



KPMG ECONTECH

Economic
Modelling of
Improved
Funding and
Reform
Arrangements
for Universities

31 March 2009

ADVISORY

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Executive summary

Introduction

Universities are a key contributor to economic growth in Australia. By producing skilled and highly employable workers and investing in research, universities contribute to increasing both the productivity and the participation rate of workers in the economy. Despite this, funding from the Commonwealth Government in recent times has been stagnant.

Universities Australia has commissioned KPMG Econtech to measure the net economic benefits over time of government policies aimed at increasing university funding and adjusting various policies in conjunction with this funding increase. Importantly, the economic modelling framework utilised in this report accounts for the direct and indirect benefits of increasing university funding as they accrue to the community and economy. This includes:

- increased productivity;
- increased labour force participation;
- boosting exports of education services (international student fees);
- returns from university-based research; and
- an increase in the population as international students choose to reside in Australia at the completion of their studies.

Background

Investing in universities leads to increases in both the level of education of the workforce and research and development (research) outcomes. This results in gains in productivity, higher levels of labour force participation and an increase in the population from international students that remain in Australia after the completion of their studies. Productivity growth, labour force participation and population growth are key drivers of long-term growth in the economy. Along with these benefits, the impact of increased university funding may be more marked than the general effect for regional universities, as regional universities play a particularly significant role in their own communities¹.

The importance of these factors is demonstrated in the Australian Government's Intergenerational Report in which the projections for real GDP and real GDP per person are constructed from the projections for population, labour force participation and productivity (Commonwealth Australia, 2007). The Commonwealth Treasury estimates that, over the last four decades, productivity growth has accounted for over 80 per cent of growth in GDP per person (Davis and Raham, 2006).

¹ This possible effect for regional universities was not incorporated into this study.

There is also a mutual relationship between education and health. Investment in education and health are essential to boost human capital. The economic value is founded in the resulting changes in productivity – both education and good health make individuals more productive. This connection between education and health levels is well documented, but the precise causal relationship between them is not well tested, hence health benefits are not included in the modelling. Likewise a range of wider benefits that are said to occur in areas such as social inclusion, environmental impact, cultural enhancement, and more, are not included in this modelling. The focus is national economic outcomes.

Despite the known benefits of investing in education and research, Government funding for universities has fallen in recent times. Government grant funding of universities has fallen from around 58 per cent of total university income in 1995 to around 40 per cent at present. Up until the year 2000, this decline also led to a total decline in university income. To increase income, universities have relied on rapidly expanding their international student programs, domestic full fee payments and investment and commercial revenues. However, in the face of a global economic slowdown and increased competition from other countries, it is unlikely that universities will be able to rely on international students, full fee payments and investments to supplement their income.

The economic benefits of increased university funding need to be weighed against the costs. These costs include reduced labour force participation of students during their time of study, and the economic cost of calling on taxpayers to fund increases in university funding. Importantly, the costs of expanding the university sector are incurred immediately, while the benefits take time to accumulate. Hence, a short-term sacrifice of living standards needs to be weighed against a medium to long-term gain. But the sacrifice in employment foregone, may be less in more difficult economic times.

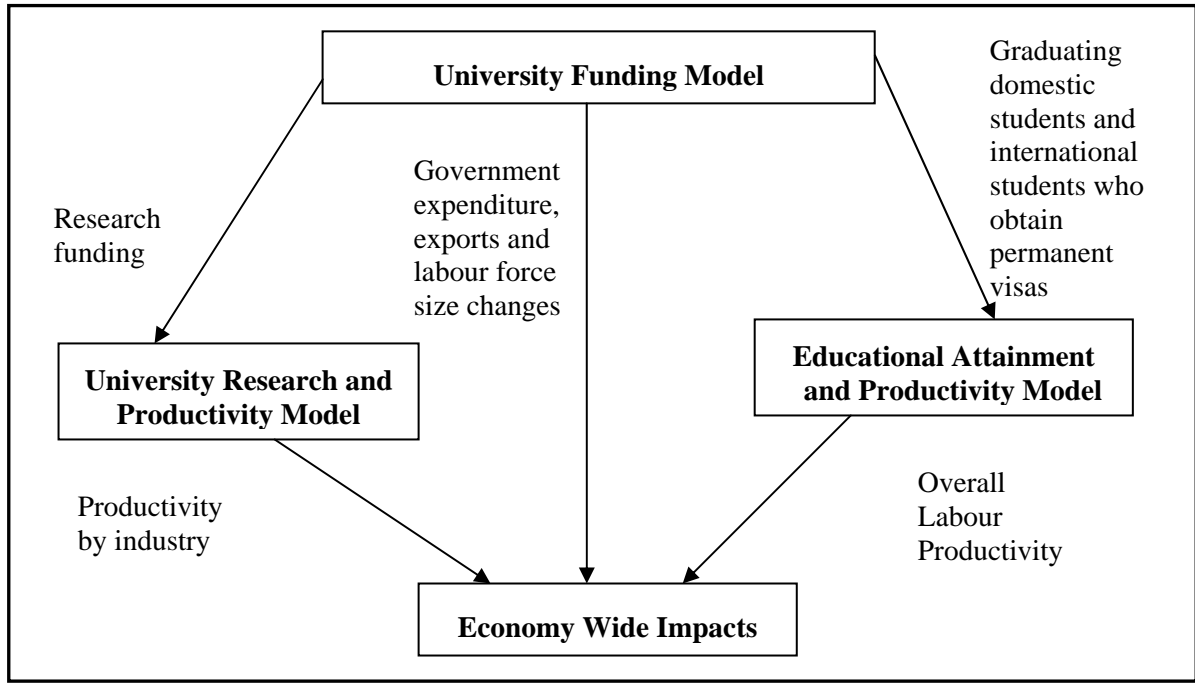
Modelling approach

To model the economic impact of increasing university funding, KPMG Econtech developed a system of models to capture both the economic costs and benefits. The modelling system consists of four models:

- a university funding model;
- an educational attainment and productivity model;
- a university research and productivity model; and
- an economy wide, computable general equilibrium model. The relationship between the four models is shown in Box A.

To our knowledge, this is the first attempt anyone has made to estimate the net economic benefits of university funding in such a comprehensive manner.

Box A: University Funding Modelling System



Source: KPMG Econtech

The system of models was constructed to account for the key economic implications of expanding the university sector. This includes:

- higher government funding;
- changes in the size of the labour force;
- gains in productivity from having a more highly educated workforce; and
- gains in productivity from the additional research funding.

The **university funding model** is the base model that feeds inputs into the other three models. It is used to convert funding increases into the various costs and benefits of university funding. Primarily, this includes allocating any funding increase into the student and research activities of universities and to estimate the direct costs of increased university funding. However, it also provides estimates of changes in education exports (international students) and the size of the labour force.

To measure the benefits from improving the education level of Australians, an index showing the contribution of education to aggregate labour productivity was constructed. The **educational attainment and productivity model** calculates this index. To construct the index, each level of educational attainment is assigned a productivity score based on prevailing wages in a base year for that level of education. The estimates of wage premiums for different levels of education were obtained from Leigh’s estimation of the so-called “Mincer equation” (Leigh

2008). These estimates were then discounted by 20 per cent, and these discounted estimates are reported in Table A.

Table A: University Qualifications and Earnings Premiums

Educational level	Earnings premium relative to those without a post-school qualification
Diploma or Advanced Diploma	15%
Bachelor Degree	40%
Graduate Diploma or Graduate Certificate	37%
Masters or Doctorate	59%

Source: Leigh (2008) Table 4, but with discount of 20 per cent rather than 10 per cent.

With wages held constant in constructing the index, movements in the index reflect changes in the educational mix of the labour force. In particular, an increase in university funding leads to a higher percentage of the labour force with university qualifications (which attract a wage premium), resulting in a gain in the index.

The wage premiums have been discounted by 20 per cent to ensure that the productivity returns from expanding the university sector are not overstated. To some extent, the existing wage premiums earned by those with a university education reflect higher innate ability rather than the university education itself. Further, expanding the university sector is likely to involve easing admission requirements so that the additional places are filled by students whose ability is below the average of existing students. Leigh uses a 10 per cent discount to allow for these factors. However, this study adopts a deeper discount of 20 per cent to ensure that our results are on the conservative side.

To determine the productivity benefits associated with university-based research, KPMG Econtech estimated the returns to this type of investment. This analysis is carried out in the **university research and productivity model**. The first step was to allocate university research expenditure to the industries that ultimately benefit. International estimates of the likely rate of return were then applied to these expenditures. Based on our literature review, most studies show a real rate of return of between 20 to 40 per cent. To be conservative, we assume that the real rate of return for university research is 20 per cent. These returns were then converted to gains in labour productivity on an industry-by-industry basis.

