders based on a 60:40 split.⁷

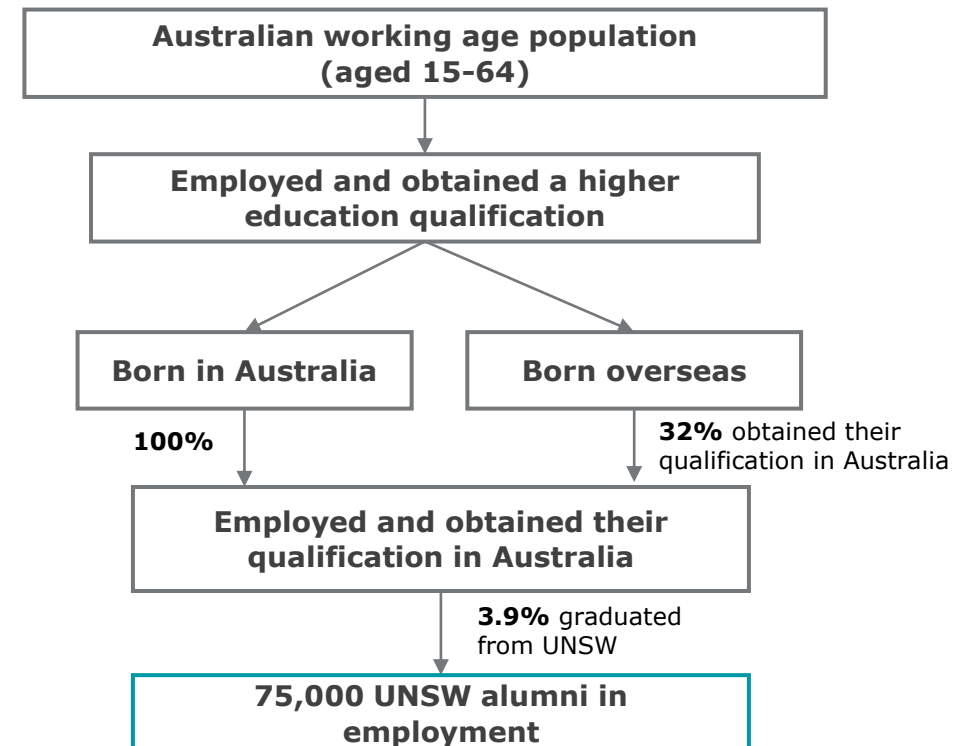
Calculating economic benefits

The average economic benefits are modelled for each age group (from the previous slides) and applied to the UNSW alumni from above. These returns include the private benefits from work, as well as the public benefits from productivity spillovers and greater taxation.

On average, each alumni contributes almost \$45,600 in public and private economic benefits, where around \$24,600 or 55% attribute to public returns and \$21,000 or 45% to private returns (noting these values are post-tax).

This includes an additional taxation calculation, which accounts for the profile of participation, employment and wages for different age groups, and current tax rates. This results in an average of \$5,050 in additional tax paid per year for a UNSW undergraduate degree holder (compared to an undergraduate degree holder from any university), and an average \$4,400 in additional tax paid per year for a UNSW postgraduate degree holder (compared to a postgraduate degree holder from any university).

Figure 2.2: Approach for estimating number of UNSW alumni in employment in the Australian labour force



Source: Deloitte Access Economics estimates using data from ABS Census and Department of Education, Skills and Employment.



3 | The University's research impact

The University's research impact in 2020

Research discovery, translation and commercialisation leads to a breadth of economic and social returns, across a diverse range of disciplines, sectors and members of the Australian public.

At the whole-of-university and individual project level, UNSW research activity supports productivity and public benefits - realised across many sectors of the Australian economy.

This report replicates the methodology from previous reporting, but with updated data for the most recent years. While there is a small variation in results, they are ultimately not statistically significant and do not materially change the findings. Other recent research re-affirms these findings. Analysis of the relationship between research, productivity and innovation finds that:

- \$1 invested in higher education research and development is linked to a \$5 return to GDP.
- This means that a public investment of \$547 million in research grants to UNSW in 2020 is expected to result in an economic benefit of \$2.7 billion (in 2021 dollar terms)

The University's contribution to Australia's innovative capability is enabled through individual university research projects, translation and community engagement. Three illustrative case studies provide specific, tangible and contemporary examples of the public and private benefits of original research and its translation:

- Dr Holly Seale, School of Population Health, undertook research (with NSW Health) to support more accessible COVID-19 and vaccination messaging for CALD communities in New South Wales.
- Dr Veena Sahajwalla, UNSW Centre for Sustainable Materials Research and Technology (with industry partner Molycop) developed technology which minimises the fossil fuels needed in the steel making process.
- Professor Bill Walsh and Dr Matt Pelletier, Prince of Wales Clinical School invented Thru-Fuze™, an orthopaedic device for the treatment of spinal disorders.

\$5 for every \$1
\$2.7 billion

return to GDP from expenditure on higher education research and development, reflecting the impact on economic productivity and innovation

economic impact from research funding received in 2020

estimated public and private returns from the \$547 million research grants UNSW received in 2020

3 case studies demonstrate the public and private benefits:

- A research paper and glossaries in 31 languages, to make COVID-19 vaccine information more accessible for CALD communities may have enabled **\$62 million** in economic benefits associated with supporting the end to the NSW lockdown, \$260,000 in avoided costs associated with hospitalisations and \$1.1 million in the value of lives saved through vaccination.
- Green steel produced using polymer injection technology invented at UNSW and commercialised through industry partnership could enable **\$34 million per year in environmental and business cost savings** for the Australian steel industry. This figure reflects the impact of a 14% reduction in coking coal – reducing both input costs and emissions - a 2.5% reduction in energy use and the potential to redirect 425,600 tyres from landfill each year.
- The Thru-Fuze™ orthopaedic device, while still in medical trial phase, could provide a less invasive alternative surgery for spinal conditions. Currently, spinal fusion surgeries are successful in less than half of all cases. If Thru-Fuze™ improved this success rate by 50%, 11,250 fewer people per year would be living without chronic back pain – reflecting a financial benefit of up to **\$500 million in avoided economic and social costs**.

Research returns at a whole-of-university level

A macro-econometric model is used to estimate the contribution of higher education research and development to supporting long term economic growth and prosperity.

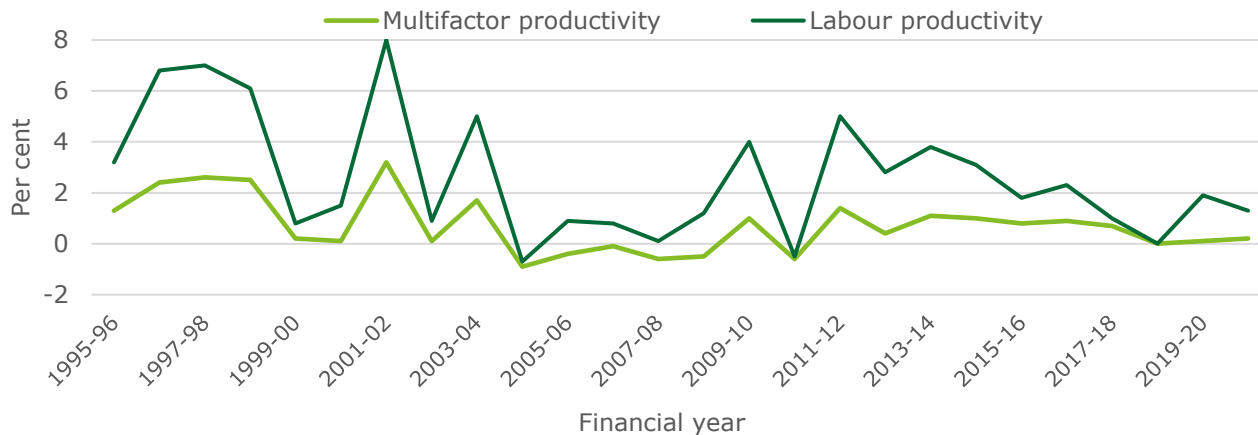
Alongside skilled graduates, research activities form a major contribution to support economic growth and productivity. This chapter examines the contribution of UNSW research activity to Australia's productivity and economic growth. The results rely on the same methodology previously undertaken by Deloitte Access Economics in a 2020 study for Universities Australia.¹

Contribution to national productivity and economic growth

Universities are leaders in research and development. Through their investment and innovation in research, universities create knowledge spill-overs into the public and private sectors and drive productivity growth. Universities can contribute significantly to productivity through their R&D activity, driving technological innovation for physical capital and increased human capital accumulation for labour productivity.

Supporting Australia's multifactor and labour productivity are essential drivers of long term economic growth. The most recent period has seen relatively lower productivity growth (Chart 3.1), which emphasises the potential role that universities can have in supporting greater productivity growth.

Chart 3.1: Australia's productivity growth (1995-6 to 2020-21)



Source: Australian Bureau of Statistics (2021)

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Measuring returns from university research

This study relies on a **cross-country macro-econometric model** to estimate the contributions of higher education research and development to long term economic growth. This approach is based on the method used by Bassanini and Scarpetta (2001) and utilises evidence from 37 countries over the period 1980 to 2018 (see Appendix C for list of countries included in this study).

In this model, the key dependent variable is GDP per capita. To account for other factors that may affect economic growth over time, the following explanatory variables are included:

- Gross capital formation (as a % of GDP)
- Tertiary education attainment (as a % of those who are aged 15 and above)
- Expenditure on higher education R&D per capita – this study's key variable of interest
- Expenditure on other R&D per capita
- Total exports and imports (as a % of GDP)

The results from this study suggests that a permanent 1% increase in higher education R&D investment generates an additional 0.12 percentage points of economic growth for Australia over the long-term – equivalent to a \$2.3 billion annual GDP increase. Further details of the methodology are provided in Appendix C.

Research returns at a whole-of-university level

Empirical analysis on the contribution of research activity to economic productivity and innovation finds that every \$1 invested in higher education R&D is linked to a \$5 return to GDP

Costs and benefits of university research

The benefits of university research are realised in many ways and can take many years, even decades, to fully materialise. One of the most measurable ways that benefits accruing to the economy are captured is through impacts on Australia's GDP.

To estimate the return on R&D, the effects of additional investments in university research and development over the 30 years to 2018 are estimated (previous page). To calculate the dollar return on this investment, the present value of total benefits are compared to the present value of the total research spend (i.e. total cost of investment).

On this basis, the effects of historical investment in university R&D suggest that **for each dollar of expenditure** over 1988 to 2018, economic output (GDP) **grew by \$5** in present value terms. These findings are broadly consistent with recent CSIRO research on the returns to general R&D.¹

The UNSW contribution

Across 21 broad fields of research and 89 specialised areas of research, the University's average Excellence in Research in Australia (ERA) score was 4.8 (out of 5, in 2018), the highest in the country. This included 17 top ratings of five for "outstanding performance well above world standard", more than any other university.² This suggests that the University's average rate of return for research is likely to be greater than average (i.e. a return of more than \$5 for every \$1), such that these estimates are likely to be conservative.

This research excellence enables productivity and public benefits across many sectors of the Australian economy. In 2020, UNSW received \$547 million in public research funding (Table 3.1), which is expected to have an economic impact of \$2.7 billion across the next 30 years (in present value terms).³

Table 3.1: UNSW Public Research Funding 2021

	Amount (\$ m)
Education Research Grants	178
Australian Research Council Grants (ARC)	57
National Health & Medical Research Council (NHMRC)	94
Other Commonwealth Research Grant funding	174
State, Territories & Local Government Research funding	44
Total	547

Source: UNSW (2021).

Notably, expenditure on R&D represents a proxy for the stock of knowledge attributed to university research that exists in the economy. As such, estimates of the marginal effects of additional R&D may in-part also capture the ongoing contributions of previous R&D investments, such that these estimates may be *overstated* in the short-run.

Nevertheless, these estimates of the long-term macroeconomic impact of university research output clearly demonstrate a strong relationship between university research and economic growth. Noting that more research is required to understand the mechanisms or pre-conditions required for success, these estimated effects apply most appropriately to aggregate research activities, and should not be more granularly applied to any individual research activity.

Results by field of education

The \$5 per \$1 estimated return presents an aggregate impact of research activity. In line with leading literature, this approach does not distinguish between research expenditure from differences sources, or directed towards different scientific and technological disciplines.³

Existing literature that analyses the public and private benefits of higher education and which seeks to differentiate returns at a field of research level has focused on the returns to teaching, rather than research, and do not provide a consensus view of how private benefits from higher education may vary across fields.

Case studies of leading research projects

Research project case studies provide an exemplar of the public benefits of UNSW research and its role in supporting Australia to navigate the most pressing social and environmental problems.

Society is facing some of the most wicked problems seen in history – a warming planet, global pandemics, social fragmentation – and the solutions to these problems lie in pairing the ground-breaking frontier thinking of university researchers with the acumen, influence and reach of businesses and government.

