The economic impact of Group of Eight universities

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The total economic impact of Group of Eight universities

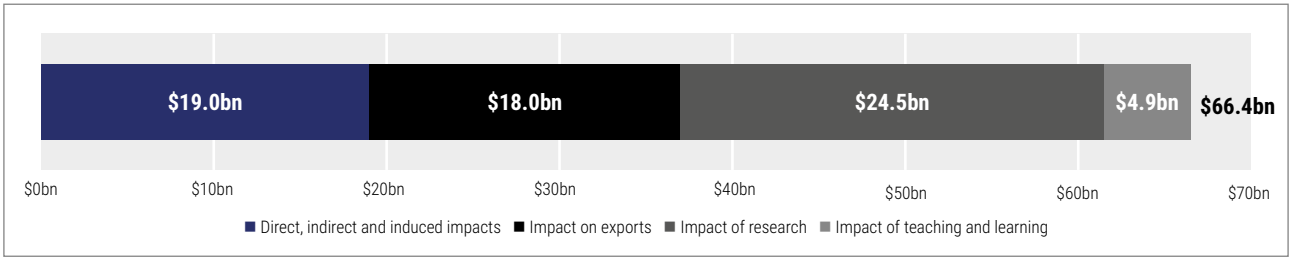
In the 2016 academic year, Group of Eight (Go8) universities taught a total of **380,100 students**, including **141,230 commencing students**, and employed **51,640 staff**. **The total economic impact associated with Go8 universities' activities across Australia in 2016 was estimated to be $66.43 billion**.

In terms of the components of economic impact (see Table 1), the value of the universities' **research** activity contributed **$24.53 billion** (**37%**), while the economic contribution associated with the **direct, indirect and induced impact** from Group of Eight universities' operational and staff expenditure was estimated to be **$19.02 billion** (**29%**). An additional **27%** (or **$17.98 billion**) was associated with the universities' contribution to **educational exports**, with the remaining **$4.91 billion** (**7%** of the total) associated with the Group of Eight universities' **teaching and learning** activities.

Compared to their total operational costs of approximately **$12.38 billion**, the total contribution of Group of Eight universities to the Australian economy in 2016 was estimated to be approximately **$66.43 billion**, which corresponds to a benefit to cost ratio of approximately **5½:1**.

Table 1: Aggregate economic impact of Group of Eight universities in Australia in 2016

Type of impact	$ billion	%
Impact of research	**$24.53bn**	**37%**
Net direct research impact	$0.75bn	1%
Spillover impact	$23.78bn	36%
Impact of university expenditure	**$19.02bn**	**29%**
Direct impact	$11.45bn	17%
Indirect and induced impacts	$7.57bn	11%
Exports	**$17.98bn**	**27%**
Net tuition fee income	$9.52bn	14%
Non-tuition fee income	$8.45bn	13%
Impact of teaching and learning	**$4.91bn**	**7%**
Students	$3.42bn	5%
Treasury	$1.49bn	2%
Total impact	**$66.43bn**	**100%**



Note: All estimates are presented in 2016 prices. Numbers and percentages may not add due to rounding. ***Source: London Economics' analysis.***

The total economic impact of the Group of Eight using an alternative discount rate

The **costs** of qualification acquisition and associated labour market **benefits** occur **over a long period of time** – starting at students' initial date of enrolment, and lasting **their entire working lives post-graduation**[1]. As a result, it is necessary for any analysis to **discount** these benefits and costs accruing at different points in time into **net present values** to ensure that the comparison of costs and benefits is made using a common 'currency'.

While there is consensus on the need to discount cash flows when conducting an economic impact analysis, **the level of the appropriate discount rate is subject to considerable debate**. In line with recommendations from the Australian Office of Best Practice Regulation (2016), our analysis of the economic impact of Group of Eight universities uses a **7% real discount rate** (i.e. not incorporating inflation). However, a recent report by the Grattan Institute[2] argues that this 7% rate is too high, and recommends that discount rates should reflect both **risk** and the government **cost of borrowing**. Incorporating these factors, this report recommends a real discount rate of between **3.5%** for projects with low systematic risk and **5%** for projects with high systematic risk (using the example of transport infrastructure projects)[3]. To place this headline discount rate in context, the discount rate adopted by a number of Australian States are often significantly lower than the Commonwealth rate, while the real discount rate adopted in comparable analyses in the United Kingdom stands at 3.5%.

Why is the choice of discount rate important?

The lower the discount rate, the greater the value of the economic benefits that occur in the future. For example, under the 7% discount rate, $1,000 received in 40 years' time is worth **$71** in today's money terms, whereas under the 3.5% discount rate, the same $1,000 is worth **$261** today.

In other words, a higher discount rate places a higher value on activities whose costs accrue earlier in time, and a much lower value on benefits occurring in the more distant future. In the case of higher education qualification attainment, this means that the use of a 7% discount rate *inflates* the costs that occur during study, and *diminishes* the value of the benefits that occur post-graduation.

Given that the impacts of teaching and learning and of overseas students at Go8 universities are measured in net present value terms over many years, we assessed the sensitivity of the total economic impact estimates to changes in the discount rate (comparing our central estimates using a **7% discount rate** to alternative results assuming a **3.5% discount rate**).

What is the impact of a lower discount rate?

The lower discount rate significantly **increases** the estimated total contribution of Group of Eight universities to the Australian economy, from **$66.43 billion** to **$79.52 billion** (equivalent to a **20%** increase). The difference is primarily driven by the increase in the estimated impact of **teaching and learning** (since this impact is measured over graduates' entire working lives) from **$4.91 billion** to **$17.48 billion**, and, to a lesser extent, by an increase in the impact on educational exports, from **$17.98 billion** to **$18.50 billion**[4].

Table 2: Aggregate economic impact of Group of Eight universities in Australia in 2016 – sensitivity analysis

Type of impact		Central estimates (7% discount rate)	Sensitivity analysis (3.5% discount rate)
	**Impact of research**	**$24.53bn**	**$24.53bn**
	Net direct research impact	$0.75bn	$0.75bn
	Spillover impact	$23.78bn	$23.78bn
	**Impact of university expenditure**	**$19.02bn**	**$19.02bn**
	Direct impact	$11.45bn	$11.45bn
	Indirect and induced impacts	$7.57bn	$7.57bn
	**Exports**	**$17.98bn**	**$18.50bn**
	Net tuition fee income	$9.52bn	$9.79bn
	Non-tuition fee income	$8.45bn	$8.70bn
	**Impact of teaching and learning**	**$4.91bn**	**$17.48bn**
	Students	$3.42bn	$10.44bn
	Treasury	$1.49bn	$7.04bn
	Total impact	**$66.43bn**	**$79.52bn**

Note: All estimates are presented in 2016 prices. Numbers may not add due to rounding. ***Source: London Economics' analysis.***

1 As presented in A3.1, this analysis measures the lifetime benefits from higher education qualification attainment up until the age of 65.

2 See Grattan Institute (2018).

3 The low-risk real discount rate proposed by the Grattan Institute's report is the same as the standard 3.5% real discount rate commonly used for government appraisal and evaluation in the United Kingdom, as recommended by the HM Treasury *Green Book*. For example, this standard rate was used as part of a key analysis of the returns to UK higher education qualifications on behalf of the (former) Department for Business, Innovation and Skills (2011). It is also important to note that 3.5% is not the lowest discount rate in use in the United Kingdom. In relation to the assessment of the proportion of higher education tuition fee and maintenance loans written off (i.e. to understand the long run economic cost to the UK government associated with the student support offered through loans), a real discount rate of **0.7%** is adopted (having recently been adjusted downwards from 2.2%).

4 Note that we implicitly assert that all overseas students will leave Australia upon completing their qualifications. Hence, the analysis of the impact of Go8 universities' contribution to exports focuses exclusively on the economic benefit generated by overseas students in Australia *during* their studies, resulting in a relatively small impact of changes in the discount rate on the estimated impact on educational exports.

It is of course possible that a proportion of overseas students undertaking their studies at Group of Eight universities will remain in Australia to work following completion of their studies (or, similarly, that domestic students might decide to leave Australia to pursue their careers in other countries). However, given the uncertainty in predicting the extent to which this is the case, and the difficulty in assessing the *net* labour market outcomes for overseas students (e.g. when considering the earnings which these students forego during their studies at university), the analysis excludes any potential labour market benefits associated with overseas students entering the Australian workforce post-graduation.

The impact of Group of Eight universities' research activities

With **687 research units** assessed as part of the 2015 Excellence in Research for Australia exercise – accounting for **39%** of all research groups assessed across all universities – Group of Eight universities are committed to delivering high-quality research with real-world impact. Overall, **99%** of Go8 universities' research was assessed to be at 'world standard' or higher (rating of 3 or more), compared to **83%** across all other universities. In addition, **45%** of research at Go8 universities was categorised as 'well above world standard' (rating of 5), compared to **23%** of research undertaken at other universities.

Group of Eight universities secured a total of **$2.44 billion**[5] in research-related income in 2016, thus accounting for **67%** of the total research income received by the Australian university sector in 2016. **Almost half** of this income (**45%**, or **$1.08bn**) was received through **Australian competitive grants,** the majority of which (**$0.99bn**) was provided by Commonwealth departments and agencies. Around **$0.73bn** (**30%**) was derived from **industry and other funding for research**, including **$0.26bn** of **international** income, and **$0.47 billion** from **Australian** sources. A further **$0.58bn** (**24%**) was received from **other Australian public sector sources**, with the remaining **$0.04bn** (**2%**) received for **Cooperative Research Centres**.

To calculate the **net direct impact** of Go8 universities' research activities on the Australian economy, we deduct a total of cost of **$1.69 billion** to the Treasury of funding Go8 research from the total research-related income received in 2016. This suggests that Go8 universities generated a **total net direct research impact** of **$0.75 billion** in the 2016 academic year.

Table 3: Impact of Go8 universities' research activities in 2016

Type of impact	$ billion
Direct research impact	$0.75bn
Productivity spillovers	$23.78bn
Total	**$24.53bn**

Note: All estimates are presented in 2016 prices. ***Source: London Economics' analysis.***

In addition to these direct impacts, higher education research activities generate **positive productivity and knowledge spillovers**, where knowledge generated through the research activities of Go8 universities improve the productivity or processes of other organisations (for instance, individuals, businesses or public sector organisations). Based on estimates from existing academic research, we estimated a weighted average spillover multiplier of **9.76** associated with Go8 universities' research activities in 2016. This implies that, **for every $1 invested in Group of Eight university research, an additional annual economic output of $9.76 is generated across the rest of the Australian economy.**

Applying this average productivity spillover multiplier to the above-presented total research income of the Go8 universities, we estimate that the research conducted by Go8 universities resulted in **total productivity spillovers of approximately $23.78 billion** in 2016. Combining the direct and spillover impacts, the total economic impact of research conducted by Group of Eight universities in the 2016 academic year was estimated at **$24.53 billion**.

If research funding for Group of Eight universities were increased (or decreased) by **$100 million** (and this funding increase (decrease) was provided in such a way so that the share of the distribution of research income remained the same), then the estimated total impact of Go8 research would increase (decrease) by approximately **$1.01 billion**.

5 To avoid double-counting with other impact strands, we exclude a total of **$69 million** of fee income from domestic and international higher degree research students received by Group of Eight universities in 2016.

The direct, indirect and induced impact of Group of Eight university expenditure

Considering universities as economic units creating output within the local economy by purchasing products and services from different industries and hiring employees, the analysis also estimated the **direct**, **indirect** and **induced** effect associated with Go8 universities' expenditures.

The **direct impact** associated with the universities' expenditures in 2016 was estimated at **$11.45 billion**, comprised of approximately **$6.75 billion** of staff spending and **$4.70 billion** of non-staff spending. In terms of employment, the universities directly employed **51,640** staff, corresponding to **43,310** full-time equivalent jobs.

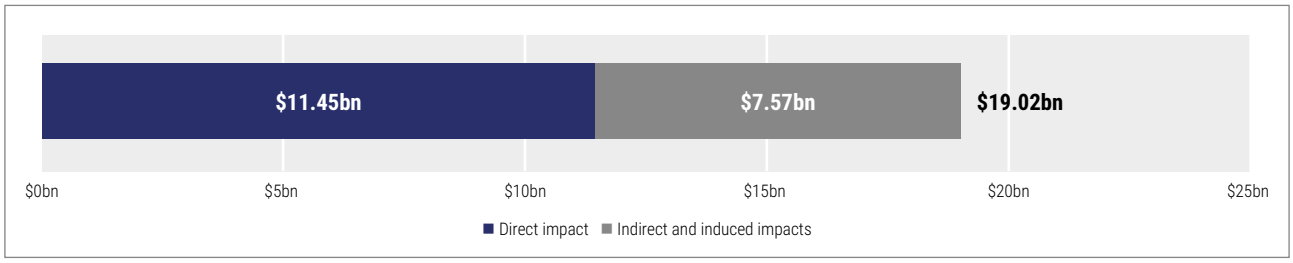
In relation to the **indirect** and **induced** effect (or knock-on effect) of Go8 universities expenditure throughout the Australian economy, we estimated that every **$1m of expenditure** by a Group of Eight university generates a total of **$3.01m of output** throughout the Australian economy. Similarly, we estimate that **every 1,000 jobs** directly created within a Group of Eight university supports a total of **2,430 jobs** throughout the Australian economy. In aggregate, the indirect and induced effect of Go8 universities expenditure was estimated to be **$7.57 billion** with **17,240** jobs supported across Australia.

The **aggregate direct, indirect and induced impact** of Group of Eight universities' physical and digital footprint on the Australian economy stands at approximately **$19.02 billion** in 2016, with **68,880** full-time equivalent jobs supported by the universities' activities.

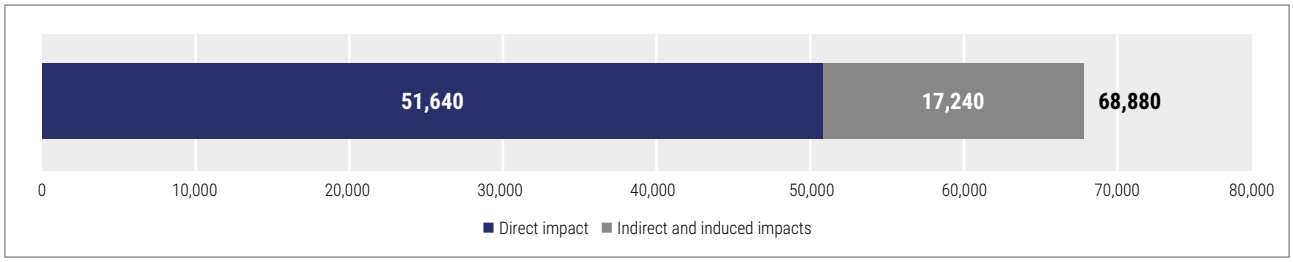
Table 4: Direct, indirect and induced impact of Go8 university expenditure in 2016, in $ billion and # of jobs supported

Type of impact	**$ billion**	**# of jobs** (headcount)
Direct impact	$11.45bn	51,640
Indirect and induced impact	$7.57bn	17,240
Total	**$19.02bn**	**68,880**

Output, $ billion



Employment, headcount



Note: All monetary estimates are presented in 2016 prices, and discounted to net present values. Employment estimates are provided in headcount, and rounded to the nearest 5. The estimates have been adjusted to avoid double-counting with other sources of economic impact as analysed in other sections of this report, as well as to take account of transfers between different agents in the economy. The impacts which would be double-counted, and any inter-economy transfers that have not 'netted out' in other strands of the analysis were deducted from the indirect and induced impacts.

The impact of Group of Eight universities on educational exports

Educational exports, like any other international trade of goods and services across national borders, contribute to the Australian economy as income from overseas. This analysis focuses on the **direct** economic contribution of the net **tuition fee income** and other **non-tuition fee expenditure** (associated with general living or study expenses) incurred by the **53,895** overseas students in the 2016 cohort of starters, over the entire duration of their studies at Go8 universities. In addition to generating direct revenue, the analysis also estimates the **indirect** and **induced impacts** associated with overseas students' expenditures that ripple throughout the Australian economy.

- In **monetary terms**, the aggregate economic impact across all overseas students commencing their studies at Group of Eight universities in the 2016 academic year was estimated at **$17.98 billion**, comprised of **$9.52 billion** associated with the net tuition fee income generated by these students (net of the Treasury cost of funding their higher education learning), and **$8.45 billion** generated through their non-tuition fee spending (on general living or study expenses).
- In **employment terms** (in headcount), the income generated from these overseas students supports a total of approximately **73,030** jobs throughout the Australian economy, of which **43,700** jobs are supported by the net tuition fee income from overseas students, with the remaining **29,330** generated by their non-tuition fee expenditures.

At an individual level, the total economic impact generated by overseas students in the 2016 cohort was estimated to be approximately **$424,000** per student undertaking a Bachelor degree, and **$312,000** per student completing a Master's degree by Coursework. The average impact across all qualification levels stands at approximately **$334,000** per student.

In other words, this implies that every 3 overseas students undertaking Bachelor degrees and every 4 overseas students undertaking Master's degrees by Coursework at Group of Eight universities generate $1 million of impact for the Australian economy. Taking a weighted average across all study levels, the analysis indicates that **there is a total economic impact of $1 million for every 3 overseas students in attending Go8 universities**.

Table 5: Impact of Go8 universities on educational exports in 2016, in $ billion and # of jobs supported

Type of impact	**$ billion**	**# of jobs** (headcount)
Net tuition fee income	$9.52bn	43,700
Non-tuition fee income	$8.45bn	29,330
Total	**$17.98bn**	**73,030**

Note: All monetary estimates are presented in 2016 prices, and discounted to net present values. Employment estimates are provided in headcount, and rounded to the nearest 5. Numbers may not add due to rounding. ***Source: London Economics' analysis.***

These estimates are **sensitive to the chosen discount rate**. The analysis indicates that a lower discount rate (of 3.5%, rather than 7%) would slightly increase the value of educational exports associated with the 2016 cohort of overseas Group of Eight students, increasing from **$17.98 billion** to **$18.50 billion** (equivalent to a **3%** increase) in monetary terms. In terms of employment, the estimates would rise from **73,030** to **75,145 jobs** supported (again equivalent to a **3%** increase).

The impact of Group of Eight universities' teaching and learning activities

The analysis estimates the **enhanced employment** and **earnings benefits** to students, and the **additional taxation receipts** to the Treasury associated with higher education qualification attainment, adjusted for the characteristics of the cohort of **87,335** domestic students[6] who **started** a higher education qualification at a Group of Eight university in the 2016 academic year.

Incorporating the costs and benefits to students, the analysis suggests that the **net graduate premium** for a representative domestic student undertaking a full-time Bachelor degree at a Group of Eight university stands at approximately **$58,000** (in 2016 money terms). Taking account of the costs and benefits to the Treasury, the **net Treasury benefit** associated with a full-time Bachelor degree at a Group of Eight university was estimated at **$13,000.** The corresponding net graduate premium and net Treasury benefit per student undertaking Master's degrees by Coursework were estimated to be **$16,000** and **$37,000**, respectively.

6 This excludes students with New Zealand citizenship, who have been categorised as *overseas* students for the purposes of this analysis (and are thus included in the impact of educational exports).

Table 6: Impact of Group of Eight universities' teaching and learning activities in 2016 by type of study, student domicile, and beneficiary

Type of study and beneficiary	Domicile		
	Australian Citizens	Other domestic students	Total
Students	**$3.33bn**	**$0.09bn**	**$3.42bn**
Full-time	$2.74bn	$0.05bn	$2.78bn
Part-time	$0.60bn	$0.04bn	$0.64bn
Treasury	**$1.39bn**	**$0.11bn**	**$1.49bn**
Full-time	$0.81bn	$0.06bn	$0.87bn
Part-time	$0.58bn	$0.05bn	$0.63bn
Total	**$4.72bn**	**$0.19bn**	**$4.91bn**
Full-time	$3.55bn	$0.10bn	$3.65bn
Part-time	$1.17bn	$0.09bn	$1.26bn

Note: All estimates are presented in 2016 prices, and have been discounted to net present values. Numbers may not add due to rounding. ***Source: London Economics' analysis.***

Combining information on completion rates, the number of domestic students in the 2016 cohort of Group of Eight university students, and the net graduate premiums and net Treasury benefits per student, the analysis estimates that the **aggregate economic benefit of teaching and learning** associated with Go8 universities' 2016 cohort stands at approximately **$4.91 billion**. Of this total, **70%** (**$3.42 billion**) is **accrued by students** undertaking qualifications at Group of Eight universities, while the remaining **30%** (**$1.49 billion**) is **accrued by the Australian Treasury**.

Box 1: Who else gains from having a highly trained workforce?

Clearly, university graduates and the Australian Treasury are not the only beneficiaries of having a highly trained workforce. Substantial additional economic benefits are accrued by **employers**, resulting from the productivity gains generated by more qualified workers in the workplace following the completion of their higher education learning. In the absence of comparable estimates for Australia, we used information from existing literature on the impact of training on firm-level and industry-level productivity in the United Kingdom to provide an indicative estimate of the size of these benefits to employers. Specifically, we estimate that the total employer benefit associated with the higher education attainment of the 2016 cohort of Group of Eight university students (net of employers' costs of additional salary and superannuation guarantee payments) stands at approximately **$11.24 billion**. While this estimate is based on evidence for the UK – and is therefore excluded from the aggregate analysis of the economic impact of Go8 universities – it illustrates that the estimated total impact of teaching and learning presented in this report is a conservative estimate of the 'true' value of higher education teaching and learning at Group of Eight universities.

These estimates of the impact of teaching and learning are **highly sensitive** to changes in the discount rate. Assuming a 3.5% real annual discount rate (as compared to 7%) would increase the impact of teaching and learning from **$4.91 billion** to **$17.48 billion** – equivalent to a **256%** increase. Disaggregating this impact, the net benefits to the Treasury would increase from **$1.49 billion** to **$7.04 billion**, the impact accrued by students would increase from **$3.42 billion** to **$10.44 billion**.

These estimates emphasise the **significant effect** of the underlying choice of discount rate on the resulting assessment of the economic impact of teaching and learning at Group of Eight universities.

1 Introduction

1 Introduction

The Group of Eight (Go8) represents the eight leading Australian universities[7] that are committed to maintaining the very best research quality, an outstanding teaching and learning experience and unrivalled links with business and the public sector. Group of Eight universities make a significant contribution to the Australian economy through their **research**; their **teaching and learning activities**; their **spending** on goods and services from within the Australian economy; and by creating **export revenues** by attracting international students to Australia. London Economics were commissioned to estimate the economic impact of the Group of Eight universities on the Australian economy, focusing on the 2016 academic year.

This report uses the same methodology used for the London Economics report for the Russell Group of universities in the UK.

The Russell Group is the UK equivalent of Australia's Group of Eight.

1.1 Structure of this report

Our approach to addressing these many impacts is as follows. In the first section of this report (**Section 2**), we combine information on the research-related income accrued by Group of Eight universities in 2016 (by source) with estimates from the wider economic literature on the extent to which public investment in university research activity results in additional or subsequent private sector productivity (i.e. positive 'productivity spillovers'). This results in an estimate of the impact of Group of Eight universities' **research activities**.

With **51,640** staff employed in 2016, and a total expenditure of **$11.45 billion**, the **direct economic impact** of the Group of Eight is substantial. In addition to these direct impacts, the universities also **indirectly** support the employment and earnings outcomes of many individuals that provide services throughout the universities' extensive supply chains and the wages paid to their staff. Similarly, the spending of students undertaking their learning at the universities within the local economy results in economic benefits to local businesses and throughout their supply chains. In **Section 3**, we estimate both the direct impact of Group of Eight universities' expenditure and the spending of its overseas students, as well as the indirect and induced impact across Australia.

Australia is a world leader in higher education and an attractive destination for many international students undertaking higher education. Many will choose to study at Group of Eight universities and in addition to the **87,335** domestic domiciled students starting higher education qualifications at Group of Eight universities in 2016, a further **53,895** international students enrolled with the universities. As such, Group of Eight universities contribute to the value of Australian **educational exports** through the receipt of income from overseas. **Section 4** of this report assesses the monetary value of the tuition fee and non-tuition fee income associated with international students, and estimates the contribution of these activities to the Australian economy.

In **Section 5**, we assess the enhanced labour market earnings and employment outcomes associated with higher education attainment, using a detailed analysis of existing research and the Australian labour market. Through an assessment of the lifetime benefits and costs associated with higher education qualification attainment, we estimate the economic impact of Group of Eight universities' **teaching and learning** activity for its **87,335 domestic students** starting higher education qualifications in 2016. We estimate both the impact on these students, as well as the impact on the Treasury (through enhanced taxation receipts).

Finally, **Section 6** of this report summarises our main findings.

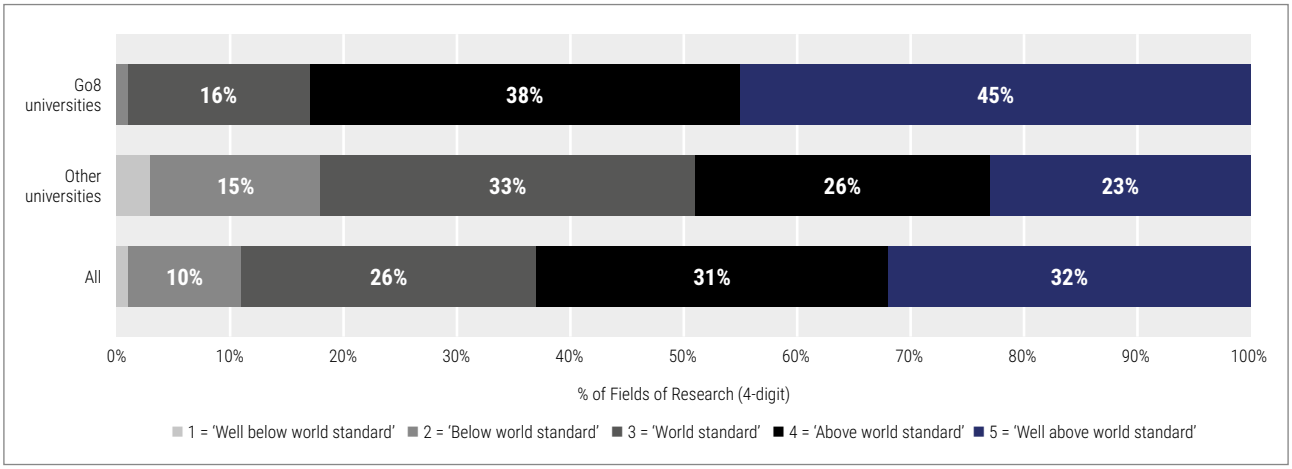
7 A list of the Group of Eight universities can be found in Annex 2.

2 The economic impact of research activities at Group of Eight universities

2 The economic impact of research activities at Group of Eight universities

With **687 research units** assessed as part of the 2015 **Excellence in Research for Australia** (ERA) exercise – accounting for **39%** of research groups assessed across all universities[8], the Group of Eight universities are committed to generating world-class research with impact. Overall, **99%** of Go8 universities' research was assessed to be at 'world standard' or higher (rating of 3 or more), compared to **83%** across all other institutions (see Figure 1). In addition, **45%** of research at Go8 universities was categorised as 'well above world standard' (rating of 5), compared to **23%** of research undertaken at other universities.

Figure 1: ERA 2015 ratings by type of institution



Note: Based on 4-digit Field of Research. ***Source: London Economics' analysis of Australian Research Council (2015)***

In the following sections, the **economic impact** of Group of Eight universities' research activities is estimated by combining information on the research-related income accrued by the universities in 2016 (by income source) with estimates from the wider economic literature on the extent to which public investment in research activity results in additional productivity (i.e. positive 'productivity spillovers').

8 The 2015 ERA exercise covered a total of 33 other higher education providers.

2.1 Direct impact of research at Go8 universities

Assuming that the **direct economic impact** of research generated by Group of Eight universities is equal to the funding these universities for the purposes of research-related activities each year, the **direct effect** of the research activities of Go8 universities can be derived from the universities' research income reported in the **Higher Education Research Data Collection** (HERDC) published by the Department of Education and Training[9]. The HERDC differentiates between four main types of research funding:

- **Australian competitive grants,** including competitive funding provided through Commonwealth Schemes (e.g. from the Australian Research Council, and the National Health and Medical Research Council) and other sources (including Rural R&D and other non-Commonwealth schemes)[10];
- **Other public sector research income** from local, state, territory and Commonwealth government departments or agencies;
- **Industry and other funding for research**, including research income from private organisations and other non-government agencies (e.g. through contracts, grants, donations or bequests), from Australian and international sources[11]; and
- **Cooperative Research Centre (CRC) funding** (for collaborative initiatives between industry and universities administered by the Department of Industry, Innovation and Science) provided by the Commonwealth government, non-university participants in CRCs and external parties contributing to CRCs.

Based on the HERDC data, Group of Eight universities secured a total of **$2.44 billion**[12] in research-related funding from these sources in 2016 (Table 7). **Almost half** of this income (approximately **45%**, or **$1.08bn**) was received through **Australian competitive grants,** the majority of which (**$0.99bn**) was provided by Commonwealth departments and agencies. Around **$0.73bn** (**30%**) was derived from **industry and other funding for research**, including **$0.26bn** of **international** income, and **$0.47 billion** from **Australian** sources. A further **$0.58bn** (**24%**) was received from **other Australian public sector sources**, with the remaining **$0.04bn** (**2%**) received for **CRCs**.

Compared to other universities (Figure 2), Group of Eight universities accounted for **67%** of the total **$3.64 billion** research income received by the Australian university sector in 2016, and an even larger proportion (**70%**) of income received from Australian competitive grants **($1.55 billion**) industry and other (non-governmental) sources (**$1.05 billion**)[13], respectively.

Table 7: Research income received by Go8 universities in 2016

Source of income		$bn	%
Australian competitive grants	Commonwealth schemes	$0.99bn	41%
	Rural R&D	$0.05bn	2%
	Non-Commonwealth schemes	$0.05bn	2%
	Total	**$1.08bn**	**45%**
Other public sector research funding	Local government	$0.01bn	0%
	State government	$0.22bn	9%
	Commonwealth government	$0.35bn	14%
	Total	**$0.58bn**	**24%**
Industry and other funding for research	Australian Funding: Contracts	$0.14bn	6%
	Australian Funding: Grants	$0.12bn	5%
	Australian Funding: Donations, bequests and foundations	$0.21bn	8%
	HDR fees for domestic students	–	–
	International A: Competitive, peer-reviewed research income	$0.13bn	5%
	International B: Other income	$0.13bn	5%
	International C: HDR fees for international students	–	–
	Total	**$0.73bn**	**30%**
Cooperative Research Centre funding	Funding derived from Commonwealth grants to CRCs	$0.03bn	1%
	Funding derived from non-university participants in CRCs	$0.01bn	0%
	Funding derived from third parties contributing to CRCs	$0.00bn	0%
	Total	**$0.04bn**	**2%**
Total		**$2.44bn**	**100%**

Note: To avoid double-counting with other impact strands, we exclude a total of **$69 million** of fee income from domestic and international higher degree research students received by Group of Eight universities in 2016. Numbers and percentages may not add due to rounding. ***Source: London Economics' analysis of Department of Education and Training (2017c)***

9 The HERDC is the most comprehensive source of R&D income provided across all Australian higher education providers (Department of Education and Training, 2018b). It covers both activities directly related to research, as well as activities that support the conduct of research more generally. A full overview of the HERDC data coverage in 2016 is provided in the published HERDC specifications (see Department of Education and Training, 2018c).

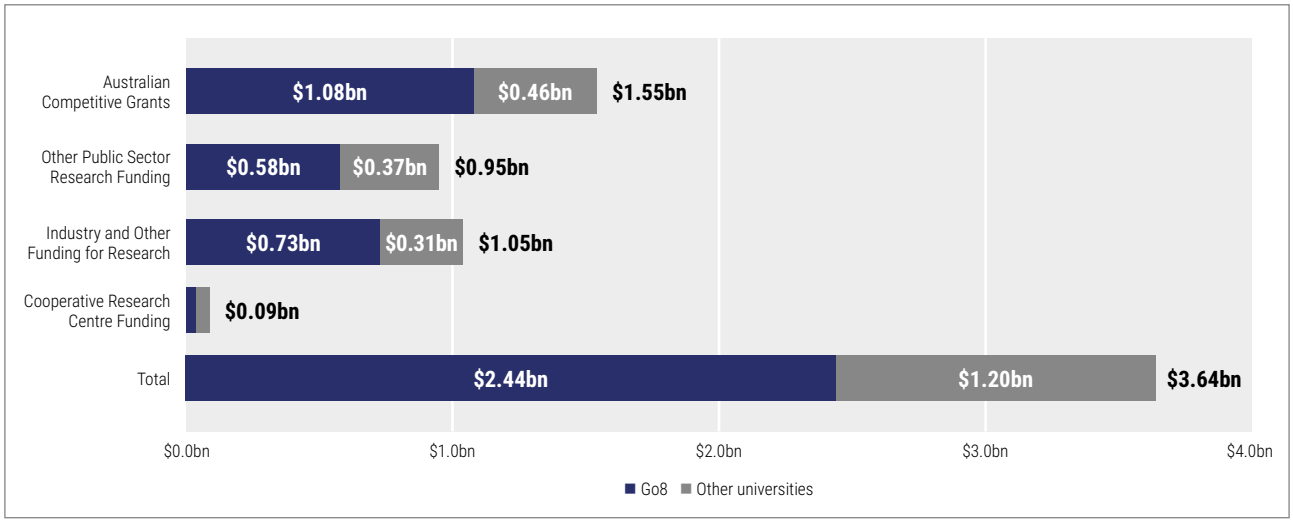
10 Australian competitive grant funding covers research schemes and programs registered on the Australian Competitive Grants Register. For more information, see Department of Education and Training (2018d).