As indicated in Box A, outputs from the university funding model, the university research and productivity model and the educational attainment and productivity model are introduced into two alternative, economy-wide models. The first is a basic growth accounting model, which demonstrates the main economic implications of expanding the university sector. The second is KPMG Econtech's economy-wide model, MM2, which provides a more developed dynamic dimension. MM2 is a fully integrated macro-CGE model, which is designed for macroeconomic forecasting and policy analysis and also contains broad industry detail.

There are two further economic implications of increased funding for the universities sector, which are accounted for in MM2, including:

- increases in export dollars (from international student fees); and
- increases in student assistance payments.

Both of the economy wide models used in this report have been updated to incorporate historical National Accounts data up to the September quarter of 2008, and the forecasts include the most recent changes in the economic environment.

Scenarios and results

Baseline

The **Baseline** scenario simply maintains funding at its existing share of GDP throughout the projection period. Currently, based on 2007 data, university funding is 1.6 per cent of GDP. In addition, the Commonwealth Government’s contribution of government grants equals 42 per cent of this contribution. As a point of comparison, these shares are maintained throughout the projection period for the baseline. This is essentially a “no policy change” scenario.

Pure Funding Augmentation

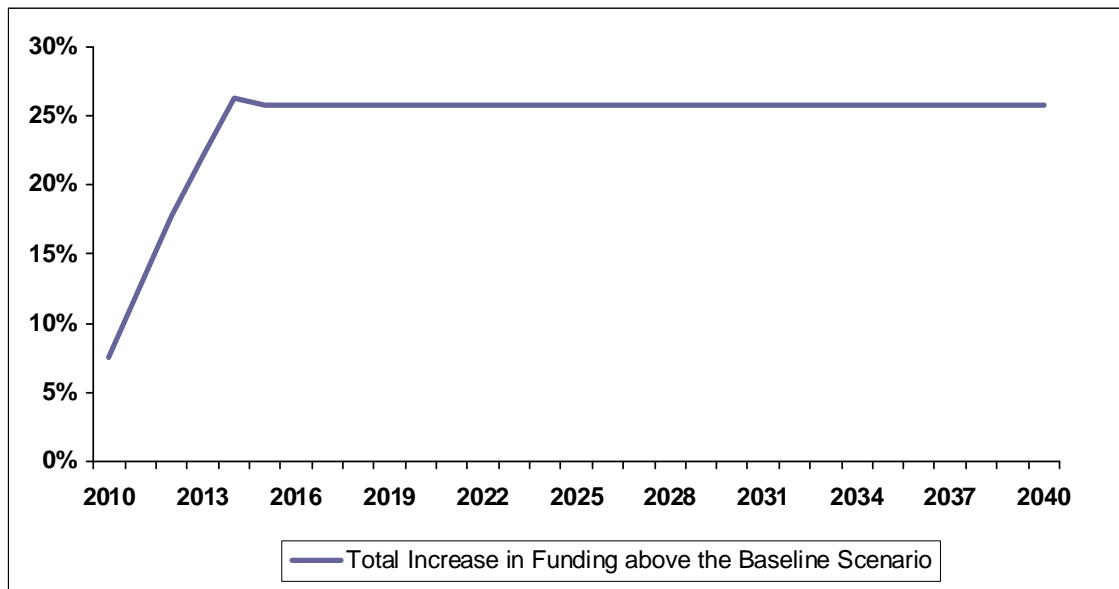
Table B shows the baseline funding scenario, based on existing funding arrangements for universities, and also the funding increases proposed by Universities Australia (UA) which are broadly in line with the funding increases outlined in the recent Bradley Review. Chart A depicts the total (from both public and private sources) increase in funding for universities above the baseline for the **Pure Funding Augmentation** scenario. The Pure Funding Augmentation scenario involves increasing university funding from 1.6 per cent of GDP to two per cent of GDP, with the Commonwealth grant share increasing from 42 per cent to 50 per cent. No other policy changes are assumed for this scenario, therefore this scenario involves a simple expansion of the university sector. The other scenario considered in this analysis involves structural reform. This initial comparison allows us to estimate the economic impact of using additional university funding to expand the sector without structural reform.

Table B: Baseline scenarios

Scenarios	Total funding as a share of GDP	Government Share
Baseline	1.6%	42%
Pure Funding Augmentation	2.0%	50%

Source: Universities Australia and KPMG Econtech

Chart A: Total Increase in Funding Above Baseline (% deviations from baseline)



Source: KPMG Econtech

As indicated earlier, increasing university funding will lead to an increase in the education level of the workforce and an increase in research outcomes. This leads to labour productivity benefits, and labour force gains arising from both gains in labour force participation rates from a more employable labour force and population gains from those international students that remain in Australia after the completion of their studies.

These two factors, labour productivity and the labour force, will both affect GDP and living standards, proxied by private consumption. To demonstrate this, GDP can be decomposed into five components using the following accounting identity.

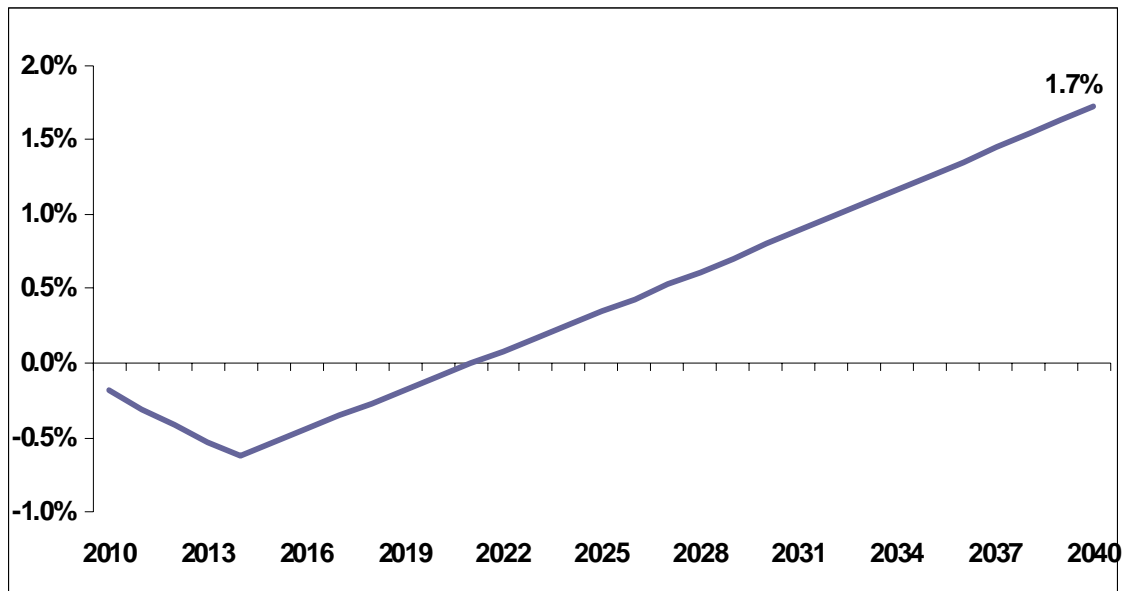
$$\begin{aligned}
 &GDP = GDP/employment \text{ (labour productivity)} \\
 &\times employment/labour \text{ supply (1 - unemployment rate)} \\
 &\times labour \text{ supply/working age population (participation rate)} \\
 &\times working \text{ age population/total population (working - age share)} \\
 &\times population
 \end{aligned}$$

This decomposition is useful because the individual components can be directly related to the modelling inputs. Thus, the decomposition provides a means of understanding how the modelling inputs impact on the estimate of gains in GDP.

However, it is important to note that changes in GDP are not an appropriate measure of this policy change. This is because it does not capture the costs associated with the change in policy. To properly assess the impact of the policy change and capture the costs, changes in living standards, proxied by private consumption, should be examined. This is because the Government will need to raise revenue, through raising taxes, in order to fund the increase in Government expenditure on universities. An increase in taxes lowers disposable income and hence consumption.

The following charts show the adjustments to labour productivity and participation from the policy change and how these both impact on real GDP. Chart B shows that the labour force is expected to shrink in the earlier years of the **Pure Funding Augmentation** scenario compared with the same years in the baseline scenario. This is because a higher level of funding increases the number of university places available. Hence, more individuals enrol in universities and thus spend less time in the workforce than would otherwise be the case. This continues until 2015, when the first intake of graduates begins to enter the workforce (both domestic graduates and approximately 3000 international graduates who obtain permanent work visas over the long-term). University graduates are more employable and hence have higher participation rates than non-university graduates of the same age. This positive effect gradually outweighs the negative effects of lower participation during years in university so that, by 2022, the labour force is larger than in the baseline scenario. By 2040, the labour force is expected to be 1.7 per cent larger than under the baseline scenario in the same year, which translates to just under 282,000 additional people in the labour force.