Across 2020 and 2021, the expertise of Australian researchers has been at the forefront of the national pandemic response, from the advice of epidemiology and immunology specialists, to the commentary of experts in social policy, law and economics, to inform and communicate public policy.

Applied research will be critical to Australia's economic recovery from the pandemic's impact – and to ensure the resilience and sophistication of the economy into the future. The results presented above reflect that the university sector is a major driver of economic activity.

A case study approach analyses the economic contributions of three exemplar research programs across the University on New South Wales – to demonstrate how leading research projects can unlock value. In consultation with the University, three research projects from different research centres have been selected as case studies – to demonstrate the breadth of benefits from research discovery, translation and community engagement activity.

These case studies focus on identifying the 'throughputs' of each research project and their associated outcomes. These throughputs are then carefully considered for the benefits generated that can be attributed to the research completed by UNSW, as compared to the counterfactual of 'business as usual'. Then, where possible, these benefits have been appropriately quantified. These case studies are designed to be illustrative, to provide insight into the types of value created by research completed at and by UNSW.

Figure 3.1: Case studies of UNSW research translation



COVID-19 Information for CALD communities

Dr Holly Seale, in the School of Population Health undertook a research project in partnership with NSW Health to understand the engagement of CALD communities with public health information about COVID-19. This led to the development of a multilingual resource on immunisation and vaccination to support the vaccine rollout, through effectively enhancing communication in response to the community's needs.*



A greener approach to producing steel

Dr Veena Sahajwalla and researchers at the UNSW Centre for Sustainable Materials Research and Technology worked in collaboration with industry partners to develop technology which minimises the fossil fuels needed in the steel making process.



Thru-Fuze™ orthopaedic device

Professor Bill Walsh and Dr Matt Pelletier in the Prince of Wales Clinical School invented the Thru-Fuze™ orthopaedic surgical device for the treatment of spinal disorders, which is currently in the clinical trial phase.

* UNSW has provided input to and completed a range COVID-19 related research - see slide 29



Case study | COVID-19 information for CALD communities

Research undertaken by Dr Holly Seale, School of Population Health, focused on understanding engagement of CALD communities with public health information for COVID-19. This led to the development of multilingual resources on vaccinations in collaboration with NSW Health, and a series of informational webinars to help community leaders and health professionals tackle vaccine misinformation.

The challenge

Australia launched its COVID-19 vaccination program in early 2021, prioritising frontline workers in hotel quarantine, health care and aged care. People from Culturally and Linguistically Diverse (CALD) backgrounds form a significant and growing share of Australia's frontline workforce. This is especially true for the aged, disability and community care sectors, in addition to hotel quarantine.¹ For instance, 37% of Australian frontline care workers were born overseas and around 28% are from non-English-speaking backgrounds.²

In early 2021, research found that those who speak a language other than English at home were less willing to receive the COVID-19 vaccine compared to the rest of the Australian population.³ These findings are echoed by ABS data, which revealed that in June 2021, Australians that reported receiving at least one dose of a COVID-19 vaccination were more likely to be people born overseas who arrived more than 10 years ago (38%) than those born overseas who arrived more recently (18%).⁴ Those who actively sought information about COVID-19 were more likely to be people born overseas (65%) than born in Australia (56%).⁵

The UNSW research project

In early 2021, Dr Holly Seale - infectious disease social scientist at the School of Population Health at the University of New South Wales - led a research project to understand how people from CALD communities had engaged with public health information during the pandemic and to identify strategies to improve communication about the COVID-19 vaccination program.

Dr Seale led a team of researchers who together undertook 70 in-depth interviews with stakeholders across Australia including Government agencies, government funded community-based organisations, CALD community peak bodies and councils, migrant resource centres, refugee health services, settlement services, translation services, women's support groups and community groups.

The study identified key information gaps among these communities, including delays in translating information into all languages and a lack of access to information at the appropriate level for those with low literacy or low 'health literacy'. The study also found that where information was being tailored to some audiences, there were concerns about the accuracy and consistency of messages.

The research made 19 recommendations to enhance and support the COVID-19 vaccination program with reference to CALD communities, focusing on enhancing communication, vaccine delivery and system responsiveness.⁶ Recommendations included translating vaccination messages into new emerging CALD communities' languages and developing a glossary of immunisation terms.

Research translation and community engagement

There were a range of audiences for and outputs from the work, including:

- Publishing findings for use by the NSW Health public health network.⁶
- Communicating findings and their implications to a broader audience, such as via *The Conversation*.⁷
- Developing the glossary of immunisation terms relevant to COVID-19 for community organisations, community leaders and translators/ interpreters in 31 languages, targeting migrant and refugee groups.⁸

Dr Seale has since facilitated around 30 training sessions, targeting health providers, social workers, and community and faith leaders working with CALD communities. These sessions - estimated to have reached 600 people to date - have focused on how to address misinformation relating to COVID-19 and the immunisation process.

Case study | COVID-19 information for CALD communities



OECD research revealed that trust in vaccines is critically dependent on the ability of government to communicate the benefits of vaccination.¹ Accessible and in-language information is a key component of developing that trust. Leading health literature has also found that lower health literacy is associated with a reluctance to accept vaccines.²

Figure 3.2 sets out the benefits associated with the research and its dissemination. Translating and tailoring information to align with community needs and practices and supporting policy makers to alter their communication processes appropriately led to greater information access for CALD communities in NSW, which in turn reduces vaccine hesitancy in the community. Outcomes might include a higher vaccination rate and a faster vaccine uptake, enabling economic benefits associated with avoided costs to the health system and avoided costs of a longer lockdown.

Figure 3.2: Benefits of the research project and glossaries

Fewer deaths

Increased vaccination will reduce the spread of COVID to vulnerable groups, resulting in fewer deaths.

More accessible and better tailored vaccine information will help to reduce vaccine hesitancy, increasing both the pace and level of vaccinations.

Avoided costs to the health system

Increased vaccinations will lead to fewer COVID cases being spread amongst the community, reducing costs associated with hospitalisation.

Avoided costs of lockdown

Increased vaccinations brings forward the end of lockdown in NSW.

Benefits of the COVID-19 glossary for CALD communities

If 5% of the 1.3 million CALD community members in NSW were vaccinated as a result of clearer information...

Of the 31 languages which the project translated key COVID-19 vaccine information for, the ABS identifies 21 of these languages among the Australian population.^(a) At least 1.3 million NSW residents use this as their 'language spoken at home'.

If 5% of these CALD communities in NSW received a vaccination earlier or at all because they had received more accessible and tailored information through these resources, this equates to 65,000 people better protected against COVID-19.

... this would equate to around 17 hospitalisations and 3 ICU admissions avoided, saving \$259,000 in estimated costs of patient care, and 3 fatalities avoided – a monetised value of \$1.1 million.

Data from Victoria's second wave informs the estimated avoided spread of disease from COVID-19 vaccinations. If 65,000 people aged 18-79 are vaccinated, this results in 17 avoided hospitalisations, 3 avoided ICU admissions and 3 avoided fatalities.³ Based on the efficient prices of hospital care, this reduced rate of hospital and ICU admission represents avoided costs to the public health system of around \$259,000 dollars.^(b) The 3 fatalities avoided reflect a monetised benefit of \$1.1 million.^(c)

Encouraging more and more timely vaccinations contributed to the overall NSW vaccination strategy and the end of NSW lockdown – with estimates suggesting a saving of \$62 million.

Alongside the avoided health costs, the faster rates of vaccination contributed to the end of COVID-19 restrictions in NSW (alongside many other policies and programs). Across the month of October, up to 150,000 people in NSW were being vaccinated each day. If 65,000 people were supported in either getting vaccinated earlier or at all, this contribution to the overall effort is equivalent to ending lockdown half a day earlier – and with the cost of lockdowns on the NSW economy estimated at \$1 billion a week, this half day, while short, reflects an economic benefit of around \$62 million.

(a) Estimated using the Census of Population and Housing, 2016, NSW, 'Language spoken at home', available for 21 of the 31 languages in which the glossary is translated

(b) Based on the national efficient price (NEP) determined by the Independent Hospital Pricing Authority, which is updated annually. The NEP used in this analysis has not been adjusted to reflect legitimate and unavoidable variations in the cost of delivering health care services.

(c) Based on a median age of COVID related fatalities of 84 and the value of statistical life.



The University's COVID-19 research contribution

University of New South Wales researchers have been at the forefront of the national COVID-19 response – from policy development to advocacy and treatment

Across 2020 and 2021, the expertise of Australian research has been at the forefront of the national pandemic response – with academic experts in fields ranging from medicine, law, economics and social policy providing insight to inform the public health response.

In late March 2020, the *UNSW Rapid Response Research Fund* was established to support COVID-19-related projects, with funding allocated to 13 projects ranging from developing clinical immunotherapies to addressing the social and mental health aspects of COVID-19.¹

UNSW research projects which have enabled COVID-19 management at a national and global level include:

- **Research translation and public commentary**, featuring leading UNSW academics including Professor Mary Louise McLaws, Professor Raina MacIntyre, Professor Richard Holden on topics from the best response to managing the delta COVID-19 outbreak to economic government response initiatives such as the JobKeeper payment.
- **Discovery research into medical treatments**, such as Professor Tony Kelleher's work to develop critical lab infrastructure to facilitate a breadth of research, and Professor Miles Davenport's globally influential publication in *Nature* on protective antibody levels following immunisation² which provided critical evidence to increase the efficacy of vaccinations with booster shots.
- **A point-of-contact COVID-19 testing system** established by Professor Rebecca Guy at the Kirby Institute³, which was implemented in over 80 rural and remote Indigenous communities across Australia. The process cut testing times to around 45 minutes, in stark contrast to the 10-day wait period for testing in remote areas such as the Kimberley.
- **Research translation to inform public health modelling**, including Associate Professor James Wood's contribution to the Doherty Institute modelling and NSW Health modelling⁴, Dr Alexandra Hogan's contribution to the World Health Organization policy evidence on COVID-19 vaccine prioritisation⁵, and Associate Professor Holly Seale's role as a member of the World Health Organisation's working group on the behavioural and social drivers of COVID-19 vaccination.
- **Research to articulate and manage the social impacts of COVID-19**, such as Associate Professor Kylie Valentine's research within the Social Policy Research Centre to investigate the short-term impact and policy responses related to domestic and family violence in Australia during COVID-19.⁶ Another example is the research led by Dr Susanne Schweizer in the School of Psychology, to investigate the social, cognitive and mental health impacts of COVID-19.⁷
- **New disinfection systems to overcome PPE shortages**, such as the methods established by Professor Mark Willcox within the School of Optometry and Vision Science, to boost the supply of critical PPE for healthcare workers and solutions for sustained protection of surfaces to prevent the spread of COVID-19.⁸



Case study 2 | A greener approach to producing steel

Developed by UNSW researchers in collaboration with industry partners, polymer injection technology provides an innovative approach to steel production, using end-of-life rubber tyres and waste plastics as an alternative to burning fossil fuels in the steel making process. The process is now operating at commercial scale and has also been licensed by steelmakers around the world. In 2019, the technology had been used in the production of more than 30 million tonnes of steel.

The need for greener steelmaking

There are a variety of different methods to manufacture steel: the most common methods are blast furnace and the electric arc furnace (EAF). The EAF method is the project's focus and is responsible for about 30 per cent of global steel production.

The steel industry is among the three largest global producers of carbon dioxide (CO₂). This is mainly due to its use of non-renewable fuels as inputs – on average every tonne of steel produced using the EAF emits about 0.8 tonnes of CO₂,¹ and the industry as a whole is responsible for about 8 per cent of global CO₂ emissions.² Emissions reduction will be essential to meet global targets with the steel industry facing mounting pressure to reduce its carbon footprint.³

Polymer injection technology

The Green Steel technology was first developed in 2003, when UNSW Scientia Professor Veena Sahajwalla pioneered the technology in a laboratory at UNSW. Through Polymer Injection Technology (PIT), end-of-life rubber tyres and waste plastics provide a source of carbon to replace a significant proportion of the non-renewable coking coal used to make steel. Collaborating closely with steel producer MolyCOP as an industry partner, Professor Sahajwalla and the team at the UNSW Centre for Sustainable Materials Research and Technology (SMaRT@UNSW) developed and commercialised the new production approach, which minimises the fossil fuels needed in the steel making process.

The use of hydrogen in the steel making process has widely been identified as the best method to cut greenhouse emissions, however, one of the largest challenges

remains affordably securing green hydrogen.⁴ Rather than sourcing green hydrogen, PIT sources hydrogen from the end-of-life tyres. This process delivers an affordable source of hydrogen, and enables cost savings for manufacturers by reducing the input costs of coking coal.

The commercialisation phase

The project has provided proof-of-scale for the use of polymer injection technology in steel making. In 2009, MolyCOP (formerly OneSteel) incorporated the polymer injection technology into its commercial production in its major electric arc furnace facilities in Sydney and Melbourne.

