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Detailed financial analysis

Analysis supporting the *Graduate Winners* report

Ben Weidmann & Andrew Norton

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About this document

This document was prepared as part of the Grattan report *Graduate Winners.* Its main purpose is to illustrate the methdology, data and assumptions used to quantify the financial impact universities have on students and the public.

As is the case in any effort to quantify benefits or costs, we have had to make methodological choices and assumptions. This document explores how our main results are affected by changes to a number of these assumptions. We place particular emphasis on exploring variables that have policy relevance – for example the level of debt students accrue, or the level of income students receive during their studies. In general, we find that the main results presented in *Graduate Winners* are very robust.

In the interest of concision, we don't present tables illustrating how our results are affected by various combinations of assumptions – nor do we look at all narrow disciplines. However, should policy-makers or researchers be interested in fields of education or policy settings beyond those reported here, we will endeavour to supply the information where possible.

This document focuses purely on our estimates of financial impacts. This of course is only part of the picture. The many potential non-financial benefits of universities are discussed in the companion document *Non-financial benefits of higher education.*

Part 1 of this document looks at the financial impact universities have on *individuals*.

- **1.1** provides an overview of our approach for calculating the private financial impact of university
- **1.2** details our methodology. It describes sources, data manipulations, important assumptions, and how those assumptions are varied in our sensitivity testing
- **1.3** discusses the measures we use to analyse the financial impact of university: the 'rate of return' and the 'breakeven point'
- **1.4** discusses caveats and limitations
- **1.5** presents tables illustrating the senstivity of our results to changes in baseline assumptions

Part 2 looks at the financial impact universities have on the *public*.

- **2.1** provides an overview of our approach to calculating the public financial impact of university
- **2.2** presents our methodology and sources in detail, much of which relies on section 1.2.
- **2.3** briefly discusses different measures we use to analyse the financial impact of university on the public
- **2.4** outlines our baseline results, and presents tables illustrating the sensitivity of the results to a number of assumptions

1. Financial impact of higher education on individuals

There is a broad consensus that undergraduate study generally makes financial sense for students. For the average Australian graduate, the higher wages associated with having a degree tend to more than offset the costs of university.[1]

But exactly how big is this financial impact? On the question of magnitude, we find that estimates vary – and that much of this variation is driven by differences in data and approach.

Estimating the financial impact that universities have on their graduates requires a number of assumptions and methodological choices. What would graduates have earned had they not undertaken a degree? To what extent should earnings graduates receive later in life be discounted? How much income do we assume students earn while they're at university? None of these questions has a single correct answer, and in the second half of this section we illustrate the effect various responses might have on our estimates.

First, however, we outline our approach and the data we use to quantify the financial impact of completing an undergraduate degree.

[1] For recent estimates of the return on investment to an undergraduate degree in Australia, see Table 9.

1.1 Overview of approach

How much more do graduates earn?

A large body of Australian evidence suggests that graduates earn above-average wages. For women, the average bachelor-degree holder earns roughly $800,000 dollars more in a lifetime than the average year 12 graduate who completes no further study. For men, the lifetime income gap between a bachelor degree and year 12 is $1.1 million (see Table 1).

In percentage terms, these are large numbers: the average man with a bachelor degree earns 65% more over a lifetime than an average year-12 completor who does no further study. For women the difference is nearly 80%.

Table 1 – Median gross lifetime income by level of education

	Male	Female
Year 12	$1,697,851	$1,005,823
Diploma/ Advanced Diploma/ Associate degree	$2,308,428	$1,407,903
Bachelor degree	$2,814,296	$1,806,449
Difference between Year 12 and Bachelor	*$1,116,445*	*$800,626*

Note: Calculations cover ages 18 to 65. In the case of bachelor degrees, students are assumed to study for four years. For diplomas and associate degrees, students are assumed to study for 1 year.

Source: 2006 Census (using the ABS TableBuilder)

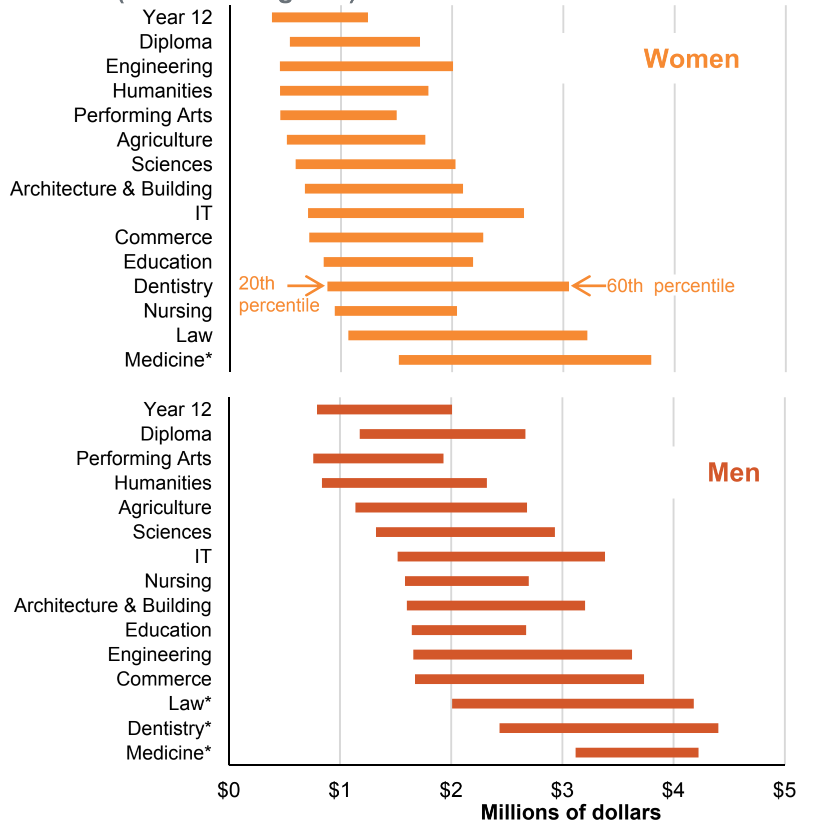
How do graduate earnings vary across disciplines?

While it's clear that the median graduate has above-average earnings, Table 1 hides some large variations.

First, there is variation across levels of education. Some graduates do financially worse than people who finish their studies in year 12. Second, there is variation across university disciplines. Law graduates, for example, tend to do better in the labour market than humanities graduates. Last, there is variation within disciplines: there's a large financial gap between the average earnings of a corporate lawyer and someone working in family law.

Figure 1 presents a more nuanced picture of the wage benefits associated with higher education. The figure shows the differences in the lifetime earnings of the 20th percentile (i.e. people on the cusp of the bottom fifth, compared to their peers) and the 60th percentile (i.e. people moderately above their group average).[2]

Figure 1 – Spread of gross lifetime earnings: 20th – 60th percentile (Bachelor degrees)



Notes: *Diploma includes advanced diploma and associate degree; 'Science' excludes maths;*The highest income category in the census is >$2,000 which applies at some point to the 60th percentile in disciplines with an asterisk. The limit also explains why the ranges we present are constrained at the 60th percentile.*

Source: *Grattan analysis based on 2006 Census (using the ABS TableBuilder)*

[2] In this context, 'peers' and a 'group' refers to a level, and field, of education; e.g. 'science bachelor degree holders'.

How much of graduates' extra earnings can be attributed to universitiy?

A fundamental problem in estimating the financial impact of universities on students is the lack of a counterfactual. To isolate the effect of higher education we need to ask: what would have happened in its absence? In our case, how much of their extra earnings would Australian graduates lose if they had decided to go straight into the workforce after finishing year 12?

It's unlikely that 100% of the difference in lifetime earnings between graduates and non-graduates can be attributed to the effect of university. We identify three broad factors – both relating to and independent of universities – that may drive higher lifetime earnings of graduates:[3]

- Training: graduates earn more because they've developed valuable skills or characteristics during their degree.
- Ability: graduates earn more because, irrespective of their university education, as a group they have above-average ability.
- Signalling: graduates earn more purely because they have a degree. The degree itself is worth something, as employers used it as a signal about graduates' capabilities (regardless of what the individual's capabilities actually are).[4]

In calculating the private financial benefits of higher education, we consider the training effect and the signalling effect. Together, these represent the benefits that an individual would forgo if they didn't attend university. Without universities, graduates would have neither the extra capacities they gain at university (training), nor a credential that distinguishes them in the labour market (signalling).

In contrast, higher earnings based on prior ability should not be included in estimates of the private financial benefits of higher education. To estimate the private financial benefits of university study we therefore need to discount the wage premium graduates receive on account of their (hypothesised) above-average capabilities.

Unsurprisingly, empirical evidence is inconclusive on the extent to which graduate extra earnings result from above-average ability. In our baseline results, we follow the practice of Leigh (2008) by reducing the graduate earnings premium by 10% to account for the possibility of ability bias.

However, as this number is imprecise and somewhat arbitrary, in section 1.5.4 we present our results when this reduction is 40% of the extra earnings graduates receive.[5]

[3] Note that the higher lifetime earnings of graduates result from both higher wages, and lower levels of unemployment. In our analysis, we do not analyse these aspects separately.

[4] This theory rests on the twin ideas that employers are unsure of the qualities of prospective employees, and that having a university degree helps sort for high-capability individuals.

Factoring in the costs

In addition to the private financial benefits of education, we also need to consider the costs.

From a student's point of view, one of the biggest costs is the opportunity cost of studying. This represents the money that a student would have earned had they not gone to university (which is defined as the median earnings of someone of the same gender who completed year 12 but did no further study).