Chart B: Labour force effects for Pure Funding Augmentation scenario (% deviations from baseline)



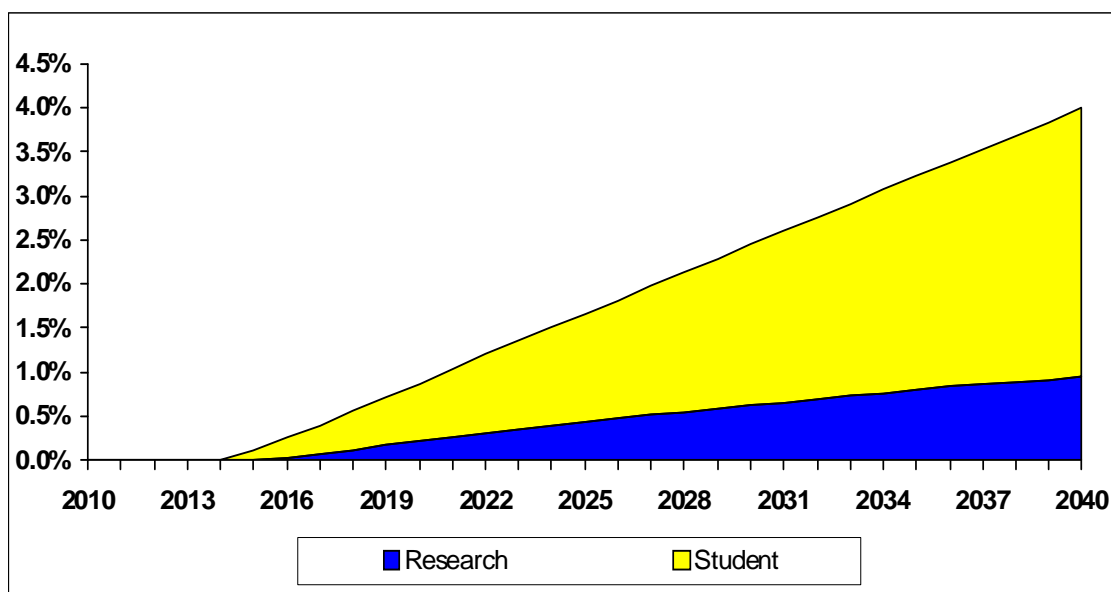
Source: KPMG Econtech

Chart C shows the estimated labour productivity effects resulting from the increase in university funding. For students, Chart C shows that the benefits of higher labour productivity commence

in 2014/15. This is because the new graduates (whose places have been financed by the increase in funding) first enter the workforce in this year. Gradually, as the funding level builds up to two per cent of GDP, the student productivity benefits begin to accumulate. By 2040, labour productivity is expected to be 3.1 per cent higher than in the baseline scenario in the same year as a result of the increase in the number of individuals with university-level education.

Turning to research funding, Chart C also shows its expected labour productivity benefits. These benefits gradually build as the knowledge base expands from sustained research. By 2040, the ongoing productivity boost exceeds 0.9 per cent. One reason the productivity boost from students is greater than from research is because more of the additional university funding is channelled to student education than to research. However, the returns from research (20 per cent) are higher than the returns from students.

Chart C: Productivity effects from students and research for the Pure Funding Augmentation scenario (% deviations from baseline)



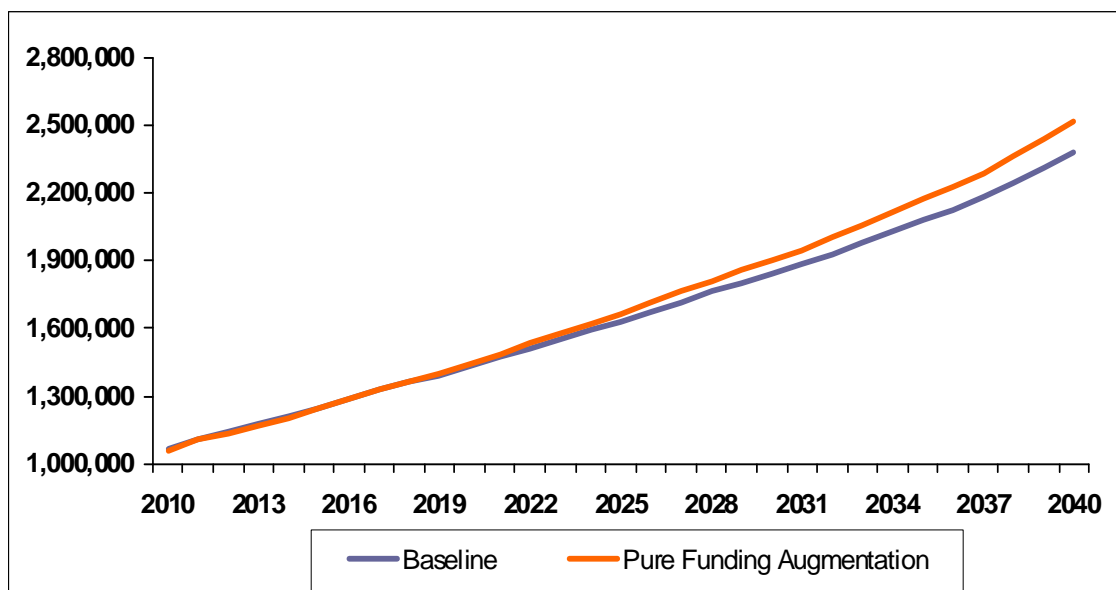
Source: KPMG Econtech

Combining the above labour force and productivity effects from Charts B and C and introducing these two effects into the **Growth Accounting Model**, Charts D and E show in different ways how real GDP is impacted by additional university funding. Chart D compares the paths of real GDP in the baseline scenario with the **Pure Funding Augmentation** scenario. Chart E presents the percentage deviations in GDP between the path of the **Pure Funding Augmentation** scenario and the path of the baseline scenario.

Chart D shows that, while GDP in the **Pure Funding Augmentation** scenario is initially below its path from the baseline scenario, it moves increasingly above baseline from 2017 onwards. This can be seen more clearly in Chart E, which presents the percentage deviations between the scenarios. Chart E shows that, by 2040, there is a gain in GDP from increased university

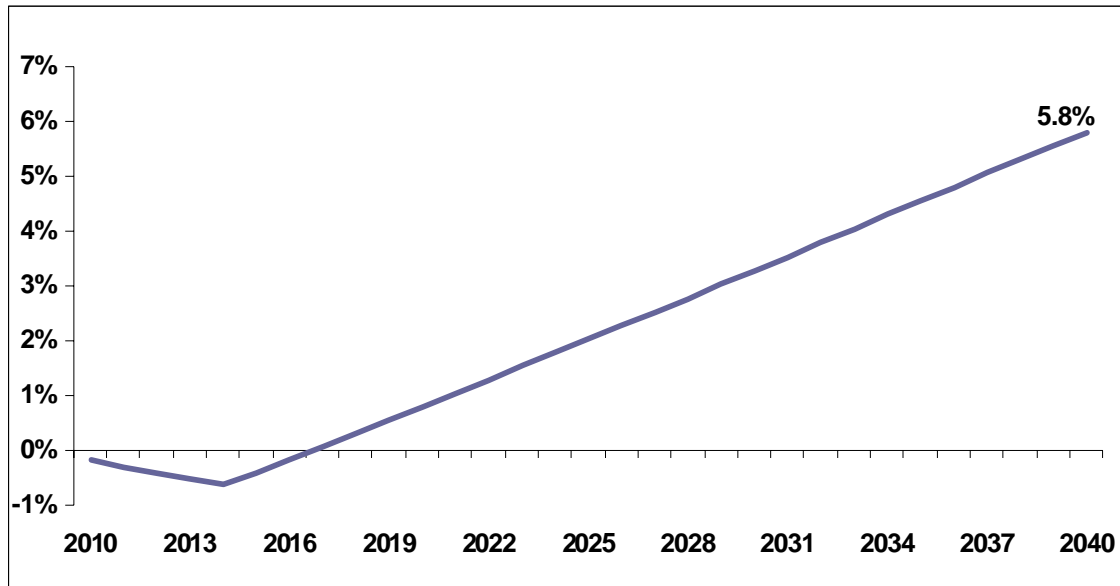
funding of 5.8 per cent. This result can be understood in terms of the labour force and productivity gains seen in Charts B and C. In particular, the 2040 GDP gain of 5.8 per cent can be attributed to the student-based labour force gain of 1.7 per cent, plus the student-based productivity gain of 3.1 per cent plus the research-based productivity gain of 0.9 per cent. So, of the total GDP gain of 5.8 per cent, 4.8 percentage points is student-based and 0.9 percentage points is research based. This percentage GDP gain in 2040 translates (in 2005/06 dollars) to around \$138 billion.