Since its initial commercialisation, the Polymer Injection Technology (PIT) has been patented and exported around the world. By 2016, the approach had been licensed by steelmakers in Thailand, South Korea, Norway and the UK. By 2019, the technology has been used to produce more than 30 million tonnes of steel.⁵

The SMaRT Centre continues to refine the production process. In October 2021, MolyCOP was awarded a federal government grant to help further commercialise the Green Steel Technology, with Professor Veena Sahajwalla identifying opportunities to realise further environmental benefits: *"We are collaborating in developing our Green Steel 2.0 technologies, which we are confident will at some point in the future allow us to be able to fully replace coking coal in EAF steel making with a range of waste materials."*

The SMaRT Centre at UNSW

Other products which repurpose waste using innovative engineering science have been developed at the SMaRT Centre. In 2019, researchers developed a way to manufacture ceramic tiles using a variety of waste materials to produce a range of 'green' materials and products for the built environment.

The ceramics products are mainly made from types of waste glass and textiles that are traditionally not subject to recycling, due to contamination and material complexity. The ceramics are used as kitchen benches, table tops, floor tiles, furnishings and for other applications. The SMaRT Centre also manages a MICROfactorie at UNSW, to produce these ceramics in partnership with industry and government clients.



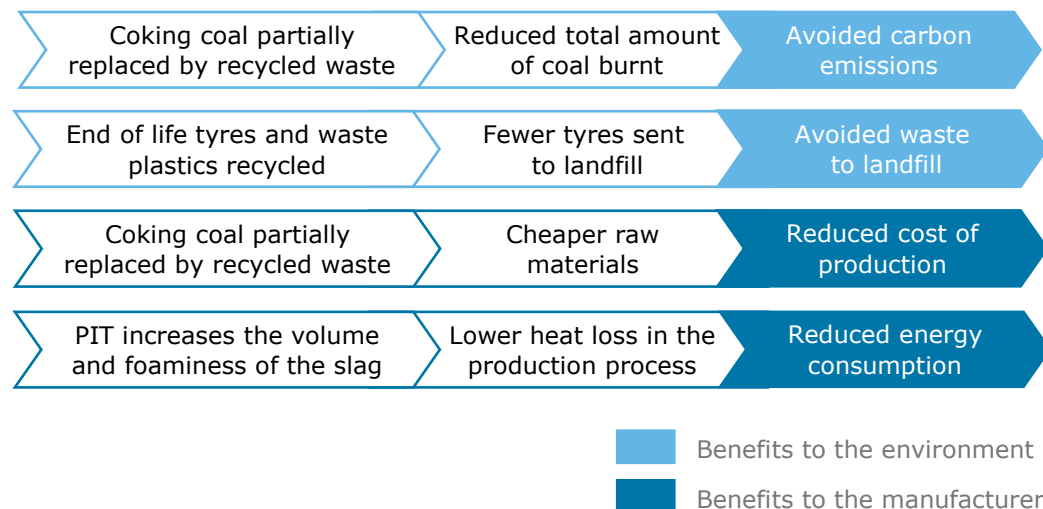
Case study 2 | A greener approach to producing steel

Australia produces approximately 5.5 million tonnes of steel per year.¹ Of the steel made in Australia about 26 per cent is made using the Electric Arc Furnace (EAF) approach, equating to about 1.43 million tonnes per annum.¹

PIT has realised environmental benefits and delivered cost savings for the project's partnering steel producer. The environmental benefits include reducing the CO₂ emissions in steelmaking by substituting out a portion of the coking coal, and redirecting end-of-life tyres from landfill.

Alongside these environmental benefits, the process is also more cost effective for producers. The polymer injection increases the volume and foaminess of the slag (non-metallic by-product consisting of silicates and oxides formed during the process of refining molten steel) which minimises heat loss in the production process. Greater heat retention reduces energy consumption and lower heat loss sees greater efficiency of production, with the process delivering higher yields than production under a standard electric arc furnace approach.

Figure 3.3: The benefits of Polymer Injection Technology (PIT)



Benefits of Green Steel developed with Polymer Injection Technology

Molycop produces an estimated 1.2 million tonnes per annum. The quantification below estimates the potential benefits for all Australia EAF steelmakers – which would mean a 16% increase in the uptake of PIT by the Australian steel industry.

\$22,300,000 in public benefits per annum, from a 14% reduction in the use of fossil fuels and by redirecting end-of-life-tyres from landfill

On average, 0.8 tonnes of CO₂ are emitted for every tonne of steel produced using the EAF.³ By replacing the coking coal, the polymer injection technology reduces the CO₂ emissions of the production process. In 2012, the implementation of PIT in Molycop's factories led to a 12%-16% reduction in the use of coking coal per ton produced.⁴ Taking the midpoint of this range, assuming a 1:1 reduction in emissions ratio^(b), and applying the social costs of carbon sees an estimated value of \$21,942,000 per annum in the avoided economic and social cost of emissions.

The Green Steel manufacturing process also enables the repurposing of end-of-life tyres and waste plastics which would otherwise be in landfill. Between 2009 and 2016, Molycop has employed PIT for over 84,000 heats^(a), consuming the equivalent of over 2.5 million end of life tyres which otherwise would've been sent to landfill in Australia.⁴ This equates to \$359,000 per annum in the avoided financial and environmental costs from sending tyres to landfill.

\$11,340,000 in benefits to steel producers per annum via reduced input costs and increased energy efficiency

Using end of life tyres is also more cost effective for producers than using coking coal. A reduction of 14%^(c) in the cost of raw materials from replacing coke with rubber equates to a saving of about \$7,405,000 per annum.

The alternative materials used in the PIT process are also more efficient and effective at improving the foaming properties of the slag to increase heat retention, thereby reducing the energy consumption required to produce each ton of steel. A 2.5% reduction in energy use under PIT, where energy use accounts for 20% of production cost,^(c) sees a cost saving of \$3,932,000 per annum.

(a) Assume 1 heat produces 100 tons

(b) Assume a 14% reduction in emissions using PIT

(c) Assume that a 14% reduction in emissions using PIT also reduces the use of coking coal as an input by 14%

(d) Assume total cost of production per tonne of steel is \$550



Case study 3 | Thru-Fuze™ Orthopaedic Device

Co-invented by Professor Bill Walsh and Dr Matt Pelletier at the UNSW Prince of Wales Clinical School, Thru-Fuze™ is an orthopaedic device designed to treat spinal disorders, alleviating chronic back pain. Currently in the clinical trial phase, the device provides an option to patients which is designed to be faster, simpler and cheaper than existing surgical interventions – reducing the need for more invasive surgery and bone grafts.

The costs of chronic pain

Chronic back pain – pain which continues for at least three months following an injury, surgery or as a result of disease - affected an estimated 4 million Australians in 2017-18, 16% of the national population.¹ Chronic back pain was the main reason for 181,000 hospitalisations in Australia 2017-18², and has been identified by the World Health Organisation as the most common reason for pain and disability in people aged under 50.³

Individuals with chronic pain also commonly experience concurrent health issues such as depression, sleep disturbance and fatigue. A 2014-15 study of Australians suffering back pain found that those with chronic back problems were more likely to report poor quality of life than those in the general population (8.9% of people with chronic back pain perceived their health as poor, compared with 4.4% of the general population).⁴

For those who experience chronic pain, it can be debilitating and have an adverse effect on work, sleep and relationships. Alongside the costs to the individual associated with treatment and lost wellbeing, there are also costs to the private sector, where chronic pain restricts some people's ability to engage in work. For the 56% of Australians living with chronic pain, their pain restricts what activities they are able to undertake.⁵ A review of related literature found that on average, there is a 30% reduction in employment associated with chronic pain.⁶

Currently, the surgical interventions for chronic back pain – used once more conservative therapies such as physical therapy, medication and injections have failed – are invasive, costly and variable in their effectiveness.

The Thru-Fuze™ device

Professor Bill Walsh and Dr Matt Pelletier, researchers at the surgical and orthopaedic research laboratory at the University of New South Wales, co-invented Thru-Fuze™, an orthopaedic device for use in the surgical treatment of spinal disorders to help alleviate chronic back pain – in particular, the back pain caused by degenerative disc disease.⁷

The device is positioned during surgery between the transverse processes of adjacent vertebrae to hold them in place. This stabilises the spine to alleviate pain, allowing for fusion of bone both on and through the device over time. Comparable processes for spinal fusion surgery include pedicle screw and rod systems, which require a bone graft from the pelvis. These alternatives are costly, difficult and time consuming to implant, involve a painful bone-graft for the patient, and have relatively low rates of success.⁸

The Thru-Fuze™ device is designed to be simpler and cheaper than alternative surgical procedures – allowing for faster surgery with less, or no, radiation exposure, and a faster biomechanical fusion.⁹

The commercialisation phase

Thru Fuze™ received seed funding (AUD\$2.3 million + IP costs) from Intellectual Ventures, to support the research and development phase of the project. Intellectual Ventures exclusively licensed the device from UNSW as part of a five-year partnership with UNSW Innovations to source inventions to commercialise. Patents for the technology have been filed in Australia, Europe, China and the United States.¹⁰

Thru-Fuze™ device was one of seven medical devices to receive funding from NSW Health's Medical Device Fund in 2015.¹¹ The grant has allowed Thru-Fuze™ to move into clinical trials, which commenced in 2016.



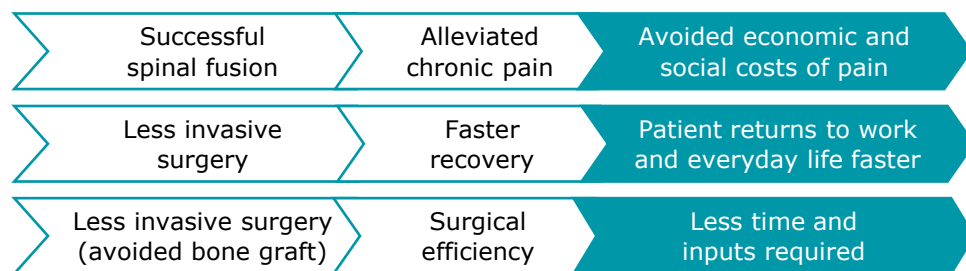
Case study 3 | Thru-Fuze™ Orthopaedic Device

An estimated 45,000 Australians undergo spine surgery every year, as a last resort to alleviate chronic back pain.¹ Spinal fusion surgery is Australia’s third most costly surgical procedure², where success is realised in less than half of all cases and around one in five patients requiring revision surgery within 10 years.³

Where the Thru-Fuze™ device is designed to be simpler and cheaper than these alternative surgical procedures, the potential benefits include:

- The reduced **incidence of chronic pain** associated with successful surgery
- The benefits of greater **workforce participation** among patients, where their recovery time is reduced
- The financial benefits associated with **surgical efficiency**, including the avoided cost of complex bone-graft surgery

Figure 3.3: The potential benefits of the Thru-Fuze™ device



Source: Deloitte Access Economics (2021)

The device remains in the medical trial stage – such that the extent of benefits compared to existing spinal fusion surgeries can not yet be quantified. However, the less invasive approach – if applied in a medical setting – could see the realisation of benefits for patients which ameliorate some of the cost of chronic pain in Australia – currently estimated at \$44,500 per-person.⁴

Benefits of the Thru-Fuze™ device

Avoided economic and social costs of pain

In 2019, Deloitte Access Economics found a \$44,550 per person cost associated with chronic pain. Of this figure, there is an estimated \$23,400 in financial costs associated with chronic pain, including productivity losses from unemployment, absenteeism and presenteeism among sufferers of chronic pain, costs to the health system and other financial costs, including the costs of informal care. The remaining \$21,100 relates to the wellbeing costs associated with chronic pain, measuring the burden of the disease using disability life adjusted years (DALYs).

Chart 3.1: The total costs associated with chronic pain, Australia 2018



Note: Other financial costs include informal care, aids and modifications, deadweight losses. Source: Deloitte, Access Economics, 2018.

For those 45,000 Australians that undergo spine surgery every year, half of these surgeries are unsuccessful.⁵ If Thru-Fuze™ improved the success rate by 50% of those that have already experienced a failed surgery, this would see 11,250 fewer people per year living with chronic back pain – reflecting a financial benefits of up to **\$500 million in avoided economic and social costs**.

A faster return to everyday life

While Thru-Fuze™ is still a surgical spinal procedure with the associated recovery time, it replaces the need for an additional painful bone graft procedure. Overall, this results in a less invasive procedure for patients with lower recovery time. This means patients will be able to enjoy a return to work and everyday life more quickly.

More efficient surgery

The surgery involving Thru-Fuze™ has been described by co-inventors as faster, simpler and cheaper than the alternative, which is Australia’s third most costly procedure. This means that the procedure also provides the potential realisation of surgical efficiencies, in the form of both the time and inputs required.