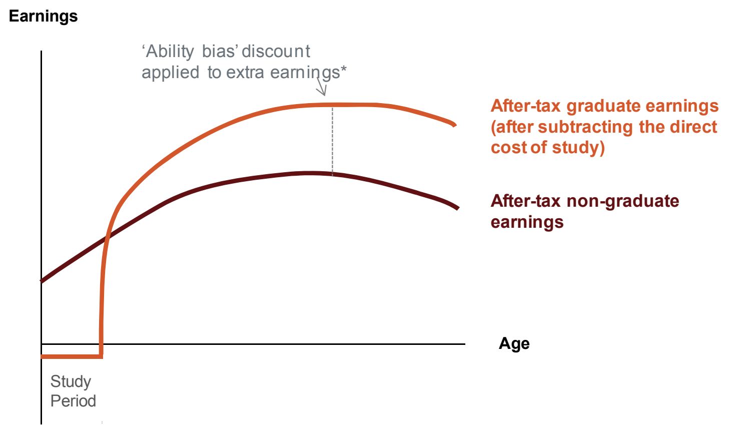
In addition to the opportunity cost, there are direct costs. These include the student contribution to tuition (usually paid through HECS-HELP) and other direct costs such as buying books.

1.2 Detailed methodology, data sources and assumptions

At a high level our basic approach is to compare the benefits of obtaining an undergraduate degree, with the costs (see Figure 2 for a stylised example). In the literature, this approach is known as the 'rate of return' method (for a discussion of what 'rate of return' measures, see section 1.3).[6]

A more detailed illustration of our methodology is presented in Table 2 (over the page). Our analysis, which covers an age span of 18-65, is split by gender and discipline. To provide an example, the table shows snapshots of the analysis for the median female law graduate at ages 18, 35 and 65 (along with the total across ages). Note that for all students we make the simplifying assumption that study begins at age 18, and is full time.

Figure 2 – Illustrative comparison of earnings profiles[7]



Note: **In our final calculations, ability bias discount is applied to the difference between* gross *graduate income rather than the after-tax difference (as this highly simplified figure suggests)*

[5] We take this as a rough upper bound – as reported in Leigh (2008) and based on an Instrumental Variable estimation: see Leigh and Ryan (2008).

[6] Two other prominent approaches in the literature are the 'Mincer equation' method and twin studies. We ultimately prefer the rate of return method, as it: uses readily available, population-wide data; incorporates the costs of study (e.g. student contributions); and lets us assess the impact of changes in policy-relevant variables (e.g. income support). For a clear discussion of all three methods, see Daly*, et al.* (2012).

[7] Note that the average graduate incomes are not always higher than their non-graduate counterparts in the peak-earning years (as this illustrative figure suggests). As demonstrated in Figure 2, there is significant variation in outcomes across and within both disciplines and education levels.

Table 2 – Example of methodology to estimate the financial impact of university
(figures are for the median female law graduate)

Age	18	35	65	Total
Graduate gross income	$0	$63,845	$48,667	**$2,704,055**
Less taxes and charges				
Income tax	$0	($14,503)	(9,950)	**($602,478)**
Medicare levy	$0	($958)	($730)	**($40,561)**
Direct study costs	($1,720)	$0	$0	**($5,160)**
HECS-HELP payments	$0	$0*	$0	**($24,510)**
After tax graduate income	($1,720)	$48,384	$37,987	**$2,031,346**
Less opportunity cost of income				
After-tax income of median yr-12 female non-grad	($6,828)	($19,716)	($12,489)	**($885,167)**
Net extra income of graduates	($8,548)	$28,668	$25,498	**$1,116,407**
*Apply 'ability discount'***	**	($4,131)	($3.503)	**($172,697)**
Net financial benefits†	($8,548)	$24,537	$21,995	**$973,483**

*Note: * by age 35, the median female lawyer has paid all HECS-HELP debt;*
***10% in baseline. This is applied to the difference between gross graduate income and gross non-graduate income. It does not apply in study years.*
†the net financial benefit figures do not include a time discount. The sensitivity of our results to this assumption is shown in section 1.5.3.
Source: sources for the data in the table are discussed below.

In the remainder of this section 1.2, we describe each of the elements presented in this table.

Graduate gross income

During the working period (e.g. ages 21-65 for a graduate studying a 3-year degree) gross income data is sourced from the 2006 Census.

We use the ABS TableBuilder 2006, and our analysis is split by gender. For graduates we select:

- "HSCP Highest Year of School Completed" as "Year 12 or equivalent"
- "QALLP Non-School Qualification: Level of Education" as "Bachelor Degree Level"
- "QALFP Non-School Qualification: Field of Study" is the discipline variable. We analyse both broad fields (e.g 'Engineering') and more narrow ones (e.g. 'Dentistry'). These fields of education are defined in the appendix, and based on the ASCED classifications outlined in ABS (2001).

The variable of interest is income, i.e. "INCP Individual Income (gross weekly)". We select all 12 categories from "negative income" through to "$2,000 or more".

We define a 'cohort' as being a group of people who hold a bachelor degree in the same discipline, and are the same age – e.g. 52 year old males with a bachelor degree in nursing. For the purposes of understanding the income distribution within disciplines, in each cohort we identify a rank for the 10th, 20th, 30th, 40th, 50th, 60th, 70th, 80th, and 90th percentile. If, for example, there are 400 people in a cohort, then the 70th percentile will have a rank of 120 (i.e. they will be the person with the 120th highest gross weekly income).

The income data comes in categories (e.g. $1600-1999). For each percentile of interest we calculate a point estimate for income, by making an assumption that the distribution of incomes within any category is uniform. To see how this works, assume that an example cohort has 400 people. From ABS TableBuilder data, we find that 80 of them have a weekly gross income of greater than $1,000 per week, and that there are 100 people in the bucket $800-$999 per week. As there are 400 people in the cohort, the person at the 70th percentile has a rank of 120. Given that there are 80 people who earn more than $1,000 per week, the 70th percentile is the 40th highest-earning person in their bucket (out of 100). Therefore, based on our assumption, we calculate this person's income to be 60% of the way from $800 to $999 (i.e. $919 per week).

We complete similar calculations at 9 evenly-spaced points in the income spectrum (i.e. ranging from the 10th to the 90th percentile), for all ages in the non-study period, and across all disciplines listed in the appendix. Weekly earnings are then annualised.

During the study period we make an assumption about the level of graduate gross incomes. In the baseline results we assume that gross income during the study period is zero. As many students either work part time, or receive income support from the Commonwealth, we check the sensitivity of the results to four assumptions:

1. No income (baseline)
2. Gross annual income equal to the average Youth Allowance, Centrelink, and Austudy payments in 2006 ($2,170)[8]
3. Gross annual income equal to the reported average income of full-time students in 2006 ($11,000)[9]
4. Gross annual income equal to double the reported average income of full-time students 2006 ($22,000)

The financial impact these assumptions are presented in section 1.5.2.

Taxes

We consider two taxes: income tax and the Medicare levy. We use the gross incomes as a base, and apply the tax rates that were in operation during 2006-07 (see Table 3 and Table 4).

Table 3 – Income tax rates

Taxable income	Rate
$0 - $6,000	Nil
$6,001 - $25,000	15c for each dollar between $6,000 and $25,000
$25,001 - $75,000	30c for each dollar between $25,000 and $75,000
$75,001 - $150,000	40c for each dollar between $75,000 and $150,000
$150,001 and over*	45c for each dollar over $150,000

Note: **Given that the upper limit on the Census gross weekly income data was $2,000 this rate was never applied in our analysis.*
Source: *ATO (2012)*

[8] AVCC (2007)
[9] Ibid.

Table 4 – Medicare levy thresholds
(FY2007)

Taxable income	Rate
$0 - $16,740	Nil
$16,741 - $19,694	0.75%*
$19,694 and over	1.5%

Note: *For the Medicare levy we use the individual thresholds.* For people eligible for a reduced rate (i.e. those earning between $16,740 and $19,694) we apply half the normal rate (i.e. 0.75%).*

Direct costs of study

We assume that students pay a direct cost each year. We use the Australian Universities Student Finances Report 2006 figure for undergraduates of $1,720 per annum for full time students.[10]

HECS-HELP costs

For each discipline we specify the **expected duration of study** for an undergraduate degree. This information is largely based on Daly et al. (2012) and where necessary is supplemented by information from the My University website (for details see Table 5, over the page). We assume that students begin studying at age 18, study full time, and complete the course in the expected number of years.

In the baseline results, **annual student contributions** are set to 2006 levels. These data were sourced from DEEWR (2008).

To understand the effect student contribution levels have to the economics of undergraduate study from a student's perspective, we explore four assumptions:

1. 'Free' (setting student contributions to zero)
2. HECS-HELP levels (the actual student contributions in 2006 – our baseline assumption)
3. Full-CSP rate (the total funding received by universities for each Commonwealth Supported Place)
4. International student fees

Data on the full-CSP funding rates were sourced from DEEWR (2008). International student fee rates are unweighted averages of fees across universities for 2007 (deflated into 2006 dollars using CPI), and were sourced from university websites. The level of student contribution in each of these four scenarios is presented by discipline in Table 5.

We assume HECS-HELP debt is paid back only when graduate earnings reach the **HECS-HELP threshold** (i.e. we assume that people don't pay early, or up-front). We use the 2006 HECS-HELP repayment thresholds and rates, as presented in Table 6.

[10] Ibid.

Table 5 – Expected duration, and fee scenarios

Discipline*	Duration (years)	Price scenarios 1. 'Free' education	2. HECS-HELP	3. Full-CSP rate	4. International fees
Agriculture	3	$0	$6,979	$24,093	$19,642
Architecture	5	$0	$6,979	$14,695	$19,129
Commerce	3	$0	$6,979	$9,568	$17,005
Dentistry	5	$0	$8,170	$24,269	$43,552
Education	4	$0	$3,920	$11,534	$15,550
Engineering	4	$0	$6,979	$19,823	$20,526
Humanities	3	$0	$4,899	$9,263	$15,451
IT	3	$0	$6,979	$14,695	$18,492
Law	3	$0	$8,170	$9,744	$19,564
Mathematics	3	$0	$6,979	$12,132	$19,790**
Medicine	5	$0	$8,170	$24,269	$43,552
Nursing	3	$0	$3,920	$14,097	$17,059
Performing arts	3	$0	$4,899	$14,388	$16,528
Sciences (excl. maths)	3	$0	$6,979	$19,823	$19,790
Bachelor degree average***	4	$0	$5,855	$12,935	$17,159

Note: **See the appendix for definitions of study areas; **Figure for mathematics represents average international student charge for natural and physical sciences; ***weighted by the number of students in each field*
Sources: Daly et al. (2012); DEEWR (2008); Univeristy websites

Table 6 – 2006 HECS-HELP repayment thresholds
(baseline assumption)

Taxable income	2006 HECS repayment rate (baseline)
$0 - $38,149	0.0%
$38,150 - $42,494	4.0%
$42,495 - $46,838	4.5%
$46,839 - $49,300	5.0%
$49,301 - $52,944	5.5%
$52,945 - $57,394	6.0%
$57,395 - $60,414	6.5%
$60,415 - $66,485	7.0%
$66,486 - $70,846	7.5%
$70,847 - $104,000	8.0%

Source: ATO (2012)

The HECS repayment threshold has moved considerably over the past 15 years. To assess the importance of these changes (and to understand the effect of potentially raising the threshold) we consider three assumptions:

1. The 2004 threshold and repayment schedule, expressed in $2006. (In 2005, the threshold was substantially increased. This assumption sets the threshold at the pre-change level of $26,945)

2. The 2006 threshold and repayment schedule (this is the baseline assumption, and has the repayment threshold at $38,159)

3. The threshold set to the median income of a full-time worker in 2006 ($56,000, as per Leigh (2006). Under this assumption, the lowest repayment rate of 4% applies to incomes of $56,001-$61,000. The rate increases by 1% for each increase in gross income of $5,000, up to a maximum of 8%, which covers incomes of greater than $76,000.)