11 Note that this type of research income covers higher degree research fees from domestic and international students, which we *exclude* from the estimates to avoid double-counting with the impact of educational exports (Section 4) and the impact of teaching and learning (Section 5).

12 To avoid double-counting with other impact strands, we exclude a total of **$69 million** of fee income from domestic and international higher degree research students received by Group of Eight universities in 2016.

13 Again, excluding any income from the tuition fees paid by domestic and international higher degree research students.

Figure 2: Research income received by Go8 and other universities in 2016



Note: Again, to avoid double-counting, we exclude any tuition fee income from domestic and international higher degree research students received by Group of Eight or other universities in 2016. Numbers and percentages may not add due to rounding. ***Source: London Economics' analysis of Department of Education and Training (2017c)***

In order to calculate the **net direct impact** of Go8 universities' research activities on the Australian economy, it is necessary to deduct the costs to the Treasury of funding Go8 research from the above total research-related income. This relates to the research grants received by Group of Eight universities from **Australian competitive grants**, **other public sector research funding** and **CRC funding from the Commonwealth government,** jointly amounting to **$1.69 billion** in 2016.

Deducting these Treasury costs from Group of Eight universities' total research-related income, the analysis suggests that Go8 universities generated a **total net direct research impact** of **$0.75 billion** in the 2016 academic year.

2.2 Productivity spillovers

In addition to the direct impact of research activities in terms of the income derived by universities, the wider academic literature indicates that investments in intangible assets such as research and development (R&D) may induce positive **externalities**. Economists refer to the term 'externality' to describe situations in which the activities of one 'agent' in the market induce either positive or negative external effects on other agents in that market (that are not reflected in the price mechanism). In other words, 'an externality is present whenever the well-being of a consumer or the production possibilities of a firm are directly affected by the actions of another agent in the economy' (Mas-Collell et al., 1995).

In the context of the economic impact of research activities, the literature suggests that higher education research activities generate **positive productivity and knowledge spillovers**, where knowledge generated through universities' research activities improves the productivity or processes of other organisations (for instance, individuals, businesses or public sector organisations).

There are many ways in which research generated at Group of Eight universities can induce such positive spillover effects. For example, the spillovers from the universities to the private sector are enabled through direct R&D collaborations between the universities and firms (CRCs), the publication and dissemination of research findings, or through the universities' graduates entering the labour market.

Cotton – help against an economically devastating pest

Cotton is the world's most important fibre crop, with India the second largest, and Australia the sixth largest cotton producer.

Almost 20 per cent of all insecticide usage worldwide is on cotton and most of this on the attempted control of cotton bollworms that feed on the growing fruit buds, flowers and developing cotton bolls. But bollworms are now resistant to most chemical insecticides and they are increasingly resistant to genetically modified cotton.

It's a scenario which threatens to devastate cotton production in both India and Australia. Already cotton crop losses in India due to bollworms are often more than half the yield, with annual losses estimated as USD$300–500 million.

It is considered essential that a reliable bollworm control solution is found to help secure the future of India and Australia's cotton industries. A joint research project between a Go8 team and two teams from India, is currently working on an eco-friendly alternative to the now non-reliable chemical insecticides.

The researchers, with the Australian team led by Professor Glenn King, are developing optimised versions of plant protease inhibitors (PPIs). PPIs are something plants themselves produce in an attempt to fight off bollworms. What is being developed is far more potent than that produced by the plants, and by mimicking how cotton plant PPIs work, will starve the developing bollworm larvae. The PPIs will be able to be used as a standalone bio-insecticide or genetically engineered into plants.

… an eco-friendly alternative to the now non-reliable chemical insecticides.

Almost **20 per cent** of all insecticide usage worldwide is on cotton

Annual cotton crop losses in India due to bollworms are estimated as **USD$300 – $500 million**

An **eco-friendly alternative** to the now non-reliable chemical insecticides

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2.2.1 Literature estimates of productivity spillovers from Higher Education research

Of particular relevance in the context of research conducted by Australian universities, a study by Elnasri and Fox (2017) investigates evidence of **spillovers from public and private funding of R&D** through a number of channels. The authors analyse the impact of public investment in R&D on Australian market sector productivity[14], including public R&D investment in research at Australian higher education institutions (e.g. through Australian Research Council funding), the business enterprise sector, research agencies (such as the Commonwealth Scientific and Industrial Research Organisation and the Defence Science and Technology Organisation), and 'multisector' research (e.g. CRCs, and funding provided by the National Health and Medical Research Council).

Using data on the value of public higher education research funding from the Science, Research and Innovation Budget (SRI) publication from the Department of Industry, Innovation and Science (between 1993–1994 to 2012–13)[15], the authors find **strong evidence of the existence of market sector productivity spillovers from public R&D expenditure in higher education**. They estimate that the **elasticity of Australian market sector productivity with respect to public spending on higher education R&D stands at 0.175**. In other words, at the margin, their findings suggest that a **1%** increase in public spending on university research is associated with an increase of **0.175%** in Australian productivity[16]. The authors' findings further suggest that the positive spillovers from public sector R&D overall are mainly driven by the spending on higher education sectors and research agencies, while there are no significant productivity impacts of business enterprise sector and multisector research.

2.2.2 Estimating productivity spillovers

In order to estimate productivity spillovers arising from Group of Eight universities' research activities, we follow the established literature, and apply the elasticity of **0.175** to the research income received by Group of Eight universities in 2016[17]. Since Elnasri and Fox's (2017) estimates are based on Commonwealth funded research, the coefficient is applied to **Commonwealth Australian competitive grants** and **other public sector research funding from Commonwealth sources** only (but not to other types of research income received by Go8 universities in 2016)[18]. Using this approach, we infer a weighted average spillover multiplier of **9.76** associated with Go8 universities' research activities in 2016[19]. This means that for **every $1 invested in Group of Eight university research, an additional in year economic output of $9.76 is generated across the rest of the Australian economy.**

Applying this average productivity spillover multiplier to the above-presented total research income of Go8 universities, we estimate that the research conducted by Go8 universities results in **total productivity spillovers of approximately $23.78 billion** in 2016.

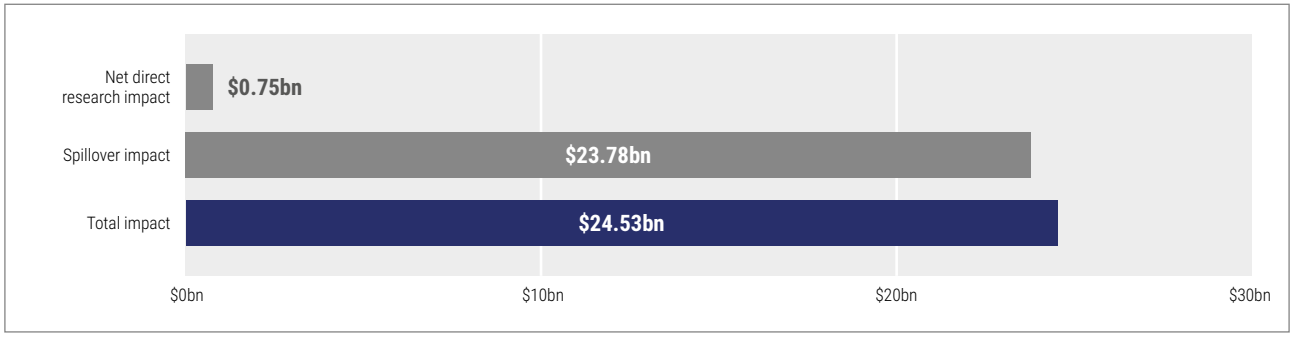
2.3 Total economic impact of Go8 universities' research activities

The total economic impact of research conducted by Group of Eight universities in the 2016 academic year was estimated at **$24.53 billion** (see Figure 3), the majority of which is driven by the productivity spillovers generated (**$23.78 billion**), with the remaining **$0.75 billion** arising from the net direct economic impact of Group of Eight universities' research activities.

Comparing the aggregate research impact to the total amount of public funding invested in Go8 universities' research, the analysis indicates **that for every $1 of publicly funded research income[20], Group of Eight universities deliver an average return of $14.5 to the Australian economy**.

In terms of the sensitivity analysis with respect to the assumed discount rate, note that this research impact is measured throughout the 2016 academic year only. As a result, the estimates are unaffected by the chosen discount rate.

Figure 3: Total impact of Go8 universities' research activities in 2016



Note: All estimates are presented in 2016 prices. ***Source: London Economics' analysis***.

14 Specifically, Elnasri and Fox (2017) focus on market sector multi-factor productivity as the key variable of interest throughout their analysis.

15 The higher education funding covered by the SRI data includes all Australian government investments in Australian Research Council funding, performance based block grant funding, former funding frameworks and other R&D. The publication does not include local and state government budget funds for higher education – and, as such, the data is less comprehensive than the HERDC publication.

16 It should be noted that this coefficient only captures the contemporaneous impact of a change in research funding on output within the same year.

17 More specifically, we estimate the effect on Australian output of *removing* particular types of public research funding received by Group of Eight universities from the total existing stock of public sector R&D in higher education. For more detailed information on our methodological approach to estimating these spillovers, please refer to Annex A3.2.

18 As outlined in more detail in Annex A3.2, while this is a conservative approach and likely understates the spillover effects associated with Go8 research activities, it ensures that the estimates accurately reflect Elnasri and Fox's findings.

19 Full details are presented in the Annex.

20 As above, the public funding research income underlying the ratio includes the total of **$1.69 billion** income received by Go8 universities from Australian competitive grants, other local, state and Commonwealth public research funding, and Cooperative Research Centre funding from Commonwealth sources.

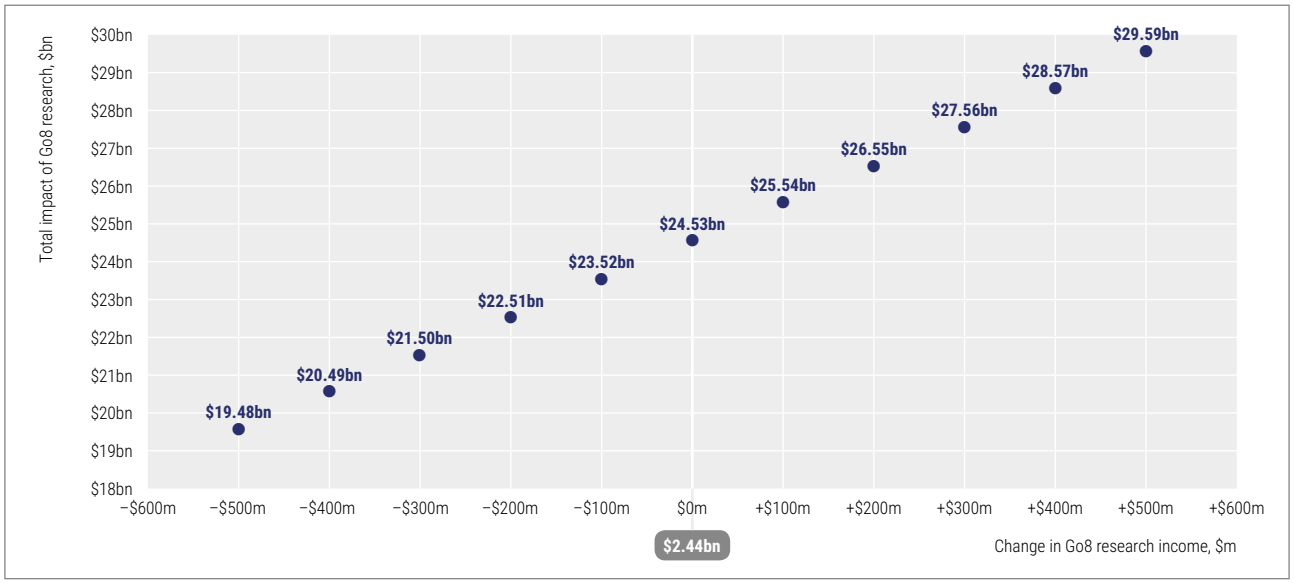
2.3.1 What would be the impact of an increase or decrease in the level of research funding?

The analysis presented above illustrates the total economic impact associated with the current level of research funding received by the Group of Eight universities. It is also informative to understand the marginal economic impact associated with a given increase or decrease in research funding provided to Group of Eight universities.

In particular, to estimate the productivity spillovers associated with Go8 universities' research activities undertaken in 2016, we estimated the effect on Australian output of *removing* particular types of public research funding received by Group of Eight universities from the total existing **stock** of public sector R&D in higher education – thus analysing the economic output that would be lost to the Australian economy without the Group of Eight universities' research activities.

Figure 4 presents the effect of different changes in the aggregate research income accrued by Group of Eight universities on the estimated total impact of the universities' research activities on the Australian Economy. For example, if research funding for Go8 universities were increased (or decreased) by **$100 million** (i.e. a **4%** change compared to the current **$2.44 billion**) – and this funding increase (decrease) was provided in such a way so that the distribution of research income remained the same (e.g. Australian competitive grants from Commonwealth schemes continued to provide **41%** of total research income to Group of Eight universities etc.), then the estimated total impact of Go8 research would increase (decrease) by approximately **$1.01 billion**[21]. Considering even larger changes in research funding, the corresponding effect of an increase (decline) in Group of Eight universities' research income by **$500 million** (**21%**) would be to increase (decrease) the economic impact of Go8 research by **$5.05 billion**.

Figure 4: Effect of changes in research income received by Go8 universities on economic research impact



Note: All estimates are presented in 2016 prices. ***Source: London Economics' analysis.***

21 This $1.01 billion effect consists of approximately **$980 million** in additional (reduced) productivity spillovers from Group of Eight research activities, as well as **$31 million** in additional (reduced) net direct research impact.

3 Total Direct, indirect and induced impact of Group of Eight universities spending

3 Total Direct, indirect and induced impact of Group of Eight universities spending

The traditional literature on the economic impact of higher education institutions typically focuses almost exclusively on the direct, indirect and induced impact of universities on their local, regional or national economies. These analyses of economic impact consider a university as an economic unit creating output within the local economy by purchasing products and services from different industries and hiring employees. In this section, we consider the **direct, indirect and induced impacts** associated with the total institutional expenditures of Go8 universities (but adjusting for double-counting with the other strands of impact considered as part of the analysis), defined as follows:

- **Direct effect:** This considers the economic output generated by a university itself, purchasing goods and services (including labour) the economy in which it operates.
- **Indirect effect:** The direct expenditures generate income for a range of Australian supplying industries across their respective supply chains (e.g. real estate services and the construction sector). In particular, these industries spend the revenue received from the university on their own input purchases to meet the institution's demands. This results in a chain reaction of subsequent rounds of spending across different industries, often referred to as the 'ripple effect'.
- **Induced effect:** The induced effect is based on a university's status as an employer, and the wage income generated and supported by university's expenditures. In return for their labour, staff employed by universities receive wage income, which they spend on consumer goods and services within the Australian economy. This generates further wage income for other employees within the industries producing these consumer goods and services, who in turn spend their own wages. Again, this leads to subsequent rounds of spending, i.e. a subsequent 'ripple effect' throughout the economy as a whole.

The sum of the direct, indirect and induced effects constitutes the *gross* economic impact on the local economy (commonly measured both in terms of monetary **output** as well as **employment**). An analysis of the *net* impact needs to include two additional factors, reducing the size of the above effects:

- **Leakage** into other geographical areas, by taking account of how much of the additional economic activity occurs in the economy under consideration, or is sourced from areas outside a specific region; and
- **Displacement** of activity within the area of analysis, i.e. taking account of the possibility that the economic activity generated might result in the reduction of activity elsewhere within the economy.

The aggregate (net) direct, indirect and induced effects are estimated using **economic multipliers** derived from **Australian Input-Output Tables**, which measure the degree to which different sectors of the economy are connected, i.e. the extent to which changes in the demand for the output of any one sector (for instance, higher education) impact on all other sectors of the Australian economy[22].

While the above definitions were discussed in the context of the expenditures of universities themselves, similar corresponding impacts are generated by the spending of overseas students in the Australian economy. Again, this spending leads to additional knock-on effects throughout the economy (through indirect effects within the supply chain, and induced effects arising from the additional wage income). While the following section focuses on the direct, indirect and induced effects associated with Go8 universities' expenditures, the economic impact associated with overseas students starting qualifications at the universities in 2016 is presented in Section 4.

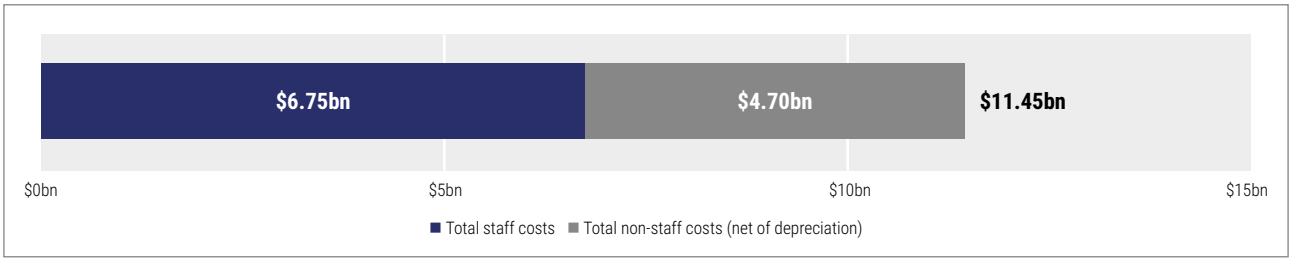
22 See Australian Bureau of Statistics (1995) for more information on these economic multipliers.

3.1 Direct impact

To measure the **direct** economic impact of Group of Eight universities' purchases of labour, goods and services within the Australian economy, we used data from the Higher Education Statistics Collection on the universities' total spending (including staff and non-staff expenditure) and the number of staff employed (measured in headcount)[23]. In line with the other strands of impact included in this analysis, we focus on expenditure and employment in the 2016 academic year.

Based on this, the total **direct impact** associated with the universities' expenditures (in terms of monetary output (net of depreciation[24])) was estimated at **$11.45 billion** in 2016, comprised of approximately **$6.75 billion** of staff costs and **$4.70 billion** of non-staff costs. In terms of employment, the universities directly employed **51,640** staff (headcount), corresponding to **43,310** full-time equivalent staff.

Figure 5: Direct economic impact associated with Group of Eight universities' expenditure in Australia in 2016



Note: All estimates are presented in 2016 prices. ***Source: London Economics' analysis based on HESC data from the Department of Education and Training (2018a).***

3.2 Indirect and induced impacts

To estimate the total (direct, indirect and induced) economic effects associated with Group of Eight universities' expenditures, we made use of **Input-Output tables** (for the 2014–15 fiscal year[25]) produced by the Australian Bureau of Statistics (2017b). These tables measure the total production output of each sector in the Australian economy[26], and the inter-industry (and intra-industry) flows of goods and services used by each of these sectors.

Using these Input-Output tables, we calculated the economic multipliers relating to **the expenditure of universities**, based on the inter- and intra-industry flows of goods and services for the technical, vocational and tertiary education services sector as a whole[27]. These multipliers were calculated in terms of **economic output** (in $) and **employment** (in headcount[28]). Further, they were calculated as **total multipliers**, capturing the aggregate impact on all industries in the Australian economy arising from an initial injection relative to that initial injection[29]. The resulting estimates were then applied to Group of Eight universities' expenditures in 2016 (as well as overseas students' tuition fee and on-campus non-fee expenditures to estimate the impact of Go8 universities on educational exports (see Section 4)).

As presented in Table 8, we estimate that every **$1m of expenditure** of a Group of Eight university generates a total of **$3.01m of output** throughout the Australian economy. Similarly, we assume that **every 1,000 jobs** directly created within a Group of Eight university supports a total of **2,430 jobs** throughout the Australian economy.

Table 8: Economic multipliers applied to Group of Eight universities' expenditure and employment

Type	Estimated multiplier
Output	3.01
Employment (headcount)	2.43

Source: London Economics' analysis of Australian Bureau of Statistics 2017b and 2017c

23 See Department of Education and Training (2016) and Department of Education and Training (2018a) for the staff and financial information, respectively.

24 We exclude from aggregate expenditure a total of **$0.93 billion** in depreciation and amortisation costs (from the total Go8 university expenditure of **$12.38 billion**), as it is assumed that these are not relevant from a procurement perspective (i.e. these costs are not accounted for as income by other organisations).

25 2014–15 is the latest year for which Input-Output tables were available at the time of writing.

26 While the original tables were provided separately for 114 sectors, for the purpose of the analysis, we combined these tables into 70 (more aggregated) industries. This was necessary to be able to calculate multipliers in terms of employment, since the employment data required for this calculation (again sourced from the Australian Bureau of Statistics (2017c)) were not available at the more granular (i.e. 114-sector) level.

27 Hence, we estimate that the income and expenditure *patterns* of Group of Eight universities are the same as for other institutions operating in the Australian technical, vocational and tertiary education services sector (including undergraduate and postgraduate education services).

28 It was not possible to provide corresponding estimates of employment impacts in full-time equivalence, since, to the best knowledge of the authors, the detailed sector-level Labour Force data required for the analysis (see Australian Bureau of Statistics, 2017c) are available in headcount terms only.

29 In mathematical terms, the multipliers are calculated as: Output multiplier = (Direct output + Indirect output +Induced output)/Direct Output, and Employment multiplier = (Direct employment + Indirect employment +Induced employment) /Direct employment. See Australian Bureau of Statistics (1995) for more detail on the definition and derivation of economic multipliers from input-output tables.

3.3 Adjusting for double counting

Before arriving at a total direct, indirect and induced impact associated with Go8 universities' institutional expenditure in 2016, it was necessary to deduct a number of items to avoid double counting, and to take account of the 'netting out' between the flow of costs and benefits between the universities, their students, and the Treasury.

Specifically, we deducted at total of approximately **$15.47 billion** from the estimated indirect and induced impacts, consisting of:

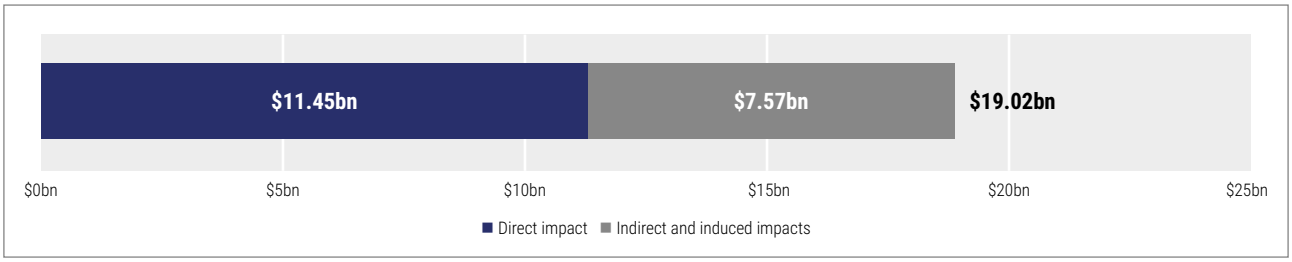
- The direct, indirect, and induced impacts associated with the (gross) tuition fee income generated by international students (**$9.55 billion**[30]), and the on-campus non-fee income generated by these students (**$3.16 billion**), in order to avoid double-counting with the impact on educational exports (see Section 4);
- The universities' total research income (**$2.44 billion**) as this was included in the estimate of research impact (see Section 2); and
- The total Commonwealth scholarship funding associated with the 2016 cohort (including Australian Postgraduate Awards, the Research Training Scheme, International Postgraduate Research Scholarships, and scholarships for indigenous students), estimated at a total of **$0.33 billion**, to ensure the 'netting out' between the flows of costs and benefits between students, the universities, and the Treasury (since all of these Commonwealth scholarships are taken account of as revenue in the universities' annual accounts).

3.4 Total direct, indirect and induced impact of Go8 universities' spending

Figure 6 presents the estimates of the total direct, indirect and induced impacts associated with expenditures incurred by Go8 universities (based on the 2016 cohort), after the above-described double-counting and 'netting' adjustments have been made.

The analysis indicates that the aggregate impact of Group of Eight universities' physical and digital footprint on the Australian economy stands at approximately **$19.02 billion** in 2016, of which approximately **$11.45 billion** relates to the direct impact of Go8 universities' spending, while the remaining **$7.57 billion** is associated with the indirect and induced impacts of this spending.

Figure 6: Direct, indirect and induced impact associated with Go8 universities' institutional expenditures, $ billion

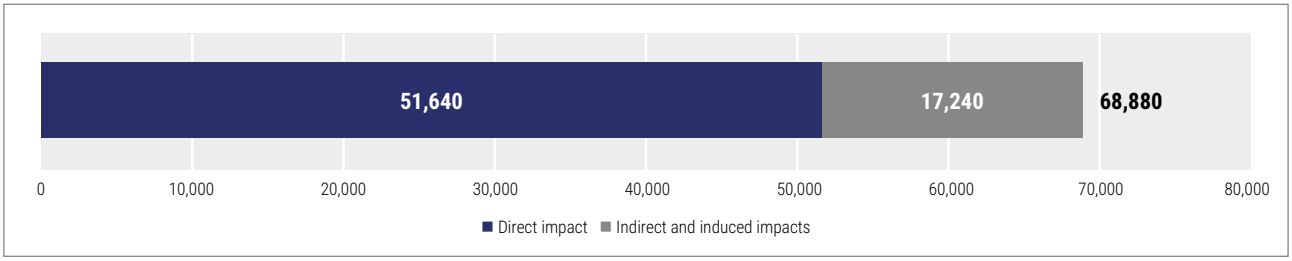


Note: All estimates are presented in 2016 prices. The estimates have been adjusted to avoid double-counting with other sources of economic impact as analysed in other sections of this report, as well as to take account of transfers between different agents in the economy. The impacts which would be double-counted and any inter-economy transfers that have not 'netted out' in other strands of the analysis were deducted from the indirect and induced impacts. ***Source: London Economics' analysis.***

In addition to these monetary impacts, the analysis also estimated the direct, indirect and induced impact of the universities' activities in terms of the number of jobs supported. The results indicate that, in addition to the **51,640** full-time equivalent staff directly employed by Group of Eight universities, there are a further **17,240** full-time equivalent jobs supported by the universities' activities across Australia.

In terms of the sensitivity analysis with respect to the assumed discount rate, note again that, as with the impact of research (Section 2), this impact is measured throughout the 2016 academic year only. As a result, the estimates are unaffected by the chosen discount rate.

Figure 7: Direct, indirect and induced impact associated with Group of Eight universities' institutional, # of jobs supported (in headcount)



Note: The employment estimates have been rounded to the nearest 5, and have been adjusted to avoid double-counting with other sources of economic impact as analysed in other sections of this report, as well as to take account of transfers between different agents in the economy. The impacts which would be double-counted and any inter-economy transfers that have not 'netted out' in other strands of the analysis were deducted from the indirect and induced impacts. ***Source: London Economics' analysis.***

30 Note that this relates to the impact of *gross* overseas tuition fee income *before* the deduction of the Treasury cost of CGS funding and *non-fee* Commonwealth scholarships for overseas students, since these have already been deducted as a cost to Treasury when estimating the impact of Go8 universities on educational exports (see Section 4).

Global leaders in zero-waste recycling

Methods developed for extracting the various valuable materials contained within e-waste; **transforming waste** to higher **value products**

Use of the "green steel" process has stopped many **millions** of tyres being sent to landfill and it has **reduced carbon emissions**

The electric arc furnace method provides both **economic** and **environmental** benefits

Professor Veena Sahajwalla

A child growing up in Mumbai, home of the world's largest rubbish dumps, became enthralled with the circle of rubbish – someone throws it away, someone else sees value and finds a way to re-use.

That circle stayed with her. The child became an engineer and then a Professor who based herself in Australia. Her globally recognised research career has been based, not only on the potential for value in rubbish, but on its astounding and unacceptable quantity and impact, which she professionally and personally would not allow to go unchallenged.

That focus has led to a Go8 university taking the global lead on zero-waste recycling where Professor Veena Sahajwalla, who is an ARC Laureate Professor, is Director of the Centre for Sustainable Materials Research and Technology.

The rubbish circle that is front and centre in 2018, is electronic waste; the development of environmentally and economically sustainable methods for micro-recycling this. It involves developing methods for

The rubbish circle that is front and centre in 2018, is electronic waste; the development of environmentally and economically sustainable methods for micro-recycling this.

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The global steel industry now produces more than **400 million tonnes** of steel using the electric arc furnace method annually, reducing the usage of coke by **four million tonnes** each year

extracting the various valuable materials contained within e-waste; transforming it from waste to higher value products. Professor Sahajwalla is a leader with promising results.

This research focus follows her development of, and the commercialisation of what is now an internationally recognised process known as "green steel". This process uses old rubber tyres and recycled plastics in electric arc furnace (EAF) steel making. The process significantly reduces the amount of coal and coke needed in the furnaces.

Use of the "green steel" process has stopped many millions of tyres being sent to landfill and it has reduced carbon emissions by reducing the need to use so much coal and coke. The global steel industry now produces more than 400 million tonnes of steel using the electric arc furnace method annually, and the green steel methodology means not using four million tonnes of coke each year.

Moreover, coke is one of the largest sources of greenhouse gas emissions in the steel industry. By using a significant proportion of rubber and plastic in place of coke, corresponding reductions in greenhouse gas emissions are achieved.

In addition to the economic and environmental benefits, there is the fundamental benefit of the technology; zero-waste recycling. Furnaces used for steelmaking operate at temperatures of 1550°C+.

Professor Sahajwalla has shown that under these high temperatures rubber and plastics, for example, undergo reactions and are entirely consumed in-situ, delivering zero-waste recycling. Professor Sahajwalla says her work is to revolutionise science and create new pathways by which we reform waste into value – reduce, reuse, recycle, reform. Her aim is to have waste as a resource in manufacturing value-add materials – creating zero-waste.

Furnaces used for steelmaking operate at temperatures of 1550°C+ … under these high temperatures rubber and plastics, for example, undergo reactions and are entirely consumed in-situ, delivering zero-waste recycling.

4 Educational exports

4 Educational exports

Educational exports, like any other international trade of goods and services across national borders, contributes to the Australian economy as an injection of funding from an overseas source. Here, we focus on the economic contribution of the **tuition fee income** (net of any Treasury costs) and other **non-tuition fee income** (associated with general living or study expenses) by overseas students[31] from the 2016 cohort of starters, over the entire duration of their studies at Go8 universities[32]. In addition to generating **direct** revenue, as with the expenditures of Go8 universities themselves (see Section 3), overseas students' expenditures generate **indirect and induced impacts** throughout the Australian economy through effects on the supply chain and by generating wage income throughout the supplying industries.

4.1 Overseas students in the 2016 Go8 cohort

The analysis of the economic impact of Group of Eight universities is based on the **2016 cohort of students**. In other words, instead of considering the entire student body of **380,100** students enrolled at Group of Eight universities in that academic year (irrespective of when these individuals may have started their studies), we focus on the economic impact generated by the **141,230 students *commencing* courses at Go8 universities in 2016**.

The assessment of educational exports specifically focuses on the **53,895** overseas students (including New Zealand citizens) in the 2016 cohort (representing **38%** of all **141,230** students in the cohort) (see Figure 8). In terms of **domicile/citizenship status**, the vast majority (**47,825**, or **89%**) of these students held temporary entry visas; **4,630** (**8%**) were (offshore) students residing outside Australia (e.g. studying Go8 courses at overseas campuses); while the remaining **1,440** (**3%**) were New Zealand citizens. In terms of **type of study**, approximately **51,680** students (**96%**) were studying on a full-time basis, with the remaining **2,215** (**4%**) undertaking their higher education courses part-time.

In terms of **study level**[33], and in contrast to domestic students, overseas students in the 2016 cohort were most likely to undertake programs at postgraduate level (**29,245** students, **54%**). The majority of these **postgraduate** students (**25,095** students, **47%** of the total overseas cohort) were studying **Master's degrees by Coursework**, with the remaining **4,150** students (**7%**) undertaking other types of postgraduate qualifications (e.g. Doctorates or Master's by Research). At **undergraduate** level, **21,360** students (**40%** of total) were commencing **Bachelor degrees**, while the remaining **3,290** students (**6%**) were undertaking other undergraduate qualifications. Table 9 provides the full breakdown of the 2016 overseas cohort of Group of Eight students by level of study, type of study and domicile.