4 | The University's role in Australia's economic sophistication

The University's contribution to Australia's economic sophistication

Beyond monetary measures of economic contribution and impact, the diverse and complex influence of university research and teaching to Australian society can be understood and quantified as they relate to Australia's economic sophistication and resilience.

Traditional measures of economic benefit, principally those related to gross domestic product (GDP), are important and useful measures of economic prosperity and development – and form the basis of the earlier chapters of this report.

These measures are typically well-understood, empirically robust and support tractable comparisons within and across economies.

However, there is increasing acknowledgement that more nuanced measures of economic development and growth are needed, particularly within the discourse of more advanced and mature economies.

An 'economic sophistication' framework provides a further basis for understanding the function and role of universities in supporting the Australian economy to navigate an everchanging global context.

This chapter considers four pillars of economic resilience – *preparedness, innovation, connections, and capabilities* – that dimension a richer narrative of economic sophistication, complexity and resilience.

The key findings of this analysis articulate the ways in which the University contributes to Australia's capabilities – through teaching, research and international and industry collaboration.



Building Australia's workforce capability

- Half of all domestic students are enrolled in courses which map to jobs in critical shortage, with 6,300 graduates into these roles each year.
- UNSW trains graduates across the five largest professional occupations in NSW, where 17,500 new jobs are created each year. Based on the current profile and volume of students, UNSW graduates could fill up almost 2 in 5 (or 6,300) of these new jobs in 2022.



Ensuring workforce preparedness for a changing economy

- 1 in 4 of the University's domestic students is enrolled via distance, online or intensive delivery - reflecting 15,000 Australians accessing flexible training.
- A diverse cohort reflects UNSW's commitment to a just society: the University enrolls more women in engineering than any other university in Australia, and outperforms the Go8 in enrolments from First Nations and CALD communities.



Enabling innovation at the frontier of research and teaching

- Employer satisfaction is at or above the NSW average with respect to students' foundations, technical and overall skills.
- A commitment to the need of industry is demonstrated through work-integrated learning, offering 24 co-operative scholarship programs across 4 fields of education.



Facilitating global connections for Australian graduates and employers

- 130 nationalities are represented by international students enrolled across UNSW's campuses, which support diverse precincts in Sydney and the ACT
- UNSW international students earn \$5,300 upon graduation more than the median, supporting NSW to attract and retain international talent.

Viewing the University through a lens of *economic sophistication*

Australia's public universities, through their operations, teaching and research activities, and global connections, enable Australia's economic sophistication, resilience and complexity.

While Australia ranks 11th globally in GDP per capita, the country is ranked far more moderately with respect to economic sophistication.

A ranking of 37th of 63 countries in terms of economic complexity – a composite measure of the *value added* to goods and services and how *connected* the industries that make these are to the rest of the world – reiterates the need for Australia to consider its sophistication and resilience.

28 years of uninterrupted growth has been to the detriment of economic diversification. Though a focus on raw materials exports in sectors like mineral resources and agriculture has provided historical wealth, Australia is positioned at the start of the global value chain rather than deeply embedded within it.

Rapid technological change, climate change, geopolitical tensions and global uncertainty strengthens the imperative for Australia to modernise its economy and pursue a more economically sophisticated path to define a resilient and globally competitive post-pandemic future.

Against this context, we apply a resilience framework which introduces the 'four pillars of economic resilience' – *preparedness, innovation, connections, and capabilities* (Figure 4.1).¹ This framework provides a strategy tool for policy makers and businesses to support developing their resilience and adaptability. The framework also provides dimensions to underpin measures of economic complexity – unsurprisingly, these dimensions align strongly with the function and role of universities within the Australian economy, and are consequently used as the basis of the analysis in this chapter.

Australia's universities are themselves sophisticated and diversified entities, and support economic sophistication at a workforce level by providing the graduate workforce, the public knowledge and the global connections required to support resilience and maturity across the Australian economy.

Figure 4.1: Pillars of the economic resilience framework



Source: Deloitte (2021)



Translating the resilience framework to a University context

This chapter uses an economic resilience framework to analyse less traditional measures of the University's contribution, as it relates to economic sophistication.



Building Australia's workforce **capability**

In its transition to a knowledge-based economy, Australia will rely on the technical skills and adaptive capability of its workforce to navigate changing conditions.

By ensuring a sufficient supply of workers with the requisite academic and adaptive skills to support employers, universities are key to enabling this capability in the Australian workforce.

In fact, education is one of the few service industries where Australia's economic sophistication exceeds the global average.¹ Further, universities train around 3 in 4 of the workers in Australia's professional industries, which tend to be the most sophisticated.²



Ensuring workforce **preparedness** for a changing economy

An Australian workforce with the skills of the future of work will be critical to employers' ability to respond to changing conditions.

Universities support the Australian economy's preparedness by ensuring graduates' adaptive skills,³ embedding research excellence into training delivery, and supporting the economy's ability to enable learners to upskill and reskill quickly.⁴

As Australia's transition to a knowledge economy continues, equitable access to higher education will be critical to enabling inclusive growth. Making study accessible to a diverse cohort - through a network of campuses, and by offering flexible and online delivery - and connecting these learners through physical and virtual experiences, the university sector makes a major contribution strengthening workforce diversity.



Supporting **innovation** at the frontier of research and teaching

Modernising the Australian economy will rely on new applications and approaches to using technology, as well as global connections - both to diversify the economy and to bring Australian industry to the frontier of its development.⁵

Through excellence in research discovery and commercialisation, the University plays a key role in supporting Australia's innovative capability - driving new discoveries across industries and the economy.⁶

By delivering industry-linked training, the University ensures that graduates are equipped with both the technical capabilities and soft skills their employers require to aid adaptation and drive innovation within their workplaces.⁷



Facilitating global **connections** for Australia's workforce

Increasing the depth and richness of connections to global markets can support a stronger positioning for Australia in the global value chain. As Australia's largest service export, international education represents an opportunity to leverage and strengthen global partnerships.⁸

Universities - through student mobility programs, inbound international students, and global research and teaching partnerships - connect Australia's economy and workforce to many of the world's most sophisticated economies, including in the ever-important Asia Pacific region.⁹ Quality student outcomes and ongoing alumni relationships enable deeper connections, and play a key role in attracting and retaining international talent in the knowledge sector, which can further strengthen global ties.



Supplying Australia's growing workforce

The University will play an important role in supplying the local labour market with graduates who are equipped with the requisite skills to deliver value from their first day, including in some of NSW largest professional occupations and areas of critical skills shortage.

Australia's skills shortages are heavily concentrated in occupations that require university level qualifications. Half of all UNSW students are enrolled in fields of education which map to roles currently in critical shortage: a contribution of 6,300 graduates into these roles each year.^(a)

In 2021, one in five (19%) professional occupations were identified as subject to skills shortages – including large employing occupations in professions such as accounting, software development, programming and software engineering.¹

Among professionals, Health Professionals^(b) are experiencing the deepest shortages (29%), followed by Design, Engineering, Science and Transport Professionals (27%) and ICT Professionals (21%). These shortages have been exacerbated as the number of temporary migrants with working rights in Australia fell to levels not seen in a decade.²

Further, UNSW trains graduates across the five largest professional occupations in NSW, where 17,500 new jobs are created each year (Chart 4.1). Based on the current volume of students, UNSW graduates alone could address almost 40% of these new skills needs in 2022.

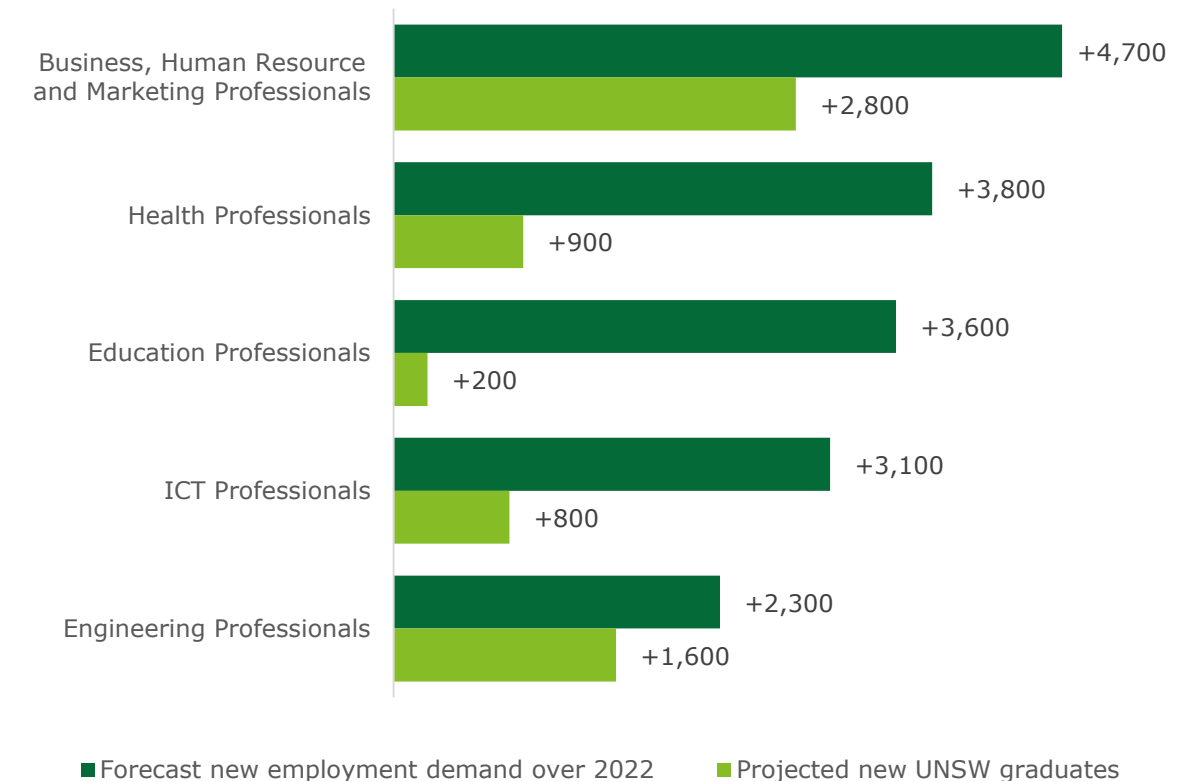
Macroeconomic forecasts show a strong outlook for workers in professional occupations, including in fields where UNSW enrolls large cohorts, such as businesses and engineering.

Chart 4.1 maps employment growth for the largest five growing occupations in across 2022 for NSW to the number of potential graduates from UNSW, based on current enrolment levels and the overall employment rates in each of these fields of education. A conservative estimate of 5% is used for UNSW graduates leaving to fill roles across the rest of Australia or overseas, to recognise that not all graduates will remain in NSW and around 2-3% of 20-24 year-olds leave NSW each year.³

^(a) Critical shortage are those occupation groups where more than 20% of reviewed sub-occupations have been identified by the National Skills Commission as being in shortage.

^(b) The National Skills Commission defines health professionals as health diagnostic and promotion professionals, health therapy professionals, medical practitioners and midwifery and nursing professionals.

Chart 4.1: Forecast new employment demand and projected UNSW graduates, for the 5 largest professional occupations in NSW (2022)



Note: Domestic students only. The number of new graduates has been adjusted to account for domestic student enrolment growth, overall employment rates within each field of education and the number of UNSW graduates which are estimated to remain in NSW (95%). New demand estimates do not account for worker replacement due to attrition or exit.

Source: QILT (2021), Department of Education, Skills and Employment (2020) and Deloitte Access Economics (2022).

Building Australia's workforce capability



Not only does UNSW deliver large volume of highly skilled graduates, the University is over-represented in delivering some of the state's key skills needs, particularly in engineering, ICT and scientific roles.

The University's core delivery areas align strongly with the nation's and the state's skills needs (see previous page). From both a skills shortage and future demand perspective, there exists strong need in NSW for a graduate workforce skilled in the areas of study in which UNSW specialises.