Opportunity cost of income

In terms of earnings, the opportunity cost for graduates is assumed to be the median **after-tax income** of year 12-completors who did not complete any further study.

Gross weekly income is once again sourced from the ABS TableBuilder. To construct the income data we follow a similar process to that described for graduates (see page 8). In the case of non-graduates, we split the data in TableBuilder by gender and select:

- "HSCP Highest Year of School Completed" as "Year 12 or equivalent"
- "QALFP Non-School Qualification: Field of Study" as "Not applicable"

Again, we select gross weekly income data for all 12 available buckets (ranging from from "negative income" through to "$2,000 or more"). Data on gross weekly income is then constructed at 10 percentile intervals ranging from the 10th to the 90th in the same way as for graduates.

The data are then annualised before subtracting income tax and the Medicare levy, at the rates laid out in Table 3 and Table 4

Discount rates

As noted in *Graduate Winners*, our baseline results are not discounted with respect to time. This is not in keeping with the literature on the returns to education, which tends to apply a discount rate to reflect the fact that people have a preference for money today over money in the future.

There is no consensus on the most appropriate discount rate. For example, in their estimates of private returns for the base funding review, Daly et al. (2012) use a range of 2-3%. In another supporting document for the base funding review, Chapman and Lounkaew (2012) use 5%.

In section 1.5.3 of this document, we illustrate the effect of discount rates, presenting our results with the discount rate set to all these levels.

1.3 Calculating results

1.3.1 The 'internal rate of return'

Most researchers using the 'internal rate of return method' (described in section 1.2) report their results as an internal rate of return, or 'IRR'.

Although the internal rate of return method has a number of advantages (see footnote 6) we don't find the IRR to be an intuitive output measure. It is also easily misunderstood: it is *not* a return in the sense of profits as a percentage of investment, nor is it a return in the sense of a percentage increase in earnings.

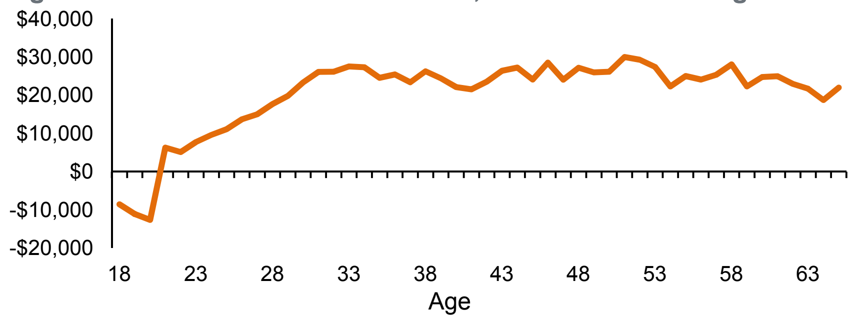
To explain what the IRR measures, we return to the example of the median female law graduate (presented in Table 2, on page 8). Using the method described in section 1.2 we calculate a series of cash flows for the median female law graduate over the ages 18-65. In the study years, these cashflows are negative (as our student misses out on the opportunity to earn money in the labour force, spends money on books, and so on). These negative cashflows – which can be thought of as an investment in education – are followed by positive cashflows later in life, as the median female law graduate earns higher wages than the median woman who completed no further study after year 12. These lifetime *net* benefits of study are presented in Figure 3.

Summed up over ages 18-65, the total net benefits are $973,483. Another way to think about this is that the total area under the curve in Figure 3 is equal to 973,483 (-32,391 during ages 18-20, and +1,005,774 from ages 21-65).

Applying a discount rate over time changes the shape of the line in Figure 3. This effect is demonstrated in Figure 4, which illustrates how the profile of cashflows changes with an annual discount rate set to 5%, and 20%. As the discount rate increases, cashflows later in life are given a lower value, and the sum of the net benefits decreases. When the discount rate is 5% for example, a benefit of $1 when someone is 65 is worth 10 cents. For a discount rate of 20%, $1 of benefits when someone is 65 is worth 0.02 cents.

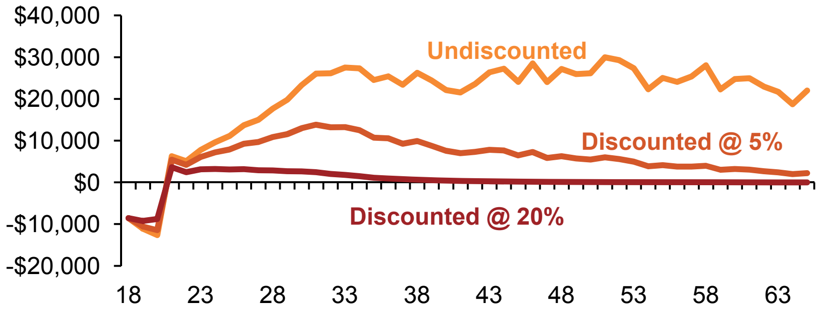
This brings us back to the IRR – which is simply the discount rate that sets the total net benefits equal to zero. As can be seen in Figure 4, by the time the discount rate reaches 20% per year, the sum of the negative cashflows during the 3 year study period appears to be similar in magnitude to the sum of the positive cashflows thereafter. This is in keeping with the data, which suggests that the IRR for the median female law graduate is 27% (provided these students only study for 3 years).

Figure 3 – Undiscounted net benefits, median female law graduate



Note: Baseline assumptions

Figure 4 – Effect of applying a discount rate
(net benefits for median female law grad)



1.3.2 The 'breakeven point'

In an effort to avoid the confusion of internal rates of return, we present our main results in terms of a breakeven point. The breakeven point has a number of other benefits:

- it can be calculated even if the sum of the net benefits is negative;
- it expresses information about the financial risk involved in a particular degree (i.e. the likelihood that it will have a negative financial effect);
- it is less volatile in the face of changes such as reducing or increasing the length of study by 1 year; or changing the income students earn during their degree; i.e. it is less sensitive than IRR to changes that affect cashflows early on in the life of the investment. For instance, in the above section we have been using law students as an example, and assuming they study for 3 years. However, many law students study double degrees (but may be indistinguishable in the Census from their single-degree counterparts). This makes a difference to the IRR. Under a scenario where law students study for 4 years (as was assumed by Daly *et al.* (2012)) the IRR for the median female law graduate falls from 27% to 22%.

How is the breakeven point calculated?

As discussed above, our analysis divides the financial outcomes of each discipline into deciles. We then ask: at what point in the spectrum of outcomes is studying a breakeven proposition? Stated more precisely, we calculate the *lowest* decile for which the sum of the net benefits of studying is *positive*. This calculation is visualised in Figure 5.

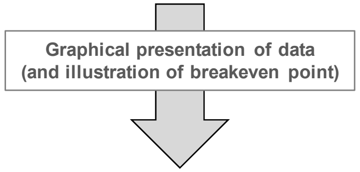
Figure 5 also illustrates two limitations of the calculation. First, that we round to deciles. Ideally, breakeven points would be calculated as a precise percentile (rather than being rounded). Given existing data, this is a possibility for future research.

Second, as Figure 5 shows we assume that the 10th percentile total is the sum of a lifetime of being at the 10th percentile. Naturally, people will move across the income spectrum at various points in their lives, and so we would expect that the range of incomes (and net benefits) to be more compressed than that presented in Figure 5.

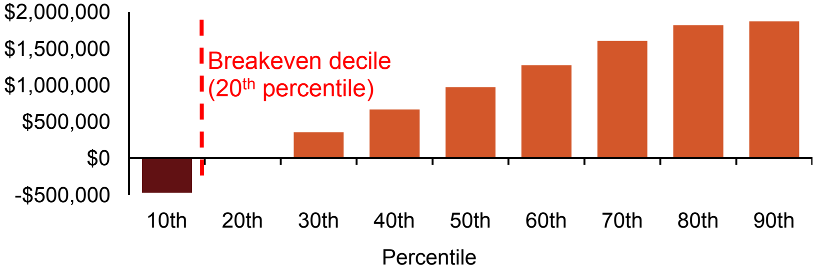
Figure 5 - Example of breakeven calculations

Table of net financial benefits across deciles for female lawyers

Age	18	35	65	TOTAL
10th Percentile	-$8,548	-$13,754	$2,706	**-$464,697**
20th Percentile	-$8,548	-$2,276	$8,533	**$1,152**
30th Percentile	-$8,548	$9,140	$13,047	**$356,892**
50th Percentile	-$8,548	$24,537	$21,995	**$973,483**
90th Percentile	-$8,548	$45,266	$51,604	**$1,873,798**



Lifetime net financial benefits



Note: *The above example takes data from the cohort female lawyers (as we did in Table 2). These figures differ from Table 2 in that we have applied an ability discount of 10%. Other assumptions are set to baseline levels (time discount rate of 0%, 2006 HECS-HELP fees, and so on).*

1.4 Caveats and limitations

1.4.1 Using cross-sectional data

There are a number of challenges with using census data to analyse the likely outcomes of current students. Historically, actual returns have differed from ex-ante estimates. As Daly *et al.* (2006) demonstrate, the actual returns to higher education in Australia for people starting their degree in 1986 were higher than those predicted at the time as the demand for graduate labour increased over the 1990s.[11] Wei (2010) generates a similar result over a longer period in a study of Census data from 1981 to 2006.[12]

Another challenge is that historical aspects of the labour market may be represented in our data, but no longer relevant to today's students. In previous generations, for example, more professional and managerial jobs were accessible without a university qualification. In some disciplines, this may have resulted in higher average earnings among the older cohorts of non-graduates. On the other hand, during periods when a lower proportion of society went to university the scarcity value of a degree may have put upward pressure on the wages of graduates.