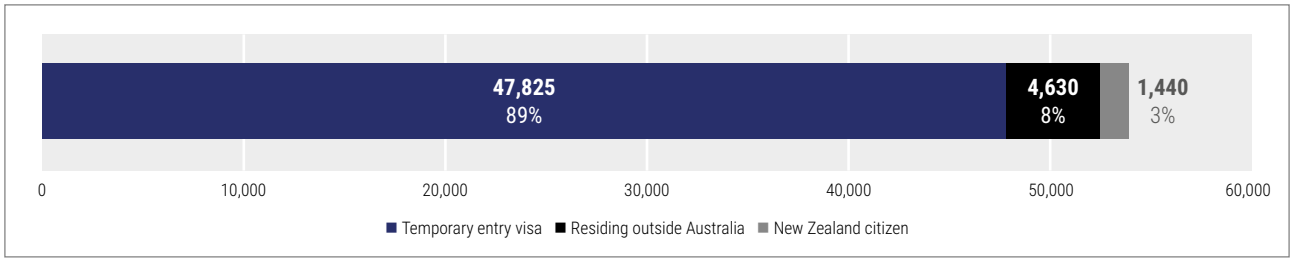
31 Note that we *include* New Zealand citizens as overseas students, thus counting their expenditures as an injection of income into the Australian economy throughout the analysis of educational exports. In other words, we assume that, following completion of their studies, these graduates are likely to return to New Zealand (so that none of the enhanced labour market outcomes associated with their Go8 qualification attainment accrue in Australia, and they are excluded from the impact of teaching and learning assessed in Section 5).

32 Note that other types of export income accrued directly by Group of Eight universities (such as research income from international sources) are taken account of in our analysis of the impact of the universities' research activity (**Section 2**) and the direct, indirect and induced impacts of Go8 universities' institutional expenditure (**Section 3**), and are thus excluded from the analysis of educational exports (to avoid double-counting).

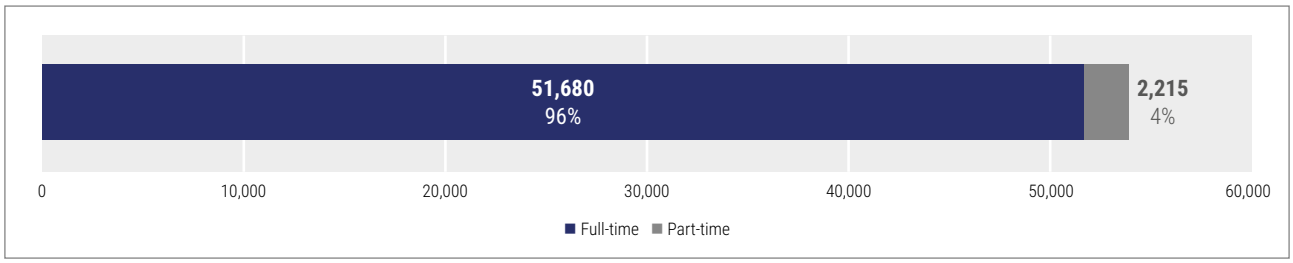
33 Note that the underlying analysis was undertaken separately for each of ten (detailed) course levels, including: Non-Award courses, Enabling courses, Bachelor degrees, other undergraduate qualifications (combined), Master's by Coursework, Master's by Research, Master's (Extended), Doctorate by Coursework, Doctorate by Research and other postgraduate qualifications (combined).

Figure 8: Profile of overseas students in the 2016 Go8 cohort, by domicile, type and level of study

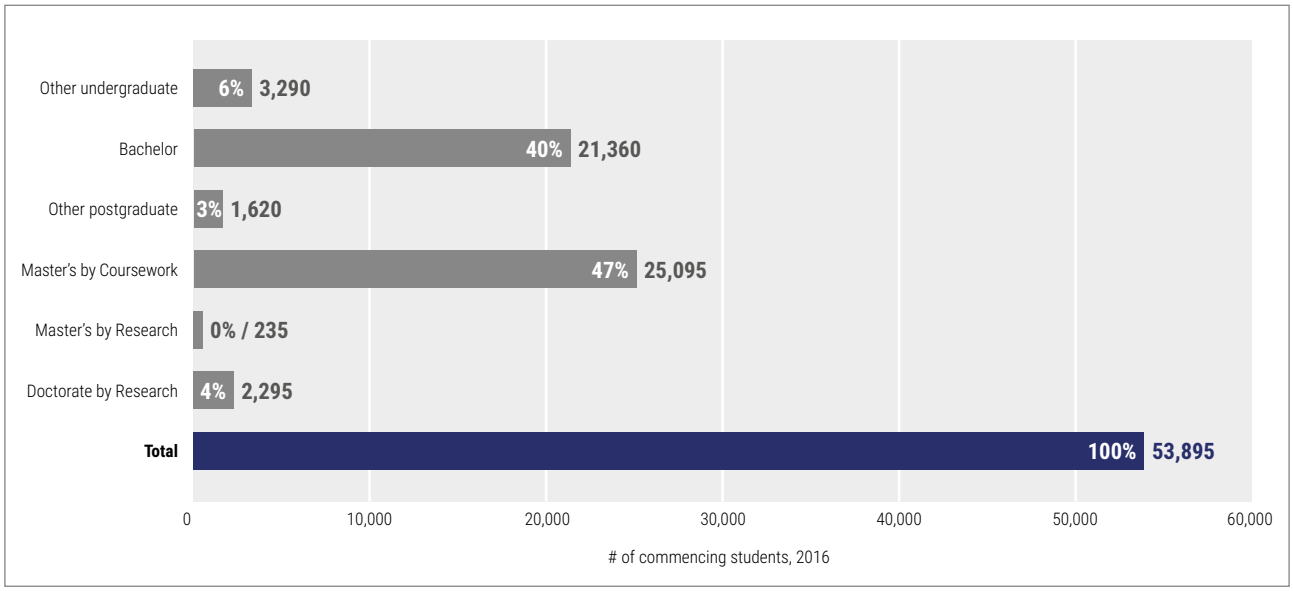
Domicile/citizenship



Type of study



Level of study



Note: All student numbers are rounded to the nearest 5, and expressed in headcount figures. We received HESC data on a total of **141,366** commencing students from the Group of Eight. From those, we excluded a total of **87** students whose gender was unspecified (given the need to break down the analysis by gender). To focus on the cohort of overseas students only (including New Zealand citizens), we then deducted a total of **87,354** Australian citizens and other domestic students.

'Other undergraduate' courses include Non-Award Courses, Enabling Courses, and other undergraduate qualifications (e.g. Associate Degrees or Advanced Diplomas). 'Other postgraduate' courses include Master's (Extended), Doctorate by Coursework, and other postgraduate qualifications (e.g. Graduate Diplomas or Certificates).

Source: London Economics' analysis of HESC data provided by the Group of Eight.

Table 9: Overseas students in the 2016 Go8 cohort, by domicile, type of study and study level

Level and type of study	New Zealand citizen	Residing outside Australia	Temporary entry Visa	Total
Full-time	**1,065**	**3,870**	**46,745**	**51,680**
Other undergraduate	10	110	2,725	**2,845**
Bachelor	695	3,190	17,070	**20,955**
Other postgraduate	40	40	1,185	**1,265**
Master's by Coursework	210	405	23,625	**24,240**
Master's by Research	15	25	190	**230**
Doctorate by Research	95	100	1,950	**2,145**
Part-time	**375**	**760**	**1,080**	**2,215**
Other undergraduate	30	65	350	**445**
Bachelor	45	215	145	**405**
Other postgraduate	120	125	110	**355**
Master's by Coursework	160	330	365	**855**
Master's by Research	0	0	5	**5**
Doctorate by Research	20	25	105	**150**
All	**1,440**	**4,630**	**47,825**	**53,895**
Other undergraduate	40	175	3,075	**3,290**
Bachelor	740	3,405	17,215	**21,360**
Other postgraduate	160	165	1,295	**1,620**
Master's by Coursework	370	735	23,990	**25,095**
Master's by Research	15	25	195	**235**
Doctorate by Research	115	125	2,055	**2,295**

Note: All student numbers are rounded to the nearest 5, and expressed in headcount figures. We received HESC data on a total of **141,366** commencing students from the Group of Eight. From those, we excluded a total of **87** students whose gender was unspecified (given the need to break down the analysis by gender). To focus on the cohort of overseas students only (including New Zealand citizens), we then deducted a total of **87,354** Australian citizens and other domestic students.

'Other undergraduate' courses include Non-Award Courses, Enabling Courses, and other undergraduate qualifications (e.g. Associate Degrees or Advanced Diplomas). 'Other postgraduate' courses include Master's (Extended), Doctorate by Coursework, and other postgraduate qualifications (e.g. Graduate Diplomas or Certificates).

Source: London Economics' analysis of HESC data provided by the Group of Eight.

4.2 The direct impact of overseas students

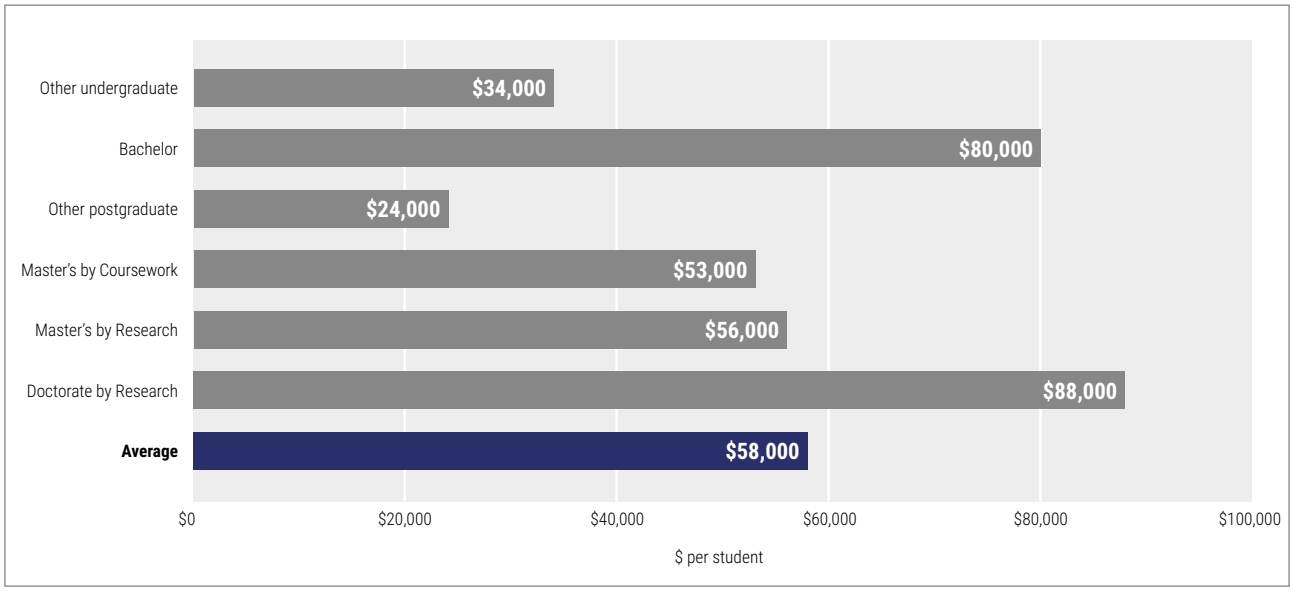
4.2.1 Tuition fee income

To assess the level of tuition fee income associated with overseas students in the 2016 Go8 cohort, we made use of financial data provided by the Department of Education and Training[34] and Group of Eight universities' Annual Reports on the total amount of fee income received in the 2016 academic year[35]. Combining this total fee income with the number of students enrolled in 2016, we then derived average tuition fees per student (by domicile, level of study[36], type of study and university). Making similar assumptions on average study duration as in the teaching and learning analysis relating to domestic students (see Section 5 for more detail), we calculated the tuition fee income per overseas student from the start of a student's learning aim until completion. Throughout the analysis, to ensure that the values of the economic benefits and costs are computed in **present value** terms (i.e. in 2016 money terms), all benefits and costs occurring at points in the future were discounted using the **7% discount rate** recommended by the Office of Best Practice Regulation[37,38]. Applying the real discount rate, and expressing the total income until completion in 2016 prices, we arrived at an estimate of the ***gross* tuition fee income per overseas student.**

To calculate the **net tuition fee income per student,** we then deducted the direct costs to the Australian Treasury associated with funding higher education for overseas students. These Treasury costs include the **Commonwealth Grant Scheme** funding paid for eligible New Zealand citizens, and **Commonwealth scholarships** (including Australian Postgraduate Awards and Research Training Scheme funding (for New Zealand citizens), and International Postgraduate Research Scholarships (for students residing outside Australia and students on temporary entry visas))[39].

As presented in Figure 9, the analysis indicates that the average net tuition fee income associated with overseas students in the 2016 Go8 cohort undertaking Master's degrees by Coursework (over the total duration of their qualification) is approximately **$53,000** per student. At undergraduate level, reflecting the relatively longer duration of study, overseas students undertaking Bachelor degrees generate net tuition fee income of approximately **$80,000** per student. The average estimate across all study levels amounts to approximately **$58,000**.

Figure 9: Net tuition fee income per overseas student in the 2016 Go8 cohort (present value over total study duration) by study level



Note: All estimates are presented in 2016 prices, discounted to present net present values, and rounded to the nearest $1,000. Figures constitute weighted averages across all Go8 universities, both full-time and part-time students, and across New Zealand citizens, students residing outside Australia, and temporary entry visa holders (weighted by the respective number of student completers in each category).

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework are included in the average but have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis.

34 See Department of Education and Training (2018).

35 To arrive at an estimated average tuition fee per student, we made use of information on income received by each Go8 university across different **student funding categories** in relation to:

- students on Commonwealth Supported Places (in terms of HECS-HELP fee loans, and student contribution payments from students who did not receive a loan);
- domestic students not on Commonwealth Supported Places (in terms of income from fee-paying domestic undergraduate and postgraduate students, fee-paying domestic non-award students, and FEE-HELP loans); and
- overseas students (i.e. fee income from fee-paying overseas students).

Note that there is zero tuition fee income associated with students funded through Commonwealth Scholarships (including the Research Training Scheme, Australian Postgraduate Awards, or International Postgraduate Research Scholarships), as well as for non-fee paying students (e.g. undertaking work experience).

To calculate **average fees per student for each of the above funding categories** (by university), we then divided the total amount of tuition fee income in each of the above categories by the number of students (measured in EFTSL) in each category studying at Go8 universities in the 2016 academic year (including both commencing and returning students). We then calculated a **weighted average fee per student by level of study and domicile**, based on the distribution of commencing students (again in EFTSL) by level of study and domicile across each of the above funding categories. Finally, to distinguish between the fees paid by full-time and part-time students (per head), we adjusted the fees for Go8 students' average study intensity (separately for each university, level of study and type of study).

36 Again, note that the analysis was undertaken separately for each of 10 qualification levels, including Non-Award courses, Enabling courses, Bachelor degrees, other undergraduate qualifications, Master's by Coursework, Master's by Research, Master's (Extended), Doctorate by Research, Doctorate by Coursework, and other postgraduate qualifications.

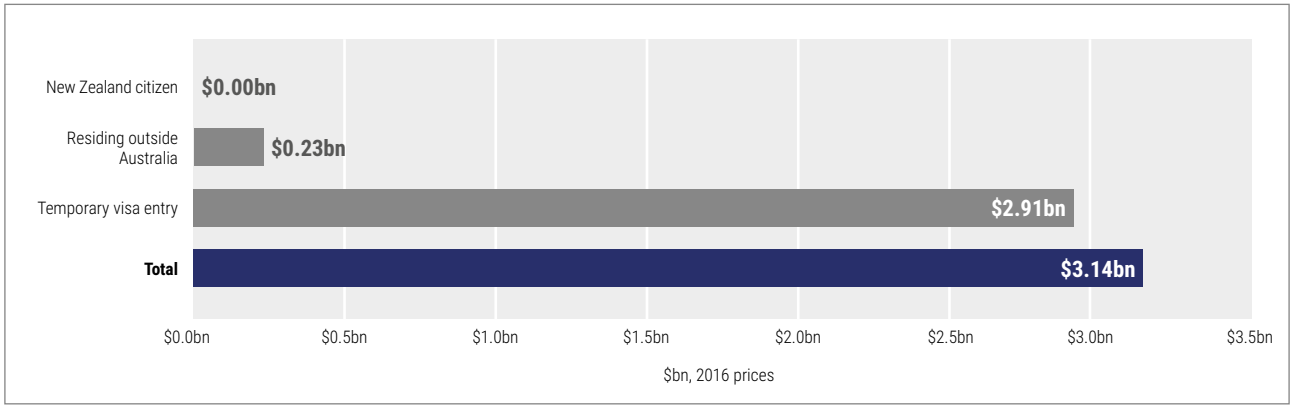
37 See Office of Best Practice Regulation (2016).

38 Note that an analysis of the implications of this discount rate on the results is presented in Section 5.9.

39 As with average tuition fees, these Treasury costs per student were calculated based on the respective Commonwealth Grant Scheme and Commonwealth scholarship income received by Go8 universities in 2016, and divided by the respective number of eligible students enrolled, to arrive at average funding costs per student (by university, domicile, level and type of study).

Using the number of students in the 2016 cohort of Group of Eight students, and applying the same completion rates as in the analysis of the economic impact of teaching and learning (see Section 5.4 for more detail), the analysis generates Group of Eight universities' total net fee income from overseas students (see Figure 10). This was estimated to be **$2.91 billion** for students with temporary entry visas**,** and **$0.23 billion** generated by New Zealand citizens and students residing outside of Australia. The total net tuition fee income generated by overseas students in the cohort was estimated at **$3.14 billion**.

Figure 10: Total net tuition fee income associated with overseas students in the 2016 Go8 cohort, by domicile



Note: All estimates are presented in 2016 prices, and discounted to net present values. ***Source: London Economics' analysis***.

4.2.2 Non-fee income

In addition to the tuition fee income that overseas students generate, they also incur expenditure on non-tuition fee related items whilst acquiring their qualification, including **general expenses** (e.g. on mortgage/rent, food and house supplies, utilities, transport costs, medical and health costs, etc.) as well as **study-related expenditures** (e.g. on textbooks, stationary, university fees (other than tuition fees), union/guild/sports fees, etc.). This non-tuition fee expenditure constitutes a significant component of Australia's export income from overseas students coming to study at Australian universities.

To analyse the level of non-tuition fee expenditure associated with the 2016 cohort of Group of Eight university students, we used expenditure estimates from the **2012 Australian University Finances Survey**[40]. The survey provides estimates of the average annual general and study-related expenditures by international students studying in Australia, separately for undergraduate, postgraduate coursework and postgraduate higher degree research students[41].

For the purpose of this analysis, we made two key adjustments to the estimates:

1. We adjusted the original expenditure estimates for **inflation** to reflect 2016 prices[42]; and
2. We excluded any expenditures incurred by overseas students in the 2016 cohort **residing outside Australia** (i.e. offshore students), assuming that these students' expenditures would be incurred entirely outside the Australian economy (i.e. we include only the fee income generated by these students as revenue to Group of Eight universities).

Similar to fee income, we calculated the non-tuition fee income over the entire study duration of overseas students in the 2016 cohort (discounted to reflect present values), to arrive at the estimated **non-tuition fee income per student** (in 2016 prices) by level of study, type of study and domicile (including New Zealand citizens and temporary entry visa holders only).

Presented in Figure 11, reflecting the differences in course duration, the average non-fee expenditure per overseas Bachelor degree student in the 2016 Go8 cohort was estimated at **$58,000**, compared to **$49,000** for students undertaking Master's degrees by Coursework. The average estimated non-fee income per student across all study levels amounts to approximately **$51,000**. Although these estimates are smaller than the average (net) fee income per student presented above, they illustrate that non-tuition fee expenditures are an important component of the export income from overseas students coming to study in Australia.

40 See Universities Australia (2013). The survey results are currently being updated for the 2017 academic year. Unfortunately, at the time of writing, the results had not yet been published, so that the 2012 survey results were used instead.

41 Note that the survey results for international students were not broken down by type of study, so we assume the same average expenditure per year for full-time and part-time students.

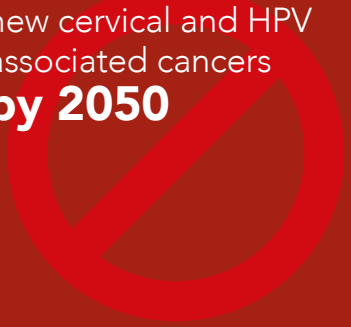
42 The 2012 University Finances Survey was undertaken in November 2012. Hence, to adjust for inflation, we used estimates of the change in the Consumer Price Index between the 4th quarter of 2012 and the 1st quarter of 2016, based on data provided by the Australian Bureau of Statistics (2017a).

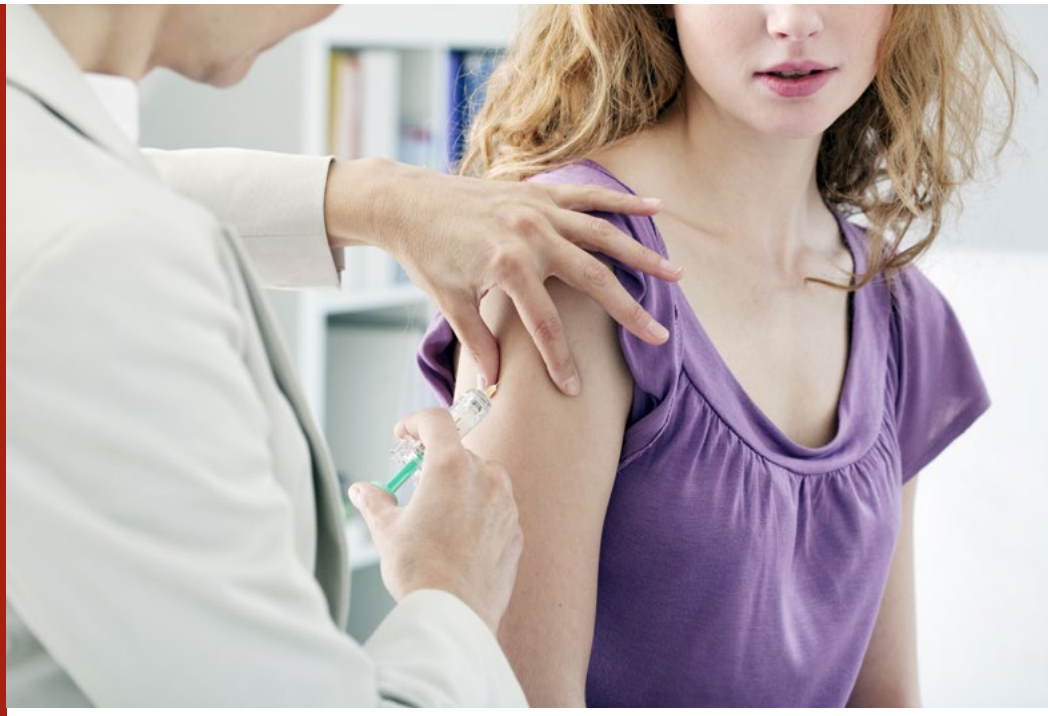
Gardasil cervical cancer vaccine

Gardasil could potentially increase the protection rate for cervical cancer to around **90 per cent**

Gardasil is used in **more than 130 countries**

Gardasil should lead to the **global elimination** of new cervical and HPV associated cancers **by 2050**





Globally lauded cervical cancer vaccine Gardasil was developed by a Go8 university.

It enabled Australia to be the first country in the world to roll out a national cervical cancer immunisation campaign, to protect young women from the strains of human papillomavirus (HPV) that cause 70 per cent of cervical cancers.

Cervical cancer is the second most common cancer in women, estimated to kill about 275,000 women each year. Now Gardasil is used in more than 130 countries and has led to an up to 90 per cent decrease in the prevalence of HPV in countries with high levels of immunisation. Gardasil also protects males against HPV and teenage boys are now also being vaccinated.

It enabled Australia to be the first country in the world to roll out a national cervical cancer immunisation campaign…

Professor Ian Frazer an immunologist, and Chinese virologist the late Dr Jian Zhou, created virus-like particles that could mimic HPV but were non-infectious, activating the body's immune response and protecting against future infection.

Professor Ian Frazer said he was simply in the right place at the right time. "I just happened to be in the right lab in Brisbane, with the right people around me and the right prompt," he said.

"That's the other thing about science, it's a lot of hard work but … also, you have to have luck. We realise now that about 20 per cent of cancers are caused by virus infections," Professor Frazer said. "We picked a winner … because we picked a cancer that was caused by an infection. It's much easier to prevent an infection."

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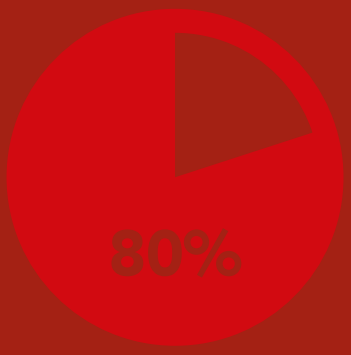
There has been a reduction of **over 80 per cent** in new presentations with genital warts amongst young women and men



UniQuest, licensed the Gardasil intellectual property to CSL Ltd in Melbourne which sub-licensed it to Merck & Co. Inc – one of the largest pharmaceutical companies in the world, in 1996.

In late 2014, the FDA approved the next generation 9 valent vaccine, Gardasil 9, which protects against an additional nine high-risk HPV types and could potentially increase the protection rate for cervical cancer to around 90 per cent.

It has also been noted that there has been a dramatic reduction in genital warts since the introduction of the vaccine – a reduction of over 80 per cent in new presentations with genital warts amongst young women and men.

There is particular interest worldwide that the current vaccines could also assist with reducing the levels of other cancers associated with HPV such as some neck and head cancers – and whether the vaccine might also prevent re-infection after successful treatment for HPV associated disease, and therefore avoid the need for ongoing surveillance of women treated for the infection.

The vaccine has enormous economic benefits also with a significant reduction in the health system costs associated with cervical cancer, anal cancer and genital wart treatments …

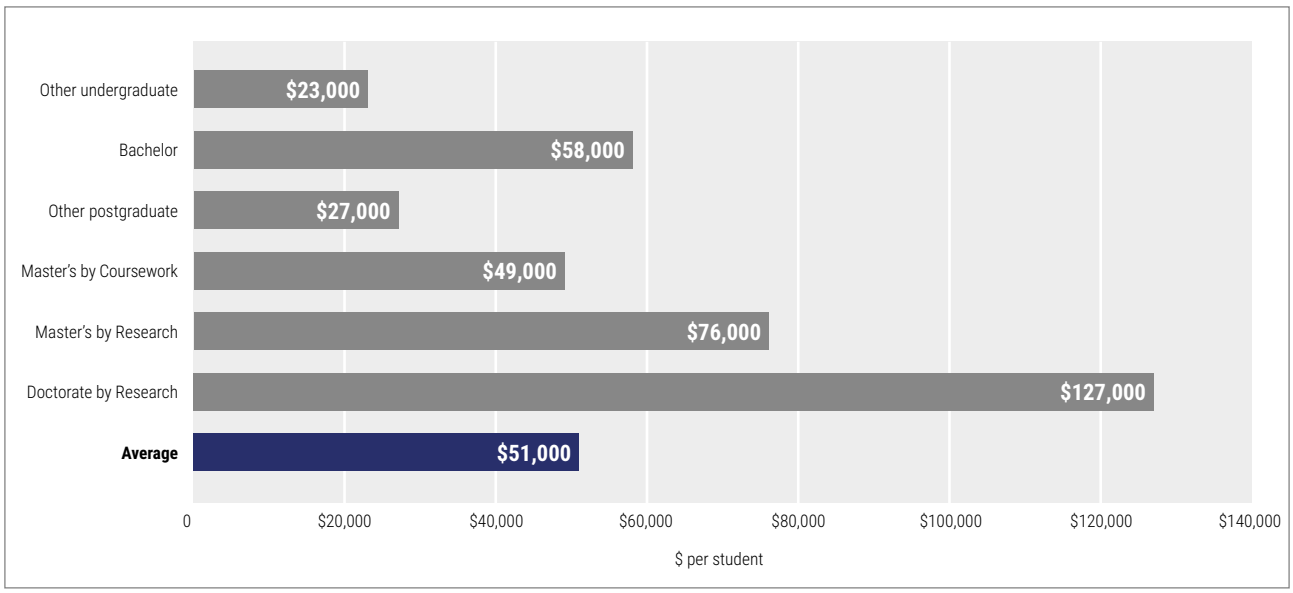
The vaccine will have enormous economic benefits also with a significant reduction in the health system costs associated with preventing and treating cervical cancer, anal cancer and genital wart treatments and ongoing surveillance of affected patients after treatment.

Observations from the past decade are that the HPV vaccines if delivered effectively to the majority of 10–12 year old girls in the developing world from today forward should lead to the global elimination of new cervical and HPV associated cancers by 2050.

The current challenge is how to deliver universal vaccination in the developing world, where cervical cancer incidence is high and strategies for prevention are non-existent or ineffective.

Drug manufacturing companies have sharply reduced their vaccine charges for the developing world to assist, and there are further subsidies for countries with an annual GDP of less than $US1580 a person.

Figure 11: Non-fee income per overseas student in the 2016 Go8 cohort (present value over total study duration) by study level



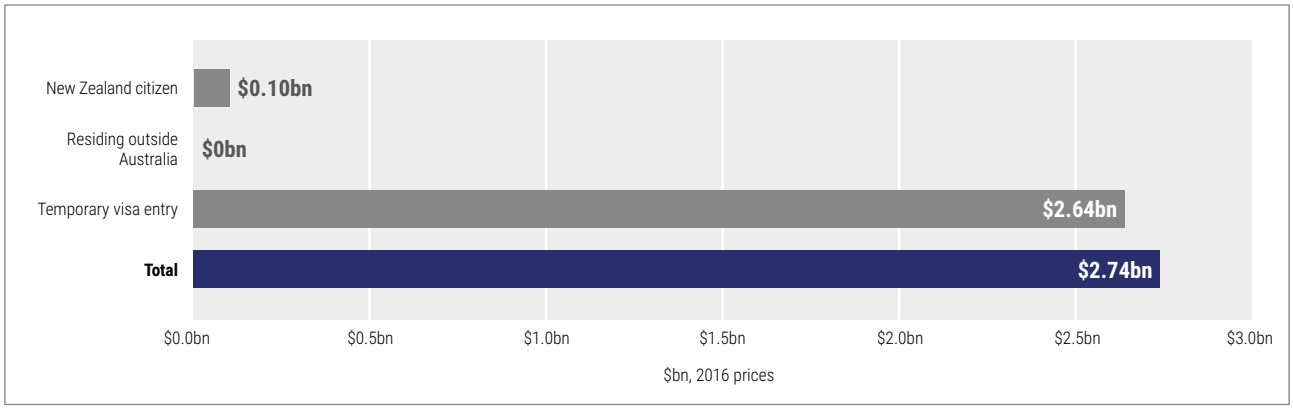
Note: All estimates are presented in 2016 prices, discounted to present net present values, and rounded to the nearest $1,000. Figures constitute weighted averages across all Go8 universities, both full-time and part-time students, and across New Zealand citizens and temporary entry visa holders (weighted by the respective number of student completers in each category). We did not take account of non-fee expenditures by students residing outside Australia, assuming that these would be accrued outside of the Australian economy.

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework are included in the average but have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis.

Combining these estimates per student with the number of overseas students in the 2016 cohort (and assumed completion rates), we arrive at **total non-tuition fee income** associated with the cohort. Across all qualification levels, this stood at **$2.64 billion** for students on temporary entry visas, and at **$0.10 billion** for New Zealand citizens. The total non-fee income generated by overseas students in the 2016 cohort of Group of Eight university students was estimated at **$2.74 billion**.