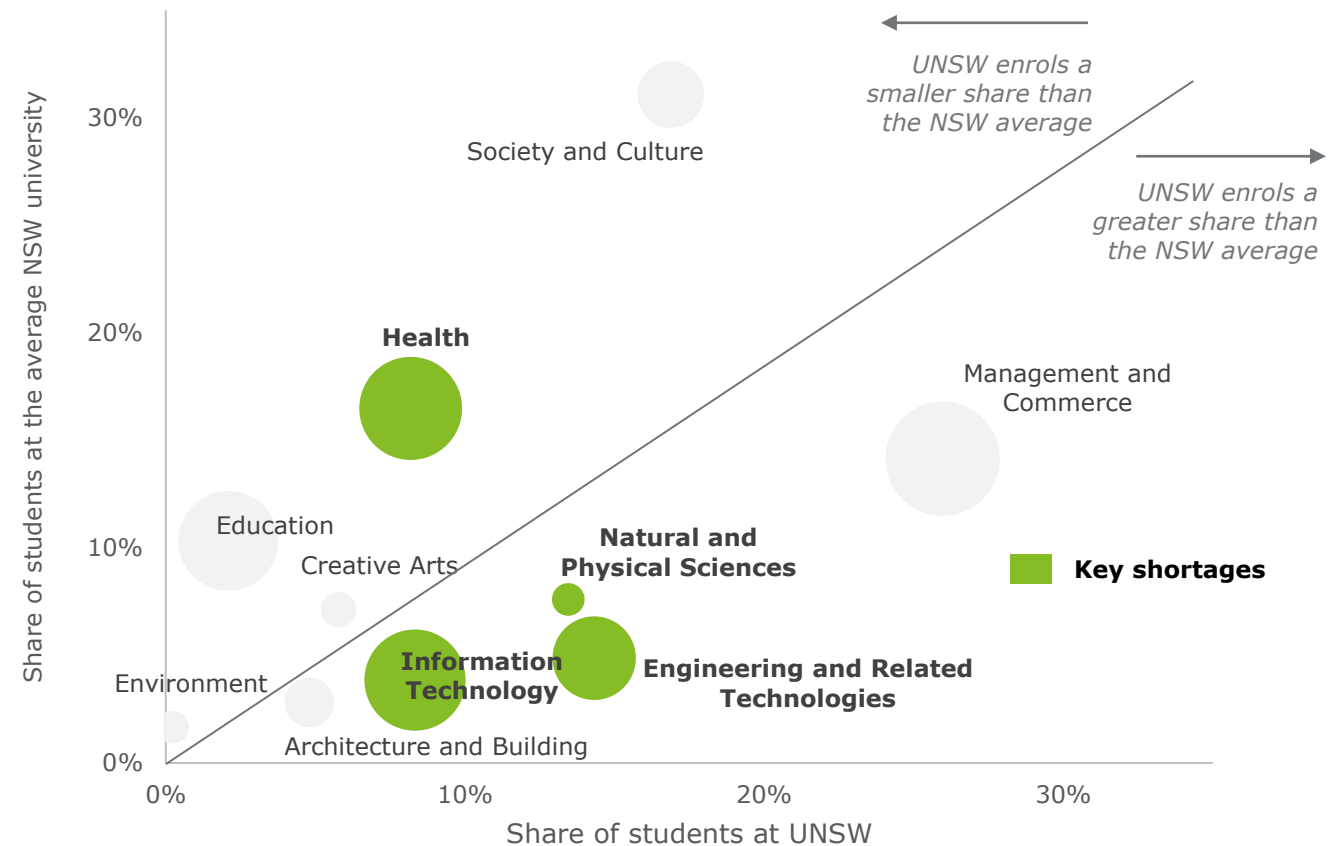
Not only does UNSW deliver a large *volume* of these graduates, the University is over-represented in the *share* of these graduates – representing critical professional skills needs to support the capability of the knowledge sector.

In 3 of the 4 fields of study which map to major skills shortages, UNSW enrolls a larger share of students than the average Australian university. The University is critical to the skills pipeline in engineering and related technologies, information technology, and natural and physical sciences.

UNSW delivers more of these graduates than the average university in NSW. For example, while the average university in NSW has around 5% engineering students, UNSW has a cohort of around 15% in this field.

The University also makes a contribution beyond these three fields. While UNSW has a relatively smaller share of students enrolled in health related degrees compared to other universities, the health cohort of 3,300 students remains significant, particularly given the University does not have a School of Nursing. Rather, these Health students – 1,700 of whom are enrolled in postgraduate programs – are enrolled in courses such as Medicine and Public Health, where the University's postgraduate cohort of health students is the second-largest in NSW. In addition, while Management and Commerce is not a key skills shortage field, it is one of the largest employing fields for professional workers in NSW.

Chart 4.2: Share of total enrolments from UNSW and the average NSW university (excl. UNSW) (2020)
Bubble size represents the volume of new demand in NSW for these professionals



Note: Excludes students enrolled in mixed field and non-award courses. Domestic students only, at both the undergraduate and postgraduate level. UNSW's specialisations are determined by fields of education where the University has an above average share of enrolments. Size of circles reflect the relative magnitude of the skills shortage.
Source: Department of Education, Skills and Employment (2020).



Ensuring workforce preparedness for a changing economy

Accessible, flexible and high-quality online delivery by UNSW has enabled learners to upskill and reskill quickly, to meet the changing needs of industry during COVID-19

In February 2021, 25,000 Australians reported 'lacking necessary skills or education' as their main difficulty in finding work.¹ And in 2019-20, businesses identified that the biggest barrier to innovation was a lack of skilled labour – a greater challenge than the cost of innovation, or access to funding.² There is a key role to be played by universities to bridge this gap.

While border re-openings will help to ease some shortages in the labour market,³ pandemic-induced skill shortages continue and have amplified the incentives for universities to collaborate with industry.

As real wage growth remains low, the movement of workers between jobs – in an effort to increase earnings more quickly – is creating friction across the economy. In the three months leading to November 2021, more than one million Australian workers started new jobs, at a rate almost 10% higher than the pre-pandemic average – and with typically 8-10% higher wages in their new roles.⁴ This increased level of job mobility within the labour market, has been coined as the 'Great Reshuffle'.

Furnishing the labour market with the volume of workers and skills it needs to provide the productive capacity the economy requires is key to navigating the 'Great Reshuffle'.

The University's flexible course options and industry-aligned programs play a major role in supporting this objectives, enabling workforce adaptability and ensuring that workers' wage increases are supported by increasing labour productivity. With 400 graduations from short programs in 2021, the University will play a major role in softening the impact of the 'Great Reshuffle' on Australian workers and employers.

Universities will also help to ease some of the mounting skills shortages pressure through the number of job-ready graduates released into the workforce each year. Within six months of graduation, an estimated 9,400 UNSW graduates are in full-time employment, equipped with the skills they need to contribute from their first day on the job.

Online and blended delivery by UNSW provides more than 15,100 locally enrolled students with access to quality higher education, particularly at the postgraduate level.

As the Australian economy adjusts to the new COVID-19 normal, Industry 4.0 and the digitisation of the economy will continue to fuel Australian workers' appetite for lifelong learning, particularly for those who are looking for study options to complement or extend their undergraduate qualifications.⁵

One third of UNSW's domestically enrolled students are undertaking their studies mostly online through a range of delivery modes – predominately in postgraduate degrees⁶ (Chart 4.3).

In 2020, UNSW Online students recorded a 96% satisfaction rate with the quality of teaching.⁷ The University plans to further strengthen this arm of delivery, through the expansion of UNSW Online, particularly for postgraduate level courses but also for non-award offerings.

Chart 4.3: UNSW domestic student delivery modes (2019)



Note: An additional 137 students undertake their studies through independent and research modes.
Source: UNSW (2019).

Alongside these online enrolments, UNSW's face-to-face delivery is supported by an ecosystem of campuses across NSW and the ACT. These campuses, coupled with a strong capability to deliver courses online, enhances access to high quality education for more regionally placed students who can support local labour markets.

Supporting diversity in the graduate cohort



As Australia's transition to a knowledge economy continues, equitable access to higher education will be critical to enabling inclusive growth. UNSW's diverse student cohort reflects this commitment.

UNSW's 2025 Strategy outlines a bold strategy for equity, diversity and inclusion. As a leader in the delivery of STEM – and particularly, engineering courses – the University is committed to supporting a diverse cohort of graduates, including by addressing gender disparity in the number of graduates and employees in the field.

In 2020, UNSW's cohort of female engineering students totalled 2,900: the most of any university in Australia, and the third-highest as a share of enrolments.

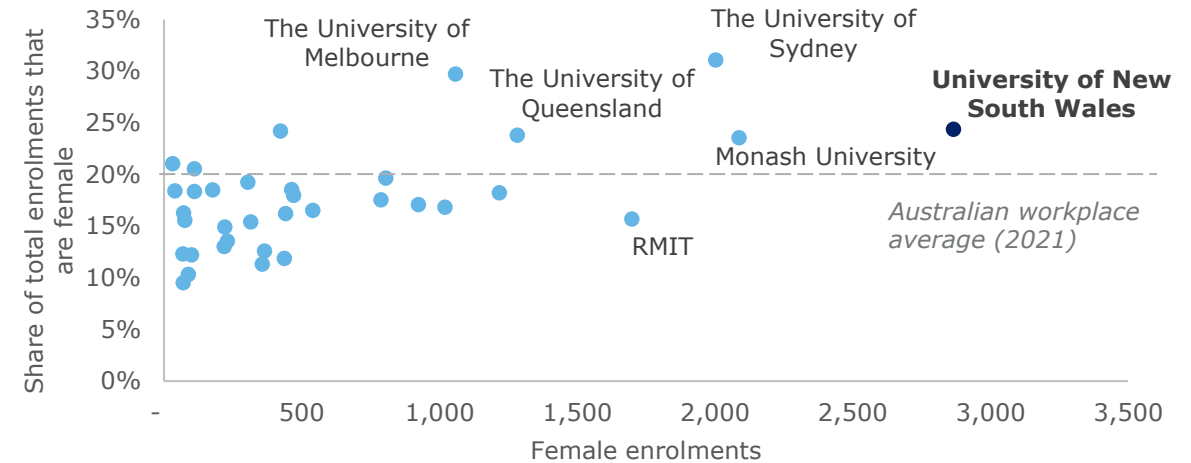
Across the Architectural, Engineering and Technical Services industry, women represented less than one-third (28%) of the total number of workers across Australia. Considering the engineering subsectors within this broader industry group, overall female representation drops as low as 20%, with those working in more senior roles a fraction of this.¹ Compared to all other STEM fields, engineering records the lowest share of enrolments from female students.²

Given that 3 in 4 professional workers hold university qualifications, UNSW is playing a major role in creating a diverse pipeline of engineers, equipped with the necessary skills to succeed, particularly coupled with the entrepreneurship skills embedded within UNSW qualifications (see page 44).

The University's student cohort is diverse – The share of students from Non-English Speaking Backgrounds (5.3%) and First Nations (1.2%) exceed the sector average.

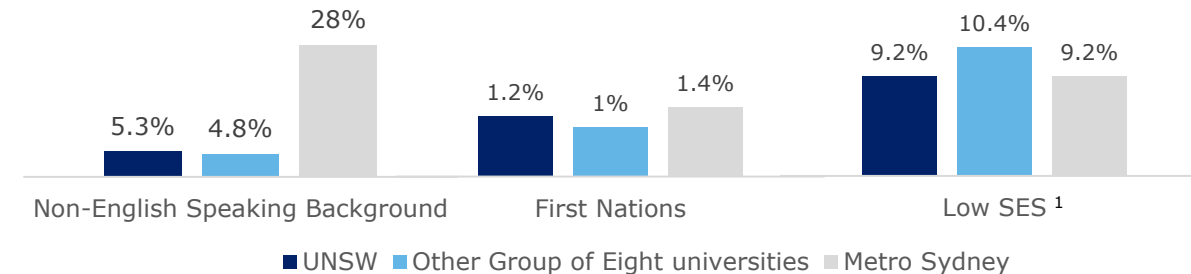
Student equity is part of UNSW's commitment to a just society. UNSW students are culturally diverse, with 5.3% of its local student cohort having migrated to Australia within the past 10 years from a non-English background. The UNSW Indigenous Strategy, launched in 2018, has seen the University grow the number of First Nations students and staff, and catalysed an Indigenous research agenda. While the University's domestic student cohort reflects the sector average for representation of low socioeconomic status (SES) students, but there is always more progress needed to correct underrepresentation. The 2025 Strategy will guide the University to continue to make headway on this important issue over the coming years.

Chart 4.4: Female representation in engineering programs by university (2020)



Note: Excluded Non-University Higher Education Providers. Includes domestic and overseas students. Source: Department of Education, Skills and Employment (2020), Workplace Gender Equality Agency (WGEA).

Chart 4.5: Student access rates at UNSW and Go8 universities (excluding UNSW)



Note: Non-English speaking background includes domestic students who arrived in Australia less than 10 years prior and who comes from a home where a language other than English is spoken. Metro Sydney is measured using the Census, there may exist some variation in measurement due to different approaches between sources.

Source: Department of Education, Skills and Employment (2020) and Australian Bureau of Statistics (2016)

¹ Socio-Economic Status (SES)



Ensuring graduates' innovative capabilities

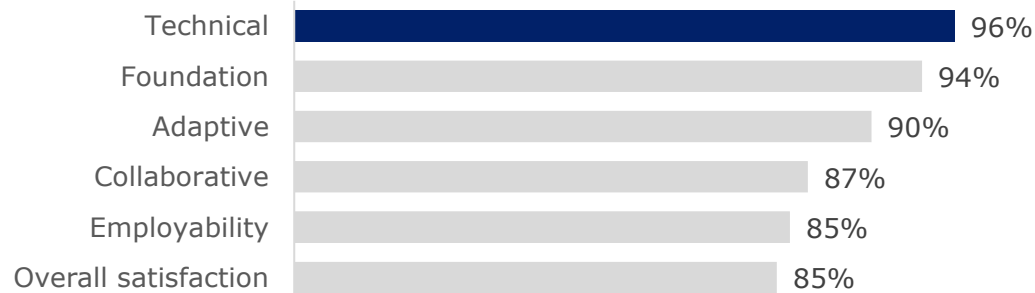
The University is recognised, by employers, for supporting graduates attain both the technical capabilities and soft skills required to support adaptation and enable innovation within the workforce.