Lastly, as we have relied on one cross section our results are sensitive to macroeconomic conditions at the time of the 2006 census. It's possible, for example, that the strong economy of 2006 may have reduced the returns to education. This is

[11] Daly, *et al.* (2012)
[12] Wei (2010), tables 3.1-3.4

illustrated in Wei (2010) who reports that overall returns declined sharply in 2006 after 20 years of growth (see Table 7). In this case, our estimates of the private benefits to education could be downwardly biased relative to what today's students could expect.

Table 7 – Estimates of returns to higher education: 1981 to 2006

	1981	1986	1991	1996	2001	2006
Men	13.1%	17.5%	17.6%	18.4%	19.6%	15.3%
Women	18.0%	20.3%	18.7%	19.3%	19.0%	17.3%

Note: *In this set of results Wei includes people regardless of their labour force status (an approach we follow). It's worth noting that when he controls for non-participation Wei's estimates* increase *in 2006 – suggesting that the graduate wage premium was higher than it had been in previous years (but that this effect was dominated by the higher levels of non-graduate workforce participation).*
Source: *Wei (2010), Table 3.1*

1.4.2 Interpreting our results

As discussed in section 1.1, one of the primary challenges of estimating the financial impact of education is the lack of a counterfactual. Ideally, we would like to assess the effect university has on lifetime earnings *holding everything else constant.*

In the absence of being able to do this, we have tried to partially address the problem by assuming an 'ability discount' (an approach which is common in the literature). We assess the impact of this assumption in section 1.5. Despite the relative robustness of the main results to this assumption, our analysis is no randomised controlled trial, and we counsel against applying a strong causal interpretation to our estimates.

1.5 Baseline results and changing assumptions

Graduate Winners largely reports results as a 'breakeven point' rather than as a rate of return (see section 1.3 for a discussion). However, for the purposes of comparing our results to previous research, we reproduce our baseline results in Table 8 for breakeven points, rates of return, and the 'net present value' (NPV). Table 9 then presents some previous Australian estimates of the internal rate of return to higher education.

The main baseline assumptions for our analysis are:

- Students pay 2006 HECS-HELP rates.
- Students receive no income during the study period.
- No discount rate is applied to benefits which come further in the future.
- The extra income graduates receive (i.e. the difference between gross graduate earnings, and the earnings of year 12 completors who do no further study) is discounted by 10%.
- Tax rates, HECS repayment thresholds, and HECS repayment rates are at their 2006 levels.
- Students begin studying at age 18.

In subsections 1.5.1 through to 1.5.5 we vary these assumptions to illustrate how they affect the breakeven points for different disciplines. As discussed in the text, our primary results are very robust to a wide range of assumptions.

Table 8 – Baseline results*

Discipline	Gender	Breakeven point (lowest decile)	Median Rate of return	Median NPV
Agriculture	F	40th	11%	$205,445
	M	40th	11%	$320,387
Architecture	F	40th	10%	$375,830
	M	30th	8%	$452,806
Commerce	F	30th	25%	$501,757
	M	30th	21%	$806,693
Dentistry	F	30th	23%	$855,076
	M	20th	25%	$1,323,083
Education	F	30th	18%	$503,231
	M	30th	14%	$404,913
Engineering	F	40th	21%	$331,712
	M	30th	19%	$771,701
Humanities	F	40th	10%	$236,161
	M	50th	4%	$107,065
Information Technology (IT)	F	30th	23%	$693,625
	M	30th	20%	$677,134
Law	F	20th	27%	$973,483
	M	20th	22%	$1,180,143
Mathematics	F	40th	18%	$522,778
	M	30th	15%	$578,680
Medicine	F	20th	19%	$1,244,669
	M	10th	18%	$1,262,014
Nursing	F	30th	28%	$446,356
	M	30th	23%	$408,527
Performing arts	F	50th	6%	$112,806
	M	60th	**	-$69,873
Sciences (excl. maths)	F	40th	15%	$365,800
	M	30th	11%	$458,624
Bachelor degree average	**F**	**30th**	**16%**	**$442,174**
	M	**30th**	**14%**	**$606,693**

Note: * *Assumptions as listed above.*
*** Iindicates that internal rate of return could not be calculated.*

Table 9 – Previous estimates of 'returns' to an undergraduate degree

Study	Data from	Gender	Return
Borland et al. (2000)	1997	Both	12%
Wei (2010)	2006	Males	15%
		Females	17%
Daly et al. (2012)	2006	Males	15%
		Females	12%

Notes: Assumptions differ across these studies, making comparisons difficult.
Sources: Borland et al. (2000); Wei (2010); Daly et al. (2012).

Note that differences in methodology make results from different studies difficult to compare. In Daly *et al.* (2012), for example, students are assumed to pay their student contributions up front (as opposed to our assumption, whereby students pay back their HECS-HELP debt when their incomes go above the threshold level). This difference would have significant implications for the calculation of an internal rate of return, with the Daly estimate being lower than ours (as negative cash-flows are assumed to happen earlier in life). We note the similarity of our results to the Wei (2010) analysis – which also utilised the 2006 census.

1.5.1 Changing the level of student contribution

BREAKEVEN POINTS (lowest decile)					
Discipline	Gender	1. 'Free' education	2. HECS-HELP	3. Full-CSP rates	4. International student fees
Agriculture	F	40th	40th	40th	40th
	M	40th	40th	40th	40th
Architecture	F	40th	40th	40th	40th
	M	30th	30th	40th	40th
Commerce	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Dentistry	F	30th	30th	30th	30th
	M	20th	20th	20th	20th
Education	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Engineering	F	40th	40th	40th	40th
	M	30th	30th	30th	30th
Humanities	F	40th	40th	40th	40th
	M	50th	50th	50th	50th
IT	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Law	F	20th	20th	20th	20th
	M	20th	20th	20th	20th
Mathematics	F	30th	40th	40th	30th
	M	30th	30th	30th	30th
Medicine	F	20th	20th	20th	20th
	M	10th	10th	10th	10th
Nursing	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Performing arts	F	50th	50th	50th	50th
	M	60th	60th	60th	60th
Sciences (excl. maths)	F	40th	40th	40th	40th
	M	30th	30th	40th	40th
Bachelor degree average	**F**	**30th**	**30th**	**30th**	**30th**
	M	**30th**	**30th**	**30th**	**30th**

Note: all other assumptions at baseline levels

MEDIAN Rate of return					
Discipline	Gender	1. 'Free' education	2. HECS-HELP	3. Full-CSP rates	4. International student fees
Agriculture	F	12%	11%	11%	10%
	M	13%	11%	9%	9%
Architecture	F	11%	10%	10%	10%
	M	9%	8%	7%	7%
Commerce	F	27%	25%	25%	24%
	M	22%	21%	20%	19%
Dentistry	F	26%	23%	22%	22%
	M	28%	25%	24%	23%
Education	F	20%	18%	18%	18%
	M	16%	14%	13%	13%
Engineering	F	23%	21%	20%	20%
	M	21%	19%	18%	18%
Humanities	F	10%	10%	10%	9%
	M	5%	4%	3%	3%
IT	F	25%	23%	23%	22%
	M	21%	20%	19%	18%
Law	F	29%	27%	27%	26%
	M	24%	22%	22%	22%
Mathematics	F	19%	18%	18%	na
	M	16%	15%	14%	16%
Medicine	F	21%	19%	19%	19%
	M	20%	18%	17%	17%
Nursing	F	31%	28%	28%	28%
	M	26%	23%	21%	21%
Performing arts	F	6%	6%	6%	5%
	M	**	**	**	**
Sciences (excl. maths)	F	16%	15%	15%	14%
	M	12%	11%	11%	10%
Bachelor degree average	**F**	**18%**	**16%**	**16%**	**15%**
	M	**16%**	**14%**	**14%**	**13%**

*Note: all other assumptions at baseline levels ; **could not be calculated*

1.5.2 Changing the level of student income

BREAKEVEN POINTS (lowest decile)					
Discipline	Gender	1. No income	2. Average income support	3. Average income	4. Double the average income
Agriculture	F	40th	40th	40th	40th
	M	40th	40th	40th	40th
Architecture	F	40th	40th	30th	30th
	M	30th	30th	30th	30th
Commerce	F	30th	30th	30th	30th
	M	30th	30th	30th	20th
Dentistry	F	30th	30th	30th	30th
	M	20th	20th	20th	20th
Education	F	30th	30th	30th	30th
	M	30th	30th	30th	20th
Engineering	F	40th	40th	40th	40th
	M	30th	30th	30th	20th
Humanities	F	40th	40th	40th	40th
	M	50th	50th	50th	50th
IT	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Law	F	20th	20th	20th	20th
	M	20th	20th	20th	20th
Mathematics	F	40th	30th	30th	30th
	M	30th	30th	30th	30th
Medicine	F	20th	20th	20th	20th
	M	10th	10th	10th	10th
Nursing	F	30th	30th	30th	20th
	M	30th	30th	30th	30th
Performing arts	F	50th	50th	50th	40th
	M	60th	60th	60th	60th
Sciences (excl. maths)	F	40th	40th	40th	30th
	M	30th	30th	30th	30th
Bachelor degree average	**F**	**30th**	**30th**	**30th**	**30th**
	M	**30th**	**30th**	**30th**	**30th**