Figure 12: Total non-fee income associated with overseas students in the 2016 Go8 cohort, by domicile

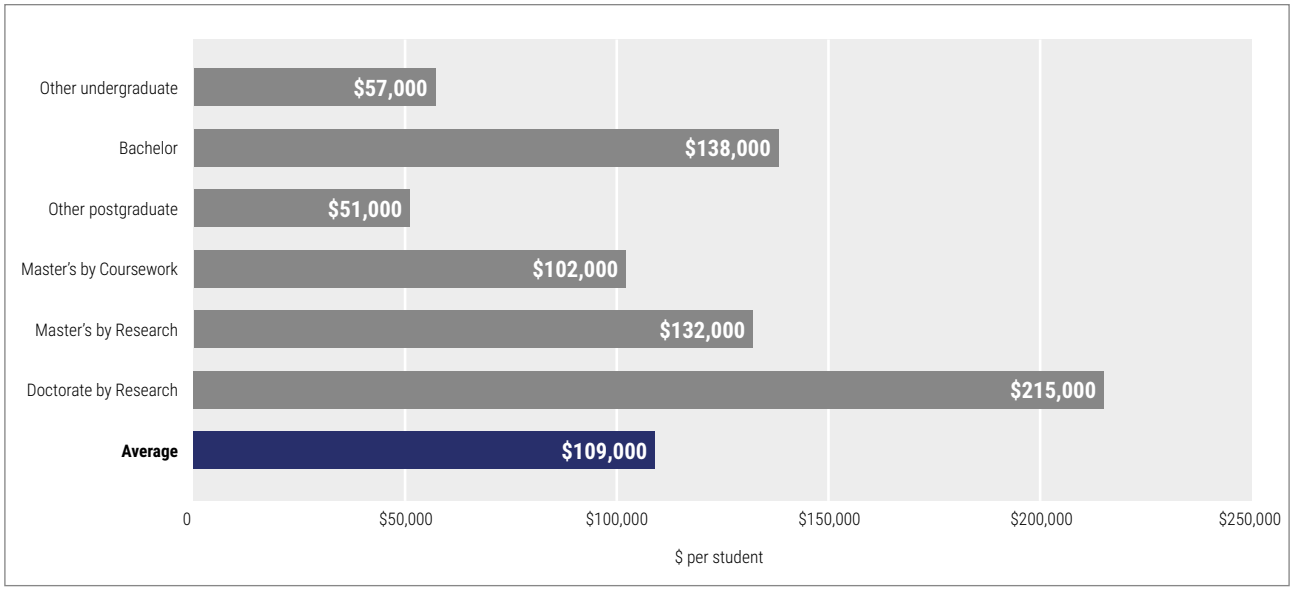


Note: All estimates are presented in 2016 prices, and discounted to net present values. We did not take account of non-fee expenditures by students residing outside Australia, assuming that these would be accrued outside of the Australian economy. ***Source: London Economics' analysis***.

4.2.3 Total direct impact of overseas students

Adding the above estimates of fee and non-fee income, the analysis indicates that the aggregate **direct** economic impact generated by overseas students in the 2016 cohort stands at approximately **$138,000** per student undertaking a Bachelor degree, and **$102,000** per student completing a Master's degree by Coursework. The average total direct impact across all qualification levels was estimated to be approximately **$109,000** per student (Figure 13).

Figure 13: Total income per overseas student in the 2016 Go8 cohort (present value over total study duration) by study level



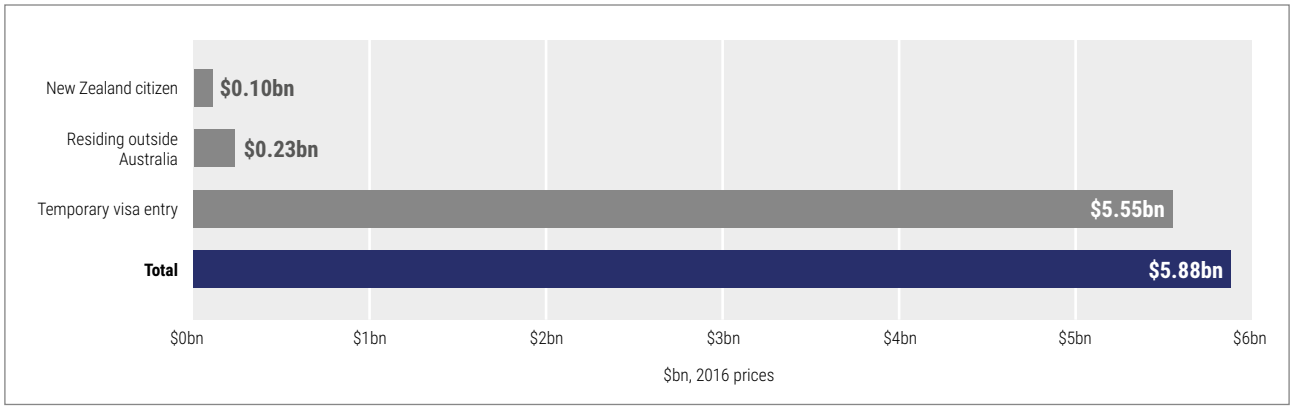
Note: All estimates are presented in 2016 prices, discounted to present net present values, and rounded to the nearest $1,000. Figures constitute weighted averages across all Go8 universities, both full-time and part-time students, and across New Zealand citizens, students residing outside Australia, and temporary entry visa holders (weighted by the respective number of student completers in each category).

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework are included in the average but have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis.

Aggregated across the **53,895** overseas students in the 2016 Group of Eight cohort of starters, the **total direct economic impact of overseas students' expenditure** stands at **$5.88 billion**, with **$5.55 billion** generated by students on temporary entry visas, **$0.23 billion** from (offshore) students residing outside Australia, and **$0.10 billion** from students with New Zealand citizenship (Figure 14).

Figure 14: Total fee and non-fee income associated with overseas students in the 2016 Go8 cohort, by domicile



Note: All estimates are presented in 2016 prices, and discounted to net present values. ***Source: London Economics' analysis***.

4.3 Total economic impact of overseas students

As outlined in Section 3, **indirect and induced** economic effects are typically estimated with the help of **Input-Output** models, to develop a series of **multipliers** to estimate the **extent to which the direct output produced by a university generates additional activity throughout the economy**.

To estimate the total (direct, indirect and induced) economic effects associated with the income generated by overseas students studying at Go8 universities, as for the impact generated by the expenditures of Go8 universities themselves (see Section 3), we made use of **Input-Output tables** produced by the Australian Bureau of Statistics (2017b). Specifically, we applied two sets of multipliers to the above fee and non-fee income associated with overseas students in the 2016 Go8 cohort:

- Multipliers relating to **income from overseas students accrued by universities themselves**: As discussed in relation to the impact of Go8 university expenditure (see Section 3), these are calculated based on the inter- and intra-industry flows of goods and services for the technical, vocational and tertiary education services sector as a whole. The resulting estimates are then applied to overseas students' **tuition fee**[43] and **on-campus non-fee expenditures**[44], in order to estimate the economic impact of the share of income associated with overseas students that is accrued by Group of Eight universities themselves.
- Multipliers relating to **income from overseas students' other (off-campus) expenditures**: These are calculated based on the final consumption expenditure patterns by Australian households[45], and subsequently applied to the estimated off-campus non-fee expenditures of overseas students in the 2016 cohort of Group of Eight students.

Again both of these types of multipliers are calculated in terms of **economic output** (in $) and **employment** (in headcount), and are calculated as **total multipliers**, capturing the aggregate impact on all industries in the Australian economy arising from an initial injection relative to that initial injection.

Table 10 presents the estimated economic multipliers applied to the income generated by overseas students studying at Go8 universities. Reflecting the multipliers presented in Section 3.2, the analysis indicates that every $1 million of fee and on-campus non-fee expenditure incurred by overseas students generates a total of **$3.01 million** of output and supports **13.83 (headcount) jobs** throughout the Australian economy[46]. In addition, we estimated that every $1 million of off-campus non-fee expenditure incurred by overseas students generates **$3.14 million** of output and supports **8.78 (headcount) jobs** throughout the Australian economy.

Table 10: Economic multipliers applied to income from overseas students in the 2016 Go8 cohort

Type	Estimated multiplier
Tuition fee and on-campus non-fee income	
Output ($m per $m)	3.01
Employment (headcount per $m)	13.83
Off-campus non-fee income	
Output ($m per $m)	3.14
Employment (headcount per $m)	8.78

Note: Multipliers applied to Group of Eight universities' expenditures (see Section 3.2) amount to 3.01 for output ($m per $m) and 2.43 for employment (headcount per headcount). This is equivalent to 13.8 for employment (headcount per $m of output). ***Source: London Economics' analysis of Australian Bureau of Statistics 2017b and 2017c.***

43 We apply the multipliers to the *gross* tuition fee income generated by overseas students in the 2016 Go8 cohort, and then deduct the Treasury cost of provision (again, in terms of Commonwealth Grant Scheme funding and Commonwealth scholarships) to arrive at the net direct, indirect and induced impact associated with this income.

44 The split between on-campus and off-campus expenditures was needed to distinguish the amount of income generated by overseas students accrued directly by Go8 universities themselves. To do this, based on the spending categories detailed in the 2012 Australian Universities Finances Survey, we assume that overseas students' *on-campus* expenditures include any spending on mortgage/rent (i.e. it is expected that all overseas students would be staying in campus accommodation provided by the Go8 universities); university fines and fees (other than tuition fees); and union/guild/sports fees – while all other spending was categorised as *off-campus* spending (i.e. not accrued as revenue by Go8 universities themselves). Using this distinction, we estimate that, of the total non-fee income of **$2.74 billion** generated by overseas students in the 2016 Go8 cohort, **$1.05 billion** was spent on-campus (and accrued by Go8 universities), while the remaining **$1.69 billion** was spent off-campus.

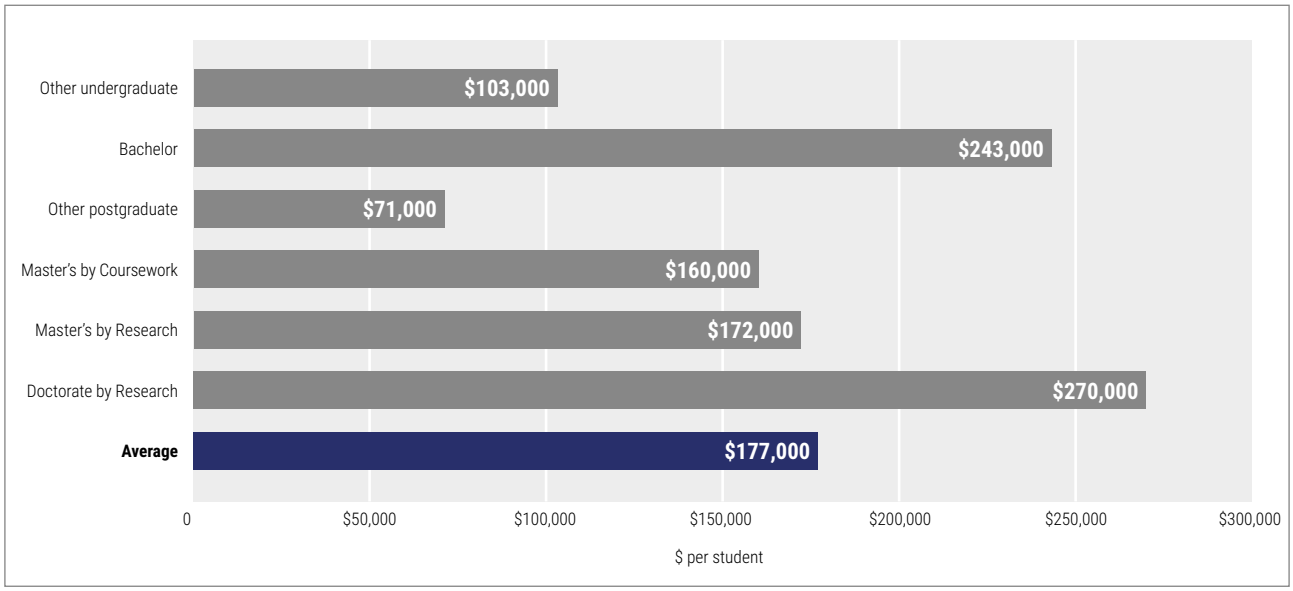
45 In other words, for the purpose of calculating economic multipliers, we assume that overseas students studying at Go8 universities have similar expenditure patterns as Australian households more generally.

46 Note that multipliers applied to Group of Eight universities' expenditures (see Section 3.2) amount to 3.01 for output ($m per $m) and 2.43 for employment (headcount per headcount). This is equivalent to 13.8 for employment (headcount per $m of output).

4.3.1 Tuition fee income

Combining the estimates of net tuition fee income per student with these economic multipliers, as presented in Figure 15, we estimate that the total (direct, indirect and induced) economic impact associated with the **fee income** from overseas students in the 2016 Go8 cohort completing a Master's degree by Coursework stands at approximately **$160,000** per student. The comparable estimate per overseas Bachelor degree student stands at **$243,000**, while the average across all course levels amounts to **$177,000**.

Figure 15: Total impact of net tuition fee income per overseas student in the 2016 Go8 cohort (present value over total study duration) by study level



Note: All estimates are presented in 2016 prices, discounted to present net present values, and rounded to the nearest $1,000. Figures constitute weighted averages across all Go8 universities, both full-time and part-time students, and across New Zealand citizens, students residing outside Australia, and temporary entry visa holders (weighted by the respective number of student completers in each category).

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework are included in the average but have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

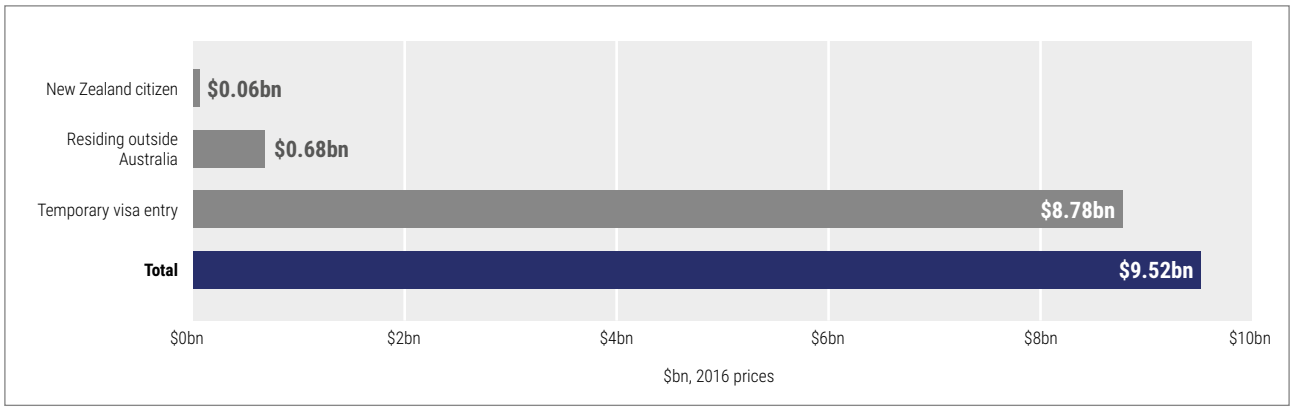
Source: London Economics' analysis.

Aggregating across all students in the cohort (Figure 16, upper panel), the total economic impact generated by the (net) fee income associated with overseas students commencing their studies at Group of Eight universities in 2016 amounts to **$9.52 billion**. Out of this total, **$8.78 billion** is generated by students holding temporary entry visas, **$0.68 billion** is associated with students residing outside of Australia, and **$0.06 billion** is generated by students with New Zealand citizenship.

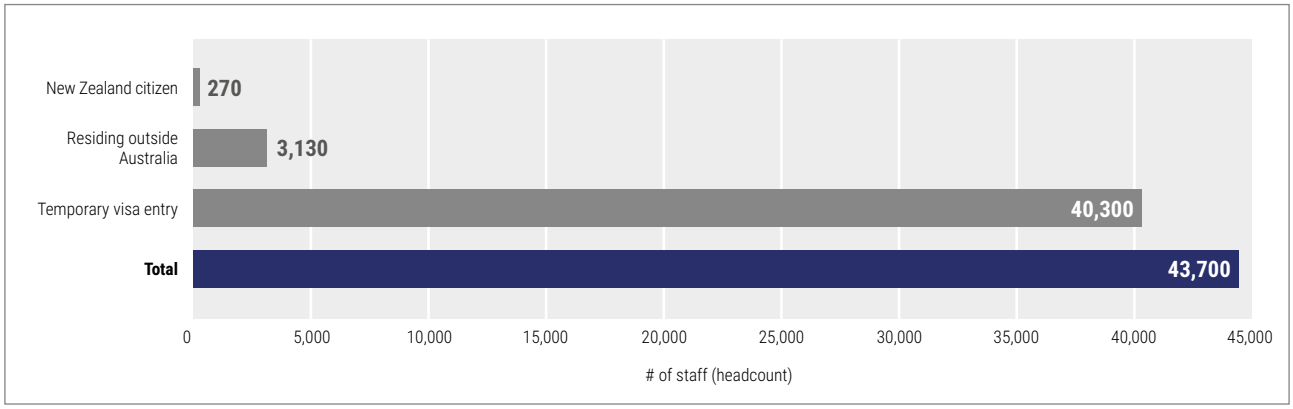
In addition to these monetary figures, using the above employment multipliers, it is possible to calculate the number of jobs (in headcount terms) supported by the income generated by overseas students. This is displayed in the lower panel of Figure 16. The (net) fee income associated with overseas students in the 2016 Go8 cohort supports a total of **43,700** jobs throughout the Australian economy, both directly through the staff employed by Go8 universities themselves, as well as through additional supply chain and staff spending activity throughout the Australian economy. This total includes **40,300** jobs associated with the fee income of students on temporary entry visas, **3,130** jobs associated with students residing outside Australia, and **270** jobs associated with New Zealand citizens.

Figure 16: Total impact of net tuition fee income associated with overseas students in the 2016 Go8 cohort, by domicile

Output, $bn



Employment, # (headcount)

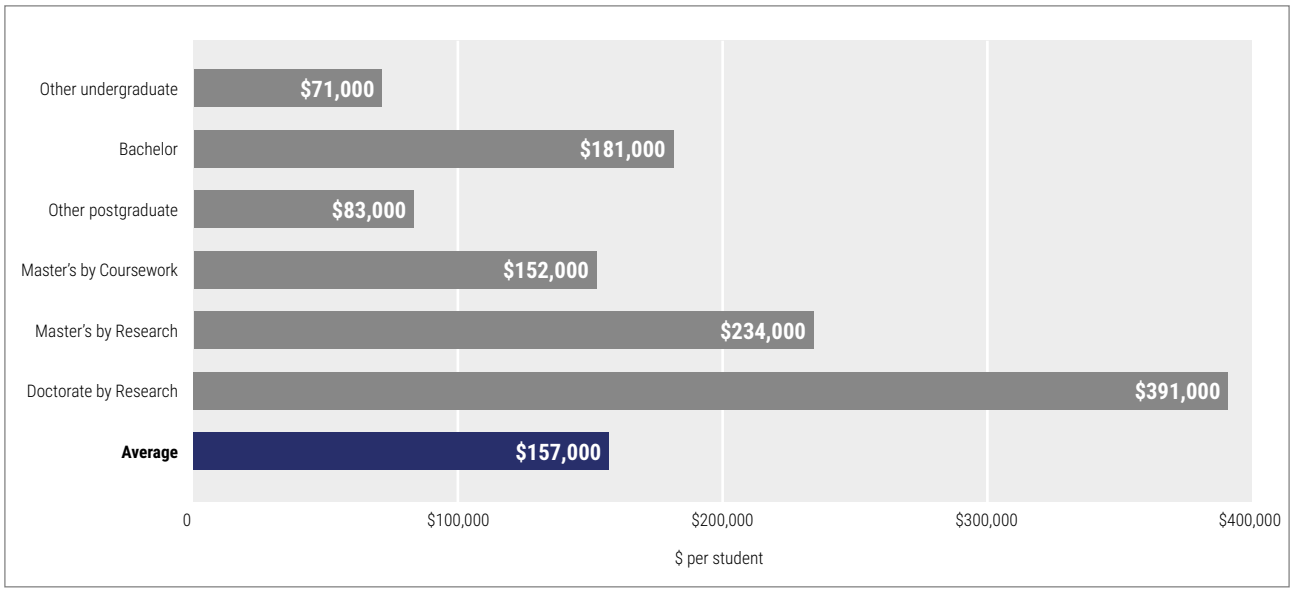


Note: All monetary estimates are presented in 2016 prices, and discounted to net present values. Employment estimates are provided in headcount, and rounded to the nearest 5.
Source: London Economics' analysis.

4.3.2 Non-fee income

Applying the relevant economic multipliers to the non-fee income per student, the analysis indicates that the direct, indirect and induced impact associated with the non-fee expenditures of overseas students in the 2016 Go8 cohort undertaking a Master's degree by Coursework stands at approximately **$152,000** per student (Figure 17). The corresponding estimate per overseas Bachelor degree student stands at **$181,000**, while the average across all course levels amounts to **$157,000**.

Figure 17: Total impact of non-fee income per overseas student in the 2016 Go8 cohort (present value over total study duration) by study level



Note: All estimates are presented in 2016 prices, discounted to present net present values, and rounded to the nearest $1,000. Figures constitute weighted averages across all Go8 universities, both full-time and part-time students, and across New Zealand citizens and temporary entry visa holders (weighted by the respective number of student completers in each category). We did not take account of non-fee expenditures by students residing outside Australia, assuming that these would be accrued outside of the Australian economy.

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework are included in the average but have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

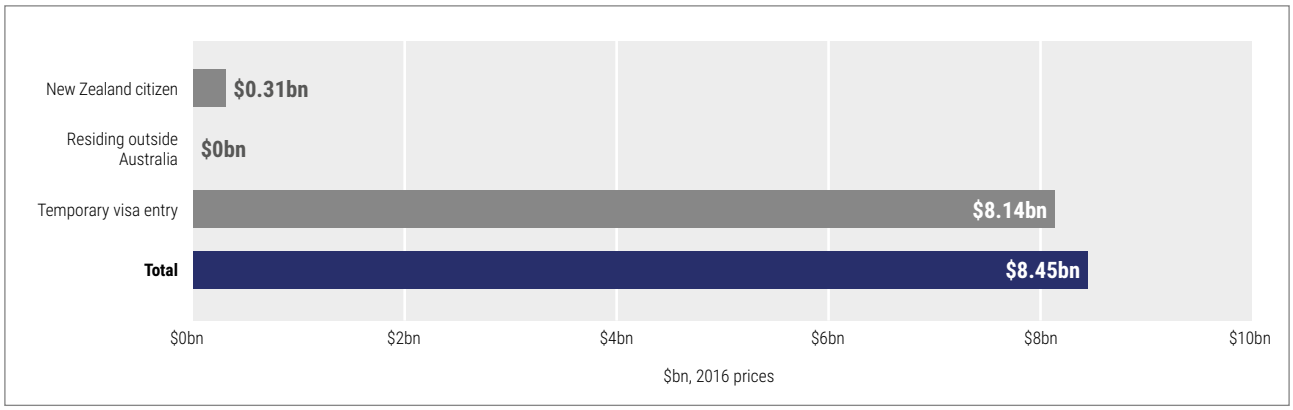
Source: London Economics' analysis.

Aggregating across all students in the cohort, as presented in Figure 18 (upper panel), the total economic impact (in monetary terms) associated with the non-fee income generated by overseas students in the 2016 Go8 cohort was estimated to be **$8.45 billion**. Of this total, **$8.14 billion** is generated by students holding temporary entry visas, and **$0.31 billion** is associated with students holding New Zealand citizenship.

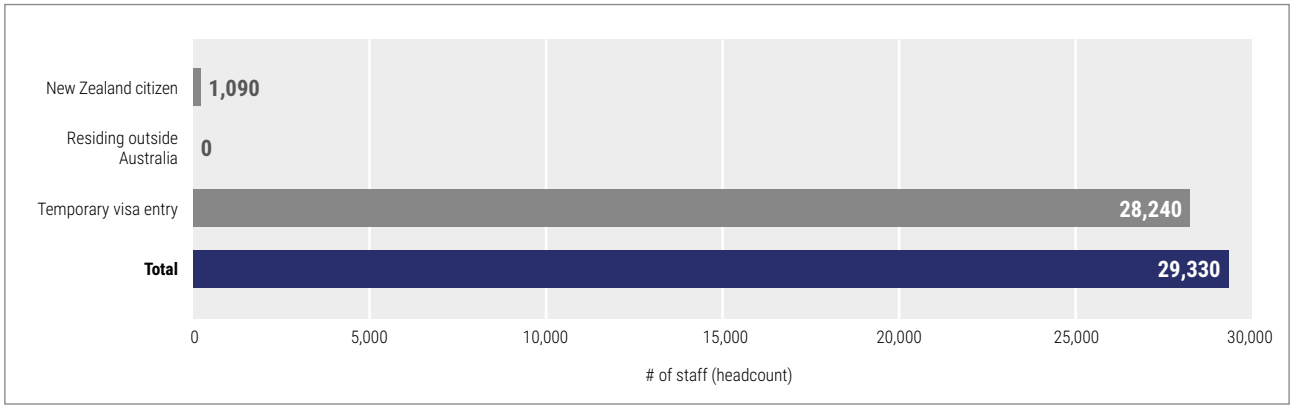
Expressed in employment terms (see lower panel of Figure 18), this non-fee income is estimated to support **29,330** jobs throughout the Australian economy, including **28,240** jobs supported by the non-fee expenditures of students on temporary visas, and **1,090** jobs generated by students holding New Zealand citizenship.

Figure 18: Total impact of non-fee income associated with overseas students in the 2016 Go8 cohort, by domicile

Output, $bn



Employment, # (headcount)



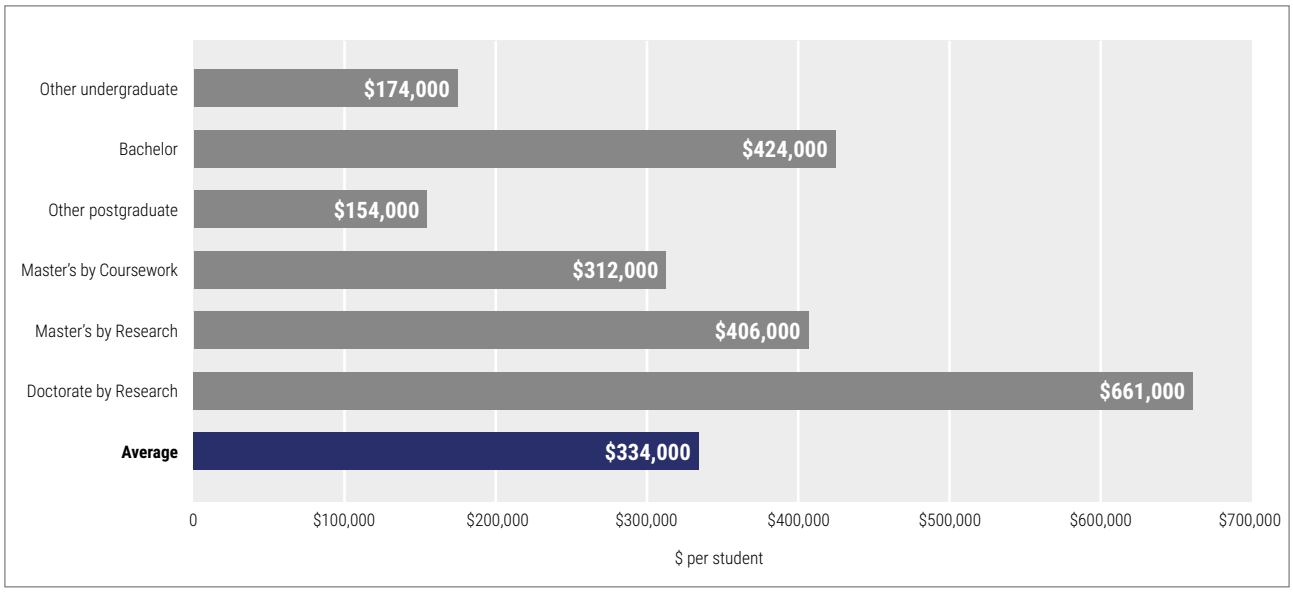
Note: All monetary estimates are presented in 2016 prices, and discounted to net present values. Employment estimates are provided in headcount, and rounded to the nearest 5. We did not take account of non-fee expenditures by students residing outside Australia, assuming that these would be accrued outside of the Australian economy. ***Source: London Economics' analysis***.

4.3.3 Total impact of educational exports

Combining the above estimates, the total economic impact generated by overseas students in the 2016 cohort was estimated to be approximately **$424,000** per student undertaking a Bachelor degree, and **$312,000** per student completing a Master's degree by Coursework. The average impact across all qualification levels stands at approximately **$334,000** per student (Figure 19).

In other words, this implies that **every 3 overseas students undertaking Bachelor degrees** and **every 4 overseas students undertaking Master's degrees by Coursework** at Group of Eight universities generate **$1 million** of impact for the Australian economy. Taking a weighted average across all study levels, the analysis indicates that there is a **total economic impact** of **$1 million** for **every 3 overseas students** attending Go8 universities.

Figure 19: Total impact per overseas student in the 2016 Go8 cohort (present value over total study duration) by study level



Note: All estimates are presented in 2016 prices, discounted to present net present values, and rounded to the nearest $1,000. Figures constitute weighted averages across all Go8 universities, both full-time and part-time students, and across New Zealand citizens, students residing outside Australia, and temporary entry visa holders (weighted by the respective number of student completers in each category).

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework are included in the average but have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

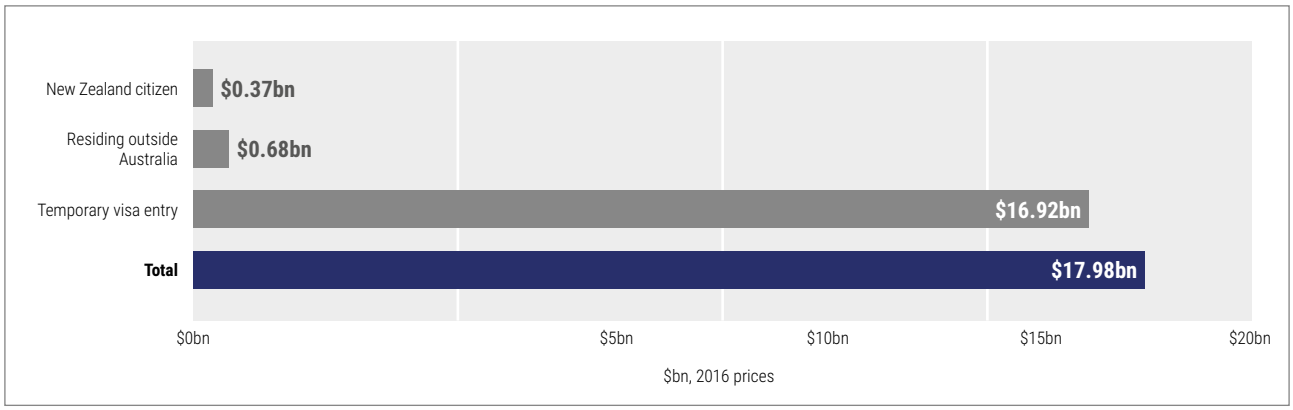
Source: London Economics' analysis.

In monetary terms (i.e. economic output), the aggregate economic impact across all overseas students commencing their studies at Group of Eight universities in the 2016 academic year was estimated at **$17.98 billion**, comprised of **$16.92 billion** associated with students on temporary entry visas, **$0.68 billion** associated with offshore students residing outside Australia, and **$0.37 billion** generated by students with New Zealand citizenship.

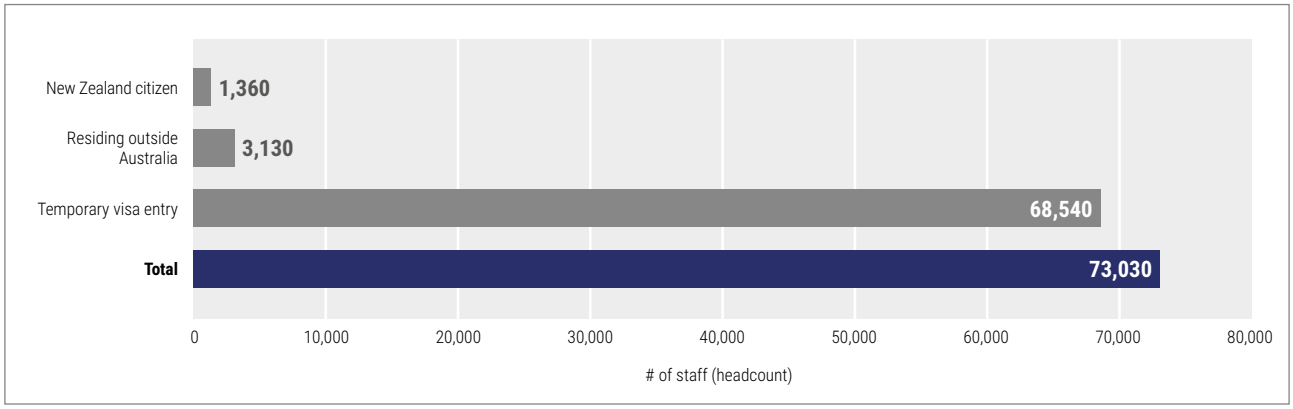
In employment terms (in headcount), the income generated from these overseas students supports a total of **73,030** jobs throughout the Australian economy, of which **68,540** are associated with students on temporary visas, **3,130** are associated with students residing outside Australia, and **1,360** are associated with New Zealand citizens.