UNSW is a leader in teaching – which is critical to the research discovery and excellence which breeds innovation.

The University's graduates are highly rated by their employers across all types of skills (Chart 4.6) – this is especially true for technical skills, which is a critical component of a higher education qualification.¹ This high quality teaching is supported by a culture of research excellence and innovation, as UNSW's discovery research translates to meaningful and measurable impact (page 27). This is particularly true across scientific and social science disciplines at UNSW, with 36 academics identified as among the world's most influential in their fields, based on global citations over a 10 year period.³

The University's overall position in the Academic Ranking of World Universities (ARWU) is 3rd in Australia and 65th in the world.² The University also performs well on other, less conventional ranking approaches: for instance, Scimago rankings place the University 3rd for research, 5th for societal impact and 15th for innovation outputs in Australia.³ Scimago compares universities to a more diverse range of research institutions, noting that UNSW is ranked ahead of major research organisations, such as the CSIRO.

Chart 4.6: Employer reported satisfaction with UNSW graduates (2021)



Source: QILT (2021).

Named Australia's most entrepreneurial university,⁴ the UNSW Founders program provided entrepreneurial skills training to almost 16,000 workshop participants in 2021.

The Founders Program provides a comprehensive range of programs for UNSW entrepreneurs, from delivering foundational training to educating founders on how to design and execute successful business models, and connecting entrepreneurs to local and international innovation ecosystems. The Founders program has incubated over 200 start-ups, and Crunchbase reports that 98 UNSW start-ups have received venture capital funding – the strongest overall result for a University in Australia.⁵

The University also invests in supporting gender balance in entrepreneurship. UNSW reports that 45% of its startups are founded by women, almost double the industry average of 22%.

Established in 2017 to address the systemic and cultural barriers that lead to significant under-representation of women in entrepreneurship, the *New Wave* program provides women students, staff and alumni free access to workshops, masterclasses and industry mentors to prepare them to work as entrepreneurs (see below).

The *GoodGivs* platform, co-founded by *New Wave* alum Frances Atkins and Naomi Vowels, helps people celebrate without waste, by combining group gifting with charitable crowdfunding. The *New Wave* program developed the founders' pitching, networking and design thinking skills: "*The New Wave program allowed me to work on a start-up concept. I learned how to build a minimal viable product, how to test and how to launch a product that is fit for the market...I was able to work with like-minded women on an idea which we pitched to industry leaders*" – Frances Atkins.

Atkins and Vowels have since established a second startup, *Givvable*, to provide a platform for businesses to source goods sustainably. Since its launch in 2020, *Givvable* has received significant financial backing, including a Federal Government *Accelerating Commercialisation* grant and an *Xccelerate2020* grant worth \$300,000 in support from Commonwealth Bank and Microsoft.



Collaboration with industry across teaching and research

The University has deep ties to industry, playing an important role as a platform through which employers can collaborate with thought leaders and specialists across a diverse suite of teaching and research expertise.

UNSW's research discovery and commercialisation capabilities play a key role in supporting Australia's innovative capability – driving new discoveries across industries and the economy.

Two UNSW research commercialisation initiatives – on recycling and clean energy and defence – have recently been shortlisted, amongst six other projects, to compete for a share of \$243 million in funding. This funding is geared towards accelerating Australia's innovation agenda through greater research commercialisation.¹

More widely, the University supports all of its experts through the UNSW Knowledge Exchange – a dedicated team of business managers, which assists researchers to bridge the gap between discovery and commercial reality. There are more than 200 discoveries and new technologies available for industry, government and communities to invest in and support. In 2018, UNSW secured \$29 million in funding from external businesses. This is more than double of that of the average Australian university, procuring \$12 million on average.²

The case studies of crucial UNSW research projects (Chapter 3) provide an exemplar of the public benefits of UNSW research translation, and its role in supporting Australia to navigate its most pressing social and environmental problems.

UNSW courses are developed and designed in consultation with industry, and many offer embedded work integrated learning opportunities, recognising the role of practical and workplace experience in delivering a qualification.

UNSW has strong ties to industry, where employers are involved in both curriculum development and content delivery, coupled with opportunities for work integrated learning (WIL) in many courses. There is a wide range of WIL activities at UNSW, including industry placements, client-based projects, internships and fieldwork experiences (see right). This deep collaboration with industry allows UNSW graduates to be adaptive to the needs of their future employers.

Work integrated learning at UNSW

Students' opportunities to gain work-related experience varies from embedded courses within specific degrees to cross-disciplinary subject options for students across the university. These options include:

- **UNSW's Co-op industry-sponsored scholarships**, which were launched in 2000, in direct response to the industry's unmet demand for exceptional IT graduates. These Co-op programs have since expanded to other faculties based on industry demand, with 24 programs now offered across Business, Science, Engineering and the Built Environment.
- **The Practice Of Work course**, which allows students undertake a placement with a partner organisation addressing multi-disciplinary issues.³ This opportunity is unique as it allows students to undertake a placement outside their field of education. For example, one cohort worked for the Australian Museum to assist them in engaging more effectively with young adults on issues relating to climate change.
- The Business School's **Social Entrepreneurship Practicum course**, delivered in partnership with the Centre for Social Impact, allows students to integrate theory with practice through a purposeful engagement with a partner organisations from industry, social enterprise and not-for-profits.⁴
- The **Translation and Interpreting Practicum course** introduces students undertaking arts and languages degrees to the business and industry practice of translation and interpreting studies.⁵

Facilitating global connections for Australian graduates and employers



Student mobility programs, inbound international students, and global research and teaching partnerships see UNSW connecting Australia to many of the world's most sophisticated economies.

Inbound and outbound student program and international research collaborations connect the University to many of the world's most sophisticated economies

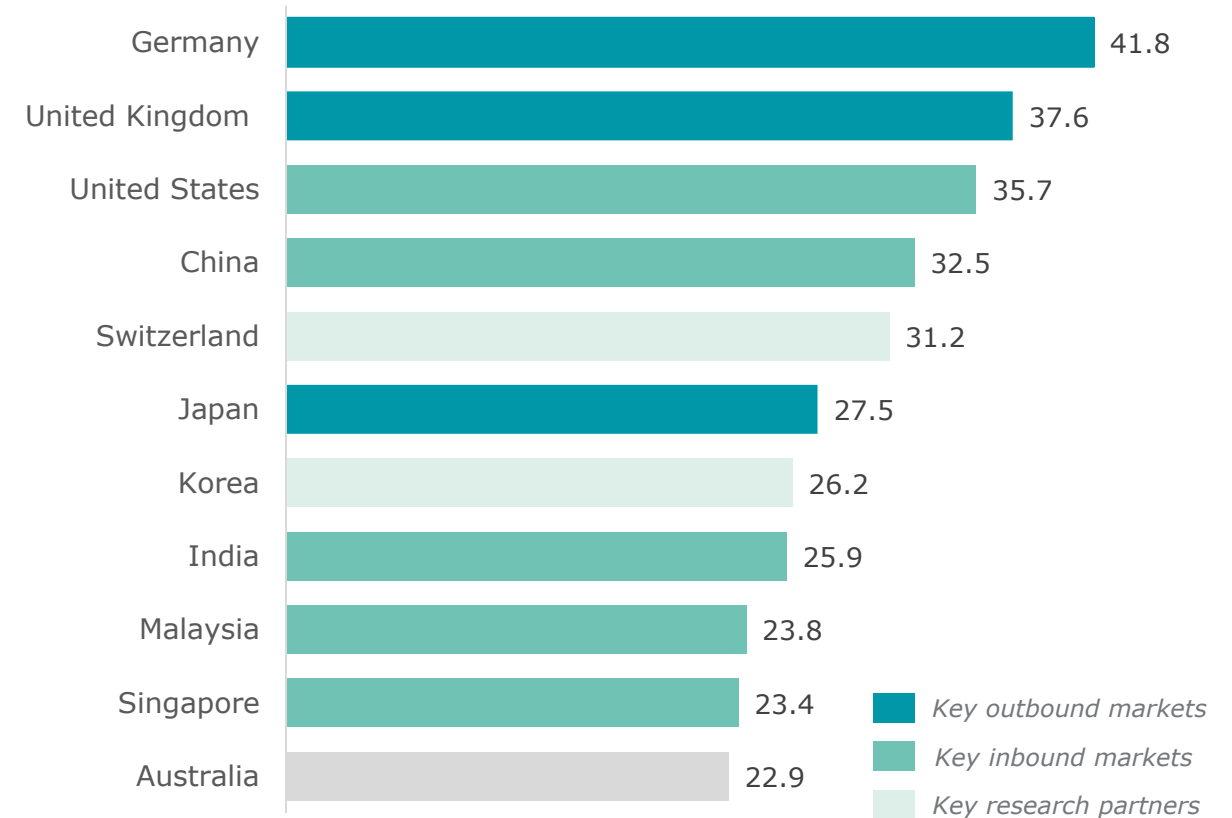
Many of Australia's international education and training partners, in terms of inbound and outbound student programs and international research collaboration, have more sophisticated economies than Australia's – currently ranked 37th in the world.¹ These global partners can be thought of as more resilient to economic shocks through greater diversification of production channels, ultimately maximising their economic growth.

- China, the United States and India are key inbound student markets
- UNSW has more than 250 exchange partner universities in 40 countries, some of the top markets are the United Kingdom, Germany and Japan
- UNSW is a member of several global partnerships, guided by a shared vision of solving global challenges such as climate change, health and social justice.

Some of the top markets for inbound students are also important markets for outbound students or international research, for instance markets like the United Kingdom and the United States are important for all three categories.

These connections with more sophisticated economies, particularly through human centric service industries– like higher education – with alumni located globally, are great partners to enhance Australia's own economic resilience. Strong global connections across the university also supports a realm of other benefits – most of which cannot be easily quantified, including an enriched learning experience that prepares graduates to enter a globalised workforce, increased social cohesion and a higher quality of research through international collaboration.²

Chart 4.7: Economic sophistication scores for UNSW's top markets for inbound students, outbound students and international research collaboration



Source: Deloitte Access Economics (2021).



Connecting the local economy to the global economy

The University hosts more than 23,000 students across a multiple campuses who help to connect the local precincts to the global economy.

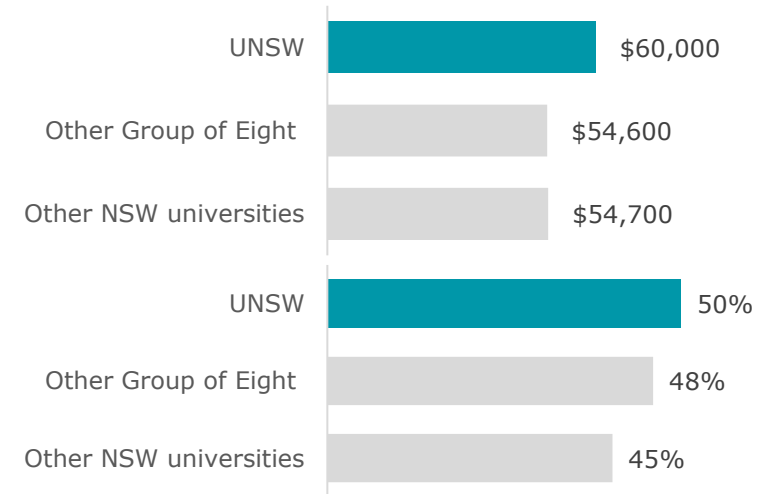
With earnings \$5,300 above the NSW median for international graduates, UNSW's international students starting salaries and employment rates in Australia exceeds the Group of Eight and NSW average.

UNSW's international graduates experience better labour market outcomes than the other Group of 8 and NSW universities, both in terms of full-time employment and starting salaries (Chart 4.8). In 2020, more than 23,000 international students from more than 130 countries were enrolled at UNSW. Just under a fifth of these students were undertaking these studies through blended and online delivery modes, with the majority studying in person.

As a hub for international students and staff, the UNSW Sydney campus connects Kensington to the global economy

Students from more than 90 different countries live in the eastern suburbs region – which includes the precinct surrounding the main UNSW campus – hosting nearly 10,900 international student residents.¹ The outbreak of COVID-19 saw Kensington experience one of the greatest reductions in the number of international students across Australia, losing an estimated 2,030 students.² International students were critical to the local economies surrounding university hubs, leading to high rental market vacancies coupled with struggling businesses. As Australia's travel restrictions ease and international students continue to return onshore, this will help to revitalise and restore the precinct.