Chart D: Real GDP (millions, 2005/06 dollars, Growth Accounting Model)



Source: Universities Australia and KPMG Econtech

Chart E: Real GDP (% deviations from baseline, Growth Accounting Model)

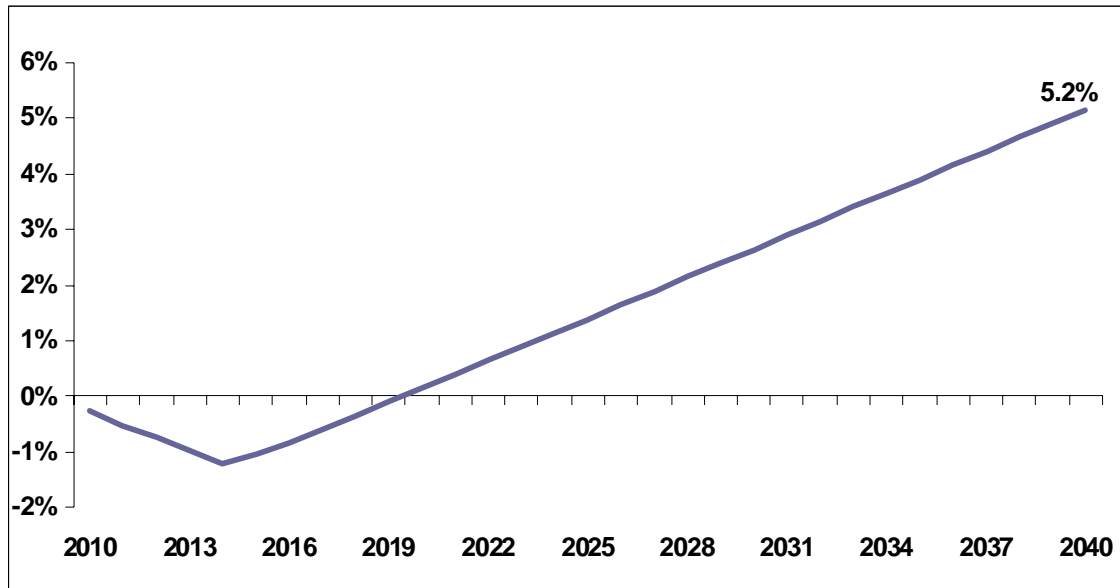


Source: Universities Australia and KPMG Econtech

These estimated gains in GDP do not tell the full story. They show the benefits of an expanded university sector before taking into account the costs. Over time, higher government expenditure on universities would be funded by taxpayers or reallocations from other programs. This is taken into account by assuming taxpayer funding, so that higher funding is balanced by taxes and therefore leads to lower household disposable income and consumption. Under this approach, the net benefit of an increase in university funding can be measured by the impact on living standards, proxied by private consumption. An increase in university funding leads both to higher GDP, which boosts household consumption, as well as higher taxes, which reduces household consumption.

Chart F shows the final net benefit of increased university funding as measured by the impact on living standards, proxied by private consumption. Importantly, the costs of expanding the university sector are incurred immediately, while the benefits take time to accumulate. Hence, a short-term sacrifice of living standards needs to be weighed against a medium to long-term gain. Chart F shows that the sacrifice extends for around 10 years before a growing gain emerges. The sacrifice incorporates the cost to the taxpayer of an expanded university sector as well as the loss in the labour force while individuals are studying at university. The gains incorporate the labour productivity gains from a more educated workforce and from more university research, as well as the labour force gains from a more employable workforce which is also expanded by foreign students who remain in Australia after the completion of their studies. By 2040, the boost to living standards amounts to 5.2 per cent.

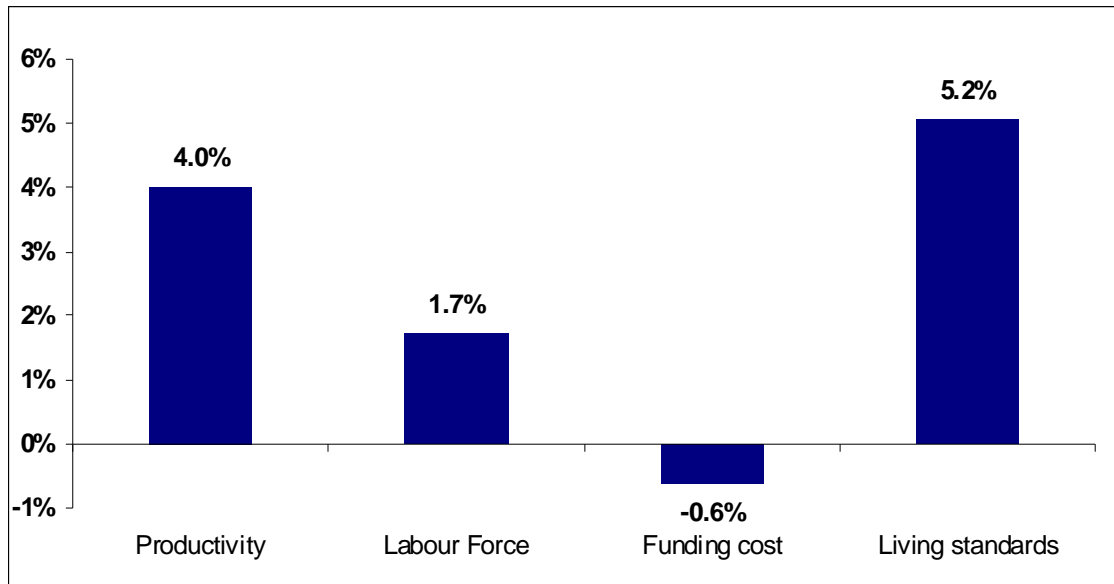
Chart F: Living standards (% deviations from baseline, Growth Accounting Model)



Source: Universities Australia and KPMG Econtech

This 5.2 per cent gain in living standards in 2040 can be decomposed into its elements as discussed above. Chart G shows that the gains in productivity (4.0 per cent) and labour force (1.7 per cent) are only partially offset by the increase in taxes associated with this policy (0.6 per cent) by the year 2040.

Chart G: Source of impact on living standards (private consumption) in 2040
 (% deviations from baseline)



Source: Universities Australia and KPMG Econtech

The usual way of balancing short-term costs against long-term gains is to calculate an internal rate of return (IRR) from investment in the policy. It is a useful tool to analyse the efficiency of investments and allows for comparisons across different investment options to determine which will deliver the highest return for each dollar of investment. The estimated IRR for this investment is 14 per cent per annum in real terms, considering the labour force benefits, productivity benefits, the cost of raising taxes and the timing of each. This high internal rate of return provides strong support for increased university funding.

However, whilst the benefits from increasing funding for universities appear clear, this applies to the particular funding expansion that is modelled in this report. This should not be extrapolated further to infer that funding should be further increased to the point where all individuals are university educated. This is because, as indicated earlier, as more students are educated, it is likely that the productivity benefits will diminish. For the particular funding increase that is modelled here, this point is taken into account under our approach of applying a 20 per cent discount to the productivity benefits. A larger discount would need to be applied for a larger funding increase.

As indicated earlier, outputs from the **university funding model**; **educational attainment and productivity model**; and **university research and productivity model** are also introduced into KPMG Econtech's economy-wide model, **MM2**, which provides a more developed dynamic dimension. In addition, **MM2** also accounts for additional exports from international student fees and the increase in student assistance payments.

The results from **the Growth Accounting Model** and **MM2** are broadly similar. For instance, the IRR from the **MM2** modelling provides a return to university funding of 15 per cent, close to the return calculated from the **Growth Accounting Model** of 14 per cent. The results also show that there is an initial reduction in living standards as a result of lower labour force participation and the cost of financing the additional university funding through taxes. However, over time the gains in population, productivity and participation mount, and living standards increase above the baseline scenario. By 2023, both the **Growth Accounting Model** and **MM2** show that living standards are well above baseline.