Figure 20: Total impact of overseas students in the 2016 Go8 cohort, by domicile

Output, $bn



Employment, # (headcount)



Note: All monetary estimates are presented in 2016 prices, and discounted to net present values. Employment estimates are provided in headcount, and rounded to the nearest 5.
Source: London Economics' analysis.

The first successful non-invasive treatment for sleep apnoea

Sleep apnoea is a significant health issue. According to the World Health Organisation it affects 100 million people worldwide. As well as the health issues it causes sufferers such as a higher risk of stroke, it has economic societal effects, such as loss of productivity.

The first successful non-invasive treatment for it was developed at a Go8 university and is now in high demand globally. The technology, nasal continuous positive airway pressure (CPAP), led to the formation of start-up ResMed, a spin-off company formed to commercialise it.

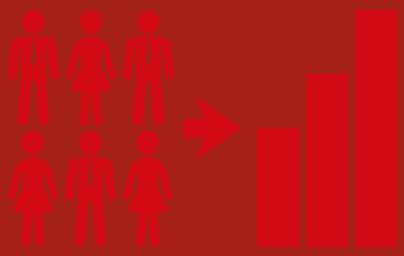
ResMed now operates in more than 100 countries and has more than 4000 employees worldwide. It is listed on the New York stock exchange with revenues of almost $US2 billion. In 1990 it had revenues of less than $AU1 million and just nine employees.

The company's success has come from the research successes of Professor Colin Sullivan and his team. Professor Sullivan not only invented CPAP, he was instrumental in developing the first adult and paediatric sleep laboratories in Australia, and his work on sleep apnoea was instrumental in the evolution of sleep medicine.

It was in 1980 that Professor Sullivan first tested the idea of positive pressure applied through the nasal airway in order to alleviate the obstructed passageways that caused sleep apnoea. The CPAP system is now the affliction's most common treatment worldwide.

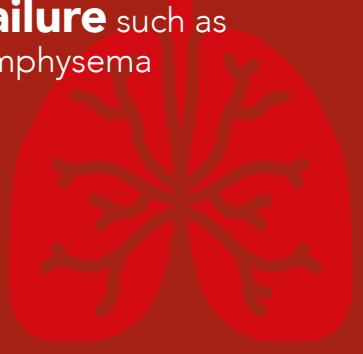
It comprises a continuous flow machine and a vented nasal mask. It has come a long way from its inventor's view it was a rescue therapy to delay or avoid tracheostomy; then seen only as a temporary treatment, rather than on-going. Its recognition as an available on-going treatment only occurred when a patient requested the device for self-treatment at home. The idea of a mass-produced portable device was born. The device was patented and led to the formation of ResMed. The device now also helps patients with severe respiratory failure such as emphysema.

ResMed now operates in **more than 100 countries** and has **more than 4000 employees** worldwide



ResMed is listed on the New York stock exchange with revenues of almost **$US2 billion**

The device now also helps patients with **severe respiratory failure** such as emphysema



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5 The impact of teaching and learning activities at Group of Eight universities

5 The impact of teaching and learning activities at Group of Eight universities

5.1 Introduction and rationale

Simple economic impact analyses of higher education institutions typically consider the **direct** economic effect of universities' physical and digital footprints on their local economies, as well as the **indirect** and **induced** impacts through the institutions' extensive supply chains and the expenditures of their staff (see Section 3). Furthermore, these analyses often consider the direct, indirect and induced effects associated with the expenditures of overseas students (see Section 4). **However, given that Group of Eight universities' primary 'products' include undertaking world-class research, and the delivery of high-quality teaching and learning, a traditional impact analysis of this nature would significantly underestimate the economic value of these higher education institutions to the Australian economy.**

5.2 Valuing the economic contribution of higher education institutions

Traditionally, to estimate the economic value associated with **education outcomes**, straightforward *input-output* analysis has been used. This approach simply asserts that the value of inputs into the education system essentially equals the value of outputs associated with educational attainment. However, this approach in no way captures the productivity or growth impacts associated with having a more highly educated workforce, and as such undervalues the productivity benefits associated with higher education. Although there are many non-economic benefits associated with higher education (and positive spillovers to the wider economy), **the economic value of education and training is represented by the value placed on that qualification as determined by the labour market in the form of enhanced earnings and/or employment outcomes**.

In this section of the report, we detail the methodological approach we used to place a value on the **teaching and learning activities** undertaken at Group of Eight universities. This was achieved by analysing the **labour market benefits** associated with enhanced qualification attainment and skills acquisition – to **both the individual and the Treasury**.

5.3 Cohort of students considered

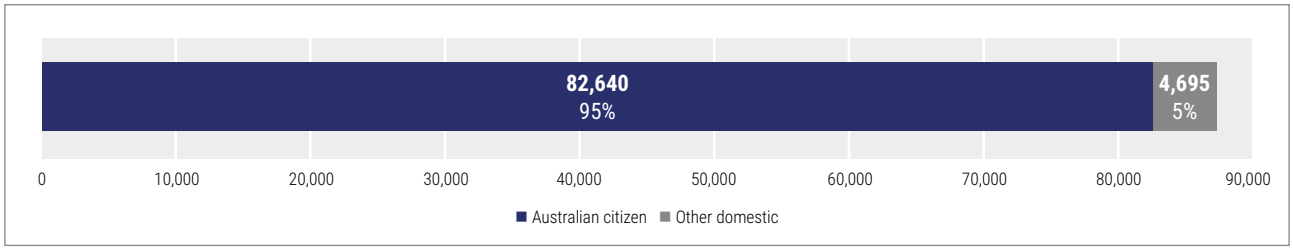
The analysis of the impact of teaching and learning described in this section specifically focuses only on the **87,335 domestic students**[47] in the Go8 student cohort. In other words, we implicitly assert that all domestic students studying at Group of Eight universities will enter the Australian labour market upon graduation, and that all **53,895** overseas students in the 2016 cohort will leave Australia upon completing their qualifications. It is of course possible that a proportion of overseas students undertaking their studies at Group of Eight universities will remain in Australia to work following completion of their studies; similarly, domestic students might decide to leave Australia to pursue their careers in other countries. However, given the uncertainty in predicting the extent to which this is the case, and the difficulty in assessing the *net* labour market outcomes for overseas students (e.g. when considering the earnings which these students forego during their studies at university), the analysis of teaching and learning focuses on domestic students only. Overseas students were instead considered as part of the analysis of Group of Eight universities' contribution to **exports**, through an analysis of the economic impact of the tuition fee and non-tuition fee income generated by these students (see **Section 4**).

Considering the **domicile/citizenship status** of these domestic students, as presented in Figure 23, while **82,640** students (**95%**) were Australian citizens, the remaining **4,695** students (**5%**) were classified as 'other domestic' students (i.e. without Australian citizenship, but holding permanent Australian visas instead). In terms of **type of study**, **66,670** students (**76%**) were undertaking their qualification on a full-time basis, with the remaining **20,665** students (**24%**) studying part-time.

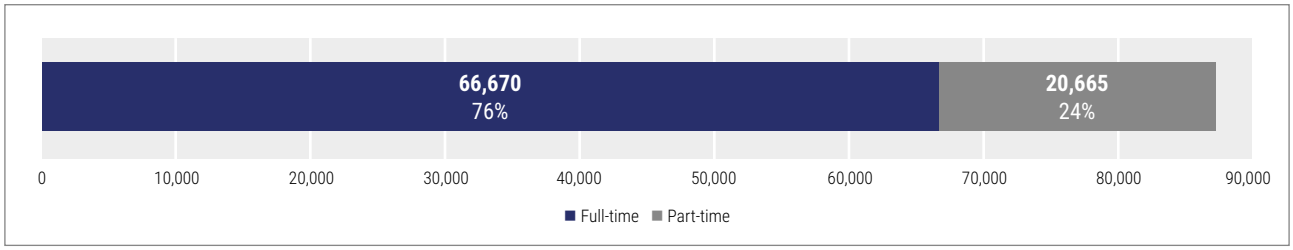
47 Note again that the impact of teaching and learning *excludes* students with New Zealand citizenship from the domestic student cohort – i.e. we assume that, following completion of their studies, these graduates are likely to return to New Zealand (so that none of the enhanced labour market outcomes associated with their Go8 qualification attainment accrue in Australia). Instead, these students have been categorised as *overseas* students for the purposes of this analysis (and are thus included in the impact of educational exports).

Figure 21: Profile of domestic students in the 2016 Go8 cohort, by domicile and type of study

Domicile/citizenship



Type of study



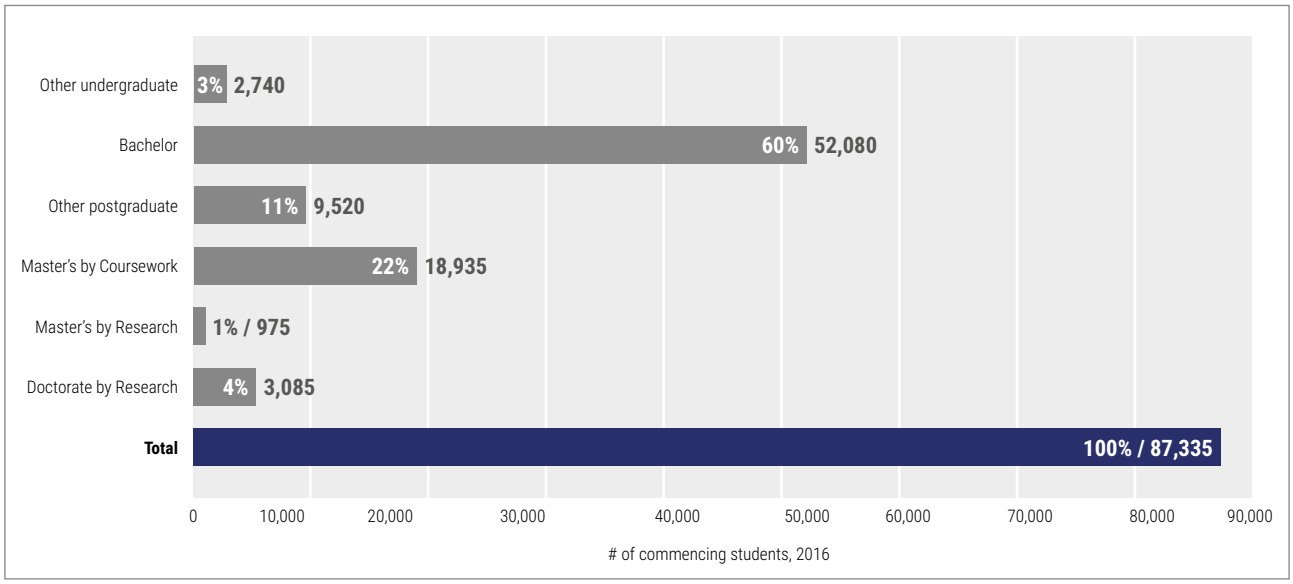
Note: All student numbers are rounded to the nearest 5, and expressed in headcount figures.

We received HESC data on a total of **141,366** commencing students from the Group of Eight. From those, we excluded a total of **87** students whose gender was unspecified (given the need to break down the analysis by gender). For a total of **46** students, previous highest attainment was specified as 'Domestic commencing students incorrectly coded'. For those students, we imputed the 'typical' prior attainment level using a group-wise imputation approach, based on the typical highest attainment of students undertaking qualifications at the same institution, course level and with the same attendance type (i.e. full-time or part-time). To focus on the cohort of domestic students only (excluding New Zealand citizens), we then deducted a total of **53,925** New Zealand citizens and overseas students. 'Other domestic' includes permanent visa holders (excluding New Zealand citizens).

Source: London Economics' analysis of Higher Education Statistics Collection (HESC) data provided by the Group of Eight.

Figure 22 presents the distribution of the 2016 domestic Go8 cohort by **study level**[48]. At an aggregate level, **54,820** (**63%**) students in the domestic cohort were enrolled in undergraduate courses, with **32,515** (**37%**) undertaking postgraduate programs instead. While the majority of **60%** (**52,080**) students were undertaking Bachelor degrees, **22%** (**18,935**) were studying Master's degree by Coursework, and **18%** (**16,320**) were undertaking other qualifications. Table 11 provides the full breakdown of the 2016 domestic cohort of Group of Eight students by level of study, type of study and domicile.

Figure 22: Profile of domestic students in the 2016 Go8 cohort by domicile and level of study



Note: All student numbers are rounded to the nearest 5, and expressed in headcount figures.

'Other undergraduate' courses include Non-Award Courses, Enabling Courses, and other undergraduate qualifications (e.g. Associate Degrees or Advanced Diplomas).
'Other postgraduate' courses include Master's (Extended), Doctorate by Coursework, and other postgraduate qualifications (e.g. Graduate Diplomas or Certificates).

Source: London Economics' analysis of HESC data provided by the Group of Eight.

48 Again, as in the impact on educational exports (see Section 4), while we present more aggregate information in this report, the underlying analysis was undertaken separately for each of ten (detailed) course levels, including: Non-Award courses, Enabling courses, Bachelor degrees, other undergraduate qualifications (combined), Master's by Coursework, Master's by Research, Master's (Extended), Doctorate by Coursework, Doctorate by Research and other postgraduate qualifications (combined).

Table 11: Domestic students in the 2016 Go8 cohort, by domicile, type of study and study level

Level and type of study	Australian citizen	Other domestic	Total
Full-time	**63,460**	**3,210**	**66,670**
Other undergraduate	915	55	**970**
Bachelor	46,775	1,815	**48,590**
Other postgraduate	3,275	165	**3,440**
Master's by Coursework	9,930	735	**10,665**
Master's by Research	495	90	**585**
Doctorate by Research	2,070	350	**2,420**
Part-time	**19,180**	**1,485**	**20,665**
Other undergraduate	1,615	155	**1,770**
Bachelor	3,330	160	**3,490**
Other postgraduate	5,635	445	**6,080**
Master's by Coursework	7,655	615	**8,270**
Master's by Research	360	30	**390**
Doctorate by Research	585	80	**665**
All	**82,640**	**4,695**	**87,335**
Other undergraduate	2,530	210	**2,740**
Bachelor	50,105	1,975	**52,080**
Other postgraduate	8,910	610	**9,520**
Master's by Coursework	17,585	1,350	**18,935**
Master's by Research	855	120	**975**
Doctorate by Research	2,655	430	**3,085**

Note: All student numbers are rounded to the nearest 5, and expressed in headcount figures.

'Other undergraduate' courses include Non-Award Courses, Enabling Courses, and other undergraduate qualifications (e.g. Associate Degrees or Advanced Diplomas).
'Other postgraduate' courses include Master's (Extended), Doctorate by Coursework, and other postgraduate qualifications (e.g. Graduate Diplomas or Certificates).

Source: London Economics' analysis of HESC data provided by the Group of Eight.

The most flexible surgical glue ever developed

The glue, known as Me Tro, appears set to **revolutionise emergency care** and **surgical procedures** around the world

Me Tro acts like a superglue that can be squeezed into a deep cut or gunshot wound to seal it shut in **60 seconds**

For Me Tro to work it needed one very precise trigger – light. Once it's applied, **a zap of UV light seals everything shut within seconds**

Professor Anthony Weiss has led his team to another globally recognised Go8 research innovation, with the development of a highly elastic and adhesive surgical glue that quickly seals wounds without the need for common staples or sutures.

The glue, known as Me Tro, appears set to revolutionise emergency care and surgical procedures around the world. It is ideal for sealing wounds in body tissues that continually expand and relax such as lungs, hearts and arteries that are otherwise at risk of reopening. It also works on internal wounds in hard to reach areas.

Professor Weiss describes the process as resembling that of silicone sealants used around bathroom and kitchen tiles. It is provided in a syringe-like tube and acts like a liquid, filling gaps and conforming to the shape of the wound.

Importantly it can rapidly stem blood flow, giving it another use; perfect for any emergency situation where one or dozens of people require fast medical assistance, such as war zones. It acts like a superglue that can be squeezed into a deep cut or gunshot wound to seal it shut in 60 seconds.

The adhesive is made from a synthetic version of a protein called tropoelastin which forms naturally in the growing tissues of newborn babies. It is the precursor to functional elastin which gives skin, blood vessels, lung tissue, ligaments and tendons the ability to regain their shape after stretching and contracting.

It is ideal for sealing wounds in body tissues that continually expand and relax such as lungs, hearts and arteries that are otherwise at risk of reopening.

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It is the precursor to functional elastin which gives skin, blood vessels, lung tissue, ligaments and tendons the **ability to regain their shape** after stretching and contracting

As the world leader in tropoelastin research, Weiss worked out how to create a perfect copy of tropoelastin from scratch in the lab, and it has formed the basis for the most flexible surgical glue ever.

The copy tropoelastin looks like how it forms in newborns, and the research team worked out how to tame these building blocks so they can reassemble like LEGO pieces.

The benefit of having an exact replica of a natural protein is that Me Tro does not set off a patient's immune system response. Importantly it also mimics the natural protein's ability to kick-start the body's healing process. When the wound is sealed and the body has regrown its own cells, Me Tro is broken down by the body like a piece of old skin.

For Me Tro to work it needed one very precise trigger – light. Once it's applied, a zap of UV light seals everything shut within seconds. In an example of Go8 International research collaboration, Weiss worked with friends in the US from Harvard and Northeastern Universities, and together they came up with the idea to add light-activated molecules; combining the Australian team's work with the US light-activating technology.

Weiss says the key to successful research outcomes such as Me Tro is collaboration with great minds from around the world. "If you want to do the best, you need to work with the best," he says. "We do great science and the ability to work internationally allows you the best possible outcomes – it's done through networks."

The benefit of having an exact replica of a natural protein is that Me Tro does not set off a patient's immune system response. Importantly it also mimics the natural protein's ability to kick-start the body's healing process. When the wound is sealed and the body has regrown its own cells, Me Tro is broken down by the body like a piece of old skin.

5.4 Completion rates

The above information provides an overview of the number of students *starting* qualifications at Group of Eight universities in the 2016 academic year. However, to aggregate individual-level impacts of the universities' teaching and learning activities, it is necessary to adjust the number of 'starters' to account for **completion rates**.

Table 12 presents the completion rates assumed throughout the analysis, based on information on progression outcomes for previous years' cohorts provided by the Group of Eight and the Department of Education and Training (2017a)[49,50]. Note that, in instances where the estimated completion rate was lower than 100%, we assume that the remaining proportion of students would at least complete one or more units associated with their intended qualification. For example, we assume that a Bachelor degree student who does not complete their intended degree instead completes learning at a lower level[51]. Similarly, we assume that a student undertaking a postgraduate degree by coursework who does not complete the intended qualification instead completes learning at 'other postgraduate' level. Though relatively small, this ensures that the analysis comprehensively captures the associated wage and employment returns associated with any and all higher education learning undertaken at Group of Eight universities.

The resulting information suggests that of those individuals commencing a full-time Bachelor degree at a Group of Eight university in 2016, approximately **90%** are expected to complete the degree as intended, while the remaining **10%** only undertake one or more of the units associated with their degree[52] before discontinuing their studies. The respective estimates for part-time undergraduate degrees stand at **56%** and **44%**. In all of these cases, the analysis calculates the estimated returns associated with the *completed* qualification or course unit(s).

Table 12: Completion rates by study intention and type of study

Qualification intention	Full-time students			Part-time students		
	Complete as intended	Other outcome	Total	Complete as intended	Other outcome	Total
Other undergraduate	90%	10%	**100%**	57%	43%	**100%**
Bachelor	90%	10%	**100%**	56%	44%	**100%**
Other postgraduate	100%	0%	**100%**	100%	0%	**100%**
Master's by Coursework	92%	8%	**100%**	57%	43%	**100%**
Master's by Research	43%	57%	**100%**	36%	64%	**100%**
Doctorate by Research	74%	26%	**100%**	46%	54%	**100%**

Note: While we present weighted averages across all Go8 universities here, the analysis makes use of separate information by university (i.e. the analysis is tailored to each university's specific characteristics). 'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis based on information provided by the Group of Eight, and HESC data from the Department of Education and Training (2017a).

49 All completion rates relate to cumulative completion rates 9 years after commencement.

The information at **undergraduate** level was based on data provided by the Department of Education and Training did not include a breakdown by university *and* type of study (i.e. full-time or part-time). We thus imputed this breakdown, using the overall ratio of full-time relative to part-time completion rates across all Australian higher education institutions. We further assume that students who do not complete their intended undergraduate qualification complete only one or more of the units associated with their qualification. These students are categorised as completing education at 'Non-Award' level. As a result, we assume a 100% completion rate for students commencing Non-Award courses.

The information for **postgraduate research degrees** was based on historical completion rate information provided by the Group of Eight, separately by study intention, type of study and university, on the number of students commencing Master's or Doctorate degrees by Research and completing either of these qualifications (including the extent to which graduates might 'switch' between them, i.e. including information on the proportion of students who started a Doctorate Research degree but instead completed a Master's degree by Research). We assume that students who commence these qualifications but do not complete them instead complete only one or more of the units associated with their qualification. These students are categorised as completing education at 'other postgraduate' level.

For students undertaking **postgraduate degrees by coursework** (including Master's degrees by Coursework, Extended Master's degrees and Doctorate degrees by Coursework), given the lack of specific completion data for these qualifications, we assume the same completion rates as for undergraduate qualifications, and again assume that any students who do not complete their intended postgraduate degree by coursework instead complete only one or more units associated with their qualification (again categorised as completing education at 'other postgraduate' level).

50 The same completion rates were applied to estimate the impact of Go8 universities on educational exports (see **Section 4**).

51 i.e. Non-award Course level.

52 I.e. at Non-Award Course level.

5.5 Defining the returns to higher education qualifications

The key objective of the analysis of the impact of teaching and learning is to generate the **net graduate premium** to the individual and the **net Treasury benefit** associated with higher education qualification attainment at Group of Eight universities. These concepts are defined in Box 3. The specific components of the analysis are presented in Figure 23, and discussed in greater detail in subsequent sections.

Box 2: Definition of gross and net graduate premiums and Treasury benefits

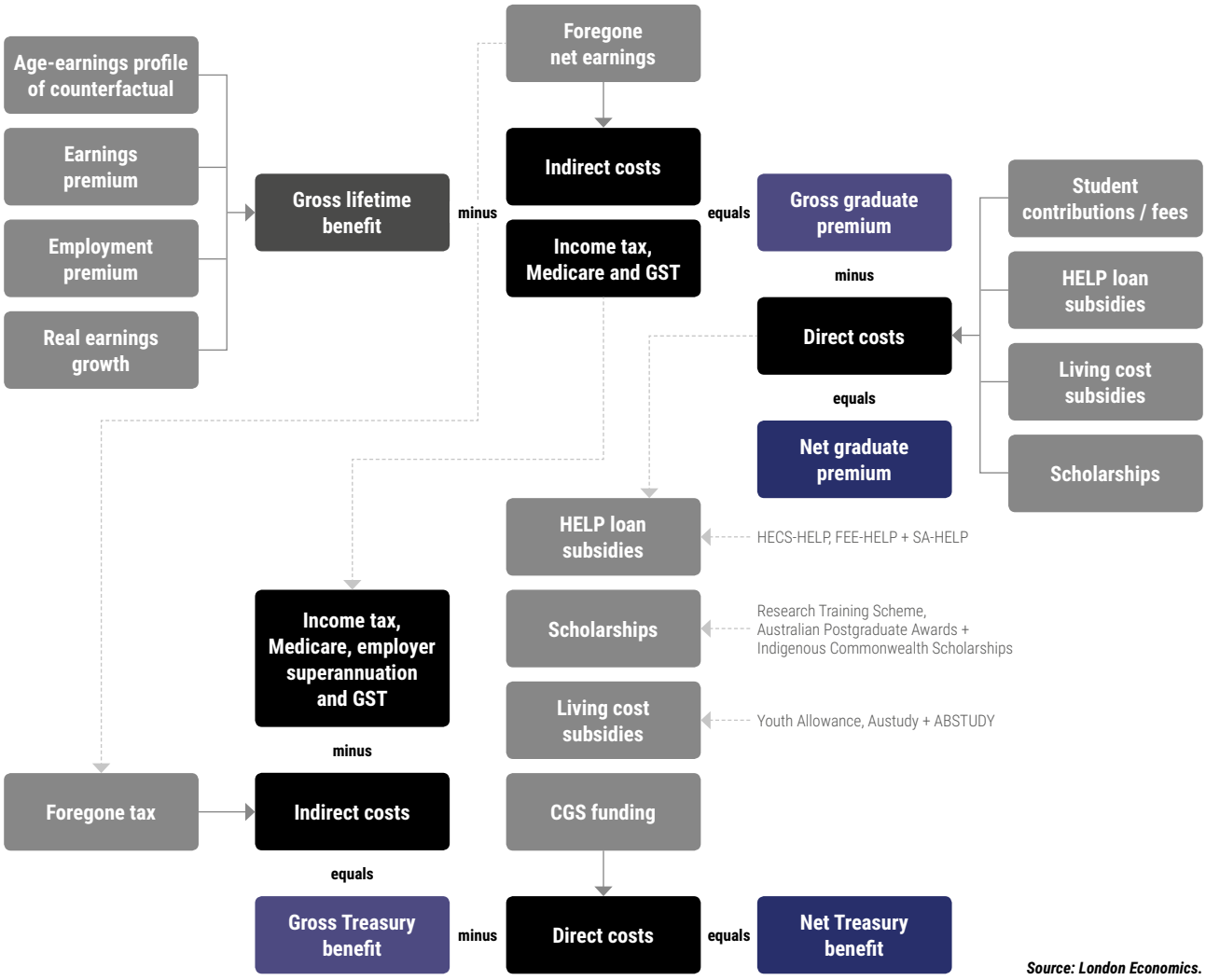
The ***gross*** **graduate premium** associated with qualification attainment is defined as the **present value** of **enhanced after-tax earnings** (i.e. after income tax, Medicare and Goods and Services Tax (GST) are removed, and following the deduction of any foregone earnings) relative to an individual in possession of the counterfactual qualification.

The ***gross*** **benefit to Treasury** associated with qualification attainment is defined as the **present value** of **enhanced taxation** (i.e. income tax, Medicare, GST and employer superannuation contributions, and following the deduction of the costs of foregone tax earnings) relative to an individual in possession of the counterfactual qualification.

The ***net*** **graduate premium** is defined as the gross graduate premium *minus* the present value of the direct costs associated with qualification attainment (i.e. student contribution/tuition fees following receipt of Higher Education Loan Program (HELP) loan subsidies, Commonwealth scholarships and public living cost support (including Youth Allowance, Austudy and ABSTUDY).

Similarly, the ***net*** **Treasury benefit** is defined as the gross benefit *minus* the direct costs of provision during the period of attainment (i.e. the cost of HELP loan provision, Commonwealth scholarships, public living cost support and Commonwealth Grant Scheme (CGS) funding).

Figure 23: Overview of gross and net graduate premium and Treasury benefit



Source: London Economics.

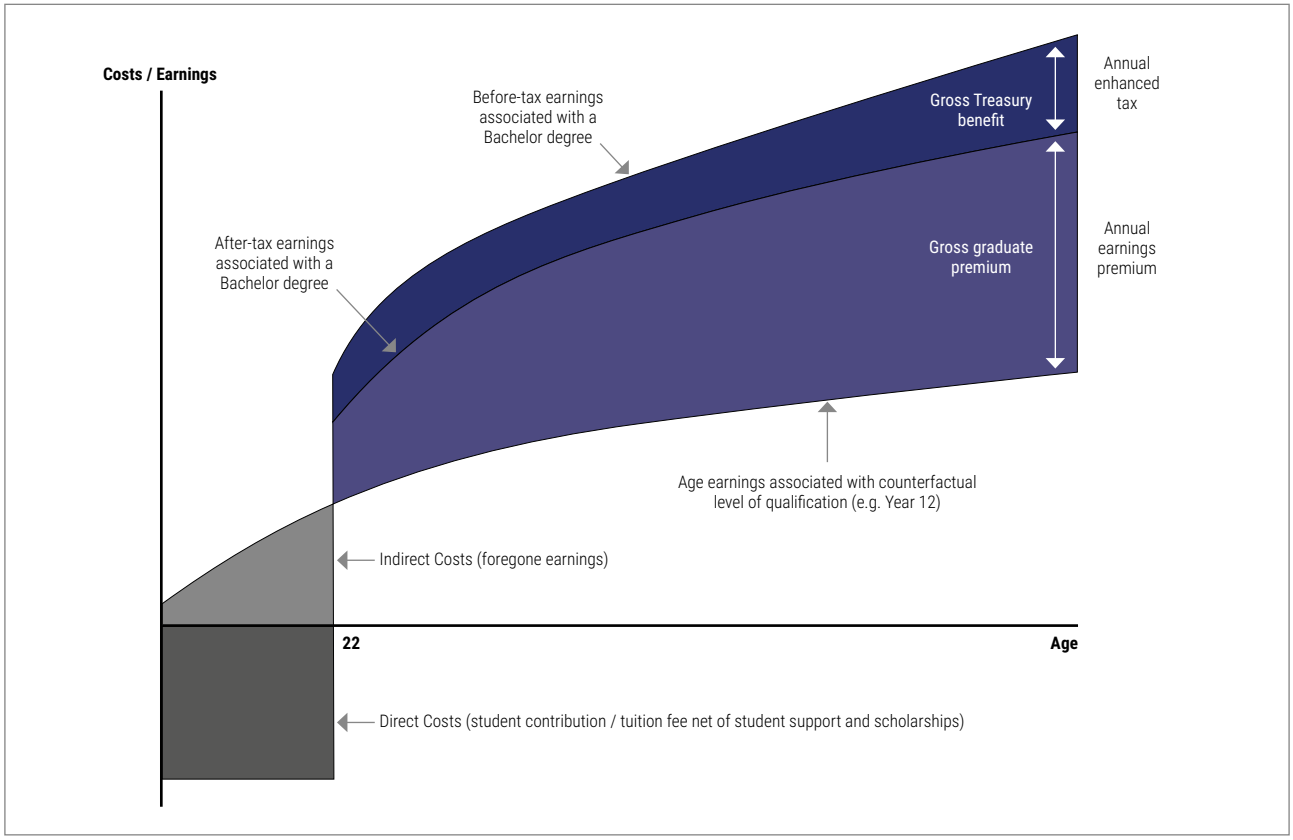
5.6 Estimating the returns to higher education qualifications

5.6.1 Estimating the gross graduate premium

To measure the **economic benefits to higher education qualifications**, rather than assessing the labour market outcomes achieved by individuals *in possession* of higher education qualifications, we use existing estimates of the *additional* labour market value associated with higher education qualifications, based on a study undertaking by Wilkins (2015).

Using the 2012 wave of the **Household, Income and Labour Dynamics in Australia (HILDA) Survey**, Wilkins undertakes an econometric analysis of the labour market returns to higher education qualifications, where the 'treatment' group consists of individuals in possession of the qualification of interest (as their highest qualification), and the 'counterfactual' group consists of individuals with comparable personal and socioeconomic characteristics but with the next highest (adjacent) level of qualification. The rationale for adopting this approach is that the comparison of the earnings and employment outcomes of the treatment group and the counterfactual groups 'strips away' those other personal and socioeconomic characteristics that might affect labour market earnings and employment (such as cognitive ability scores, gender, age, or region of employment), leaving just the labour market gains attributable to the qualification itself. An illustration of this is presented in Figure 24.

Figure 24: Estimating the gross graduate premium



Note: We assume that the opportunity costs of foregone earnings associated with further qualification attainment are applicable to full-time students only. For part-time students, we have assumed that these students are able to combine work with their academic studies and as such, do not incur any opportunity costs in the form of foregone earnings. This illustration is based on an analysis of the Group of Eight 2016 cohort, where the mean age of starting a full-time undergraduate degree stands at 19, and requires an average of three years to complete (although the expected duration varies between three and four years across the different universities).

Source: London Economics.

Using this approach, Wilkins estimates both the employment returns to higher education courses as well as the earnings returns (in terms of weekly earnings of full-time employees) to these qualifications. Throughout the Wilkins analysis, the assessment of earnings and employment outcomes associated with higher education qualification attainment (at different levels) is undertaken **separately by gender**, reflecting the different labour market outcomes between men and women. In addition, given the fact that part-time students typically undertake higher education qualifications later in life than full-time students, our analysis of part-time students applies a **'decay function'** to the returns associated with qualification attainment, to reflect the shorter period of time in the labour market.

Full details of Wilkins' estimation results, and the incorporation of these results in our analysis, are provided in Annex A3.2.1, while further information on our application of the age 'decay function' is presented in Annex A3.2.2. More information on the estimation of the monetary gross graduate premium and gross Treasury benefit is provided in Annex A3.2.3.

5.6.2 Estimating the gross Treasury benefit

The potential benefits accruing to the Treasury from the provision of higher education learning are derived from the additional taxation receipts that are associated with the enhanced likelihood of employment and higher earnings associated with more highly-skilled and productive employees. Based on the estimated lifetime earnings and employment benefits associated with higher education qualification attainment, and combined with administrative information on the relevant taxation rates and bands (from the Australian Taxation Office), we estimated the **present value** of additional income tax, Medicare, employer superannuation guarantee and GST contributions associated with higher education qualification attainment (by Group of Eight university, gender, level of study, type of study, and prior attainment[53]).