Note: all other assumptions at baseline levels

1.5.3 Changing the discount rate

BREAKEVEN POINTS (lowest decile)					
Discipline	Gender	Discount rates			
		0%	2%	3%	5%
Agriculture	F	40th	40th	50th	50th
	M	40th	40th	40th	40th
Architecture	F	40th	40th	40th	40th
	M	30th	40th	40th	40th
Commerce	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Dentistry	F	30th	30th	30th	30th
	M	20th	20th	20th	20th
Education	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Engineering	F	40th	40th	40th	40th
	M	30th	30th	30th	30th
Humanities	F	40th	50th	50th	50th
	M	50th	50th	50th	60th
IT	F	30th	30th	30th	40th
	M	30th	30th	30th	30th
Law	F	20th	30th	30th	30th
	M	20th	20th	20th	30th
Mathematics	F	40th	40th	40th	40th
	M	30th	30th	40th	40th
Medicine	F	20th	20th	20th	20th
	M	10th	10th	20th	20th
Nursing	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Performing arts	F	50th	50th	50th	50th
	M	60th	60th	60th	60th
Sciences (excl. maths)	F	40th	40th	40th	40th
	M	30th	40th	40th	40th
Bachelor degree average	**F**	**30th**	**30th**	**40th**	**40th**
	M	**30th**	**30th**	**30th**	**40th**

Note: all other assumptions at baseline levels

1.5.4 Changing the 'ability bias' assumption

BREAKEVEN POINTS (lowest decile)					
Discipline	Gender	No ability bias	10% of earnings premium	20% of earnings premium	40% of earnings premium
Agriculture	F	40th	40th	40th	50th
	M	40th	40th	40th	40th
Architecture	F	40th	40th	40th	40th
	M	30th	30th	30th	40th
Commerce	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Dentistry	F	30th	30th	30th	30th
	M	20th	20th	20th	20th
Education	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Engineering	F	40th	40th	40th	40th
	M	30th	30th	30th	30th
Humanities	F	40th	40th	40th	40th
	M	50th	50th	50th	50th
IT	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Law	F	20th	20th	30th	30th
	M	20th	20th	20th	20th
Mathematics	F	30th	40th	40th	40th
	M	30th	30th	30th	30th
Medicine	F	20th	20th	20th	20th
	M	10th	10th	10th	20th
Nursing	F	30th	30th	30th	30th
	M	30th	30th	30th	30th
Performing arts	F	50th	50th	50th	50th
	M	60th	60th	60th	60th
Sciences (excl. maths)	F	40th	40th	40th	40th
	M	30th	30th	30th	40th
Bachelor degree average	**F**	**30th**	**30th**	**30th**	**40th**
	M	**30th**	**30th**	**30th**	**30th**

Note: all other assumptions at baseline levels

1.5.5 HECS repayment threshold[13]

BREAKEVEN POINTS (lowest decile)				
Discipline	Gender	1. $26,945	2. $38,149	3. $56,000
Agriculture	F	40th	40th	40th
	M	40th	40th	40th
Architecture	F	40th	40th	40th
	M	30th	30th	30th
Commerce	F	30th	30th	30th
	M	30th	30th	30th
Dentistry	F	30th	30th	30th
	M	20th	20th	20th
Education	F	30th	30th	30th
	M	30th	30th	30th
Engineering	F	40th	40th	40th
	M	30th	30th	30th
Humanities	F	40th	40th	40th
	M	50th	50th	50th
IT	F	30th	30th	30th
	M	30th	30th	30th
Law	F	30th	20th	20th
	M	20th	20th	20th
Mathematics	F	40th	40th	30th
	M	30th	30th	30th
Medicine	F	20th	20th	20th
	M	10th	10th	10th
Nursing	F	30th	30th	30th
	M	30th	30th	30th
Performing arts	F	50th	50th	50th
	M	60th	60th	60th
Sciences (excl. maths)	F	40th	40th	40th
	M	30th	30th	30th
Bachelor degree average	**F**	**30th**	**30th**	**30th**
	M	**30th**	**30th**	**30th**

[13] The scenarios are: 1. the 2004 threshold (in $2006); 2. the baseline assumption, i.e. the threshold in 2006; 3. the median income of a full-time worker, as per Leigh (2006)

2. Financial impact of higher education on the public

Section 1 illustrates the intuitive idea that graduates tend to be better off financially than the average person who does no study after finishing school. In this section, we estimate how these private financial benefits impact public finances.

In *Graduate Winners* we report that the median female graduate makes a net public contribution of around $360,000 more than the median female non-graduate. For men, we report the difference to be around $240,000.

As was the case with estimates of private financial benefits, these calculations require a number of assumptions and choices. This section explains the methodology and sources behind our results, and illustrates how sensitive they are to a number of important assumptions.

2.1 Overview of approach

What is included in 'public financial contributions'?

In our analysis, we define a person's positive public financial contribution to be the sum (over ages 18-65) of their income taxes and Medicare levy payments. (Note that these figures are calculated as part of our assessment of net individual financial benefits. See Table 2, and section 1.2 for more detail).

From this we subtract public costs. As our focus is on higher education, we include only those public costs relating to universities – i.e. the tuition subsidies paid by the Commonwealth, and Grattan's estimates of HECS-HELP debt that remains outstanding when people reach the retirement age.

We do not include an estimate of possible 'productivity spillovers' – i.e. the idea that someone with higher levels of education may raise the productivity (and earnings) of co-workers, largely as a consequence of analytical intractability.

Our analysis also omits savings in welfare payments that stem from graduates' lesser need of income support. These savings, along with the potential for graduates to reduce public healthcare costs, are considered briefly in section 4.2 of *Graduate Winners*.

How much more tax do graduates pay?

Comparing median outcomes, graduates pay significantly more taxes than people who complete no further study after year 12. This is illustrated at a high level in Table 10 (using data from the 2006 Census).

Table 10 – Median tax contribution

Men	Income tax	Medicare	Total	*Difference*
Year 12	$295,661	$24,705	$320,366	*$362,843*
Bachelor degree	$640,995	$42,214	$683,209	
Women	Income tax	Medicare	Total	*Difference*
Year 12	$108,037	$12,619	$120,656	*$243,821*
Bachelor degree	$337,380	$27,097	$364,477	

Note: In the case of bachelor degrees, students are assumed to study for four years.
Source: 2006 Census (using the ABS TableBuilder)

As was the case when analysing total earnings (page 6) the averages presented in Table 10 mask considerable variations. These variations are evident in Figure 6, which presents our measure of financial contribution by discipline, ranging from the 20th percentile outcome (i.e. someone on the cusp of the bottom fifth of their group in terms of public financial contribution) to the 60th percentile (i.e. someone moderately above their group median).[14]

How much of graduates' extra tax contributions can be attributed to university?

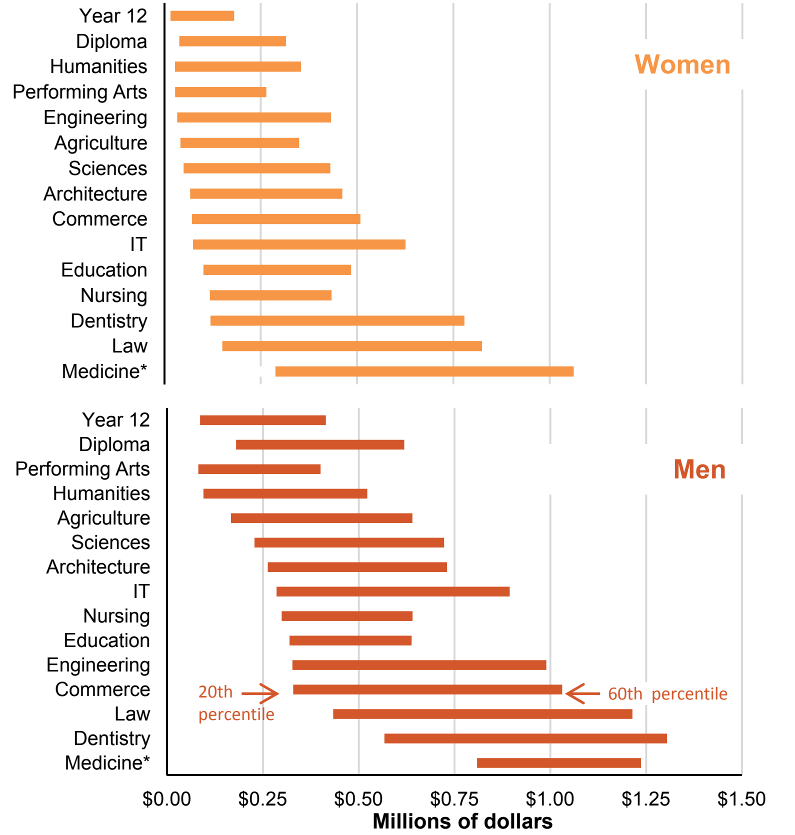
As discussed in section 1.1 (page 5) it's unlikely that 100% of the difference in lifetime earnings between graduates and non-graduates can be attributed to university alone. In section 1.1 we identify three broad factors – both relating to and independent of universities – that may drive higher lifetime earnings: a training effect, an ability effect and a signalling effect.

The *public* primarily benefits from the training effect. Without the training university provides, Australian workers would be less productive, earn lower wages, and contribute less tax revenue.

In contrast, the extra tax paid by graduates on account of their above-average ability is a public benefit, but not one produced by higher education. The absence of universities would not mean the absence of high-ability individuals. The public would benefit from the labours of talented people regardless of whether or not they go to university.

[14] In this context, 'peers' and a 'group' refers to a level (and field) of education, e.g. 'science bachelor degree holders'.

Figure 6 – Spread of lifetime tax contribution: 20th – 60th percentile*



Notes: *'Science' excludes maths;*The highest income category in the census is >$2,000 which applies at some point to the 60th percentile in disciplines with an asterisk. This data limiation also explains why the ranges we present are constrained at the 60th percentile.*

Source: *Grattan analysis based on 2006 Census (using the ABS TableBuilder)*

Signalling provides some benefit by matching people with jobs that suit their skills, abilities and attributes. However, studying for years is probably not an efficient way of identifying the likely characteristics of potential employees. Moreover, signalling benefits are largely private. Graduates benefit largely at the expense of non-graduates who could do the job, but whose skills are less observable. Employers benefit by saving on employee search costs and reducing the risk of bad hires.