Chart 4.8: International graduates full-time employment rates and starting salary at UNSW, NSW universities and the Group of Eight (2021)



Note: NSW and Group of Eight averages exclude UNSW. Source: QILT (2021).

Chart 4.9: Citizenship of residents nearby UNSW campuses who are attending university, largest 30 markets (2016)



Note: Regions surrounding UNSW campuses include the Sydney Eastern Suburbs, Sydney City and Inner South and the ACT
Source: Australian Bureau of Statistics Census (2016).

Final remarks

A breadth of contributions across Australia and its communities

The contributions of the University of New South Wales are rich and diverse, from its immediate operations as an employer and business, to its vast contributions to Australia's knowledge base, skilled workforce and innovative capability.

This report has demonstrated and quantified a breadth of contributions by the University of New South Wales each year to the Australian economy and broader society.

The University plays a vital role in the Australian economy - supporting economic activity through its business operations, educating skilled graduates inline with the needs of industry to support productivity, translating and commercialising academic research, and fostering connections between local and global economies.

As a large public institution, employing more than 7,500 workers, purchasing a breadth of goods and services and attracting students from across Australia and internationally, the University makes a major contribution to national economic activity: \$2.7 billion in 2019.

Of course, the University's value is far beyond the contributions of its business operations. Academic and professional staff deliver services to support teaching and research activity which supply critical skills to the Australian workforce, and deliver a range of public goods for society through the creation, dissemination and translation of knowledge.

The University develops and credentials the skills of graduates to ensure that they can support business and industry in navigating a changing economy. Skilled workers benefit personally, with significant labour market returns in the form of higher annual wages and lifetime earnings. These also translate to public benefits via greater taxation revenue, while skilled graduates bring new capabilities and skills to their roles, which produce productivity spillovers across businesses and other industries.

Beyond these contributions and returns, there are also important and material non-market benefits of higher education attainment - such as pro-social behaviours, increased social cohesion, and improved mental and physical health.

Universities are also critical to national innovation. Research at the frontier, paired with the translation of these findings through industry partnerships, provides a greater knowledge base throughout the economy.

This research is highly valuable, critical to enabling economic productivity and - as the research case studies in this paper demonstrate - provide the tools and information needed to tackle some of Australia's most pressing social and environmental challenges.

It is not possible to catalogue, analyse and assess every one of the university's contributions through teaching and research. However, applying a lens of economic sophistication showcases the ways in which the University contributes to increasing the resilience of the Australian economy.

By supporting workforce capability, preparing a diverse cohort for the future of work, enabling innovation by working in partnership with industry, and facilitating global connections, the University can drive Australia's economic maturity. This further articulates and emphasises the importance of the contributions that the University of New South Wales makes to Australian industry, society and local communities.

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Appendices

Appendix A | Economic contribution analysis

Methodology and approach

Economic contribution framework

Economic contribution studies

Economic contribution studies are intended to quantify measures such as value added, exports, imports 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.

Value added

The measures of economic activity provided by a contribution study are consistent with those provided by the Australian Bureau of Statistics. For example, value added is the contribution the sector makes to total factor income and gross domestic product (GDP).

The value added of each industry in the value chain can be added without the risk of double counting across industries caused by including the value added by other industries earlier in the production chain. Other measures, such as total revenue or total exports, may be easier to estimate than value added but they 'double count'. That is, they overstate the contribution of a company to economic activity because they include, for example, the value added by external firms supplying inputs or the value added by other industries.

Measuring the economic contribution

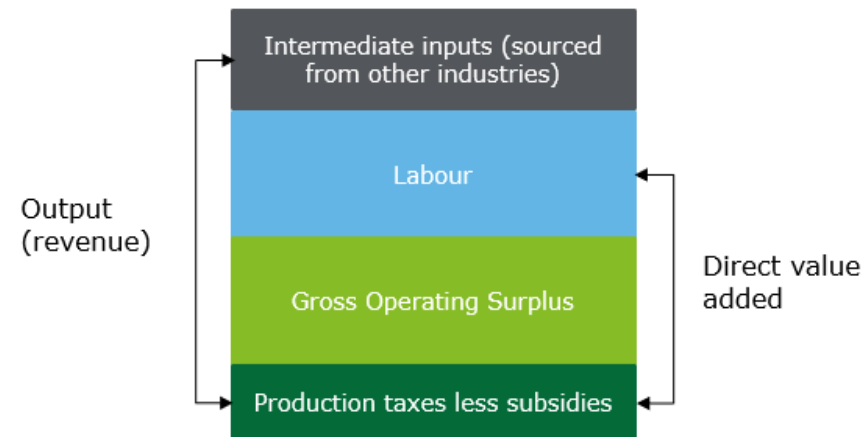
There are several commonly used measures of economic activity, each of which describes a different aspect of an industry's economic contribution:

- Value added measures the value of production (i.e. goods and services) generated by the entity's factors of production (i.e. labour and capital) as measured in the income to those factors of production. The sum of value added across all entities in the economy equals gross domestic product. Given the relationship to GDP, the value added measure can be thought of as the increased contribution to welfare. Value added is the sum of:
 - Gross operating surplus (GOS) represents the value of income generated by the entity's capital inputs, generally measured as the earnings before interest, tax, depreciation and amortisation (EBITDA)

- Tax on production less subsidy provided for production. Note: given the manner in which returns to capital before tax are calculated, company tax is not included or this would double-count that tax. In addition it excludes goods and services tax, which is a tax on consumption (i.e. levied on households)
- Labour income is a subcomponent of value added. It represents the value of production generated by the entity's direct labour inputs, as measured by the income to labour.

Figure A.1 shows the accounting framework used to evaluate economic activity, along with the components that make up output. Output is the sum of value added and the value of intermediate inputs used by the firm. Net taxes on products are not included in value added but are included in GDP. The value of intermediate inputs can also be calculated directly by summing up expenses related to non-primary factor inputs.

Figure A.1: Economic activity accounting framework



Source: Deloitte Access Economics (2021)

Economic contribution framework

Direct and indirect contribution

The **direct economic contribution** is a representation of the flow from labour and capital at UNSW.

The **indirect economic contribution** is a measure of the demand for goods and services produced in other industries as a result of demand generated by UNSW. Estimation of the indirect economic contribution is undertaken in an input-output (IO) framework using Australian Bureau of Statistics IO Tables which report the inputs and outputs of specific industries of the economy.

The total economic contribution to the economy is the sum of the direct and indirect economic contributions.

Treatment of capital expenditure

Rather than explicitly including capital expenditure, the report measures value added through GOS (the rent on existing capital) and depreciation (the value of capital stock as it is 'used' over time) captured by EBITDA in UNSW's financial statements. It is assumed that contributions to the existing capital stock will be accounted for in future year's income streams and hence, future contribution studies. Thus, inclusion of capital expenditure as it is purchased would result in double counting.

Limitations of economic contribution studies

While describing the geographic origin of production inputs may be a guide to a firm's linkages with the local economy, it should be recognised that these are the type of normal industry linkages that characterise all economic activities.

Unless there is unused capacity in the economy (such as unemployed labour) there may not be a strong relationship between a firm's economic contribution as measured by value added (or other static aggregates) and the welfare or living standard of the community.

The use of labour and capital by demand created from the industry comes at an opportunity cost as it may reduce the amount of resources available to spend on other economic activities.

In a fundamental sense, economic contribution studies are simply historical accounting exercises. No 'what-if', or counterfactual inferences – such as 'what would happen to living standards if the firm disappeared?' – should be drawn from them.

The IO framework and the derivation of the multipliers also assume that the relevant economic activity takes place within an unconstrained environment. That is, an increase in economic activity in one area of the economy does not increase prices and subsequently crowd out economic activity in another area of the economy. As a result, the modelled total and indirect contribution can be

regarded as an upper-bound estimate of the contribution made by the supply of intermediate inputs.

Similarly the IO framework does not account for further flow-on benefits as captured in a more dynamic modelling environment like a Computable General Equilibrium (CGE) model.

Input-output analysis

Input-output tables are required to account for the intermediate flows between industries. These tables measure the direct economic activity of every industry in the economy at the national level. Importantly, these tables allow intermediate inputs to be further broken down by source. These detailed intermediate flows can be used to derive the total change in economic activity associated with a given direct change in activity for a given industry.

A widely used measure of the spill-over of activity from one industry to another is captured by the ratio of the total to direct change in economic activity. The resulting estimate is typically referred to as 'the multiplier'. A multiplier greater than one implies some indirect activity, with higher multipliers indicating relatively larger indirect and total activity flowing from a given level of direct activity.

The IO matrix used for Australia is derived from the ABS 2018-19 IO tables, the latest available IO data at the time of analysis. The industry classification used for IO tables is based on the Australian and New Zealand Standard Industrial Classification (ANZSIC), with 114 sectors in the modelling framework.

Total economic contribution

Contribution to New South Wales

Combining, the ongoing operations of UNSW, the expenditure of international and interstate students who move to NSW to study and their visitors, it is estimated that UNSW contributed a total \$2.6 billion in value added to the NSW GSP and supported 14,500 FTE jobs in 2019 (Table 1.5).

Contribution to Australia

Nationally, the ongoing operations of UNSW and the expenditure of the international students and the visitors these students attract contributed approximately \$2.8 billion to the Australian economy and supported 15,700 FTE jobs in 2019 (Table 1.6).

Table A.1: Total economic contribution of UNSW to NSW, 2019

	University	Students and visitors	Total
Contribution to value added (\$m)	1,806	762	2,568
Direct	1,464		1,464
Indirect	342	762	1,124
Contribution to employment (FTE)	9,951	4,577	14,528

Source: Deloitte Access Economics. Discrepancies may occur in total due to rounding.
Note: Includes domestic interstate students in student and visitor spend.

Table A.2: Total economic contribution of UNSW to Australia, 2019

	University	Students and visitors	Total
Contribution to value added (\$m)	1,974	771	2,745
Direct	1,544		1,544
Indirect	430	771	1,201
Contribution to employment (FTE)	11,092	4,749	15,841

Source: Deloitte Access Economics. Discrepancies may occur in total due to rounding.

Appendix B | Returns to skilled graduates

Methodology and approach

Private returns of university teaching

Overview of the modelling approach

Following the approach used in Deloitte Access Economics (2016), micro-econometric modelling was conducted to separate the contribution of a university qualification to an individual's outcomes from that of other factors. The three models include:

- Wages (conditional on employment)
- Employment (conditional on being in the labour force)
- Participation in the labour force.

This was conducted using the Household, Income and Labour Dynamics in Australia (HILDA) Survey (pooled from wave 1 to wave 19), which is a longitudinal survey that examines broad social and economic factors, with a particular focus on family, household formation, income and work.

The dataset was used as it includes a rich set of information on individuals' employment and wage outcomes over time, and includes information on their qualification levels, and other factors that may affect their labour market outcomes.

In addition to the key dependent variables of interest highlighted above, the following controls were included in each of the models:

- Education variables - including qualification level, field of education; and provider type.
- Controls for demographic characteristics - including age, gender, born in Australia, indigenous status, State of residence, ABS Remoteness Area, disability, English language proficiency, hours worked, employment status, experience, family type, and age of youngest child.

- Controls for cognitive ability – including Backward Digits Span, Symbol Digits Modalities, and Word Pronunciation Score.

Consistent with other studies of this nature, the analysis was limited to those:

- Aged 25 to 64 years
- Had zero business income
- Reported details about their educational attainment
- Did not hold a doctorate (to exclude higher degree research degrees).

Any observations with any missing data were excluded.

Private returns of university teaching

Model specifications

Earnings model

The earnings model is specified as an 'augmented Mincer equation', based on Mincer's (1974) seminal work on the effects of education on wages and taking into account the key variables detailed above. The estimated equation is given by:

$$\log_e w_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 X_{it} + \beta_3 \theta_{it} + \gamma_t + \epsilon_{it}$$

where:

- w_{it} is the wage of individual i at time t
- E_{it} is a vector of educational characteristics (qualification level, field of education)
- X_{it} is a vector of individual characteristics (including demographic characteristics and cognitive ability)
- θ_{it} is a vector including the natural logarithm of hours worked and a dummy for whether the individual was employed full time
- γ_t is a year fixed effect
- ϵ_{it} is a random error term.

The β 's are parameters to be estimated and the data is obtained by pooling across the waves of HILDA data. Standard errors are clustered at the individual level, to account for the likelihood that the outcomes of each individual (and hence error terms) are highly correlated over time.

Employment model

The second part of this modelling examines the effect of higher education (including qualification level and field of education) on the likelihood of an individual participating in the labour force to be employed.