5.6.3 Estimating the net graduate premium

The differences between the gross and net graduate premium essentially relate to the **direct costs** of undertaking higher education qualifications[54]. These direct costs to the student refer to the **student contribution/tuition fee** paid[55] net of any:

- **Higher Education Loan Program (HELP) loans** (through HECS-HELP, FEE-HELP and SA-HELP) provided to Australian citizens through StudyAssist[56],
- **living cost support** (through the Youth Allowance, Austudy and ABSTUDY schemes) administered by the Department of Social Services[57] (and again available to students with Australian citizenship only), and
- **Commonwealth scholarship funding** (in terms of Australian Postgraduate Awards and the Research Training Scheme[58] (both available to Australian citizens and other domestic students), and scholarships for indigenous students (including Commonwealth Education Costs Scholarships, Commonwealth Accommodation Scholarships and Indigenous Access Scholarships[59]).

In terms of HELP loan funding, the student benefit associated with this loan support equals the **proportion of the loan expected not to be repaid by the student**, estimated at **23%**[60]. In other words, for every **$1,000** in HELP loans provided to students, it is expected that **$770** would be repaid by the student, while the remaining **$230** would be written off by the Treasury. In addition, the estimates of the average FEE-HELP loan per student have been adjusted for the **25% loan fee** required to be paid by undergraduate students in receipt of such loans[61]. Given the differences in funding eligibility, the direct costs incurred by students were assessed separately for students with Australian citizenship, and other domestic students (as well as by course level and type of study).

5.6.4 Estimating the net Treasury benefit

The direct costs[62] to the Treasury include the **Commonwealth Grant Scheme** (CGS) funding for eligible domestic students paid directly to universities[63], as well as the above-described funding support provided to students in the form of **HELP loans** (again adjusted for the proportion of loans expected not to be repaid), **living cost funding** and **Commonwealth scholarships**.

The above-described direct costs per student associated with qualification attainment to both students and the Treasury (by institution, course level, type of study and domicile/citizenship status) were calculated from start to completion of a student's learning aim. As with the impact on exports (Section 4), throughout the analysis, to ensure that the values of the economic benefits and costs are computed in **present value** terms (i.e. in 2016 money terms), all benefits and costs occurring at points in the future were discounted using the **7% discount rate** recommended by the Office of Best Practice Regulation[64,65].

Deducting the resulting costs from the estimated gross graduate premium and gross Treasury benefit, we arrive at the estimated **net graduate premium** and **net Treasury benefit** per student.

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53 Again, see Annex A3.1.3 for further information.

54 Note again that the *indirect* costs associated with qualification attainment, in terms of the foregone earnings during the period of study (for full-time students only), are already taken account of in the gross graduate premium. See Annex A3.1.3 for further information.

55 To arrive at an estimated average tuition fee per student, we made use of information on income received by each Go8 university in 2016 across different **student funding categories** in relation to:

- Students on Commonwealth Supported Places (in terms of HECS-HELP fee loans, and student contribution payments from students who did not receive a loan);
- Domestic students not on Commonwealth Supported Places (in terms of income from fee-paying domestic undergraduate and postgraduate students, fee-paying domestic non-award students, and FEE-HELP loans); and
- Overseas students (i.e. fee income from fee-paying overseas students).

Note that there is zero tuition fee income associated with students funded through Commonwealth scholarships (including the Research Training Scheme, Australian Postgraduate Awards, or International Postgraduate Research Scholarships), as well as for non-fee paying students (e.g. undertaking work experience).

To calculate **average fees per student for each of the above funding categories** (by institution), we then divided the total amount of tuition fee income in each of the above categories by the number of students (measured in EFTSL) in each category studying at Go8 universities in the 2016 academic year (including both commencing and returning students). We then calculated a **weighted average fee per student by level of study and domicile**, based on the distribution of commencing students (again in EFTSL) by level of study and domicile across each of the above funding categories. Finally, to distinguish between the fees paid by full-time and part-time students (per head), we adjusted the fees for Go8 students' average study intensity (separately for each university, level of study and type of study).

56 We included the loans provided through **HECS-HELP** (for students on Commonwealth supported places), **FEE-HELP** (for students *not* on Commonwealth supported places) and **SA-HELP** (but exclude any OS-HELP loans available to students undertaking some of their studies overseas). Specifically, we divided the total income received by each Go8 university from each of these loan programs in 2016 by the estimated total number of domestic students (in EFTSL, including commencing and returning students) eligible for these loans studying at Go8 universities in 2016. We then calculated the weighted average HECS-HELP, FEE-HELP and SA-HELP loan per student **by level of study**, based on the proportion of commencing students (again in EFTSL) eligible for each type of loan at each level of study. Finally, as with tuition fees, to distinguish between the loans received by full-time and part-time students, we adjusted the average estimated loans per student for Go8 students' average study intensity (separately for each university, level of study and type of study).

57 We made use of information on the average **living cost funding** outlay per *recipient* in 2016 (separately for Austudy, the Youth Allowance, and ABSTUDY), based on information published by the Department of Social Services (2017). To calculate average values per *student* (i.e. including those *not* in receipt of the funding), we multiplied the values per recipient with data on the proportion of students in receipt of each of these types of funding (by level and type of study) based on the 2012 Australian University Finances Survey (2012 being the most recent year for which the data were available at the time of the analysis; see Universities Australia (2013)). We assume that all of these types of living cost funding provided by the Department of Social Services are available to full-time students only.

58 Note that, from the 2017 academic year onwards, the **Australian Postgraduate Awards**, **Research Training Scheme**, and **International Postgraduate Research Scholarship** programmes were consolidated into the new Research Training Program. Further note that not all of the Research Training Scheme funding is paid to students through scholarships; instead, a proportion of it is retained by the universities to support their delivery of Research Doctorate and Research Masters degrees. However, since the underlying university financial data do not provide a more detailed breakdown of this funding, we have assumed that all of the Research Training Scheme funding is allocated to students through scholarships.

59 Similar to the calculation of average HELP loan support per student, we divided the total **Commonwealth scholarship** income received by each Go8 university in 2016 by the estimated total number of domestic students (in EFTSL, including commencing and returning students) eligible for each type of scholarship studying at Go8 universities in 2016. Again, we then adjust for the estimated average study intensity (by study level and type, and by university) to arrive at estimates per student in headcount (rather than EFTSL). Further note that our analysis treats the Research Training Scheme funding as a tuition fee scholarship (i.e. it constitutes a direct reduction in the fees paid by students to the universities), while Australian Postgraduate Awards and scholarships for indigenous students are assumed to be non-fee scholarships (i.e. to fund students' living costs and other expenses related to their studies).

60 See Department of Education and Training (2017b). Note that this estimate relates to all parts of the HELP loan program (not only including HECS-HELP, FEE-HELP and SA-HELP, but also OS-HELP and VET-HELP (for students undertaking vocational qualifications). The **23%** estimate relates to the expected proportion of all new debt issued in the fiscal year 2016-17 expected not to be repaid).

61 See Study Assist (2016) for more information on the loan fee.

62 Again, the indirect Treasury costs (in terms of the income tax, Medicare, employer superannuation guarantee and GST receipts foregone during the period of study (applicable to full-time students only)) are already incorporated in the gross Treasury benefits described above.

63 The **CGS grant costs** per student were calculated based on the Commonwealth Grant Scheme income received by Go8 universities in 2016, and divided by the number of students on Commonwealth supported places, to arrive at average public funding costs per student. Again, we then calculated **weighted average funding rates by level of study and domicile**, based on the proportion of students (in EFTSL) at Go8 universities on Commonwealth supported places for each level of study and domicile (and university). Finally, to distinguish between full-time and part-time students (per head), we adjusted for Go8 students' average study intensity (separately for each university, level of study and type of study).

64 See Office of Best Practice Regulation (2016).

65 Note that an analysis of the implications of this discount rate on the results is presented in Section 5.9.

3D replacement skin

This pioneering medical material can also assist with advanced healing of **broken bones, damaged lungs** and **chronic wounds**

3D replacement skin ensures that a patient's skin can **function normally**

It allows a patient's own blood vessels and cells to grow through it, and significantly **minimises** or **removes scarring**

Replicating elastin, the same building block that nature provides in skin, a Go8 research team has developed a 3D replacement skin, a pioneering medical material that is soft and flexible.

The much-lauded invention has its most obvious benefit in cancelling out the major limitations of skin grafting for burns victims. But it has a long list of other applications. As examples, it can also assist with advanced healing of broken bones, damaged lungs and chronic wounds, plus it has uses in a suite of surgical procedures where it will replace sutures, and its usage extends to being an aesthetic product that will correct stretch marks and acne scars.

… its most obvious benefit in cancelling out the major limitations of skin grafting for burns victims … and its usage extends to being an aesthetic product that will correct stretch marks and acne scars.

In February 2018 it was announced that Allergan plc, a leading global biopharmaceutical company would commercialise the invention in a deal that was worth some $US120 million. The acquisition was approved by Australia's Foreign Investment Review Board. Allergan plc is headquartered in Dublin Ireland, and is well-known for its focus on skin pharmaceuticals. It has had a strong aesthetic focus through its highly successful Botox and skin filler products.

Elastagen **halves skin repair time**, with resulting economic benefits for both patient and health system

The 3D replacement skin's developer, Professor Anthony Weiss, had formed a clinical stage biotechnology company in 2005 (now within Allergan) to capitalise on 20 years of research. Professor Weiss is the main inventor and scientific expert behind the licenced Intellectual Property.

His 3D replacement skin ensures that a patient's skin can function normally, because to do so, it is crucial to repair its deeper layer, the dermis, which provides the skin's elasticity. However, until Professor Weiss' work, even the newer burns treatment of "spray-on" skin, while very effective at sealing the wound, had only been able to repair the skin's top layer, the epidermis.

Patients with severe burns have been left with grafted skin that can't regulate temperature, and scarred skin that always feels and looks foreign and half numb. Their limbs can be left rigid.

In this 3D replacement skin breakthrough, a skin scaffold called Tropoelastin is placed across burns to replace the deep damaged layers of skin.

The Tropoelastin is identical to that present in human tissue. Professor Weiss' team has not only developed an entirely synthetic form of skin's own elastin; they had to develop an ingenious way of spinning it into a matrix of fibres to create the flat sheets required. The team painstakingly progressed from creating milligrams of the fibre to kilograms, enough for diverse human applications.

Professor Weiss' team has not only developed an entirely synthetic form of skin's own elastin; they had to develop an ingenious way of spinning it into a matrix of fibres to create the flat sheets required.

With sheets of Tropoelastin laid on the damaged site, a synthetic skin forms. According to Professor Weiss it halves skin repair time, with resulting economic benefits for both patient and health system. It allows a patient's own blood vessels and cells to grow through it, becoming a soft flexible replacement skin that can sweat, and have hair follicles regrow. It significantly minimises or removes scarring.

"Our technology has come a long way from the lab bench towards developing products for patients around the world," he says.

5.7 Net graduate premiums and net Treasury benefits per student

5.7.1 Net graduate premiums

Table 13 presents the estimated **net graduate premiums** achieved by students starting qualifications at Group of Eight universities in 2016, separately by level and type of study. While the estimates for undergraduate qualifications are presented relative to individuals who completed Year 12 as their highest prior attainment, the net graduate premiums for postgraduate students are presented relative to Bachelor degrees as the counterfactual level of attainment.

The analysis indicates that the net graduate premium achieved by a representative student in the 2016 cohort completing a **full-time Bachelor degree** at a Group of Eight university with Year 12 completion as their highest level of prior attainment amounts to **$58,000** in today's money terms, with the corresponding estimate per **part-time** student standing at **$56,000**.

The relatively small differences between the estimates for full-time and part-time students are driven by two opposing effects. On the one hand, as part-time students typically tend to undertake their studies at Go8 universities later in life than full-time students[66], and as such, they spend fewer years in the labour market post-graduation accruing the labour market benefits associated with their qualification attainment. In addition, part-time students incur higher *direct* costs throughout their study, given the longer duration of study as well as the lower tuition fee and living cost subsidies available to them. On the other hand, part-time students incur lower *indirect* (opportunity) costs of earnings foregone during study (as it is expected that part-time students are able to combine work with their academic studies[67]). These two sets of effects offset each other overall, resulting in comparable net graduate premiums for full-time and part-time Bachelor degree students.

At postgraduate level, the analysis indicates that the net graduate premium achieved by a representative student in the 2016 cohort completing a **full-time Master's degree by Coursework** at a Group of Eight university in possession of a Bachelor degree as their highest level of prior attainment amounts to **$16,000** in today's money terms. The corresponding estimate per representative **part-time** student stands at **$64,000** (driven by the lower indirect costs of foregone earnings during study, as described above).

Table 13: Estimated net graduate premiums to Group of Eight qualifications, by level and type of study

Level and type of study	Highest prior attainment	Net graduate premium, $
Full-time students		
Other Undergraduate	Year 12	–$1,000
Bachelor	Year 12	$58,000
Other Postgraduate	Bachelor degree	–$22,000
Master's by Coursework	Bachelor degree	$16,000
Master's by Research	Bachelor degree	–$12,000
Doctorate by Research	Bachelor degree	–$82,000
Part-time students		
Other Undergraduate	Year 12	$2,000
Bachelor	Year 12	$56,000
Other Postgraduate	Bachelor degree	$2,000
Master's by Coursework	Bachelor degree	$64,000
Master's by Research	Bachelor degree	$41,000
Doctorate by Research	Bachelor degree	$26,000

Note: All values constitute weighted averages across all Go8 universities, across men and women, and across students with Australian citizenship and other domestic students (where all averages are weighted by the estimated number of student completers). The estimates are rounded to the nearest $1,000 and discounted to reflect net present values.

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis.

66 The average age at graduation for part-time students in the 2016 Go8 cohort was estimated to be 22 (for both men and women), compared to 32 (men) and 33 (women) for part-time students. See Table 24 in Annex A3.1.2 for more information.

67 As outlined in Annex A3.1.2, throughout our analysis, we assume that any opportunity costs of foregone earnings associated with further qualification attainment are applicable to full-time students only. For part-time students, we assume that these students are able to work during their studies and do not incur any opportunity costs in the form of foregone earnings.

Note that there are negative estimated net graduate premiums for **other postgraduate courses** (i.e. **Master's or Doctorate degrees by research, and other postgraduate qualifications**[68]) undertaken on a full-time basis. Although these graduates benefit from high labour market benefits after completing their qualifications, they forego a significant amount of income while studying (based on the earnings achieved by comparable individuals in possession of Bachelor degrees as their highest attainment over the same period)[69]. However, only around **7%** in the 2016 Go8 cohort of domestic students were undertaking postgraduate qualifications other than Master's by Coursework[70], so that these negative estimates have a relatively limited effect on the estimated total impact of teaching and learning.

More generally, as outlined in further detail below, it should be noted that **all of these estimates are very sensitive to the discount rate applied to benefits and costs accruing in the future**. Whereas the estimates presented here are based on the 7% real discount rate recommended by the Office of Best Practice Regulation (2016), Section 5.9 presents what would happen to the estimated impact of teaching and learning under a lower – and more internationally comparable – discount rate.

5.7.2 Net benefits to the Treasury

Table 14 presents the corresponding **net Treasury benefits** generated by students commencing higher education qualifications at Group of Eight universities in 2016, again separately by level and type of study.

Overall, although they are generally smaller than the above-presented net graduate premiums, the estimates nevertheless show that the Treasury typically incurs significant (net) benefits from funding the provision of higher education teaching and learning at Group of Eight universities.

Table 14: Estimated net Treasury benefits to Group of Eight qualifications, by level and type of study

Level and type of study	Highest prior attainment	Net Treasury benefit, $
Full-time students		
Other Undergraduate	Year 12	–$15,000
Bachelor	Year 12	$13,000
Other Postgraduate	Bachelor degree	–$5,000
Master's by Coursework	Bachelor degree	$37,000
Master's by Research	Bachelor degree	–$80,000
Doctorate by Research	Bachelor degree	–$185,000
Part-time students		
Other Undergraduate	Year 12	–$12,000
Bachelor	Year 12	$23,000
Other Postgraduate	Bachelor degree	$8,000
Master's by Coursework	Bachelor degree	$66,000
Master's by Research	Bachelor degree	$36,000
Doctorate by Research	Bachelor degree	$23,000

Note: All values constitute weighted averages across all Go8 universities, across men and women, and across students with Australian citizenship and other domestic students (where all averages are weighted by the estimated number of student completers). The estimates are rounded to the nearest $1,000 and discounted to reflect net present values.

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis.

The results indicate that the net Treasury benefit associated with a representative student in the 2016 cohort completing a **full-time Bachelor degree** at a Go8 university (relative to Year 12 completion as their highest prior attainment) stands at **$13,000** in today's money terms, with the corresponding estimate per **part-time** student estimated at **$23,000**. Again, all of these estimates are calculated after deducting the Treasury cost of funding provided directly to universities through the Commonwealth Grant Scheme, and the support provided to students through HELP loans, living cost funding and Commonwealth scholarships.

At postgraduate level, it was estimated that the net Treasury benefit generated by a representative student completing a **full-time Master's degree by Coursework** in the 2016 Go8 cohort (in possession of a Bachelor degree) amounts to **$37,000** in today's money terms. The comparable net Treasury benefit per **part-time** student was estimated at **$66,000**. Again, note that there are negative estimates of the net Treasury benefits associated with **other full-time postgraduate courses** (i.e. **Master's or Doctorate degrees by research, and other postgraduate qualifications**), again driven mainly by the relatively high tax revenues foregone by the Treasury throughout the duration of study.

68 Here, other postgraduate qualifications *exclude* Master's (Extended) or Doctorates by Coursework. The estimates for these courses have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

69 The negative impact of foregone earnings is particularly strong for full-time students undertaking Doctorate Degrees by Research, driven by the relatively long average study duration of 5 years (see Table 24 in Annex A3.1.2).

70 See Section 5.3 for an overview of the 2016 cohort by study level and type.

5.8 The total economic impact of teaching and learning activities at Go8 universities

Combining the information on completion rates, the number of domestic students in the 2016 cohort of Group of Eight university students, and the net graduate premium and net Treasury benefits per student, the analysis estimates the aggregate economic impact of Group of Eight universities' teaching and learning activities.

As presented in Table 15, the analysis indicates that the **aggregate economic benefit of teaching and learning** associated with Go8 universities' 2016 cohort on the Australian economy stands at approximately **$4.91 billion**. Of this total, **70%** (**$3.42 billion**) is **accrued by students** undertaking qualifications at Group of Eight universities, while the remaining **30%** (**$1.49 billion**) is **accrued by the Australian Treasury**.

Further, considering the breakdown by type of study, reflecting the profile of the domestic student cohort, the analysis suggests that approximately **74% ($3.65 billion**) of the total impact is associated with full-time students attending Group of Eight universities, with the remaining **26%** (**$1.26 billion**) generated by students undertaking qualifications on a part-time basis. In addition, in terms of domicile, **96%** (**$4.72 billion**) of the economic impact is associated with Australian citizens in the 2016 Go8 cohort, with the remaining **4%** (**$0.19 billion**) generated by other domestic students[71].

It is important to emphasise that these impacts are associated with the 2016 cohort of students only. Depending on the size and composition of subsequent cohorts of Group of Eight university students, a comparable estimate of the economic impact associated with these universities' teaching and learning activities would occur for each successive cohort of starters.

Table 15: Aggregate impact of Group of Eight universities' teaching and learning activities by type of study, domicile, and beneficiary

Type of study and beneficiary	Domicile		
	Australian citizens	Other domestic students	Total
Students	**$3.33bn**	**$0.09bn**	**$3.42bn**
Full-time	$2.74bn	$0.05bn	**$2.78bn**
Part-time	$0.60bn	$0.04bn	**$0.64bn**
Treasury	**$1.39bn**	**$0.11bn**	**$1.49bn**
Full-time	$0.81bn	$0.06bn	**$0.87bn**
Part-time	$0.58bn	$0.05bn	**$0.63bn**
Total	**$4.72bn**	**$0.19bn**	**$4.91bn**
Full-time	$3.55bn	$0.10bn	**$3.65bn**
Part-time	$1.17bn	$0.09bn	**$1.26bn**

Note: All estimates are presented in 2016 prices, and have been discounted to net present values. ***Source: London Economics' analysis.***

71 Note again that we implicitly assert that all overseas students will leave Australia upon completing their qualifications, so that the analysis of teaching and learning focuses on domestic students only. Overseas students are instead considered as part of the analysis of Group of Eight universities' contribution to **exports**, through an analysis of the economic impact of the tuition fee and non-tuition fee income generated by these students (see Section 4).

Box 3: Who else gains from having a highly trained workforce?

University graduates and the Australian Treasury are not the only beneficiaries of having a highly trained workforce. Clearly, substantial economic benefits are accrued by **employers**, resulting from the productivity gains generated by more qualified workers in the workplace following the completion of their higher education learning.

To provide an indication of the extent of these benefits to employers, in the absence of comparable information in Australia, we used information from two studies addressing the impact of training on firm-level and industry-level productivity in the United Kingdom. The most recent piece of analysis for the UK Department for Business, Innovation and Skills (see London Economics, 2016) assessed the **impact of education and training on firm-level and industry-level productivity and the wage bill**[72]**.** At industry level, the analysis suggests that increasing the overall level of education and training (in terms of training intensity) by **1 percentage point** is associated with an increase in productivity of about **0.74%** and around **0.36%** in wages.

In a comparable analysis, though subject to a number of caveats[73], Dearden et al. (2005)[74] found that the overall effect of training on productivity at industry level is positive, around **twice as high as the wage effect**, and robust to different model specifications. Based on these results, the authors report that an increase in training by one percentage point at industry level is associated with an increase in productivity of between **0.6%** and **0.7%** and an increase in wages of **0.3%.**

The implication of these findings – which are very consistent given the modelling approaches and data sets adopted – is that **the benefits associated with publicly funded training are shared approximately equally between the employer and the employee**.

Converting this evidence into a monetary value

Using the information from Section 5.6.1 and Section 5.6.2, it is possible to generate an estimate of the direct productivity benefits to Australian employers associated with higher education attainment at Group of Eight universities – assuming that there is some degree of comparability between UK and Australian employers and employees in respect of the division of labour market benefits.

To generate a monetary benefit to employers, we assessed the **gross lifetime benefits to graduates** associated with higher education qualification attainment (through enhanced earnings and employment) (see Figure 23) *before* deducting any of the (direct or indirect) **costs** associated with higher education qualification attainment or the value of the enhanced **taxation** paid). The estimated aggregate gross lifetime benefit associated with the 2016 Go8 cohort stands at approximately **$11.70 billion**.

Based on the recent London Economics' (2016) analysis, we estimate that **employees** capture approximately **49%** of the total productivity gain associated with education and training (i.e. (0.36%/0.74%)), with **employers** accruing the remaining **51%** of the impact (i.e. (0.74%–0.36%)/0.74%). This implies that the above **$11.70 billion** in gross lifetime benefit to graduates represents approximately **49%** of the total productivity gain associated with higher education teaching and learning at Go8 universities, with a further **$12.35 billion** (**51%**) in economic benefit accrued by employers. Deducting the costs to employers of additional superannuation guarantee payments associated with the higher earnings (**$1.11 billion**), we arrive at a total estimated employer benefit of **$11.24 billion** associated with Go8 universities' 2016 cohort.

This information is provided to illustrate the magnitude of the economic benefits accrued by employers; however, given the fact that the basis for the estimation is derived from the United Kingdom (with no comparable estimates available for Australia), we do not incorporate this component into the aggregate analysis. However, the estimates illustrate that the overall estimated impact of teaching and learning presented in this report is a conservative estimate of the 'true' value of higher education teaching and learning at Group of Eight universities.

72 The analysis was undertaken using information derived from the matched *Individualised Learner Record* (which contains information on all publicly funded training provided in England) and the *Interdepartmental Business Register* (which is a 'live' register of all UK firms). This information was combined with data on firm-level and industry-level training and more general business characteristics (derived from the ONS *Annual Business Survey* and *Employers Skills Survey*).

73 In this respect, a key limitation of the study is that it uses relatively dated information from the Labour Force Survey and the Annual Census production, focusing on the period 1983 to 1996. In addition, it is important to note that the analysis focuses exclusively on the production industries, but omits service industries from the econometrics.

74 This analysis combined individual-level data on training from the *Labour Force Survey* with industry-level data from the *Annual Census of Production* (the predecessor of the UK *Annual Business Inquiry* and the *Annual Business Survey*).

5.9 Sensitivity analysis

The **costs** of qualification acquisition and labour market **benefits** associated with higher education qualification attainment occur over a long period of time – starting at students' initial date of enrolment, and lasting **their entire working lives post-graduation**[75]. As a result, to ensure a proper comparison of these costs, it is necessary for any analysis to **discount** these benefits and costs accruing at different points in time in the future into **net present values**. This ensures that the comparison of costs and benefits is made using a common 'currency'.

The need to discount future cash flows arises from two main considerations (see Office for Best Practice Regulation, 2016), both of which are based on the opportunity cost of these cash flows. The first of these is known as the '**time preference**' of money, and relates to the general observation that individuals place a higher value on a dollar received today than a dollar received in the future (in other words, placing a greater value on current consumption compared to future consumption). The second consideration is that there is an **opportunity cost** of investing funds into a particular project, in terms of the income foregone if the money had been put to a different use (e.g. the opportunity cost to a student investing in attaining a higher education qualification might be the interest that *would* have been accrued if the individual had instead placed the cost of purchasing the education in their savings account).

While there is widespread consensus on the need to discount cash flows when conducting a cost-benefit analysis of a particular project, **the level of the appropriate discount rate is subject to considerable debate**. As outlined by Harrison (2010), 'a key element of the cost-benefit analysis framework is the use of a discount rate to compare costs and benefits received at different points in time. Yet there is **little agreement about the appropriate discount rate**, with cost-benefit guides, academics and textbooks giving conflicting advice. A wide range of discount rates has been recommended, with the average and the bottom of that range **falling** over recent years.' Davis (2012) provides an overview of some of the discount rates used by different governmental agencies in Australia (ranging between **3.5%** (the real risk-free rate recommended by the Victoria Department of Treasury and Finance) and **7%** (recommended by the Office of Best Practice Regulation, and the NSW Treasury).

In line with common practice applied across different Australian Government Agencies, our above-presented analysis of the economic impact of teaching and learning at Group of Eight universities uses a **7%** real discount rate as recommended by the Office of Best Practice Regulation (2016). However, in analysing discount rates for public transport infrastructure projects, a recent report by the Grattan Institute (2018) argues that this rate is too high, and recommends that discount rates should instead vary over time, and vary with the systematic risk of the project under consideration[76]. In terms of the necessity for variation over time, the authors outline the how discount rates are typically inferred from government borrowing costs, which stood at around **6.8%** in 1989 (when the 7% discount rate was first used), but had declined to around **0.8%** by 2017. Incorporating the risk and cost of low-risk borrowing, the report recommends a real discount rate of between **3.5%** for projects with low systematic risk and **5%** for projects with high systematic risk (by the standards of transport infrastructure projects).

The low-risk real discount rate proposed by the Grattan Institute's report is the same as the standard 3.5% real discount rate commonly used for government appraisal and evaluation in the United Kingdom, as recommended by the HM Treasury Green Book[77]. For example, this standard rate was used as part of a key analysis of the returns to UK higher education qualifications on behalf of the (former) Department for Business, Innovation and Skills (2011). It is also important to note that 3.5% is not the lowest discount rate in use in the United Kingdom. In relation to the assessment of the proportion of higher education tuition fee and maintenance loans written off (i.e. to understand the long run economic cost to the UK government associated with the student support offered through loans), a discount rate of 0.7% is adopted (having recently been adjusted downwards from 2.2%[78]).

In the following section, we analyse the sensitivity of our estimates of the aggregate impact of Group of Eight universities' teaching and learning activities to changes in the assumed discount rate, comparing our central estimates (using a **7% discount rate**) to **alternative results assuming a 3.5% discount rate**.

5.9.1 Why is the choice of discount rate important?

Fundamentally, **the lower the discount rate, the greater the value of the economic benefits that occur in the future**. As Table 16 illustrates, there are significant differences in the net present values of a (hypothetical) $1,000 cash flow (at different points in time) calculated under each of these alternative discount rates, with the discrepancies increasing the further in the future the cash flows occur. For example, under the 7% discount rate, $1,000 received in 40 years' time is worth **$71** in today's money terms, whereas under the 3.5% discount rate, the same $1,000 is worth **$261** today.

A higher discount rate places a higher value on projects whose costs accrue earlier in time, and a substantially lower value on benefits occurring in the distant future. In the case of higher education qualification attainment, this means that the use of a 7% discount rate *inflates* the costs that occur during study, and *diminishes* the value of the benefits that occur post-graduation.

75 As presented in A3.1, this analysis measures the lifetime benefits from higher education qualification attainment up until the age of 65 (i.e. the assumed age at retirement).

76 Where systematic risk is defined as 'the extent to which the returns on any specific public sector project are expected to fluctuate in line with returns to the market, or the economy as a whole' (see Grattan Institute, 2018).

77 See HM Treasury (2011).

78 See HM Treasury (2015).

A world leader in solar

The Go8 is home to world-leading solar PV researcher Professor Martin Green known as the "father of PV". Professor Green is Director of the Australian Centre for Advanced Photovoltaics.

Green and his team have revolutionised the efficiency and costs of solar photovoltaics. The enormous reduction in the world's cost of photovoltaic solar systems is directly related to his scientific efforts, and to his students then establishing manufacturing centres in Asia.

In 1989, it was Green's team who supplied the first photovoltaic system with an energy conversion rate of 20 per cent. In 2014 he headed the development team that first demonstrated the conversion of sunlight into electricity with an energy conversion efficiency of 40 per cent.

Among his many breakthroughs, Green invented the PERC solar cell which accounted for more than 24 per cent of the world's silicon cell manufacturing capacity by the end of 2017.

In doing so his fundamental and applied research has transformed the global energy sector, creating the highest efficiency solar cells using techniques that have made them accessible to the world through commercialisation.

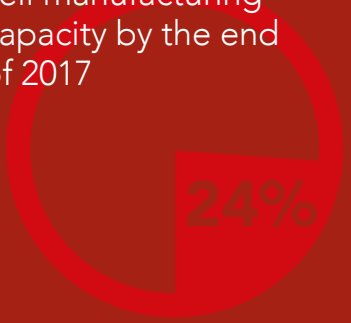
Sales of systems containing this solar cell exceeded $US10 billion in 2017, and are predicted to exceed $US1 trillion by 2040.

… revolutionised the efficiency and costs of solar photovoltaics.

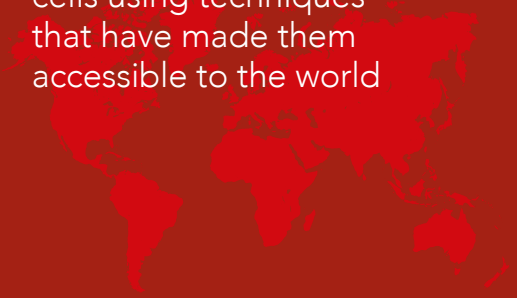
Professor Green is also co-inventor of the laser-doped selective emitter solar cell used in solar panels worth more than $1 billion in sales between 2009 and 2011.

Green's team have held the lead in being able to increase the efficiency of solar cells for more than 30 years.

The PERC solar cell accounted for **more than 24 per cent** of the world's silicon cell manufacturing capacity by the end of 2017



Transformed the global energy sector, creating the highest efficiency solar cells using techniques that have made them accessible to the world



Sales of systems containing this solar cell exceeded **$US10 billion** in 2017, and are predicted to exceed **$US1 trillion** by 2040

GROUP OF EIGHT AUSTRALIA | LE London Economics

Table 16: Effect of alternative discount rates on the value of $1,000 dollars received at different points in time

$1,000 received in…	Net present value, $	
	7.0% discount rate	3.5% discount rate
…10 years	$544	$734
…20 years	$277	$520
…30 years	$141	$369
…40 years	$71	$261
…50 years	$36	$185

Note: All calculations apply discounting at the end of each year (i.e. values in the first year have not been discounted). ***Source: London Economics' analysis.***

5.9.2 Sensitivity analysis of the net graduate premium and net Treasury benefit

Table 17 and Table 18 present our estimates of the net graduate premium and net Treasury benefit per student associated with higher education qualification attainment at Go8 universities under the two discount rate assumptions.

As presented in Table 17, assuming a lower discount rate of 3.5% would **almost triple** the estimated net graduate premium achieved by a representative student in the 2016 cohort undertaking a full-time **Bachelor degree** (relative to Year 12 completion) from **$58,000** to **$163,000**. Similarly, the corresponding estimate for part-time students would **more than double**, from **$56,000** to **$123,000**. At postgraduate level, the net graduate premium associated with a full-time **Master's degree by Coursework** (relative to possession of Bachelor degree) would increase by even more, from **$16,000** to **$126,000** for full-time students, and from **$64,000** to **$141,000** for part-time students.