The literature on the relative importance of training, ability and signalling is inconclusive. The *Higher Education Base Funding Review Final Report* (drawing on the work of Chapman and Lounkaew (2012)) suggests "the range of human capital contribution [training] to the higher income of a university graduate can be argued to be around 25-40 per cent". However, the empirical estimates underpinning the 25-40 per cent range are highly uncertain, and we have been unable to verify this range with any confidence.

Consequently, we do not favour any particular estimate. However, to inform the reader of the impact of this assumption, in section 2.3 we present public financial benefit estimates based on the guess that 40% of the increase in graduate earnings can be attributed to the training effect (i.e. that graduates increase their capacities above-and-beyond non graduates' while at university). We also note that it is relatively straightforward to vary this assumption: multiplying the results in Table 16 by the factor of choice will give a close approximation to the model results.[15]

Factoring in the costs

In addition to the public financial benefits of education, we also need to consider the costs.

From the public's point of view, there are three main costs:

- The direct, upfront cost of subsidising students' education, i.e. the Commonwealth contribution
- The direct cost (often recognised later) of unpaid HECS-HELP debt
- The opportunity cost of higher education, i.e. the tax contribution that graduates would have made had they not gone to university (which is defined as the tax contribution of someone who completed year 12 but did no further study)

2.2 Detailed methodology

To calculate the *net* public financial impact of unviersity, we compare the median lifetime public financial contributions of non-graduates, with those of graduates in various disciplines (discounting for the possibility of ability bias, and signalling effects). This approach is summarised in Table 11.

[15] In the model, the discount factor is applied to the extra tax contributions paid by graduates (relative to the median non-graduate). This yields marginally different results to simply applying a discount rate to the net public financial benefit estimates.

Table 11 – Net public benefit methodology
(for median female lawyer; discount rate = 0%)

Age	18	35	65	Total
Graduate contribution				
Income taxes	$0	$14,503	$9,950	**$602,478**
Medicare levy	$0	$958	$730	**$40,561**
Total graduate taxes	**$0**	**$15,461**	**$10,680**	**$643,039**
Less tuition subsidy	($1,574)	$0	$0	**($4,722)**
Less unpaid HECS-HELP				**$0**
Total graduate contribution	($1,574)	$15,461	$10,680	$638,317
Less median non-graduate contribution				
Income tax	($146)	($2480)	($1,145)	**($108,037)**
Medicare levy	($0)	($338)	($0)	**($12,619)**
Total median non-graduate contribution	($146)	($2,818)	($1,145)	($120,656)
Net public financial benefits	($1,720)	$12,643	$9,535	$517,661
Discount to reflect the fact that not all extra tax results from university*	$0	($7,586)	($5,721)	($314,396)
Final net public financial benefit of graduate*	($1,720)	$5,057	$3,814	$203,264

Notes: *The discount factor is an assumption that attempts to account for the 'ability' bias, and screening effects (see section 1.1 for more). In this example, we assume that 40% of net public benefits are due to the 'training' effect; in Graduate Winners our baseline assumption is to assume that 100% of graduates' net public financial contribution results from university. The discount is set to zero in the study years.*

Source: *Sources for the data in the table are discussed below.*

Tax contributions

Gross incomes are used as the base for the tax calculations. These data are sourced from the 2006 Census (as described in section 1.2. The tax rates are those that were in operation in 2006, as presented in Tables 3 and 4).

Naturally, an increase in these tax rates would result in a lift in the overall public financial contribution graduates make. In *Graduate Winners* we report that changing the marginal tax rate from 30% to 40% in the middle tax bracket (which at the time of the 2006 census covered incomes of $25,000 to $75,000 per year), increases the estimated net public financial benefit of average female graduates from around $240,000 to $310,000. The tax rates assumed in this calculation are presented in Table 12.

Table 12 – Alternate tax assumption
(appearing in *Graduate Winners)*

Taxable income	Assumed rate
$0 - $6,000	Nil
$6,001 - $25,000	15c for each dollar between $6,000 and $25,000
$25,001 - $75,000	*40c for each dollar between $25,000 and $75,000*
$75,001 - $150,000	40c for each dollar between $75,000 and $150,000
$150,001 and over	45c for each dollar over $150,000

Tuition subsidies

As discussed in section 1.3, in each discipline we specify the **expected duration of study** for an undergraduate degree. This information is based in part on Daly et al. (2012) and where necessary is supplemented by information from the My University website (for details, see Table 13). We assume that students begin studying at age 18, study full time, and complete the course in the expected number of years. In the baseline results, tuition subsidies are set to 2006 levels. These data were sourced from DEEWR (2008), and are presented in Table 13.

To understand the effect that changing levels of tuition subsidy have on the overall public financial impact of universities, we explore the impact of three assumptions:

1. 'Public pays everything' (the tuition subsidy is set equal to the total funding for each Commonwealth Supported Place)
2. 2006 tuition subsidies (our baseline assumption)
3. 'Public pays nothing' (the tuition cost is set to zero; in this instance there is still a cost, as more HECS-HELP debt will be outstanding at the end of graduates' working lives)

The level of student contribution in each of these three scenarios is presented by discipline in Table 13.

The cost of outstanding HECS-HELP debt

As was the case for private benefits, we assume HECS-HELP debt is paid back only when graduate earnings reach the HECS-HELP threshold (i.e. we assume that people don't pay early, or up-front). We use the 2006 HECS-HELP repayment thresholds and rates, as presented in Table 6 (see page 12).

However, some students do not reach the threshold in enough years to repay the debt. For these students, there is a larger public cost than just the tuition subsidy.

Table 13 – Tuition subsidy assumptions

Discipline	Duration (years)	Annual tuition subsidy scenarios 1. 'Public pays everything	2. 2006 tuition subsidies	3. 'Public pays nothing'
Agriculture	3	$24,093	$17,114	$0
Architecture	5	$14,695	$7,716	$0
Commerce	3	$9,568	$2,589	$0
Dentistry	5	$24,269	$16,099	$0
Economics	3	$9,568	$2,589	$0
Education	4	$11,534	$7,614	$0
Engineering	4	$19,823	$12,844	$0
Humanities	3	$9,263	$4,364	$0
IT	3	$14,695	$7,716	$0
Law	3	$9,744	$1,574	$0
Mathematics	3	$12,132	$5,153	$0
Medicine	5	$24,269	$16,099	$0
Nursing	3	$14,097	$10,177	$0
Performing arts	3	$14,388	$9,489	$0
Sciences (excl. maths)	3	$19,823	$12,844	$0

Source: DEEWR (2008)

Based on the gross income data described in section 1.3, we identify years in which graduates do not earn enough to trigger HECS-HELP repayment. This process is conducted across the income distribution, ranging from the 10^{th} percentile to the 90^{th} percentile. If, by age 65, the level of HECS-HELP repayments is less than the total debt accrued (based on 2006 student contributions, see Table 5), the difference is subtracted from the total public financial contribution. For example, in our data set male accounting graduates at the 10^{th} percentile only surpass the

2006 HECS-HELP repayment threshold of $38,149 in two years. In these two years, they repay $3,111 of the $20,937 they owe in HECS-HELP. We therefore subtract $17,826 from our estimate of the total public financial contribution made by male accountants at the 10th percentile.

Discount rates over time

As noted in the main report (and in section 1.2 of this document) our baseline results are not discounted with respect to time. In line with our analysis of individual financial benefits, we assess the sensitivity of our results at discount rates of 0% (baseline), 2%, 3% and 5%.[16]

2.3 Calculating results

As discussed above, public and private benefits are two sides of the same coin. If the financial impact of university on an individual is negative, then the impact on public finances will also be negative. In terms of breakeven points (our preferred measure, as noted in section 1.3), results on public benefit and private benefits will be virtually identical. This is illustrated in Table 14 which shows the baseline results for public and private breakeven points).

In *Graduate Winners* we largely report our public financial results as 'net present values'. To illustrate the sensitivity of these results to various assumptions, this is the meausre we use in section 2.4.

[16] These rates reflect: our baseline assumption (0%); the rates used by Daly, *et al.* (2012) in their analysis of individual private financial benefits for the base funding review (2% and 3%); the rate used by Chapman and Lounkaew (2012) in their review of public benefits for the base funding review (5%).

Table 14 – Comparing public and private breakeven points

Discipline	Gender	Private	Public
Agriculture	F	40th	50th
	M	40th	40th
Architecture	F	40th	40th
	M	30th	30th
Commerce	F	30th	30th
	M	30th	20th
Dentistry	F	30th	30th
	M	20th	20th
Education	F	30th	30th
	M	30th	30th
Engineering	F	40th	40th
	M	30th	30th
Humanities	F	40th	40th
	M	50th	50th
Information Technology (IT)	F	30th	30th
	M	30th	30th
Law	F	20th	20th
	M	20th	20th
Mathematics	F	40th	30th
	M	30th	30th
Medicine	F	20th	20th
	M	10th	10th
Nursing	F	30th	30th
	M	30th	30th
Performing arts	F	50th	50th
	M	60th	60th
Sciences (excl. maths)	F	40th	40th
	M	30th	30th
Bachelor degree average	**F**	**30th**	**30th**
	M	**30th**	**30th**

Note: Baseline assumptions.

2.4 Baseline assumptions for public financial contributions and sensitivity testing

Baseline assumptions

- Government subsidies reflect the rates paid in 2006.
- No discount rate is applied to benefits which come further in the future.
- The extra tax revenues generated by graduates (i.e. the difference between income tax and medicare levy payments of graduates, and those of 12 completors who do no further study) are not discounted. [Note that this is the most generous possible assumption in terms of assessing the public financial contribution of universities]
- Tax rates, HECS repayment thresholds, and HECS repayment rates are at their 2006 levels.

In this section, we illustrate the effect of changing three critical assumptions in putting a dollar value on the public financial benefits of higher education:

1. The contribution the public makes to students in each year of study. This is explored in Table 15;
2. The discount rate. This is explored in Tables 16,17 and 18;
3. The proportion of graduates' above-average tax contributions which can be attributed to higher education. This is explored in Table 19.