Structural reforms

Whilst the previous section clearly demonstrated the net benefits of increasing university funding, simply increasing the size of the sector may not be the most efficient and effective way for the Government to spend its tax dollars. To better understand this, Universities Australia is also interested in modelling the impact of varying policy settings. Given this, KPMG Econtech modelled the following scenario that illustrates the impact of undertaking reform within the university sector in conjunction with an increase in university funding.

The **Reform** scenario is an illustrative scenario that considers the impact of undertaking reform within the university sector in conjunction with an increase in funding. This scenario involves the same funding increase as the **Pure Funding Augmentation** scenario and also includes:

- reducing student-staff ratios;
- a reduction in the administration costs for universities;
- increasing the returns to research;
- reducing the Leigh wage premium discount;
- reducing attrition rates; and
- increasing completion rates.

Table C presents a summary of the results from all scenarios modelled in the year 2040. Table C shows that all scenarios provide positive benefits to the economy which suggests that any investment in university funding by the Commonwealth Government will yield benefits for the economy. This is in terms of their impact to real GDP and, more importantly, on living standards.

There are a number of reasons why it may be desirable to pursue a model that combines reforming the university sector in conjunction with an increase in funding. More intensive support to students, particularly those from traditionally disadvantaged backgrounds, may produce lower attrition rates and shorter completion times. Innovative course delivery could also help more people to complete in shorter times. Reducing student-staff ratios may free up staff time to produce research that could bring significant additional benefits to national productivity. There are, in other words, many other possible combinations of additional

research and student returns and improvements in attrition rates which achieve a gain in GDP which is the same as the gain under the **Pure Funding Augmentation** scenario, which is achieved primarily from expanding student numbers. The scenario discussed here is only an illustration of possible reforms which could be undertaken.

When modelling the **Reform** scenario for the purposes of this report, a reduction in the student-staff ratio 20.5:1 to 15.6:1 was simulated. The scenario assumes that the rate of return to research then increases from 20 per cent to 25 per cent, owing to more staff time being available for research, which is within the range observed in the literature for the benefits from publicly funded research. This scenario also assumes attrition rates fall from 21 per cent to 16 per cent for undergraduates and from 27 per cent to 22 per cent for PhD students, as a result of increasing engagement between staff and students. The Leigh wage premium discount employed of 20 per cent was reduced to 16.5 per cent to account for increased quality of teaching and learning outcomes. Finally, the Reform scenario also involved a reduction in administration costs for universities following the streamlining of unnecessary 'red tape' in collaboration with Government, which would allow for a greater proportion of the increased funding to be directed to students and research. These reform options, coupled with the same funding increase to two per cent of GDP, leads to a gain in GDP which is the near the same level achieved for the **Pure Funding Augmentation** scenario.

Table C: Summary of results for each scenario (2040)

	Participation (% deviations)	Student productivity (% deviations)	R&D productivity (% deviations)	Real GDP (% deviations)	Living standards (% deviations)
1 Pure Funding Augmentation	1.7%	3.1%	0.9%	5.8%	5.2%
2 Reform	1.4%	3.2%	1.2%	5.9%	5.3%

Source: KPMG Econtech

Tables D and E provide 10 year averages of each of the scenarios considered in this analysis. The first period does indicate reductions in participation, real GDP and living standards, relative to the baseline for both scenarios. As indicated earlier, reductions in participation in the short run are expected as more individuals enrol in universities and thus spend less time in the workforce than would otherwise be the case. The reductions in real GDP and living standards in the short run can be attributed to the fact that the costs of expanding the university sector are incurred immediately, while the benefits take time to accumulate. Over the longer term, it is clear that the benefits outweigh the costs of the expansion of the university sector.

Table D: 10 year averages for the Pure Funding Augmentation scenario

Pure Funding Augmentation scenario	2010-2019	2020-2029	2030-2039
Participation (% deviations)	-0.4%	0.3%	1.2%
Student Productivity (% deviations)	0.2%	1.2%	2.4%
R&D Productivity (% deviations)	0.0%	0.4%	0.8%
Real GDP (% deviations)	-0.2%	1.9%	4.4%
Living Standards (% deviations)	-0.7%	1.3%	3.8%

Source: KPMG Econtech

Table E: 10 year averages for the Reform scenario

Reform scenario	2010-2019	2020-2029	2030-2039
Participation (% deviations)	-0.3%	0.2%	1.0%
Student Productivity (% deviations)	0.4%	1.5%	2.6%
R&D Productivity (% deviations)	0.1%	0.5%	1.0%
Real GDP (% deviations)	0.1%	2.3%	4.6%
Living Standards (% deviations)	-0.4%	1.7%	4.0%

Source: KPMG Econtech

Tables F and G present 10 year averages for each of the scenarios considered in this analysis. The participation rate refers to the average participation rate for each of the three 10 year periods. The real GDP gain and living standards gain refer to the average annual increases above the baseline over each of the three 10 year periods. New graduates entering the labour force refers to the average per annum gain of new graduates entering the labour force. Under both scenarios, the average number of new graduates entering the labour force grows substantially over the long term. For instance, under the Pure Funding Augmentation scenario, the increased funding will result in:

- around 425,000 new graduates entering the labour force by 2020;
- around 975,000 new graduates entering the labour force by 2030; and
- around 1.7 million new graduates entering the labour force by 2040.

As indicated earlier, the reductions in real GDP and living standards in the short run can be attributed to the fact that the costs of expanding the university sector are incurred immediately, while the benefits take time to accumulate.

Table F: 10 year averages for the Pure Funding Augmentation scenario

Pure Funding Augmentation scenario	2010-2019	2020-2029	2030-2039
Participation rate (%)	64%	63%	63%
Real GDP gain (\$m, 2005/06 prices)	-1,933	31,487	91,828
Living Standards gain (\$m, 2005/06 prices)	-4,242	11,303	41,585
New Graduates entering the labour force (persons per annum)	42,400	54,864	70,016

Source: KPMG Econtech

Table G: 10 year averages for the Reform scenario

Reform scenario	2010-2019	2020-2029	2030-2039
Participation rate (%)	64%	63%	62%
Real GDP gain (\$m, 2005/06 prices)	1,620	37,665	96,207
Living Standards gain (\$m, 2005/06 prices)	-2,430	14,557	43,901
New Graduates entering the labour force (persons per annum)	36,452	47,142	60,161

Source: KPMG Econtech

Policy implications

The results presented in this report demonstrate that increasing university funding can have substantial impacts on productivity and participation and bring important economic benefits to the Australian economy.

Our modelling of the Pure Funding Augmentation scenario shows that increasing university funding from its current level of 1.6 per cent of GDP to two per cent of GDP, and increasing the share of Commonwealth Government grants up to 50 per cent from 42 per cent, leads to a 5.8 per cent gain in real GDP and a 5.2 per cent gain in living standards in the long term. Funding increases gradually from present levels under this analysis to reach an additional \$9.8 billion over present public funding levels by 2040, with a net gain in GDP of \$137.8 billion and \$1.5 billion in exports relative to the baseline in the long term. More importantly, living standards are \$64.3 billion above baseline in the long term. This gain in living standards occurs due to gains in the labour force and productivity of workers, which more than offsets the costs associated with increasing funding. The results from the Growth Accounting Model and MM2 are broadly similar. For instance, the IRR from the MM2 modelling provides a return to university funding of 15 per cent, close to the return calculated from the Growth Accounting Model of 14 per cent².

The results in this report suggest that, if the Commonwealth Government were to consider increasing funding in conjunction with additional policy changes, the benefits of increasing university funding would not be lost. Rather, additional policy changes aimed at meeting other policy objectives could be made in conjunction with this funding increase. This suggests that the government may want to consider not only increasing university funding but also how this money is spent within the sector. This is to ensure that taxpayers obtain the best return from their tax dollars and the Commonwealth Government is meeting its broader policy objectives.

² Our MM2 modelling results shows that increasing university funding leads to a 4.1 per cent gain in real GDP and a 3.4 per cent gain in living standards in the long term. The results from MM2 are slightly lower than the Growth Accounting model results as MM2 reaches equilibrium over the long-run, whereas the Growth Accounting Model reaches equilibrium each year.

1 Introduction

Universities are a key contributor to economic growth in Australia. By producing skilled and highly employable workers and investing in research, universities contribute to increasing both the productivity and the participation rate of workers in the economy. Despite this, funding from the Commonwealth Government has been stagnant in recent times.

Universities Australia has commissioned KPMG Econtech to measure the net economic benefits over time of government policies aimed at increasing university funding and adjusting various policies in conjunction with this increase in funding. Importantly, the economic modelling framework utilised in this report accounts for the direct and indirect benefits of increasing university funding as they accrue to the community and economy. This includes:

- increasing productivity;
- boosting exports of education services (international student fees);
- returns from university-based research; and
- an increase in the population as international students choose to reside in Australia at the completion of their studies.