This propensity is estimated using a linear probability model, which isolates the effect of higher education and controls for other explanatory characteristics. The functional form of this equation is shown below:

$$\Pr(\text{Employed}_{it} = 1 \mid \text{Participation}_{it} = 1) = \alpha_0 + \alpha_1 E_{it} + \alpha_2 X_{it} + \gamma_t$$

where:

- Employed is a dummy variable that equals one if individual i at time t is employed and equals zero if they are not employed
- Participation is a dummy variable that equals one if individual i at time t is participating in the labour force and equals zero if they are not
- E_{it} is a vector of educational characteristics (qualification level, field of education)
- X_{it} is a vector of individual characteristics (including demographic characteristics and cognitive ability)
- γ_t is a year fixed effect.

The α 's are parameters to be estimated and the data is obtained by pooling across the waves of HILDA data. Standard errors are clustered at the individual level, to account for the likelihood that the outcomes of each individual (and hence error terms) are highly correlated over time.

Private returns of university teaching

Model specifications

Participation model

The participation model similarly uses a linear probability model to isolate the effect of higher education (and other explanatory variables) on the likelihood of an individual participating in the labour force. The functional form of the equation is shown below:

$$\Pr(\text{Participation}_{it} = 1) = \alpha\gamma_0 + \gamma_1 E_{it} + \gamma_2 X_{it} + \gamma_t$$

where:

- *Participation* is a dummy variable that equals one if individual *i* at time *t* is participating in the labour force and equals zero if they are not
- E_{it} is a vector of educational characteristics (qualification level, field of education)
- X_{it} is a vector of individual characteristics (including demographic characteristics and cognitive ability)
- γ_t is a year fixed effect.

The γ 's are parameters to be estimated and the data is obtained by pooling across the waves of HILDA data. Standard errors are clustered at the individual level, to account for the likelihood that the outcomes of each individual (and hence error terms) are highly correlated over time.

Private returns of university teaching

Econometric modelling results – Earnings model

Explanatory variable	Coefficient estimates
Qualification level	
Advanced diploma	0.126***
Cert III or IV	0.041***
Bachelor	0.0291***
Grad diploma	0.348***
Postgraduate	0.414***
Work experience	
Years of experience	31.280***
Years of experience ²	-13.880***
FOE	
Agriculture, environment and related studies	-0.126***
Architecture and building	0.039***
Education	-0.052***
Engineering	0.148***
Food and hospitality	-0.042***
Health	0.010
IT	0.139***
Management and commerce	0.073***
Natural and physical sciences	-0.083***
Other	0.099**
Society and culture	0.097*
Demographics	
Aged 30-34	0.090***
Aged 35-39	0.101***
Aged 40-44	0.115***
Aged 45-49	0.080***
Aged 50-54	0.041***

Explanatory variable (cont'd)	Coefficient estimates (cont'd)
Aged 55-59	-0.014
Aged 60-64	-0.137***
Female	-0.159***
Indigenous	0.053***
Not born in Australia	-0.036***
Low English proficiency	-0.241***
Has long-term health conditions	-0.148***
Cognitive ability	
Backward Digits Span	0.004**
Symbol Digits Modalities	0.006***
Word Pronunciation Score	0.010***
UNSW	0.110*

Source: Deloitte Access Economics. Note: *** represents significance at the 1% level; ** at the 5% level; and * at the 10% level. Base categories are: no post-school qualification, FoE Creative Arts, and Aged 25-29. Coefficient estimates for: year fixed effects, state and remoteness area, and family type are not reported for brevity.

Private returns of university teaching

Econometric modelling results – Employment and participation model

Explanatory variable	Employment model	Participation model
Qualification level		
Advanced diploma	0.015	0.055
Cert III or IV	0.006	0.058
Bachelor	0.017	0.073
Grad diploma	0.023	0.092
Postgraduate	0.012	0.087
FOE		
Agriculture, environment and related studies	0.004	0.025
Architecture and building	0.017	-0.006
Education	0.012	0.004
Engineering	0.007	0.044
Food and hospitality	0.010	0.004
Health	-0.007	0.039
IT	-0.023	0.051
Management and commerce	0.004	0.003
Natural and physical sciences	-0.005	-0.050
Other	-0.007	0.0192
Society and culture	-0.001	-0.007
UNSW	-0.040	0.040

Source: Deloitte Access Economics. Note: Only the key average marginal effects are reported in the table, for brevity.

Public returns of university teaching

Methodology

To estimate the public market benefits associated with a university education – which include increased returns to other factors of production and tax revenues – Deloitte Access Economics’ inhouse computable-general equilibrium model (DAE-RGEM) is utilised. The utilisation of a CGE model in this context allows the broader economic impacts of higher education to be simulated.

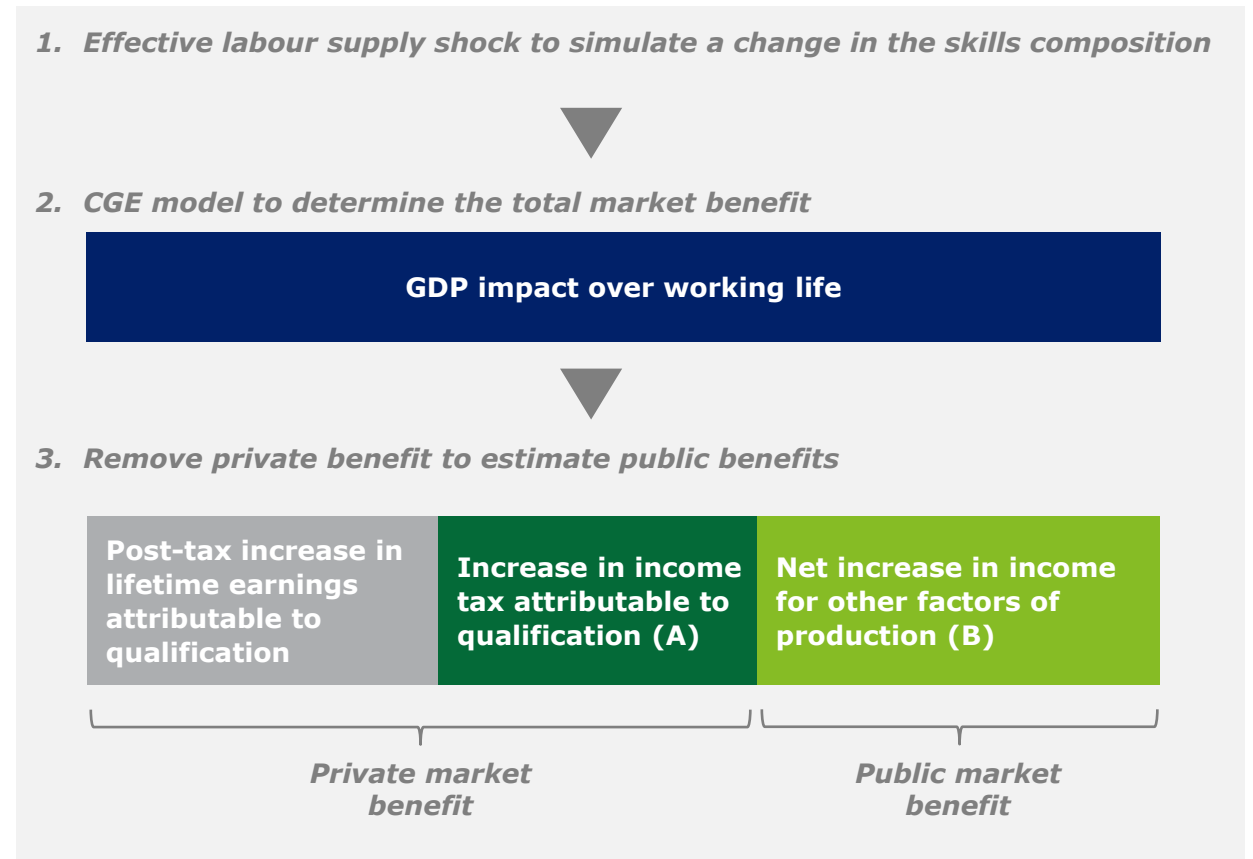
The Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium (CGE) model. The model:

- Allows policy analysis in a single, robust, integrated economic framework.
- Projects changes in macroeconomic aggregates such as Gross National Product (GNP), employment, export volumes, investment and private consumption.
- At the sectoral level, detailed results such as output, exports, imports and employment are produced.

Capturing university trained workers in DAE-RGEM

- While labour is typically produced by a representative agent, the underlying database of DAE-RGEM has been modified to accommodate workers of different occupation and qualification types.
- This modification allows the modelling to account for a shift in the composition of the workforce from individuals with no post-school qualifications to individuals with bachelor level qualifications.

Figure: Measuring benefits using a CGE modelling framework



Appendix C | Returns to R&D activity

Methodology and approach

Research returns at a whole-of-university level

Modelling specification

Estimating the effect of higher education research and development on productivity

In line with a large body of economic development literature, this report seeks to estimate the effects of higher education research and development (R&D) on economic growth using a neoclassical production function.

The formal framework is first set out by Mankiw et al (1992) with an augmented-form implemented by Bassanini and Scarpetta (2001). The models used in this report adhere closely to this literature, with modifications provided to accommodate the focus on higher education R&D. The standard neo-classical growth model is derived from a 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:

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

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, $\Omega(t)$ and economic efficiency, $I(t)$.

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

This research incorporates higher education R&D along with other R&D activities and exposure to international trade as key determinants of economic efficiency $I(t)$ embodied in $V_j(t)$.

$$\ln I(t) = p_0 + \sum p_j \ln V_j(t)$$

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

$$\Omega(t) = g(t)\Omega(t)$$

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

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

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):

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

In addition to estimating the steady state solutions, the analysis also estimate another functional form, adding short-term dynamics to the model. 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:

$$\begin{aligned} \Delta \ln y(t) = & \alpha_0 - \phi \ln y(t-1) + \alpha_1 \ln s_k(t) + \alpha_2 \ln h(t) - \alpha_3 n(t) + \alpha_4 t + \sum_{j=1}^3 a_{j+4} \ln V_j + b_1 \Delta \ln s_k(t) + b_2 \Delta \ln h(t) \\ & + b_3 \Delta \ln n(t) + \sum_{j=1}^3 b_{j+3} \Delta \ln V_j \end{aligned}$$

Research returns at a whole-of-university level

List of countries included in the model

Similar to specifications used in Bassanini and Scarpetta (2001), this analysis uses a sample of 37 countries between 1980 and 2015 (see Table C.1). Where appropriate, data is converted to constant 2015 US dollars using constant Purchasing Power Parity to allow for better comparability across countries.

Country list

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

Research returns at a whole-of-university level

Modelling results

Variable	Source
Gross domestic product	OECD
Tertiary education attainment (% of 15+ population)	Barro-Lee (2010)
Total population growth	OECD
Gross capital formation (% of GDP)	World Bank
Expenditure on higher education R&D per capita	OECD
Expenditure on other R&D per capita	OECD
Exports and imports of goods and services (% of GDP)	World Bank
2008 dummy variable	
2009 dummy variable	

Explanatory variable	Coefficient estimate
$\ln y(t - 1)$	-0.0571***
$\ln s_k(t)$	1.2939***
$\ln h(t)$	-0.1181
$n(t)$	-26.4545***
$V_1(H\ R\&D)$	0.1174*
$V_2(O\ R\&D)$	0.1452**
$V_3(Trade)$	0.5614***
$\Delta \ln s_k(t)$	0.1191***
$\Delta \ln h(t)$	0.0066
$\Delta n(t)$	0.6684
$\Delta V_1(H\ R\&D)$	0.0001
$\Delta V_2(O\ R\&D)$	0.0265***
$\Delta V_3(Trade)$	-0.0205

Research returns at a whole-of-university level

Estimating the return on investment of higher education research and development

To estimate the return on investment of higher education research and development, its costs and benefits are estimated over a 30 year periods between 1988 and 2018.¹ The calculation draws on the results from the cross-country econometric model.

Total costs are calculated using annual higher education research and development expenditure data from the OECD. This is the same expenditure data which is used in the cross-country model. Similar to the cross-country model, the years with missing expenditure data was interpolated using cubic splines. The net present value of the additional cost of higher education research and development funding for each year is calculated and summed over all years to derive the total cost.²

To calculate the benefits, the higher education research and development expenditure on steady state GDP elasticity and the convergence term from the econometric model is used to derive the percentage increase in steady-state GDP per year from university research.

The model assumes that not all the benefits are realised in the year that the expenditure occurs and accounts for this by gradually phasing in the percentage increase in steady-state GDP over the 30 years. The annual increase is then multiplied by the annual GDP figure to obtain the level of growth due to higher education research and expenditure. Similar to the costs approach, the net present value of the additional benefit of higher education research and development expenditure for each year is calculated. This is done to discount the value of the benefits of research in later years as the benefits of the research will have a more significant impact closer to release than in later years. The sum of the net present values for all years is calculated to obtain the total benefits figure.

The final return on investment figure is obtained by dividing the discounted benefits of higher education research and development by the costs.

¹ Data on research and development spending was only available up to 2018 (from the OECD), hence 2018 was chosen as the end of the modelling period.

² All calculations use a discount rate of 7%. The first year discounted is the year in which the expenditure was incurred.



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