Table 15 – Changing the level of government subsidy

PUBLIC **BREAKEVEN POINTS (lowest decile)**				
Discipline	**Gender**	**1. Gov pays total cost**	**2. 2006 Subsidy levels**	**3. Gov pays nothing**
Agriculture	F	50th	50th	40th
	M	50th	40th	40th
Architecture	F	40th	40th	30th
	M	40th	30th	30th
Commerce	F	30th	30th	30th
	M	30th	20th	20th
Dentistry	F	30th	30th	30th
	M	20th	20th	20th
Education	F	30th	30th	30th
	M	30th	30th	30th
Engineering	F	40th	40th	40th
	M	30th	30th	20th
Humanities	F	50th	40th	40th
	M	50th	50th	50th
IT	F	30th	30th	30th
	M	30th	30th	30th
Law	F	20th	20th	20th
	M	20th	20th	20th
Mathematics	F	40th	30th	30th
	M	30th	30th	30th
Medicine	F	20th	20th	20th
	M	20th	10th	10th
Nursing	F	30th	30th	30th
	M	30th	30th	30th
Performing arts	F	50th	50th	50th
	M	60th	60th	60th
Sciences (excl. maths)	F	40th	40th	40th
	M	40th	30th	30th
Bachelor degree average	F	40th	30th	30th
	M	30th	30th	30th

Changing the discount rate over time – scenario 1

Table 16 – Net public financial gain/loss across disciplines: 0% discount rate over time (baseline estimates)

	PERCENTILES →	10th	20th	30th	40th	50th	60th	70th
Agriculture	Female	-$178,694	-$147,335	-$94,471	-$30,656	**$50,377**	$160,793	$267,625
	Male	-$331,734	-$222,265	-$93,254	$25,600	**$140,623**	$251,051	$375,112
Architecture	F	-$147,567	-$92,475	-$19,972	$68,144	**$186,056**	$302,540	$428,429
	M	-$255,957	-$96,346	$34,620	$149,429	**$255,594**	$371,287	$539,038
Commerce	F	-$123,463	-$56,998	$35,717	$146,561	**$258,938**	$380,290	$516,991
	M	-$190,009	$1,032	$160,179	$310,651	**$488,259**	$702,640	$839,791
Dentistry	F	-$132,182	-$39,536	$110,627	$290,336	**$450,281**	$619,612	$863,630
	M	-$74,631	$207,819	$475,264	$736,967	**$881,061**	$945,400	$971,338
Education	F	-$126,667	-$49,798	$44,235	$145,835	**$242,018**	$333,750	$424,030
	M	-$201,809	-$31,391	$73,524	$147,509	**$217,550**	$286,941	$363,284
Engineering	F	-$171,859	-$138,670	-$57,352	$45,096	**$149,221**	$260,256	$388,184
	M	-$244,615	-$45,036	$119,237	$269,726	**$426,592**	$617,830	$787,357
Humanities	F	-$133,537	-$106,275	-$55,579	$14,149	**$109,302**	$220,785	$343,995
	M	-$305,760	-$238,711	-$140,813	-$36,373	**$70,234**	$188,991	$322,009
IT	F	-$136,195	-$69,471	$40,012	$184,155	**$348,978**	$482,104	$640,481
	M	-$245,479	-$57,945	$103,297	$240,458	**$383,597**	$550,373	$731,972
Law	F	-$100,686	$25,132	$193,765	$355,823	**$517,661**	$703,006	$966,764
	M	-$147,322	$108,552	$323,253	$567,545	**$779,605**	$891,467	$930,784
Mathematics	F	-$130,489	-$81,515	$9,784	$134,167	**$264,272**	$398,872	$533,105
	M	-$271,076	-$102,090	$56,235	$198,024	**$329,542**	$485,359	$680,714
Medicine	F	-$152,617	$87,099	$283,186	$456,425	**$656,054**	$861,288	$993,455
	M	$39,793	$407,734	$682,369	$766,672	**$808,918**	$835,594	$856,846
Nursing	F	-$113,665	-$33,251	$41,239	$122,020	**$202,212**	$282,859	$372,375
	M	-$208,829	-$52,116	$52,659	$137,111	**$210,431**	$289,615	$367,218
Performing Arts	F	-$147,135	-$121,117	-$80,145	-$32,135	**$28,274**	$115,662	$226,473
	M	-$319,256	$267,576	-$199,388	-$121,548	**-$39,207**	$51,351	$165,539
Science (excluding maths)	F	-$156,379	-$109,342	-$41,717	$50,514	**$158,005**	$271,615	$391,013
	M	-$284,238	-$130,970	$9,185	$124,170	**$236,231**	$363,623	$547,320
Bachelor degree average	F	-$139,728	-$76,618	$7,965	$108,624	**$215,504**	$322,422	$433,956
	M	-$252,341	-$73,437	$74,507	$204,225	**$334,527**	$500,369	$734,837

Note: Baseline assumptions

Changing the discount rate over time – scenario 2

Table 17 – Net public financial gain/loss across disciplines: 2% discount rate over time

	PERCENTILES →	10th	20th	30th	40th	50th	60th	70th
Agriculture	Female	-$137,143	-$116,549	-$83,450	-$42,814	**$7,667**	$71,736	$135,184
	Male	-$225,557	-$157,000	-$78,242	-$8,499	**$57,343**	$120,437	$191,671
Architecture	F	-$106,934	-$72,675	-$26,578	$26,654	**$93,423**	$159,118	$230,108
	M	-$172,130	-$78,169	-$2,880	$62,297	**$122,273**	$187,421	$279,757
Commerce	F	-$81,595	-$38,919	$21,363	$90,697	**$159,283**	$232,335	$313,907
	M	-$120,501	-$5,706	$88,979	$177,691	**$282,075**	$406,881	$485,270
Dentistry	F	-$139,587	-$83,661	$13,866	$129,906	**$229,305**	$335,751	$483,960
	M	-$106,874	$64,151	$229,262	$386,842	**$473,195**	$513,307	$528,021
Education	F	-$90,413	-$41,763	$16,195	$77,870	**$135,665**	$189,958	$242,708
	M	-$131,968	-$26,869	$36,768	$80,486	**$120,779**	$160,177	$203,623
Engineering	F	-$125,785	-$103,351	-$46,945	$22,967	**$90,577**	$159,351	$236,885
	M	-$166,208	-$43,185	$55,905	$145,249	**$236,468**	$346,074	$442,899
Humanities	F	-$89,473	-$74,213	-$43,188	-$899	**$56,865**	$123,743	$197,038
	M	-$194,328	-$153,606	-$94,791	-$33,185	**$29,550**	$100,020	$179,207
IT	F	-$95,662	-$57,273	$11,589	$99,525	**$195,047**	$276,891	$370,580
	M	-$158,787	-$44,614	$51,906	$134,023	**$219,111**	$317,754	$424,089
Law	F	-$66,230	$13,782	$117,293	$212,706	**$307,281**	$414,516	$565,999
	M	-$93,930	$58,653	$183,431	$324,412	**$445,600**	$507,646	$536,142
Mathematics	F	-$88,945	-$60,520	-$5,649	$70,382	**$149,686**	$231,219	$313,091
	M	-$173,100	-$70,024	$24,226	$107,190	**$185,988**	$280,287	$397,584
Medicine	F	-$126,163	$23,346	$139,126	$236,982	**$346,724**	$463,581	$544,931
	M	-$15,229	$192,727	$346,940	$397,000	**$426,758**	$448,268	$465,560
Nursing	F	-$79,616	-$26,905	$19,319	$68,836	**$117,162**	$165,071	$217,719
	M	-$134,463	-$35,553	$26,228	$75,780	**$118,974**	$164,419	$210,203
Performing Arts	F	-$103,275	-$86,908	-$61,669	-$32,461	**$3,998**	$56,005	$121,452
	M	-$206,641	-$174,802	-$134,396	-$87,541	**-$38,306**	$15,435	$81,592
Science (excluding maths)	F	-$112,551	-$84,117	-$42,212	$14,727	**$80,576**	$148,321	$219,317
	M	-$190,041	-$98,616	-$15,825	$51,431	**$117,245**	$192,135	$299,198
Bachelor degree average	F	-$98,765	-$59,520	-$6,225	$55,929	**$120,975**	$184,727	$250,913
	M	-$165,750	-$57,521	$30,523	$107,135	**$183,650**	$280,424	$414,850

Note: *Apart from discount rate over time, baseline assumptions*

Changing the discount rate over time – scenario 3

Table 18 – Net public financial gain/loss across disciplines: 5% discount rate over time