This report is structured as follows.

- Section 2 provides background on the benefits of university funding and current funding arrangements.
- Section 3 presents a literature review on rates of return to education, public research and participation rate effects from increasing university funding. It also provides discussion on some of the key concerns of universities, namely student-staff ratios and administrative costs.
- Section 4 presents the modelling approach.
- Section 5 presents the scenarios modelled and the results.
- Section 6 presents policy implications of the results.

While all care, skill and consideration has been used in the preparation of this report, the findings refer to the terms of reference of Universities Australia and are designed to be used only for the specific purpose set out below. If you believe that your terms of reference are different from those set out below, or you wish to use this report or information contained within it for another purpose, please contact us.

The specific purpose of this report is to model the net economic benefits of increasing university funding over time.



The findings in this report are subject to unavoidable statistical variation. While all care has been taken to ensure that the statistical variation is kept to a minimum, care should be taken whenever using this information. This report only takes into account information available to KPMG Econtech up to the date of this report and so its findings may be affected by new information. Should you require clarification of any material, please contact us.

2 Background

The purpose of this section is to highlight the importance of the university sector to the economy. As a starting point, some illustrative figures may highlight the importance of the university sector to the Australian economy. For the first year (2009/10) of the policy change, KPMG Econtech's forecast of real GDP (in 2005/06 dollars) is around 1.08 trillion dollars and around 600 billion dollars for living standards. University educated workers currently make up around 23 per cent of the labour force. If we assume that these workers were removed from the workforce and replaced by non-skilled workers, this would result in a loss of labour productivity of around 11 per cent, or 119 billion dollars worth of GDP and 68 billion dollars in living standards. Whilst this is unrealistic, it does illustrate the value of the university sector to Australia. Table 2.1 provides some additional insights into Australia's higher education system.

Table 2.1: Australia's Higher Education System

Overall size of the sector in 2006 (millions)	\$15,913
Percentage of GDP	1.59%
Commonwealth Government Grants in 2006 (millions)	\$6,552
Number of Students in 2006	
Post graduate	270,449
Undergraduate	683,588
Enabling courses	7,309
Non-award courses	22,715
Total	984,061
Value of exports from education 2007-08 (millions)	\$12,864

Source: Department of Education, Science and Training (2007): Finance 2006, Financial Reports of Higher Education Providers; DEEWR (2006 and 2007): Students, Selected Higher Education Statistics; and ABS 5368.0.

Universities over the past half century have experienced a great deal of change in their regulatory arrangements. In the 1970s, Australian higher education moved from an elite model to a mass system funded by the Commonwealth with two tiers of universities and colleges/institutes. In the 1980s, the two tiers were brought into a unified, national system and student contributions were introduced through the Higher Education Contribution Scheme (HECS). More recently, access to HECS-style loans has been extended to students of private higher education providers.

These changes were made to point the higher education sector in a new direction and have been responsible for improving many parts of the higher education system. In many ways, Australia has been seen as a leader in reforming and investing in higher education. However, as other countries have now accepted the link between tertiary education participation and productivity, this has led other countries to develop new structures, funding levels and regulatory regimes.

Other countries have begun to substantially increase investment and reform their higher education systems, and this is likely to improve their relative performance. According to

research compiled by the OECD, Australia’s relative international position is likely to fall without substantial additional investment in, and reform of, Australia’s higher education system.

Table 2.2 provides an extract from the OECD’s comparison of educational attainment, specifically, the percentage of the population with a bachelor degree or above. Australia’s relative ranking for 25 to 34 year olds has declined over the 10 years from 1996 to 2006 (OECD 1998; OECD 2008). Table 2.2 shows that, between 1996 and 2006, the proportion of Australia’s population aged 25 to 34 years who had attained undergraduate qualifications increased from 16 to 29 per cent. However, Australia’s relative ranking slipped from seventh among OECD countries to ninth.

Table 2.2: International comparisons of education attainment - percentage with a bachelor degree or above

Age Group	1996		2006	
	25-64	25-34	25-64	25-34
Australia	15	16	24	29
OECD median	12	14	19	27
OECD - top 6 countries	19	23	28	34
United Kingdom	13	15	22	29
United States	26	26	35	35
Korea	19	30	23	33
Australia Ranking	6	7	6	9

Source: OECD (1998) Tables A1.2a and A1.3a; OECD (2008) Table A1.2a.

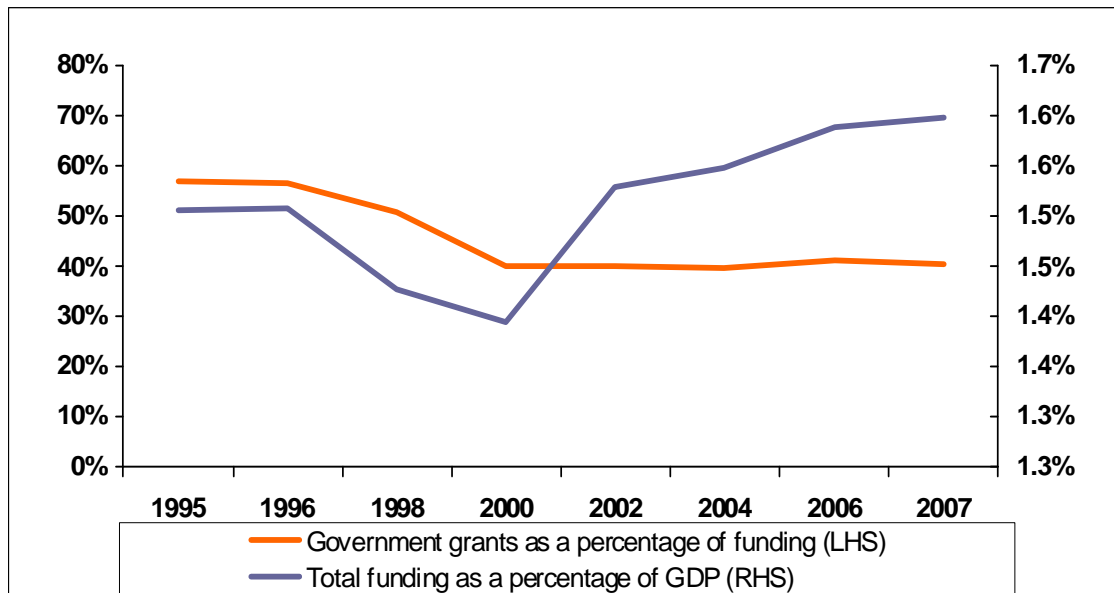
Investing in universities leads to increases in both the level of education of the workforce and research and development (research) outcomes. This results in gains in productivity, higher levels of labour force participation and an increase in the population from international students that remain in Australia. Productivity growth, labour force participation and population growth are key drivers of long-term growth in the economy. Along with these benefits, the impact of increased university funding may be more marked than the general effect for regional universities as regional universities play a particularly significant role in their own communities³.

The importance of these factors is demonstrated in the Australian Government’s Intergenerational Report in which the projections for real GDP and real GDP per person are constructed from the projections for population, labour force participation and productivity (Commonwealth Australia, 2007). The Commonwealth Treasury estimates that, over the last four decades, productivity growth has accounted for over 80 per cent of growth in GDP per person (Davis and Raham, 2006).

³ This was not incorporated into this study.

Despite the known benefits of investing in research and education, Government funding for universities has fallen in recent times. Government grant funding of Universities has fallen from around 58 per cent of total university income in 1995 to around 40 per cent at present. Up until the year 2000, this decline also led to a total decline in university funding. To increase income, universities have relied on rapidly expanding their international student programs, domestic full fee payments and investment and commercial revenues. However, in the face of a global economic slowdown and increased competition from other countries, it is unlikely that universities will be able to rely on international students and investments to supplement their income.

Chart 2.1: University funding over time (percentage)



Source: Department of Education Employment and Workplace Relations Source and KPMG Econtech.

If additional funding is provided to the higher education system, the economic benefits of an increase in university funding need to be weighed against the costs. These costs include reduced labour force participation of students during their time of study, and the economic cost of calling on taxpayers to fund university expansion. Importantly, the costs of expanding the university sector are incurred immediately, while the benefits take time to accumulate. Hence, a short-term sacrifice of living standards needs to be weighed against a medium to long-term gain.

This report models the net economic benefits over time of government policies aimed at increasing university funding and adjusting various policies in conjunction with this funding increase. Importantly, the economic modelling framework utilised in this report accounts for the direct and indirect benefits of increasing university funding as they accrue to the community and economy. This includes:

- increasing productivity;
- boosting exports of education services (international student fees);
- greater returns from university-based research; and
- an increase in the population as international students choose to reside in Australia at the completion of their studies.