The estimated net Treasury benefits per student (Table 18) would also increase significantly under the alternative discount rate, rising from **$13,000** to **$92,000** and from **$23,000** to **$73,000** for full-time and part-time **Bachelor degree** students, respectively. The comparable estimates for students undertaking **Master's degrees by Coursework** in the 2016 Go8 cohort would increase from **$37,000** to **$136,000** per full-time student, and from **$66,000** to **$136,000** per part-time student.

Table 17: Net graduate premiums to Group of Eight qualifications – sensitivity analysis

Level and type of study	Highest prior attainment	Central estimates (7% discount rate)	Sensitivity analysis (3.5% discount rate)
Full-time students			
Other Undergraduate	Year 12	–$1,000	$18,000
Bachelor	Year 12	$58,000	$163,000
Other Postgraduate	Bachelor degree	–$22,000	–$10,000
Master's by Coursework	Bachelor degree	$16,000	$126,000
Master's by Research	Bachelor degree	–$12,000	$49,000
Doctorate by Research	Bachelor degree	–$82,000	–$30,000
Part-time students			
Other Undergraduate	Year 12	$2,000	$11,000
Bachelor	Year 12	$56,000	$123,000
Other Postgraduate	Bachelor degree	$2,000	$7,000
Master's by Coursework	Bachelor degree	$64,000	$141,000
Master's by Research	Bachelor degree	$41,000	$68,000
Doctorate by Research	Bachelor degree	$26,000	$46,000

Note: All values constitute weighted averages across all Go8 universities, across men and women, and across students with Australian citizenship and other domestic students (where all averages are weighted by the estimated number of student completers). The estimates are rounded to the nearest $1,000 and discounted to reflect net present values.

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis.

Table 18: Net Treasury benefits to Group of Eight qualifications – sensitivity analysis

Level and type of study	Highest prior attainment	Central estimates (7% discount rate)	Sensitivity analysis (3.5% discount rate)
Full-time students			
Other Undergraduate	Year 12	–$15,000	$0
Bachelor	Year 12	$13,000	$92,000
Other Postgraduate	Bachelor degree	–$5,000	$6,000
Master's by Coursework	Bachelor degree	$37,000	$136,000
Master's by Research	Bachelor degree	–$80,000	–$28,000
Doctorate by Research	Bachelor degree	–$185,000	–$145,000
Part-time students			
Other Undergraduate	Year 12	–$12,000	–$5,000
Bachelor	Year 12	$23,000	$73,000
Other Postgraduate	Bachelor degree	$8,000	$13,000
Master's by Coursework	Bachelor degree	$66,000	$136,000
Master's by Research	Bachelor degree	$36,000	$59,000
Doctorate by Research	Bachelor degree	$23,000	$40,000

Note: All values constitute weighted averages across all Go8 universities, across men and women, and across students with Australian citizenship and other domestic students (where all averages are weighted by the estimated number of student completers). The estimates are rounded to the nearest $1,000 and discounted to reflect net present values.

'Other undergraduate' qualifications include Associate Degrees, Advanced Diplomas (AQF)/Diplomas (pre-AQF), Diplomas (AQF)/Associate Diplomas (pre-AQF), and other undergraduate award courses. 'Other postgraduate' qualifications include Graduate Diplomas and Graduate Certificates. Estimates for students undertaking Non-Award Courses, Enabling Courses, Master's (Extended) or Doctorates by Coursework have not been presented here, as there are relatively few students in the 2016 Go8 cohort undertaking these courses.

Source: London Economics' analysis.

5.9.3 Sensitivity analysis of the aggregate impact of teaching and learning

Table 19 presents the sensitivity of the aggregate estimates of the impact of teaching and learning at Group of Eight universities to changes in the discount rate. Assuming a 3.5% real discount rate (as compared to 7%) would increase the total **teaching and learning** impact associated with the 2016 cohort from **$4.91 billion** to **$17.48 billion** – equivalent to a **256%** increase. In terms of the components of this impact, while the net benefits to the Treasury would increase from **$1.49 billion** to **$7.04 billion**, the impact accrued by students would increase from **$3.42 billion** to **$10.44 billion**.

Using a similar analytical approach (discussed in more detail in Box 3), employers would see the value of the economic benefit accrued from having a more highly qualified workforce increase from **$11.24 billion** to **$22.52 billion** under the 3.5% discount rate (though again note that this estimate is not included in the total impact of teaching and learning).

5.9.4 Sensitivity analysis of the aggregate impact of educational exports

As in the impact of teaching and learning, given that the economic impact of overseas students at Go8 universities is measured over multiple years (over the total study duration), we replicate the sensitivity of the results relating to **educational exports** to changes in the discount rate. As before, we compare our central estimates – using a **7% discount rate** as recommended by the Office of Best Practice Regulation (2016) – to alternative results assuming a **3.5% discount rate** typically used for comparable analysis undertaken in the United Kingdom (as recommended by HM Treasury (2011)), and as recently recommended for Australia by the Grattan Institute (2018). These estimates are presented in Table 20 overleaf.

The analysis indicates that a lower discount rate would slightly **increase** the value of educational exports associated with the 2016 cohort of overseas Group of Eight students, increasing from **$17.98 billion** to **$18.50 billion** (equivalent to a **3%** increase) in monetary terms. In terms of employment, the estimates would rise from **73,030** to **75,145 jobs** supported (again equivalent to a **3%** increase).

Table 19: Aggregate impact of Group of Eight universities' teaching and learning activities – sensitivity analysis

Type of study and beneficiary	**Central estimates** (7% discount rate)			**Sensitivity analysis** (3.5% discount rate)		
	Domicile			**Domicile**		
	Australian citizens	**Other domestic students**	**Total**	**Australian citizens**	**Other domestic students**	**Total**
Students	**$3.33bn**	**$0.09bn**	**$3.42bn**	**$10.01bn**	**$0.43bn**	**$10.44bn**
Full-time	$2.74bn	$0.05bn	**$2.78bn**	$8.74bn	$0.34bn	**$9.08bn**
Part-time	$0.60bn	$0.04bn	**$0.64bn**	$1.27bn	$0.09bn	**$1.36bn**
Treasury	**$1.39bn**	**$0.11bn**	**$1.49bn**	**$6.65bn**	**$0.39bn**	**$7.04bn**
Full-time	$0.81bn	$0.06bn	**$0.87bn**	$5.51bn	$0.29bn	**$5.81bn**
Part-time	$0.58bn	$0.05bn	**$0.63bn**	$1.14bn	$0.09bn	**$1.23bn**
Total	**$4.72bn**	**$0.19bn**	**$4.91bn**	**$16.66bn**	**$0.82bn**	**$17.48bn**
Full-time	$3.55bn	$0.10bn	**$3.65bn**	$14.25bn	$0.63bn	**$14.89bn**
Part-time	$1.17bn	$0.09bn	**$1.26bn**	$2.41bn	$0.18bn	**$2.59bn**

Note: All estimates are presented in 2016 prices, and have been discounted to net present values. ***Source: London Economics' analysis.***

Table 20: Aggregate impact of Group of Eight universities' educational exports – sensitivity analysis

Type of impact	**Central estimates** (7% discount rate)				**Sensitivity analysis** (3.5% discount rate)			
	New Zealand citizens	**Residing outside Australia**	**Temporary entry visa**	**Total**	**New Zealand citizens**	**Residing outside Australia**	**Temporary entry visa**	**Total**
Output, $bn								
Net tuition fee income	$0.06bn	$0.68bn	$8.78bn	**$9.52bn**	$0.06bn	$0.71bn	$9.02bn	**$9.79bn**
Non-fee income	$0.31bn	$0.00bn	$8.14bn	**$8.45bn**	$0.33bn	$0.00bn	$8.38bn	**$8.70bn**
Total	**$0.37bn**	**$0.68bn**	**$16.92bn**	**$17.98bn**	**$0.39bn**	**$0.71bn**	**$17.40bn**	**$18.50bn**
Employment, # (headcount)								
Net tuition fee income	270	3,130	40,300	**43,700**	275	3,245	41,435	**44,955**
Non-fee income	1,090	0	28,240	**29,330**	1,135	0	29,055	**30,190**
Total	**1,360**	**3,130**	**68,540**	**73,030**	**1,410**	**3,245**	**70,490**	**75,145**

Note: All monetary estimates are presented in 2016 prices, and discounted to net present values. Employment estimates are provided in headcount, and rounded to the nearest 5.
We did not take account of non-fee expenditures by students residing outside Australia, assuming that these would be accrued outside of the Australian economy.
Source: London Economics' analysis.

6 The aggregate economic impact of Group of Eight universities

6 The aggregate economic impact of Group of Eight universities

6.1 Central estimates

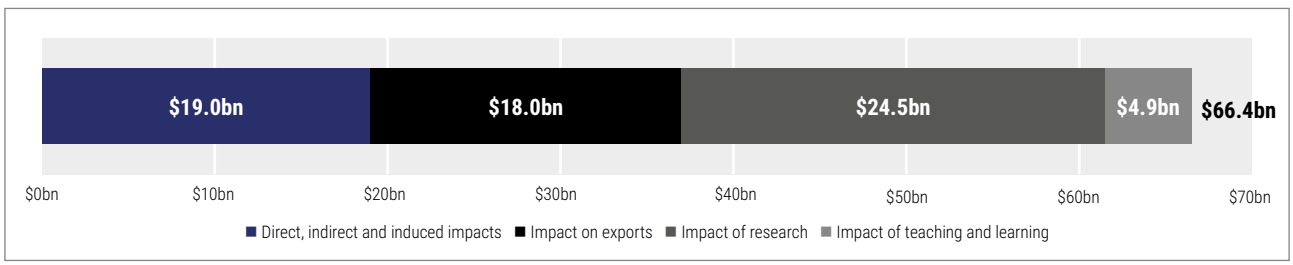
In the 2016 academic year, Group of Eight universities taught a total of **380,100 students**, including **141,230 commencing students**, and employed **51,640 staff**. **The total economic impact associated with Go8 universities' activities across Australia in 2016 was estimated to be $66.43 billion**.

In terms of the components of economic impact (see Table 21), the value of the universities' **research** activity contributed **$24.53 billion** (**37%**), while the economic contribution associated with the **direct, indirect and induced impact** from Group of Eight universities' operational and staff expenditure was estimated to be **$19.02 billion** (**29%**). An additional **27%** (or **$17.98 billion**) was associated with the universities' contribution to **educational exports**, with the remaining **$4.91 billion** (**7%** of the total) associated with the Group of Eight universities' **teaching and learning** activities.

Compared to Group of Eight universities' total operational costs of approximately **$12.38 billion**, the total contribution of the universities to the Australian economy in 2016 was estimated to be approximately **$66.43 billion**, which corresponds to a benefit to cost ratio of approximately **5½:1**.

Table 21: Aggregate economic impact of Group of Eight universities in Australia in 2016

Type of impact		$ billion	%
	**Impact of research**	**$24.53bn**	**37%**
	Net direct research impact	$0.75bn	1%
	Spillover impact	$23.78bn	36%
	**Impact of university expenditure**	**$19.02bn**	**29%**
	Direct impact	$11.45bn	17%
	Indirect and induced impacts	$7.57bn	11%
	**Exports**	**$17.98bn**	**27%**
	Net tuition fee income	$9.52bn	14%
	Non-tuition fee income	$8.45bn	13%
	**Impact of teaching and learning**	**$4.91bn**	**7%**
	Students	$3.42bn	5%
	Treasury	$1.49bn	2%
	Total impact	**$66.43bn**	**100%**



Note: All estimates are presented in 2016 prices. ***Source: London Economics' analysis.***

6.2 Aggregate sensitivity analysis

Given that the economic impact of overseas students at Go8 universities (Section 4) and the impact of teaching and learning (Section 5) are measured in net present values over multiple years, we analysed the sensitivity of the total economic impact estimates to changes in the discount rate (comparing our central estimates using a **7% discount rate** to alternative results assuming a **3.5% discount rate**). This is presented in Table 22.

A lower discount rate would significantly **increase** the estimated total contribution of Group of Eight universities to the Australian economy, from **$66.43 billion** to **$79.52 billion** (equivalent to a **20%** increase). The difference is primarily driven by an increase in the estimated impact of **teaching and learning** (since this impact is measured over graduates' entire working lives) from **$4.91 billion** to **$17.48 billion**, and, to a lesser extent, by an increase in the impact on **educational exports**, from **$17.98 billion** to **$18.50 billion**.

Table 22: Aggregate economic impact of Group of Eight universities in Australia in 2016 – sensitivity analysis

Type of impact		Central estimates (7% discount rate)	Sensitivity analysis (3.5% discount rate)
	**Impact of research**	**$24.53bn**	**$24.53bn**
	Net direct research impact	$0.75bn	$0.75bn
	Spillover impact	$23.78bn	$23.78bn
	**Impact of university expenditure**	**$19.02bn**	**$19.02bn**
	Direct impact	$11.45bn	$11.45bn
	Indirect and induced impacts	$7.57bn	$7.57bn
	**Exports**	**$17.98bn**	**$18.50bn**
	Net tuition fee income	$9.52bn	$9.79bn
	Non-tuition fee income	$8.45bn	$8.70bn
	**Impact of teaching and learning**	**$4.91bn**	**$17.48bn**
	Students	$3.42bn	$10.44bn
	Treasury	$1.49bn	$7.04bn
	Total impact	**$66.43bn**	**$79.52bn**

Note: All estimates are presented in 2016 prices. Numbers may not add due to rounding. ***Source: London Economics' analysis.***

Put Science into Sewers

In 2014 the research won the prestigious **International Water Association's Global Project Innovation Award (Applied Research)**

… By then, the research had already delivered documented savings of **$400 million** to the Australian water industry

A **cost-effective** and **sustainable** method of significantly delaying the replacement of **aging** or **damaged sewage pipes,** and also decreasing associated pipe odours

Following a $21 million, five-year project, "Put Science into Sewers" that became the largest sewer-related research project ever undertaken, a Go8 research team has delivered the world's municipalities the tools necessary to save them many millions of dollars in sewage system replacement and maintenance costs. It is also improving sewer design.

An exclusive licencing agreement has been negotiated with USP Technologies, an Atlanta-based provider of chemical treatment programs for water and wastewater, and in 2014 the research won the prestigious "International Water Association's Global Project Innovation Award (Applied Research)". The research impact has already delivered documented savings of $400 million to the Australian water industry.

The research team discovered a cost-effective and sustainable method of significantly delaying the replacement of aging or damaged sewage pipes, and also decreasing associated pipe odours. "Put Science into Sewers" has translated innovative science and engineering into practical solutions with major economic outcomes.

Corrosion and odour problems in sewers are most often caused by bacteria on the sewer wall reacting with sulphates in the wastewater to form hydrogen sulphide. This enables sewer bacteria to form corrosive sulphuric acid which chemically eats away at the pipes.

An exclusive licencing agreement has been negotiated with USP Technologies …

The new technology uses free nitrous acid to remove the bacteria that adhere to the inner surfaces of sewer pipes, and so halts the production of hydrogen

One of the research project's key outcomes has been its SewX model, which is the **world's most advanced mathematical model** for predicting where hydrogen sulphide will occur and therefore where both preventative methods and remediation will have most impact.

sulphide at its source. This highly effective solution costs less to use than other methods, is used intermittently, and provides longer duration control. It can also be used in sensitive environmental areas and to treat small sewer pipes.

One of the research project's key outcomes has been its SewX model, which is the world's most advanced mathematical model for predicting where hydrogen sulphide will occur and therefore where both preventative methods and remediation will have most impact.

This is critical because sewage networks include many kilometres of underground pipes through varying topography. This can lead to network "hotspots" where corrosion is accelerated and where odours cause community complaints.

Sewerage system corrosion and odour is recognised as a huge problem for water utilities globally. In the US the total annual cost of corrosion in its sewer network was $US13.75 billion in 2000, and the systems themselves had an asset value of more than one trillion dollars. These systems must be maintained, regardless of cost, to ensure public health by preventing the spread of disease such as cholera.

The wastewater industry states that sewers around the world are under serious threat of deterioration. Engineers estimate the average lifespan of sewers at between 50 and 100 years, but deterioration requiring replacement or expensive maintenance is occurring in many areas in far fewer years, with asset losses worth billions of dollars globally. Asset losses due to sewer corrosion cost Australians in the order of $100 million each year.

The 11 Australian industry partners of the research team have already reported saving many millions of dollars in sewer system replacement and maintenance costs. The technology is now available to deliver much greater economic benefits in larger municipalities in North America, China and Europe.

In the US the total annual cost of corrosion in its sewer network was $US13.75 billion in 2000 … Asset losses due to sewer corrosion cost Australians in the order of $100 million each year.

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Annex 2: List of Group of Eight universities

List of Group of Eight universities

- The University of Adelaide
- The Australian National University
- The University of Melbourne
- Monash University
- The University of New South Wales
- The University of Queensland
- The University of Sydney
- The University of Western Australia

Annex 3: Methodological annex

A3.1 The economic impact of research activities at Group of Eight universities

As outlined in Section 2.2.2, to estimate the productivity spillovers associated with Go8 universities' research activities undertaken in 2016, we estimate the effect on Australian output of removing particular types of public research funding received by Group of Eight universities from the total existing stock of public sector R&D in higher education – thus analysing the economic output that would be lost without the Group of Eight universities' research activities.

A3.1.1 Estimating the R&D stock

The value of the public R&D stock in higher education in 2016 is constructed by applying the Perpetual Inventory Method[79], using data from the Science, Research and Innovation Budget publication for the 2016 academic year (see Department of Industry, Innovation and Science, 2017). This method assumes that the research stock in the any given period is a function of:

- The existing research stock, where knowledge depreciates or becomes obsolete from one period to the next and
- The annual expenditure on research.

More specifically, the initial research stock (at the beginning of the period of interest) is defined as:

$$S_o = R_o/(g+\delta) \qquad (1)$$

where $\mathbf{R_o}$ is the expenditure on R&D in the initial period[80], **g** is average logarithmic growth over the period covered by Elnasri and Fox (2017) (i.e. the fiscal years 1993–94 to 2012–13), and **δ** is the assumed annual depreciation rate (of 20%).

The research stock in all subsequent years was then calculated as:

$$S_t = R_t + (1-\delta)\, S_{t-1} \qquad (2)$$

where $\mathbf{S_{t-1}}$ is the stock of research in the previous period (t–1), and $\mathbf{R_t}$ is the expenditure on R&D during period t (and **δ** again refers to the assumed depreciation rate).

The research stock in the 2016 academic year was then estimated by calculating the average research stock between the 2015–16 and 2016–17 fiscal years, estimated using the above equations.

A3.1.2 Estimating productivity spillovers

As outlined above, Elnasri and Fox's analysis estimates the elasticity of Australian multi-factor productivity with respect to the public sector research stock in higher education. In terms of translating this into an economic impact, the assumed production function underlying Elnasri and Fox's calculation of multi-factor productivity implies that there is a one-to-one relationship between multi-factor productivity and economic gross value added (GVA)[81]. In other words, their assumptions imply that a 1% change in multi-factor productivity translates into a 1% change in gross value added.

Using the same assumptions, we thus estimated the proportion of Australian gross value added (GVA) that is supported by the publicly funded research undertaken at Group of Eight universities. In terms of the types of public funding considered, our analysis applies Elnasri and Fox's (2017) estimated elasticity impacts to the same types of public research funding included in their analysis, including:

- Australian competitive grants provided by the Commonwealth government; and
- Other public sector research funding provided by the Commonwealth government[82].

While this is a conservative approach and likely understates the spillover effects associated with Go8 research activities, it ensures that the estimates accurately reflect Elnasri and Fox's findings.

The proportion of GVA supported by the above types of research income received by Go8 universities in 2016 was calculated as follows:

$$\%\ GVA = 0.175 \times (LOG(S) - LOG(S - I_{i,j})) \qquad (3)$$

where is the total stock of existing higher education research (estimated as above), $\mathbf{I_{i,j}}$ is type **i** of the research income received by Go8 universities in 2016 (i.e. either Australian Competitive Grants or other public sector funding from Commonwealth sources) for each Group of Eight university **j**, and **0.175** is the elasticity estimated by Elnasri and Fox.

Finally, we multiplied the resulting estimated proportions of GVA (separately by type of public research funding and Group of Eight university) by total Australian GVA in 2016[83], to estimate the productivity spillovers generated by Go8 research in monetary terms. Dividing by the total research income received by Go8 universities in 2016 (from all sources), we thus arrive at a weighted average productivity spillover multiplier of **9.76** (across all Go8 universities and types of research income).

79 This method follows the approach to estimating the public R&D stock used by an earlier and commonly-cited analysis of the productivity spillovers from public investment in R&D undertaken by Burgio-Ficca (2004).

80 In line with Elnasri and Fox's (2017) analysis, the initial period refers to the 1993–94 fiscal year.

81 This is described in more detail in the growth accounting information provided in the Appendix of the Elnasri and Fox (2017) study.

82 This *excludes* any funding for Cooperative Research Centres provided by the Commonwealth government.

83 Based on GVA data provided by the Australian Bureau of Statistics (2017d).

A3.2 The impact of teaching and learning

A3.2.1 Marginal earnings and employment returns to higher education qualifications

Table 23 presents the original estimates of the marginal earnings and employment returns[84] associated with higher educational qualification attainment as estimated by Professor Roger Wilkins (2015) at the University of Melbourne, based on the **Household, Income and Labour Dynamics in Australia** Survey (HILDA). For example, focusing on Bachelor degrees, the estimates suggest that, compared with individuals with education at Year 11 and below as their highest level of educational attainment, a Bachelor degree increases earnings (in terms of weekly earnings of full-time employees) by approximately **51.7%** for men and **37.3%** for women. Similarly, a Bachelor degree increases the probability of being in employment by **1.0** percentage point for men and **6.2** percentage points for women.

Table 23: Marginal earnings and employment returns to higher education qualifications – Original results from Wilkins (2015)

Qualification level	Marginal earnings returns, % (weekly full-time earnings)		Marginal employment returns, percentage points	
	Male	Female	Male	Female
Year 11 and below	Reference category		Reference category	
Year 12	0.207	0.148	0.004	0.060
Diploma or Advanced Diploma	0.322	0.081	0.025	0.067
Bachelor degree	0.517	0.373	0.010	0.062
Graduate Diploma or Certificate	0.564	0.390	–0.007	0.059
Master's or Doctorate degree	0.637	0.489	0.038	0.038

Note: Marginal earnings returns have been exponentiated to reflect returns in percentages. Marginal employment returns are expressed in percentage points. All estimates are based on regressions including controls for cognitive ability scores, and are estimated relative to attainment at Year 11 and below as the baseline/reference category.

Source: Wilkins (2015) (see corrected version of Table 7.4).

Based on these estimates, we undertook a range of calculation steps and adjustments to incorporate the marginal earnings and employment returns in our analysis of the impact of teaching and learning of Group of Eight universities.

Assigning returns to HE qualification levels undertaken by Go8 students

First, we allocated the above (more aggregated) returns to the different (more disaggregated) qualification levels undertaken by students in the 2016 Group of Eight cohort. Specifically (as presented in Table 24), we applied:

- The Wilkins estimates for **Master's or Doctorate Degrees** to estimate the labour market benefits associated with **Master's degrees by Coursework, Master's degrees by Research, Extended Master's, Doctorate degrees by Coursework and Doctorate degrees by Research at Go8 universities**;
- The Wilkins estimates for **Bachelor degrees** to estimate the benefits associated **with Bachelor degrees at Go8 universities** (including Bachelor's Graduate Entry, Bachelor's Honours, and Bachelor's Pass);
- The Wilkins estimates for **Graduate Diplomas or Certificates** to estimate the benefits associated with **other postgraduate qualifications at Go8 universities** (including Graduate Diplomas or Certificates and other postgraduate qualifications); and
- The Wilkins estimated returns to **Diplomas or Advanced diplomas** to estimate the benefits associated with **other undergraduate qualifications at Go8 universities** (including Associate degrees, Diplomas and Advanced/Associate Diplomas, and other undergraduate award courses).

In addition to the analysis of higher education outcomes, we also made use of the estimates of the returns to Year 12 education (compared to attainment at Year 11 and below), to provide an indication of the fact that the academic 'distance travelled' by a (small) proportion of Group of Eight university students is **greater** than might be the case compared to those in possession of levels of prior attainment 'traditionally' associated with higher education entry.

Note that, given the lack of specific estimates available on the earnings and employment returns associated with Enabling Courses, we assume that there are no labour market benefits to these courses (thus including only the costs of attainment relating to these programs). More information on the separate estimation undertaken to assess the returns to Non-Award Courses is provided below.

84 Note that, due to the limitations associated with the econometric approach used, these estimates do not provide any evidence on the *casual* effects of education attainment on wages and employment, but rather describe the **correlation** between education and labour market outcomes. However, as Wilkins (2015) describes, the inclusion of controls for cognitive ability 'provides a stronger basis for interpreting estimates for education variables as 'causal', on the grounds that this controls for the higher innate ability of the more-educated that would suggest they would have better labour market outcomes even without the additional education' (see Wilkins, p. 70).

Table 24: Allocation of estimates from Wilkins (2015) by qualification level at Go8 universities

Qualification level for analysis	Qualification level in Wilkins (2015)	Marginal earnings returns, %		Marginal employment returns, pp	
		Male	Female	Male	Female
Year 12	Year 12	0.207	0.148	0.004	0.060
Non-award Courses	n.a.	–	–	–	–
Enabling Courses	n.a.	–	–	–	–
Other undergraduate	Diploma or Advanced Diploma	0.322	0.081	0.025	0.067
Bachelor degree	Bachelor degree	0.517	0.373	0.010	0.062
Other postgraduate	Grad. Diploma or Certificate	0.564	0.390	-0.007	0.059
Master's by Coursework	Master's or Doctorate	0.637	0.489	0.038	0.038
Master's by Research	Master's or Doctorate	0.637	0.489	0.038	0.038
Master's (Extended)	Master's or Doctorate	0.637	0.489	0.038	0.038
Doctorate by Coursework	Master's or Doctorate	0.637	0.489	0.038	0.038
Doctorate by Research	Master's or Doctorate	0.637	0.489	0.038	0.038

Note: Marginal earnings returns have been exponentiated to reflect returns in percentages. Marginal employment returns are expressed in percentage points. All estimates are based on regressions including controls for cognitive ability scores, and are estimated relative to attainment at Year 11 and below as the baseline/reference category.

Source: London Economics' analysis based on Wilkins (2015).

Adjusting for relevant counterfactual levels

Second, while the Wilkins (2015) estimates were all assessed relative to attainment at Year 11 and below as the reference category, we converted the estimates to be expressed **relative to the *typical* counterfactual level of qualification**, separately for each of the above higher education courses. For example, to calculate the returns to Bachelor degrees relative to Year 12 as the highest level of attainment, we deducted the returns to Year 12 education relative to Year 11 and below from the returns to Bachelor degrees relative to Year 11 and below.

The adjusted marginal earnings and employment returns are displayed in Table 25. Note that, in some instances, these deductions resulted in *negative* returns to achieving higher education qualifications. As this seems illogical and unlikely in reality, any negative returns were set to zero (highlighted in grey in the table). Hence, the analysis implicitly assumes that all marginal earnings and employment returns can only be greater than or equal to zero (i.e. there can be no wage or employment *penalty* associated with any higher education qualification attainment).

Table 25: Marginal earnings and employment returns relative to relevant counterfactual level of attainment

Qualification level for analysis	Counterfactual qualification	Marginal earnings returns, %		Marginal employment returns, pp	
		Male	Female	Male	Female
Year 12	Year 11 and below	0.207	0.148	0.004	0.060
Non-award Courses	Year 12	–	–	–	–
Enabling Courses	Year 12	–	–	–	–
Other undergraduate	Year 12	0.115	0.000	0.021	0.007
Bachelor degree	Year 12	0.311	0.225	0.006	0.002
Other postgraduate	Bachelor degree	0.046	0.017	0.000	0.000
Master's by Coursework	Bachelor degree	0.120	0.116	0.028	0.000
Master's by Research	Bachelor degree	0.120	0.116	0.028	0.000
Master's (Extended)	Bachelor degree	0.120	0.116	0.028	0.000
Doctorate by Coursework	Bachelor degree	0.120	0.116	0.028	0.000
Doctorate by Research	Bachelor degree	0.120	0.116	0.028	0.000

Note: Marginal earnings returns have been exponentiated to reflect returns in percentages. Marginal employment returns are expressed in percentage points.

Source: London Economics' analysis based on Wilkins (2015).

Estimation by age band

Third, while the Wilkins (2015) estimates present aggregate labour market returns to higher education qualifications across individuals of all ages, it is expected that these returns vary significantly over individuals' working lives. It is likely that the observed gaps in earnings and employment between individuals with and without higher education qualifications widen over time, with relatively modest returns to qualification attainment in the first few years post-graduation, and increasing returns in subsequent years. Whereas the HILDA data underlying the Wilkins analysis do not provide a sufficiently large sample size for a more detailed analysis of labour market outcomes[85], ideally, any such analysis should be undertaken separately by age band or age.

To address this limitation of the Wilkins analysis, we adjusted the aggregate marginal earnings and employment returns for the distribution of returns by age band based on comparable analyses undertaken in the UK. Specifically, a recent analysis of a large set of **pooled UK Labour Force Survey data** undertaken on behalf of the Russell Group of universities[86] estimated the marginal (hourly) earnings returns and employment returns to a range of education qualifications in the UK (including first degrees (i.e. Bachelor), postgraduate degrees (taught and research), other undergraduate qualifications, other postgraduate qualifications, and 2 or more GCE 'A' levels (i.e. Year 12 equivalent qualifications)). Given the relatively large size of this dataset, it was possible to estimate the labour market outcomes associated with these qualifications separately for each of 10 age bands[87]. Based on these estimates, we calculated the *ratio* of the return for each age band relative to the average return across all age bands (separately for each qualification level).

We then multiplied the aggregate Wilkins estimates for Australia (displayed in Table 25) by the ratios by age band for comparable qualifications in the UK[88], thus arriving at an estimated **distribution of the earnings and employment returns to higher education qualifications in Australia by age band**[89].

Returns to Non-Award Courses

Finally, since the Wilkins (2015) analysis did not include estimates for Non-Award Courses, we instead calculated these returns using **comparable results from the UK Labour Force Survey**. This was based on the fact that, as outlined above (see Section 5.4), we assume that students who are not completing their intended undergraduate qualifications would at least complete one or more units associated with the qualification (i.e. complete Non-Award Courses). It is expected that there are wage and employment returns associated with any and all higher education learning undertaken, so this separate estimation ensures that the analysis comprehensively captures the returns to all HE learning.

To estimate the returns to Non-Award Courses, based on the results of the UK Labour Force Survey analysis, we divided the estimated earnings and employment returns to 'other undergraduate' learning in the UK[90] by the returns to UK first degrees (again, separately by age band and gender). We then multiplied the resulting ratios by the returns to Bachelor degrees in Australia, to arrive at the estimated returns to Non-Award Courses (by age band and gender).

Table 26 presents the resulting estimated marginal earnings returns, while Table 27 displays the corresponding marginal employment returns to Australian higher education qualifications used in our analysis of the impact of teaching and learning of Group of Eight universities.

To take an example, the estimates suggest that a man aged **between 31 and 35** in possession of a Bachelor degree achieves a **34.4%** earnings premium compared to a comparable man in possession of a Year 12 Certificate as his highest level of attainment. As discussed above, these returns tend to increase over individuals' lifetimes, with the comparable estimate for men aged **between 51 and 55** standing at **38.5%**. The corresponding estimated employment returns stand at **0.5 percentage points** for both of these age bands, respectively.

For women, the estimates suggest a **27.4%** earnings premium an a for a woman aged **between 31 and 35** in possession of a Bachelor degree compared to a woman of similar characteristics with a Year 12 Certificate as her highest level of educational attainment, and a **30.1%** premium for the age band ranging **between 51 and 55**. The marginal employment returns were estimated at **0.2 percentage points** for women aged **between 31 and 35**, and **0.1 percentage points** for women aged **between 51 and 55**, respectively.

85 Specifically, Wilkins (2015) analysed labour market outcomes using the 2012 version of the HILDA survey, with small total sample sizes of between 1,901 (for female earnings returns) and 5,157 (female employment returns).

86 See London Economics (2017). The analysis made use of information from pooled Quarterly UK Labour Force Surveys between 2004 and 2016 to measure the impact of higher education qualifications on labour market outcomes, separately across 10 age bands.

To analyse the impact of qualification attainment on earnings, we estimated a standard **Ordinary Least Squares** linear regression model, where the dependent variable is the natural logarithm of hourly earnings and the independent variables include the full range of qualifications held alongside a range of personal, regional and job-related characteristics that might be expected to influence earnings. In this model specification, we included individuals who were employed on either a full-time or a part-time basis.