	PERCENTILES →	10th	20th	30th	40th	50th	60th	70th
Agriculture	Female	-$102,476	-$90,078	-$71,517	-$48,457	-$20,842	$11,325	$43,629
	Male	-$145,342	-$107,927	-$66,371	-$31,180	$986	$31,592	$66,195
Architecture	F	-$74,260	-$55,551	-$29,712	-$1,957	**$30,162**	$61,573	$95,112
	M	-$108,291	-$61,679	-$24,894	$6,470	**$34,952**	$65,795	$107,692
Commerce	F	-$49,466	-$24,970	$10,016	$48,079	**$84,534**	$122,732	$164,814
	M	-$69,462	-$10,733	$37,762	$82,847	**$135,106**	$196,617	$236,654
Dentistry	F	-$108,593	-$79,672	-$23,586	$43,291	**$97,250**	$155,311	$233,118
	M	-$92,894	-$3,218	$85,646	$167,403	**$214,580**	$238,920	$247,177
Education	F	-$61,751	-$34,088	-$2,715	$29,839	**$59,707**	$87,307	$113,808
	M	-$81,033	-$25,020	$8,733	$31,399	**$51,428**	$70,552	$91,653
Engineering	F	-$89,276	-$75,760	-$40,665	$2,049	**$40,799**	$77,789	$118,331
	M	-$108,270	-$43,012	$9,005	$55,212	**$100,431**	$153,128	$200,544
Humanities	F	-$55,632	-$48,347	-$31,678	-$9,339	**$21,159**	$55,941	$93,725
	M	-$110,268	-$89,167	-$59,069	-$28,160	**$3,604**	$39,762	$80,603
IT	F	-$63,594	-$44,634	-$6,671	$39,816	**$87,903**	$131,657	$179,418
	M	-$94,819	-$36,082	$13,432	$56,064	**$99,947**	$150,055	$203,617
Law	F	-$39,482	$5,414	$60,340	$108,613	**$155,887**	$208,535	$282,104
	M	-$54,782	$22,856	$84,658	$152,840	**$212,055**	$243,714	$263,353
Mathematics	F	-$56,645	-$42,573	-$14,168	$26,369	**$68,449**	$111,708	$155,435
	M	-$99,793	-$46,350	$1,190	$42,526	**$83,275**	$132,706	$193,407
Medicine	F	-$101,672	-$19,999	$38,404	$84,781	**$134,519**	$190,364	$234,561
	M	-$47,588	$50,530	$122,603	$149,531	**$168,902**	$184,715	$197,567
Nursing	F	-$53,597	-$22,238	$2,946	$29,471	**$54,815**	$79,538	$106,408
	M	-$81,054	-$25,705	$6,013	$31,372	**$53,659**	$76,504	$100,142
Performing Arts	F	-$69,103	-$59,875	-$46,204	-$30,717	**-$11,582**	$15,143	$48,427
	M	-$121,975	-$105,041	-$84,599	-$60,506	**-$35,151**	-$7,567	$25,409
Science (excluding maths)	F	-$78,146	-$63,192	-$40,546	-$9,930	**$25,166**	$60,340	$97,168
	M	-$118,690	-$72,946	-$31,534	$2,266	**$35,679**	$73,672	$126,704
Bachelor degree average	F	-$66,490	-$44,888	-$15,198	$18,386	**$52,822**	$85,702	$119,704
	M	-$100,741	-$45,084	-$87	$39,115	**$77,898**	$125,873	$190,616

Note: Apart from discount rate over time, baseline assumptions

Changing the assumption about how much extra tax revenue stems from university

Table 19 – Net public financial gain/(loss) across disciplines: assume only 40% of extra revenues are from training effect

	PERCENTILES →	10th	20th	30th	40th	50th	60th	70th
Agriculture	Female	-$114,231	-$101,687	-$80,542	-$55,016	-$22,603	$21,564	$64,297
	Male	-$176,151	-$132,364	-$80,759	-$33,218	$12,791	$56,963	$106,587
Architecture	F	-$84,919	-$62,882	-$33,881	$1,366	$48,530	$95,124	$145,480
	M	-$129,424	-$65,579	-$13,193	$32,731	$75,197	$121,474	$188,574
Commerce	F	-$55,013	-$28,427	$8,659	$52,997	$97,948	$146,489	$201,169
	M	-$81,960	-$5,544	$58,115	$118,304	$189,347	$275,099	$329,960
Dentistry	F	-$78,765	-$41,706	$18,359	$90,242	$154,220	$221,953	$319,560
	M	-$56,893	$56,087	$163,065	$267,746	$325,384	$351,119	$361,494
Education	F	-$70,619	-$39,872	-$2,259	$38,381	$76,855	$113,548	$149,659
	M	-$101,380	-$33,213	$8,753	$38,347	$66,363	$94,120	$124,657
Engineering	F	-$101,248	-$87,973	-$55,445	-$14,466	$27,184	$71,598	$122,769
	M	-$131,055	-$51,223	$14,486	$74,682	$137,428	$213,923	$281,734
Humanities	F	-$62,237	-$51,332	-$31,053	-$3,162	$34,899	$79,492	$128,776
	M	-$131,455	-$104,635	-$65,476	-$23,700	$18,943	$66,446	$119,653
IT	F	-$69,335	-$42,645	$1,148	$58,805	$124,735	$177,985	$241,336
	M	-$113,377	-$38,364	$26,133	$80,998	$138,253	$204,964	$277,603
Law	F	-$46,361	$3,966	$71,067	$135,471	$199,837	$273,601	$378,595
	M	-$65,720	$36,567	$122,263	$219,830	$304,441	$348,841	$363,966
Mathematics	F	-$62,439	-$42,849	-$6,329	$43,424	$95,466	$149,306	$202,999
	M	-$119,003	-$51,408	$11,922	$68,637	$121,245	$183,572	$261,714
Medicine	F	-$112,085	-$16,199	$62,236	$131,532	$211,383	$293,477	$346,343
	M	-$36,270	$110,906	$220,760	$254,481	$271,380	$282,050	$290,551
Nursing	F	-$64,751	-$32,585	-$2,789	$29,523	$61,600	$93,859	$129,665
	M	-$103,145	-$40,460	$1,450	$35,231	$64,559	$96,232	$127,273
Performing Arts	F	-$76,901	-$66,494	-$50,105	-$30,901	-$6,737	$28,218	$72,542
	M	-$146,078	-$125,406	-$98,131	-$66,995	-$34,058	$2,164	$47,840
Science (excluding maths)	F	-$86,637	-$67,822	-$40,772	-$3,880	$39,117	$84,561	$132,320
	M	-$138,110	-$76,802	-$20,740	$25,254	$70,078	$121,035	$194,514
Bachelor degree average	F	-$74,561	-$49,317	-$15,484	$24,779	$67,532	$110,299	$154,912
	M	-$120,311	-$48,749	$10,429	$62,316	$114,436	$180,773	$274,560

Note: Apart from the assumption about discounting for the ability bias and signalling effect we use baseline assumptions

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Appendix – Definition of disciplines

Table 20 – Discipline definitions

(The numbers in brackets represent the counts in census 2006 of people reporting that their highest level of qualification was a bachelor degree in the related field. Counts are based on data used in our analysis, and assume the study durations outlined in Table 5, i.e. medicine graduates are counted from ages 23-65, nurses from age 21-65 etc; m_{total} = male total; f_{total} = female total)

Agriculture (m_{total} = 7,716; f_{total} = 4,013)	Agriculture is a 4-digit field, and is a subset of the 2-digit field 'Agriculture, Environmental and Related Studies'. Agriculture includes 'Agricultural Science', 'Animal Husbandry', 'Wool Science' and 'Agriculture, n.e.c.'.
Architecture (m_{total} = 11,904; f_{total} = 5,481)	Architecture is a 6-digit field, and is a subset of the 2-digit field "Architecture and Building"..
Commerce (m_{total} = 158,904; f_{total} = 148,967)	Commerce is the 2-digit field 'Management and Commerce'. It includes 'Accounting', 'Business and Management', 'Sales and Marketing', 'Tourism', 'Office Studies', 'Banking Finance and Related Fields', and 'Other Management and Commerce.
Dentistry (m_{total} = 5,155 ; f_{total} = 3,400)	Dentistry is the 4-digit field 'Dental Studies', and is a subset of the 2-digit field 'Health'. Dental Studies includes 'Dentistry', 'Dental Assisting', 'Dental Technology', and 'Dental Studies, n.e.c'.
Education (m_{total} = 62,973; f_{total} = 185,719)	Education is a 2-digit field. It includes 'Teacher Education' Curriculum and Education Studies' and 'Other Education'.
Engineering (m_{total} = 116,317 ; f_{total} = 17,584)	Engineering is a 2-digit field. It includes, 'Manufacturing', 'Process and Resources', 'Automotive', 'Mechanical and Industrial', 'Civil', 'Geomatic', 'Electrical and Electronic', 'Aerospace', 'Maritime', and 'Other Engineering and Related Technologies'.
Humanities (m_{total} = 29,846; f_{total} = 48,638)	'Humanities' is a category defined in this paper. It is a subset of the 2-digit field 'Society and Culture'. It includes 'Political Science and Policy Studies', 'Studies in Human Society', 'Language and Literature', 'Philosophy and Religious Studies'.
Information Technology (m_{total} = 59,755; f_{total} = 19,491)	Information Technology is a 2-digit field. It includes 'Computer Science', 'Information Systems' and 'Other Information Technology'.
Law (m_{total} = 30,642; f_{total} = 26,489)	Law is a 4-digit field, and is a subset of the 2-digit field 'Society and Culture'. Law includes 'Business and Commercial Law', 'Constitutional Law', 'Criminal Law', 'Family Law', 'International Law', 'Taxation Law', 'Legal Practice' and 'Law, n.e.c.'.
Mathematics (m_{total} = 8,505; f_{total} = 6,000)	Mathematics is the 4-digit field 'Mathematical Sciences', and is a subset of the 2-digit field 'Natural and Phycial Sciences'. Mathematical Sciences includes 'Mathematics', 'Statistics' and 'Mathematical Sciences n.e.c.'.
Medicine (m_{total} = 21,657; f_{total} = 15,472)	Medicine is the 4-digit field 'Medical Studies', and is a subset of the 2-digit field Health. Medical Studies includes 'General Medicine', 'Surgery', 'Psychiatry', 'Obstetrics and Gynaecology', 'Paediatrics', 'Anaesthesiology', 'Pathology', 'Radiology', 'Internal Medicine', 'General Practice', 'Medical Studies n.e.c.'.
Nursing (m_{total} = 8,447; f_{total} = 96,351)	Nursing is a 4-digit field, and is a subset of the 2-digit field 'Health'. Nursing includes, 'General Nursing', 'Midwifery', 'Mental Health Nursing', 'Community Nursing', 'Critical Care Nursing', 'Aged Care Nursing', 'Palliative Care Nursing', 'Mothercraft Nursing and Family and Child Health Nursing', 'Nursing, n.e.c.'.
Performing arts (m_{total} = 5,440; f_{total} =8,786)	Performing arts is a 4-digit field, and is a subset of the 2-digit field 'Creative Arts'. Performing Arts includes 'Music', 'Drama and Theatre Studies', 'Dance' and 'Performing Arts n.e.c.'.
Sciences (excl. maths) (m_{total} = 54,480; f_{total} = 26,976)	'Sciences (excl. maths) is a category defined in this paper. It is the 2-digit field 'Natural and Physical Sciences' with the 4-digit field 'Mathematical Sciences' removed'. The category includes 'Natural and Physical Science n.f.d.', 'Physics and Astronomy', 'Chemical Sciences', 'Earth Sciences', 'Biological Sciences' and 'Other Natural and Physical Sciences'.

Source: Definitions and classiciations are from ABS (2001); counts are from the ABS TableBuilder 2006.