3 Literature review

This chapter examines the economic theory and several key empirical studies on:

- the returns to education, both private and social returns;
- economic impacts of publicly funded research;
- the difference in participation rates from workers of different skill levels; and
- other factors that influence the returns to university funding.

Several key papers on each of these issues are discussed and the results are used to inform the choice of parameter estimates for the modelling component of this study. Table 3.1 summarises the key findings used to inform the modelling component of this study.

Table 3.1: Key findings used to inform the modelling component of this study

Factors Considered	Implications for this Study
The returns to education, both private and social returns	We adopt the approach taken by Leigh (2008) as a starting point to estimate the returns to education, both private and social returns. That is, we assume that the total (private and social) return to education is equal to the average increase in pre-tax earnings from an extra year of education. Under this assumption, estimates from the Mincer equation are considered as indicators of the social return to education. Given this, we use Leigh's estimates to construct a labour productivity index for the Australian economy, to determine the change in Australia's productivity from increasing the education of its workers.
The economic impacts of publicly funded research	While the estimates for the return to research vary, the majority of studies have estimated a return of between 20-40 per cent. However, to be conservative, we will assume an average return of 20 per cent for university research. This allows us to determine investment returns from public research funding which can be converted into expected labour productivity benefits.
The difference in participation rates from workers of different skill levels	For this study, we use the estimated ABS labour force participation rates to determine the net change in the size of the labour force as workers exit the workforce to study and re-enter the workforce as graduates.
Other factors that influence the returns to university funding	Considering these factors, we developed several scenarios to model in order to assess the impacts of allocating funds to specific areas. These scenarios include the impact of varying student-staff ratios and reducing administration costs as already indicated. However, we also consider the implications of varying other policy settings such as the split between student and research funding, the impact of attrition rates and the impact of fast-tracking university degrees.

Source: KPMG Econtech

3.1 Returns to education

This section includes a review of the economic theory behind tertiary education, in both the Australian and international context. The theory underpinning both private returns and social returns to education are discussed, followed by several key issues considered in determining the parameter estimates for this study.

3.1.1 Private returns to education

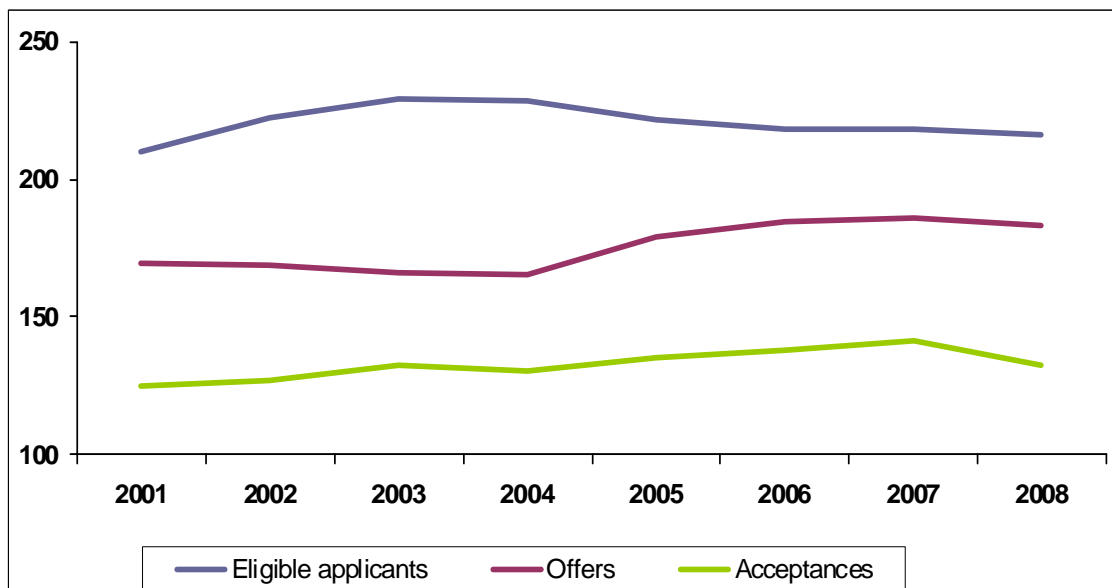
Individual returns to education are a major determinant of demand for university places. This section examines:

- drivers of demand for university places;
- empirical studies on the impact of education on earnings; and
- impact on earnings from under-and over-education.

Drivers of demand for university places

When making the decision whether to enrol in university, individuals make an assessment of the relative costs and benefits of undertaking that study. If the perceived costs, such as tuition fees and foregone income during study, are outweighed by the benefits, such as a potentially higher salary, then the individual will choose to enrol in university. The following chart illustrates trends in Australian university applications, offers and enrolments.

Chart 3.1: University Eligible Applicants, Offers and Acceptances 2008 ('000)



Source: Department of Education Employment and Workplace Relations, Undergraduate Applications Offers and Acceptances, 2008

Of interest is the decline in university applications across Australia since 2003. However, as can be observed in Chart 3.1, offers of university places increased sharply in 2004, although growth in offers has since levelled off. For this reason, despite lower applications, acceptances into university courses have increased at a slow but steady rate until 2008, when there was a sharp decline.

This evident fall in demand for university places is consistent with the idea that tertiary education can be seen as a form of investment. The fall in applications may, at least partially, be explained by the combined effects of increasing costs of university education and past strength in the Australian economy, partly supported by the resource boom.

Direct costs such as tuition fees and textbooks have been increasing over time. For example, compared to the \$2,300 per course per semester paid by students across all disciplines in 1989, Australian students beginning university in 2009 now face the following tuition fees:

Table 3.2: 2009 student contributions

Student contribution band	2009 Student contribution range (per EFTSL)
Band 3 Law, dentistry, medicine, veterinary science, accounting, administration, economics, commerce	\$0 – \$8,677
Band 2 Computing, built environment, health, engineering, surveying, agriculture	\$0 – \$7,412
Band 1 Humanities, behavioural science, social studies, foreign languages, visual and performing arts	\$0 – \$5,201
National priorities Education, nursing Mathematics, statistics and science	\$0 – \$4,162

Source: www.goingtouni.gov.au

Also, the past strength in Australia’s economy led to tightness in the labour market, which has enabled individuals to earn relatively high salaries without incurring the costs of a university education. Consequently, over the short term, the past strength in Australia’s economic growth, partly explained by the resource boom, has reduced the earnings differential between graduates and non-graduates, and fewer people have chosen to undertake university education. However, the effect of the resources boom is considered to be a short-term trend. Commodities prices have plummeted in recent months as a result of the slowdown in global economic growth.

These factors may help explain the decline in demand for university places in Australia over the past five years. However, since tuition fees are a policy instrument and since the resources boom has cooled, it should not be expected that the decline in demand will continue indefinitely into the future.

Empirical studies on education and earnings

Many attempts have been made to measure the private returns to education, using econometric methods to estimate the well known Mincer equation. The Mincer equation explains an individual's earnings as a function of their education, experience and a number of other relevant factors, and can be written as follows:

$$\ln(\text{earnings}_i) = \beta_0 + \beta_1 \text{educ}_i + \alpha Z_i + \varepsilon_i$$

where β_1 can be interpreted as the (private) return to education, since it measures the percentage increase in earnings from an increase in education by one year. Z_i is a vector of other control variables, such as labour force experience and gender.

As is widely acknowledged in the literature, there are a number of problems with such estimates of returns to education. The most significant of these is bias caused by the impossibility of measuring an individual's innate ability. Conventional measurement error is also seen as a problem.

Hausman and Taylor (1981) attempt to address the omitted variable bias problem by using an instrumental variable technique with the random effects model⁴. After correcting for omitted variable bias, the results indicate that one year of additional schooling will result in a 21 per cent increase in wages. This result is quite a bit higher than other studies. Hausman and Taylor (1981) initially used an Ordinary Least Squares and General Least Squares specification which assumes no correlation of the explanatory variables and the error and found that an additional year of schooling increased wages by 6.7 per cent. Traditional Instrumental Variable (IV) estimation yielded 9.7 per cent. The random effect IV technique yields a result of 12.5 per cent and, in the final specification (where some of the noncorrelation assumptions are relaxed), an increase in one year of schooling increases wages by 21.7 per cent. However, the standard errors are high and the coefficient estimates imprecise. The key result of their study was that all methods which control the correlation with the latent individual effects increase the schooling coefficient.