To estimate the impact of qualification attainment on employment, we adopted a **probit model** to estimate the likelihood of different qualification holders being in employment or otherwise. The basic specification defines an individual's labour market outcome to be either in employment (working for payment or profit for more than 1 hour in the reference week (using the standard International Labour Organisation definition) or not in employment (being either unemployed or economically inactive)), again controlling for a range of other characteristics that might influence employment outcomes.

87 These age-bands comprised: 16-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, and 61-65.

88 Specifically, we assumed the same distribution of earnings and employment returns to Bachelor degrees in Australia as to first degrees in the UK; to other undergraduate courses in Australia as to other undergraduate courses in the UK; to Master's or Doctorate degrees by Coursework and Extended Masters degrees in Australia as to higher taught degrees in the UK; to Master's or Doctorate degrees by Research in Australia as to higher research degrees in the UK; to other postgraduate courses in Australia as to other postgraduate courses in the UK; and to Year 12 attainment in Australia as to 2 or more GCE A levels in the UK.

89 Note that the employment returns estimated in this manner were capped at 100%. Further, the age-employment profiles for higher education qualification holders derived from these estimates (described in more detail below) were all capped at 100%, so that graduates' employment probability can never exceed 100%.

90 The other undergraduate category within the UK Labour Force Survey analysis includes other degrees, HE diplomas, Higher National Certificates, Higher National Diplomas, undergraduate teaching qualifications, and other higher education below degree level.

Labour Force Survey interviewers are instructed to use *higher education below degree* 'only if the respondent states that they have some higher education learning aim but they do not know what it is'. It is therefore not possible to provide examples of typical qualifications that would normally fall under this category. The response option serves the purpose of confirming that higher education qualifications have been achieved but that the respondent is unaware of the actual qualification title itself.

At the forefront of MRI innovation

For more than 20 years, a Go8 university has been at the forefront of magnetic resonance imaging (MRI) innovation, with its first innovation now used in almost 70 per cent of MRI scanners manufactured worldwide.

and more accurate images without adding to the cost of MRI machines.

The invention enables subtle image features to be identified, improving the quality of diagnosis at an earlier stage of disease and increasing the success rate of early medical intervention, with all the health care and economic benefits this can deliver.

of all MRI machines on the market and aiding in the diagnosis of many millions of patients worldwide.

In 2005 Magnetica Limited was established with Professor Crozier as the founding scientist, to commercialise high-performance superconducting MRI magnets for compact, portable MRI machines that can scan human

… improving the quality of diagnosis at an earlier stage of disease …

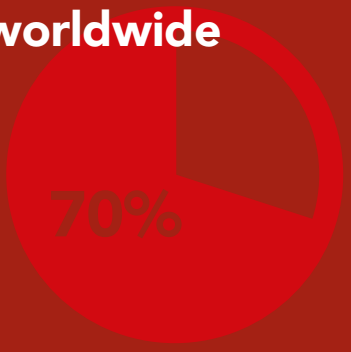
The innovation was initiated by Professor Stuart Crozier. Collaborating with Professor David Doddrell, they co-invented a technology that corrected magnetic field distortions to produce faster, clearer

The technology was licensed to companies within in the MRI industry – Siemens and GE Healthcare. The technology has now been incorporated into MRI machines, representing two-thirds

limbs without immersing the body in the magnetic field.

Magnetica has attracted more than $AUD12 million in investment and grant funding.

Go8's first MRI innovation now used in almost **70 per cent** of MRI scanners manufactured **worldwide**



Increases the **success rate** of early medical intervention, delivering **health care** and **economic** benefits

Attracted more than **$AUD12 million** in investment and grant funding

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Table 26: Marginal earnings returns (in %) spread out by age band, and including estimates for Non-Award Courses

Gender & qualification level	Counterfactual qualification	Age band									
		16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65
Men											
Year 12	Year 11 and below	0.130	0.058	0.150	0.251	0.331	0.239	0.311	0.211	0.208	0.179
Non-award Courses	Year 12	0.088	0.102	0.092	0.003	0.014	0.081	0.014	0.080	0.067	0.118
Enabling Courses	–	–	–	–	–	–	–	–	–	–	–
Other undergraduate	Year 12	0.153	0.178	0.161	0.005	0.024	0.142	0.024	0.139	0.117	0.207
Bachelor degree	Year 12	0.175	0.190	0.253	0.344	0.320	0.376	0.301	0.385	0.368	0.393
Other postgraduate	Bachelor degree	0.000	0.079	0.121	0.092	0.044	0.079	0.012	0.004	0.013	0.018
Master's by Coursework	Bachelor degree	0.000	0.100	0.140	0.094	0.119	0.147	0.154	0.145	0.130	0.170
Master's by Research	Bachelor degree	0.000	0.031	0.105	0.104	0.111	0.134	0.127	0.150	0.123	0.312
Master's (Extended)	Bachelor degree	0.000	0.100	0.140	0.094	0.119	0.147	0.154	0.145	0.130	0.170
Doctorate by Coursework	Bachelor degree	0.000	0.100	0.140	0.094	0.119	0.147	0.154	0.145	0.130	0.170
Doctorate by Research	Bachelor degree	0.000	0.031	0.105	0.104	0.111	0.134	0.127	0.150	0.123	0.312
Women											
Year 12	Year 11 and below	0.122	0.041	0.129	0.159	0.226	0.228	0.169	0.144	0.134	0.127
Non-award Courses	Year 12	0.000	0.042	0.019	0.018	0.051	0.039	0.097	0.163	0.197	0.148
Enabling Courses	–	–	–	–	–	–	–	–	–	–	–
Other undergraduate	Year 12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Bachelor degree	Year 12	0.006	0.119	0.192	0.274	0.312	0.267	0.304	0.301	0.264	0.211
Other postgraduate	Bachelor degree	0.000	0.014	0.011	0.017	0.016	0.017	0.021	0.028	0.014	0.029
Master's by Coursework	Bachelor degree	0.000	0.055	0.034	0.082	0.111	0.150	0.164	0.157	0.212	0.193
Master's by Research	Bachelor degree	0.000	0.059	0.076	0.070	0.141	0.126	0.164	0.154	0.164	0.204
Master's (Extended)	Bachelor degree	0.000	0.055	0.034	0.082	0.111	0.150	0.164	0.157	0.212	0.193
Doctorate by Coursework	Bachelor degree	0.000	0.055	0.034	0.082	0.111	0.150	0.164	0.157	0.212	0.193
Doctorate by Research	Bachelor degree	0.000	0.059	0.076	0.070	0.141	0.126	0.164	0.154	0.164	0.204

Source: London Economics' analysis based on Wilkins (2015).

Table 27: Marginal employment returns (in percentage points) spread out by age band, and including estimates for Non-Award Courses

Gender	Counterfactual qualification	Age band									
		16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65
Men											
Year 12	Year 11 and below	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Non-award Courses	Year 12	0.015	0.016	0.000	0.004	0.001	0.002	0.001	0.005	0.004	0.000
Enabling Courses	–	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other undergraduate	Year 12	0.076	0.063	0.000	0.015	0.004	0.008	0.005	0.022	0.015	0.003
Bachelor degree	Year 12	0.015	0.019	0.004	0.005	0.004	0.003	0.003	0.005	0.004	0.000
Other postgraduate	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Master's by Coursework	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.102	0.153	0.840	1.000
Master's by Research	Bachelor degree	0.000	0.086	0.016	0.002	0.002	0.015	0.002	0.035	0.054	0.069
Master's (Extended)	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.102	0.153	0.840	1.000
Doctorate by Coursework	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.102	0.153	0.840	1.000
Doctorate by Research	Bachelor degree	0.000	0.086	0.016	0.002	0.002	0.015	0.002	0.035	0.054	0.069
Women											
Year 12	Year 11 and below	0.460	0.000	0.320	0.080	0.020	0.180	0.620	0.580	0.060	0.340
Non-award Courses	Year 12	0.004	0.003	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Enabling Courses	–	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other undergraduate	Year 12	0.020	0.017	0.001	0.007	0.007	0.005	0.005	0.005	0.005	0.000
Bachelor degree	Year 12	0.004	0.004	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.000
Other postgraduate	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Master's by Coursework	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Master's by Research	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Master's (Extended)	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Doctorate by Coursework	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Doctorate by Research	Bachelor degree	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: London Economics' analysis based on Wilkins (2015).

A3.2.2 Age decay function

Many of the economic analyses (e.g. Walker and Zhu (2013)) considering the lifetime benefits associated with higher education qualifications to date have focused on the returns associated with the 'traditional path' of higher education qualification attainment – namely progression directly from secondary level education and completion of a three-year or four-year full-time undergraduate degree from the age of 19 onwards (completing by the age of 21 or 22). These analyses assume that there are **direct costs** (tuition fees etc.), as well as an **opportunity cost** (the foregone earnings whilst undertaking the qualification full-time) associated with qualification attainment. More importantly, these analyses make the implicit assumption that any and all of the estimated earnings and/or employment benefit achieved accrues to the individual.

However, the labour market outcomes associated with the attainment of higher education qualifications on a part-time basis are fundamentally different than those achieved by full-time students. In particular, part-time students typically undertake higher education qualifications several years later than the 'standard' full-time undergraduate, and generally undertake their studies over an extended period of time (and often combine their studies with full-time employment). Similarly, some full-time students at Group of Eight universities also tend to start their qualifications relatively late in life. Table 28 presents the average age at enrolment, duration of study (in years), and age at completion for students in the 2016 Go8 student cohort[91].

Given these characteristics, significant adjustments to the methodology need to be made when estimating the returns to some full-time and all part-time education attainment at Group of Eight universities.

The key change relates to the introduction of an **'age-decay' function**. This approach assumes that possession of a particular higher education qualification is associated with a certain earnings or employment premium, and that this entire labour market benefit accrues to the individual *if* the qualification is attained before the age of 25 (for undergraduate qualifications) or 30 (for postgraduate qualifications).

However, as the age of attainment increases, it is expected that a declining proportion of the potential value of the estimated earnings and employment benefit accrues to the individual[92]. This calibration ensures that those individuals completing qualifications at a relatively older age will see relatively low earnings and employment benefits associated with higher education qualification attainment (and perhaps reflect potentially different motivations amongst this group of learners). In contrast, those individuals attaining qualifications earlier in their working life will see a greater economic benefit (potentially reflecting the investment nature of qualification acquisition).

91 The average age at enrolment is based on information on students commencing courses at Go8 universities in 2016.

The assumptions on average study duration (by university and qualification level) for full-time students are based on data on course completion times of students completing their studies in 2016 provided by the Group of Eight. These data excluded Non-award courses and Enabling courses, so we have assumed a full-time study duration of 1 year for each of these course levels.

The average study duration for part-time students was derived by combining the average duration of study for full-time students with the average part-time study intensity (calculated by dividing the number of students in EFTSL by the headcount of part-time students in the 2016 Go8 cohort). To avoid over-estimating the average part-time study duration, we assume a maximum study duration of 10 years (and adjust the assumed part-time study intensity accordingly).

Any gaps in the data for particular universities were filled using weighted averages across all Go8 universities.

92 For example, using data from the UK Longitudinal Destination of Leavers from Higher Education survey, Callender et al. (2011) suggest that the evidence points to decreasing employment returns with age at qualification: older graduates are less likely to be employed than younger graduates three and a half years after graduation; however, there are no differences in the likelihood of graduates undertaking part-time and full-time study being employed according to their age or motivations to study.

Table 28: Average age at enrolment, study duration, and age at completion for students in the 2016 Go8 cohort

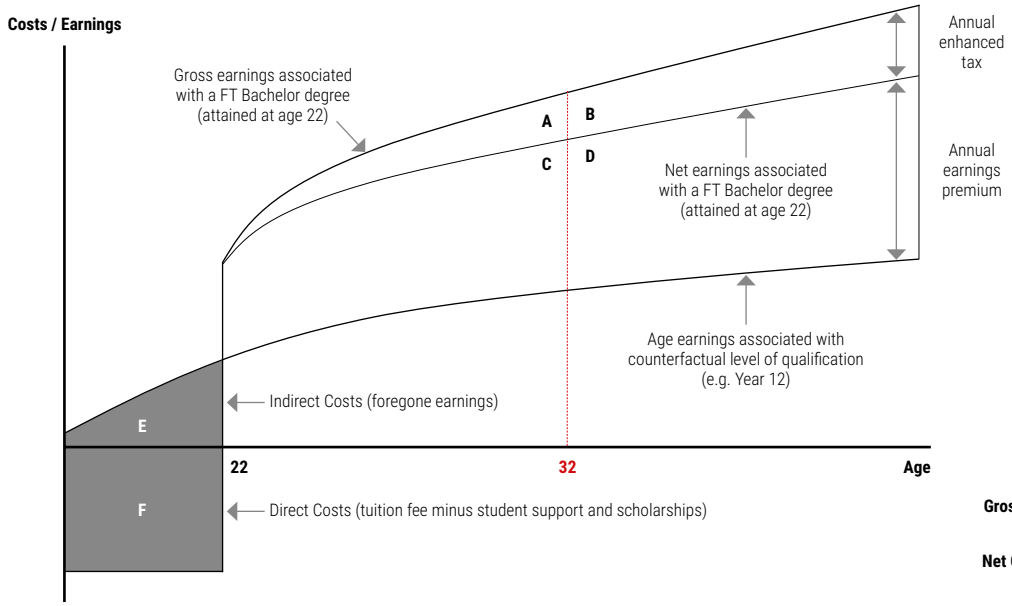
Qualification level	Full-time students			Part-time students		
	Age at enrolment	Duration (years)	Age at completion	Age at enrolment	Duration (years)	Age at completion
Men						
Non-award Courses	20	1	**21**	27	2	**29**
Enabling Courses	22	1	**23**	25	3	**28**
Other undergraduate	20	2	**22**	34	5	**39**
Bachelor degree	19	3	**22**	24	8	**32**
Other postgraduate	27	1	**28**	34	2	**36**
Master's by Coursework	25	2	**27**	33	5	**38**
Master's by Research	29	3	**32**	38	6	**44**
Master's (Extended)	24	3	**27**	28	7	**35**
Doctorate by Coursework	31	3	**34**	44	5	**49**
Doctorate by Research	29	5	**34**	38	9	**47**
Women						
Non-award Courses	20	1	**21**	28	2	**30**
Enabling Courses	22	1	**23**	29	3	**32**
Other undergraduate	21	2	**23**	34	5	**39**
Bachelor degree	19	3	**22**	25	8	**33**
Other postgraduate	27	1	**28**	34	2	**36**
Master's by Coursework	24	2	**26**	33	5	**38**
Master's by Research	30	3	**33**	38	6	**44**
Master's (Extended)	22	3	**25**	31	7	**38**
Doctorate by Coursework	28	3	**31**	31	5	**36**
Doctorate by Research	29	5	**34**	38	9	**47**

Source: London Economics' analysis based on HESC information provided by the Group of Eight.

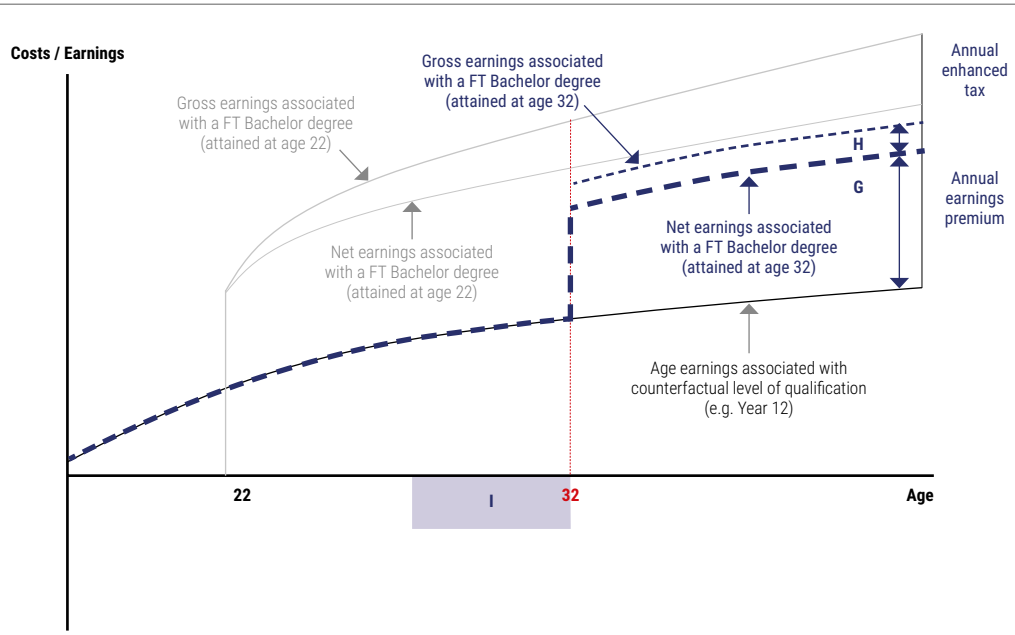
Figure 25 provides a graphical illustration of the assumed 'decay function', while Table 29 presents the assumed age-decay adjustment factors which we apply to the marginal earnings and employment returns to full-time and part-time students undertaking qualifications at Group of Eight universities. For example, we have assumed that a student undertaking a Bachelor Degree at a Group of Eight university on a full-time basis achieves the full earnings and employment premium indicated above (see Table 26 and Table 27) (for their entire working life). However, for a part-time student undertaking a similar qualification, we assume that because of the late attainment (typically at the age of 32 (men) or 33 (women)), these students recoup only 75% of the corresponding full-time earnings and employment premiums from the age of attainment.

Figure 25: Estimating the gross graduate premium for full-time and part-time students

Full-time students



Part-time students



Note: The illustration is based on an average age at graduation of 22 for full-time undergraduate degree students, and 32 (men) or 33 (women) for part-time undergraduate degree students. We assume that any opportunity costs of foregone earnings associated with further qualification attainment are applicable to full-time students only; hence, for part-time students, we assume that these students are able to combine work with their academic studies and as such, do not incur any opportunity costs in the form of foregone earnings (i.e. they are assumed to incur only direct costs). ***Source: London Economics.***

Table 29: Assumed age decay adjustment factors for students undertaking higher education qualifications at the Group of Eight universities

Qualification level	Male									
	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65
Non-award Courses	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Enabling Courses	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Other undergraduate	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Bachelor degree	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Other postgraduate	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Master's by Coursework	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Master's by Research	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Master's (Extended)	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Doctorate by Coursework	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Doctorate by Research	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Qualification level	**Female**									
	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65
Non-award Courses	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Enabling Courses	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Other undergraduate	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Bachelor degree	100%	100%	88%	75%	63%	50%	38%	25%	13%	0%
Other postgraduate	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Master's by Coursework	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Master's by Research	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Master's (Extended)	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Doctorate by Coursework	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%
Doctorate by Research	100%	100%	100%	86%	71%	57%	43%	29%	14%	0%

Note: Shaded areas indicate relevant assumed average age at graduation per full-time / part-time student at each level of study at Group of Eight universities:

■ Full-time students ■ Part-time students

Source: London Economics' analysis based on HESC information provided by the Group of Eight.

A3.2.3 Estimating the gross graduate premium and Treasury benefit

The gross graduate premium associated with qualification attainment is defined as the **present value** of **enhanced post-tax earnings** (i.e. after income tax, Medicare and GST are removed, and following the reduction of foregone earnings) relative to an individual in possession of the counterfactual qualification.

To estimate the value of gross graduate premium, it is necessary to expand upon the marginal earnings and employment returns to higher education qualifications (presented in Annex A3.2.1). In particular, the following elements of analysis were undertaken (separately by gender, level of study, Go8 university and type of study):

1. We estimated the employment-adjusted **annual earnings** achieved by individuals in the counterfactual groups (i.e. Year 11 and below, Year 12, and Bachelor degrees[93]).
2. We inflated these baseline or counterfactual earnings using the above-described marginal earnings and employment returns, adjusted to reflect late attainment (as outlined in Annex A3.2.2), to produce **annual age-earnings** profiles associated with the possession of each particular higher qualification.
3. We adjusted these age-earnings profiles to account for the fact that earnings would be expected to increase in real terms over time (at an assumed rate of **1.5%** per annum (based on the long-term (nominal) wage price index estimated by the Commonwealth of Australia (2015) and the Reserve Bank of Australia's inflation target[94]).
4. Based on the earnings profiles generated by qualification holders, and income tax and Medicare Levy rates and thresholds for the relevant academic year[95], we computed the future stream of net earnings (i.e. post-tax)[96]. Using similar assumptions, we further calculated the stream of (employment-adjusted) foregone earnings (based on earnings in the relevant counterfactual groups[97]) during the period of study, again net of tax, for full-time students only.
5. We calculated the **discounted** stream of additional (employment-adjusted) future earnings compared to the relevant counterfactual group (using a standard real discount rate of **7.0%**, as recommended by the Office of Best Practice Regulation (2016), and the discounted stream of foregone earnings during qualification attainment (for full-time students), to generate a present value figure. We thus arrive at the **gross graduate premium** (or equivalent for other qualifications).
6. The **discounted** stream of enhanced taxation revenues[98] minus the tax income foregone during students' qualification attainment (where relevant) derived in element 4 provides an estimate of the **gross Treasury benefit** associated with higher education qualification attainment at each Group of Eight university.

Note that, for individuals undertaking higher education qualifications at a level equivalent to or lower than their prior attainment, the (employment-adjusted) additional income and taxation revenue was assumed to be zero. For example, it is assumed that a student in possession of a Bachelor degree undertaking an additional Bachelor degree at a Group of Eight university will not accrue any wage or employment benefits from this additional qualification attainment (while still incurring the costs of foregone earnings during the period of study).

Further note that we assume the same gross graduate premium and gross Treasury benefits per student for domestic students irrespective of citizenship status – i.e. we assume the same premiums for Australian citizens and other domestic students. To adjust for differences across these domiciles, these gross benefits were then combined with the relevant differential tuition fees/student contribution costs and student support arrangements (in terms of HELP loans, scholarships and living cost subsidies) available to students of different citizenship status.

A3.2.4 Quality of the Group of Eight's research activity

1.1 and 1.1 illustrate the high quality of the Group of Eight's research across disciplines, with **all** Go8 research units within **16** out of the 22 Fields of Research receiving ratings of 'world class and higher' (compared to only **5** Fields of Research for all other universities).

93 The average earnings and employment probability data by age and highest level of qualification were based on the ABS Census 2016 and derived from the ABS TableBuilder (see Australian Bureau of Statistics, 2018a and 2018b). We include only individuals who were either employed full-time, employed part-time, or employed and away from work at the date of the Census.

The earnings data were based on weekly personal income per head, and converted to annual figures (by multiplying by 52.14 weeks per year). The original data was supplied in income bands, and we used mid-points for each band to arrive at income point estimates. We excluded any individuals whose income was not stated, or whose income was reported as 'not applicable'. For the employment data, we excluded any individuals whose labour force status was reported as 'not stated' or 'not applicable'.

94 Specifically, in its most recent Intergenerational Report (2015), the Commonwealth of Australia's projects a long-term (40-year) nominal wage growth of 4%. We then calculated real wage growth by adjusting this for the Reserve Bank of Australia's 2–3% inflation target (using the mid-point of 2.5%) – see Reserve Bank of Australia (no date).

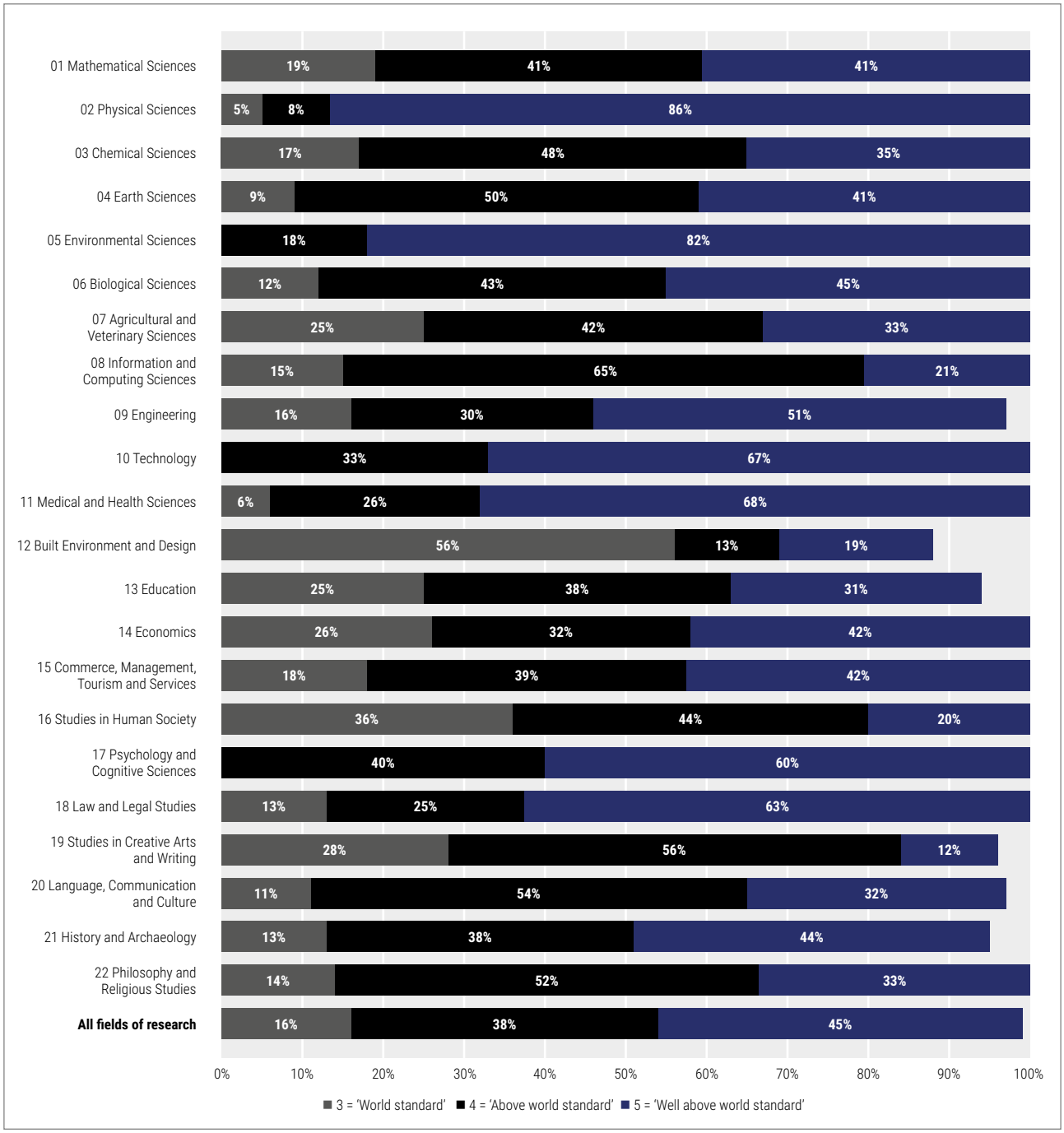
95 i.e. 2016. Note that the analysis assumes fiscal neutrality, i.e. it is asserted that the earnings tax and National Insurance income bands grow at the same rate of annual earnings growth of **1.5%**.

96 The tax adjustment also takes account of increased GST revenues for the Commonwealth Treasury, by assuming that individuals spend **87%** of their annual income consuming goods and services within the economy (i.e. based on marginal propensities to consume estimated by the Reserve Bank of Australia (2009)), and a GST rate of **10%**.

97 The foregone earnings calculations are based on the baseline or counterfactual earnings of individuals in possession of either Year 11 and below, Year 12, or Bachelor degrees as their highest level of qualification. However, some students in the 2016 cohort were in possession of other levels of prior attainment. To accommodate this, as a simplifying assumption, the foregone earnings for students previously in possession of sub-degree qualifications are based on the level of foregone earnings associated with Year 12 (adjusted for the age at enrolment and completion associated with the relevant HE qualification obtained). Similarly, the estimated foregone earnings for students previously in possession of postgraduate qualifications are based on the level of foregone earnings associated with a Bachelor degree. Finally, again taking account of the fact that the academic 'distance travelled' by a (small) proportion of Group of Eight university students is greater than might be the case compared to those in possession of levels of prior attainment 'traditionally' associated with higher education entry, the foregone earnings for students previously not in possession of any formal education attainment are based on the level of foregone earnings associated with attainment at Year 11 and below.

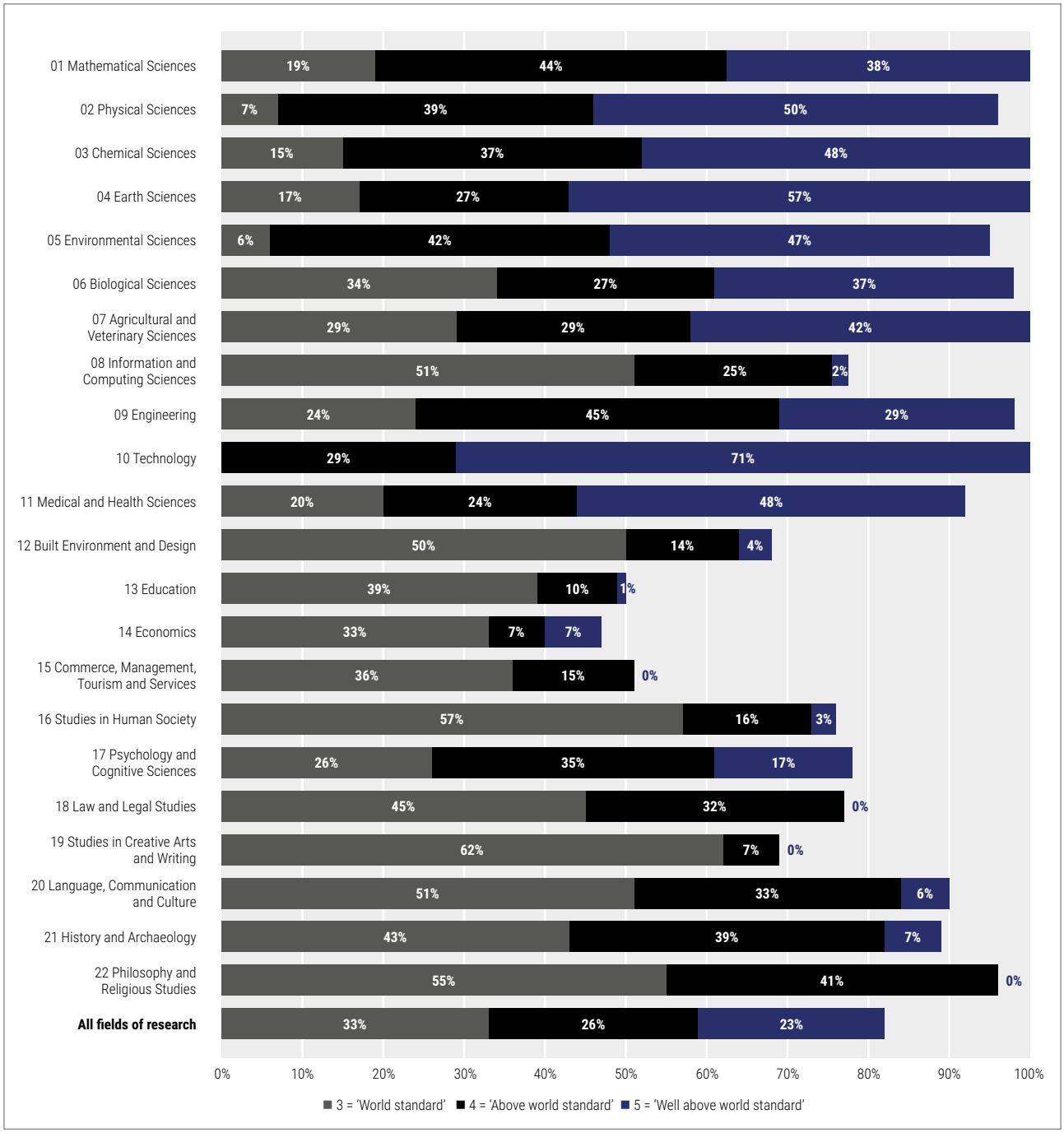
98 On the Treasury side, in addition to the revenues derived from income tax, the Medicare Levy and GST, we further included the public income generated through employers' superannuation guarantee payments.

Figure 26: ERA 2015 ratings for Go8 universities, by Field of Research



Note: Based on 4-digit Fields of Research. 3 = 'World standard'; 4 = 'Above world standard'; 5 = 'Well above world standard' (1 = 'Well below world standard'; 2 = 'Below world standard' not presented explicitly). ***Source: London Economics' analysis of Australian Research Council (2015).***

Figure 27: ERA 2015 ratings for other universities, by Field of Research



Note: Based on 4-digit Fields of Research. 3 = 'World standard'; 4 = 'Above world standard'; 5 = 'Well above world standard' (1 = 'Well below world standard'; 2 = 'Below world standard' not presented explicitly). ***Source: London Economics' analysis of Australian Research Council (2015).***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