Ashenfelter and Krueger (1994) attempt to overcome both the omitted variable bias and measurement error by using a sample of identical twins. They are able to eliminate the problem of omitted ability bias by appealing to the idea that twins will have a similar level of innate ability and adjust their data accordingly by using a fixed effects estimator. Measurement error problems are overcome by taking independent estimates of each individual's level of schooling by asking each twin to also report their sibling's years in education.

Australian authors have also taken the same methods used in the Ashenfelter and Krueger study and applied them to comprehensive data from the Australian Twin Register (Miller, et al., 1995). Their results, after correcting for the various problems, suggest that the return to schooling was between five and eight per cent at the time of the study. The same authors updated their findings in 2006, and estimated that the return to schooling is between five and

⁴ Omitted variable bias refers to the bias that appears in estimates of parameters in regression analysis when the assumed specification is incorrect, in that it omits an independent variable that should be in the model.

seven per cent (Miller, et al., 2006). This implies that, if an Australian were to increase their schooling by one year, they can expect a five to seven per cent increase in their earnings. The results also imply that standard estimates are biased upward by around 10 per cent.

Leigh and Ryan (2008) also attempt to take into account the various problems in estimating the private return to education. They also find that bias in the estimators is not a large problem, only affecting the estimated rate of return by 10 per cent. Leigh and Ryan use three different methods to estimate the returns to education. They estimate the return to an additional year of education at eight to 13 per cent. This is a higher estimate than the results from Miller et al (2006). Leigh and Ryan point to the more accurate measurement of income in their data sample, which is taken from HILDA⁵, to explain this difference.

Since bias is only a small problem, an estimate made by Voon and Miller (2005) based on the 1996 Australian Census can be considered valid. Their Mincer equations estimate a nine per cent return to an additional year of education, which is close to Leigh and Ryan’s estimate. The return can be split into a 9.2 per cent return for men and an eight per cent return for women.

The following table summarises these estimates for the return to a year of education.

Table 3.3: Returns to education in Australia

Author (s)	Sample	Return to extra year of education
Miller, Mulvey & Martin (2006)	Australian Twin Register, 759 identical twin pairs, 1031 fraternal twin pairs, young age cohort	5 - 7%
Leigh & Ryan (2008)	Household, Income and Labour Dynamics in Australia (HILDA) survey, 2003 wave, 25-64 yrs, positive income	8 - 12 %
Voon & Miller (2005)	1996 Census of Population and Housing Household Sample File (HSF), sample size 42669	9%

However, a more useful study is that by Leigh (2008), which estimates the returns to different forms of education, such as Certificates, Diplomas and Bachelor Degrees, using a Mincer equation. This approach allows the returns to education to be different across different levels of education. Leigh also estimates the effects of education on the probability of positive earnings, that is on the probability of being employed. The estimates are made using the

⁵ HILDA stands for Household, Incomes and Labour Dynamics in Australia, which is a household-based panel data study which began in 2001. It is generally thought of as a high quality data set that can be useful to more accurately measure labour market conditions and relationships. See <http://www.melbourneinstitute.com/hilda/>.

HILDA data set. The annual returns relative to individuals with non post-school qualifications are reported in Table 3.4.

Table 3.4: Post school qualifications and earnings

Educational level	Earnings premium relative to those without a post-school qualification
Diploma or Advanced Diploma	17%
Bachelor Degree	45%
Graduate Diploma or Graduate Certificate	41%
Masters or Doctorate	67%

Source: Leigh (2008) Table 4

Note: Estimates are corrected for a 10 per cent upward bias

According to Leigh's estimates, a bachelor degree is expected to increase an individual's earnings by 45 per cent, compared to the situation where that same individual had no post-school qualifications.

However, there has been criticism of the Mincer equation. Heckman, Lochner and Todd (2008) criticise the Mincer equation, used in the above studies, and argue that it oversimplifies the education-earnings relationship, in the context of the US economy. They argue that the Mincer equation does not account properly for the existence of costs of education, the reduction in earnings owing to the increased time spent in education, and income tax. That is, they rightly point out that the estimates of the return to education are the pecuniary returns to education, without subtracting any of the costs. This should be taken into account when interpreting the estimates of returns to education. We take these impacts into account by adjusting the size of the labour force in the modelling and accounting for the Government expenditure required to fund the policy change, as will be seen in Section 4 and Appendix A. In this way, the loss the economy experiences whilst individuals are being educated is taken into account.

Another useful study was compiled by Marks (2008) who investigated the effect of post-secondary education and training on the occupations and earnings of young Australians. The data used for this study was derived from annual interviews of a sample of young Australians first interviewed when they were in year nine in 1995, and this data was collected until 2005. The initial sample comprised 13,613 students from around 300 government, Catholic and independent schools. This longitudinal data was utilised to analyse the occupational status of jobs and weekly earnings by type of post-school education and training.

Marks (2008) used multi-level regression analyses to estimate the effects of participation in and qualifications from various types of post-secondary education and training on occupational status and earnings net of the effects of other influences, such as prior labour market experiences of work and unemployment, literacy and numeracy, school type, socioeconomic background and ethnicity.

The results showed that post-secondary education and training leads to higher status occupations and higher earnings when compared to not completing any further study or training. Marks (2008) also found that these broadly positive results for this study are not apparent for all forms

of post-secondary education and training. Most importantly, apprenticeships and university degrees tend to have stronger effects on earning and occupations than other forms of post-secondary education and training, at least in the early stages of these young Australians' careers. In addition, a recent study by AMP.NATSEM (2008) also found a strong relationship between tertiary qualifications and the capacity to earn higher incomes. The study found that the incomes of people with higher qualifications of both sexes generally exceed those without, at all age groups. This study, along with other research in the area, provides further evidence of the private returns to education.

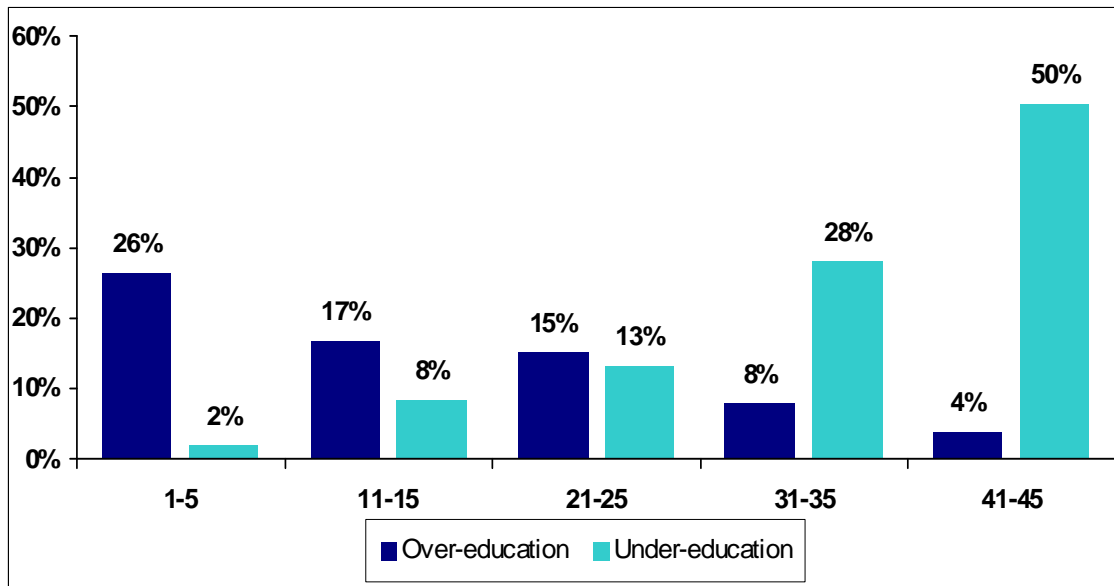
Impact of under- and over-education on earnings

The literature addressing the issue of overeducation and undereducation gives important insights into the private returns to education. Over-education refers to workers who have more education than is deemed necessary to complete their job. Under-education is the opposite situation in which a worker's educational attainment is inadequate for their job task.

According to Voon and Miller (2005), approximately 15 per cent of the Australian labour force is undereducated and 15 per cent is overeducated. They find that the return to education levels that are correctly matched to the job task is high, at 17 per cent. For education levels higher than the required level, the return is much lower at six per cent. For under-education, as expected, the return is negative at -3.4 per cent, implying that, if a worker was employed in a job that required 13 years of education and they only had 12 years, then they can be expected to earn 3.4 per cent less than a worker with 13 years of education.

Importantly, the incidence of over-education declines as labour experience increases, suggesting that, over time, workers search for jobs matching their education level. However, the incidence of under-education increases with labour market experience. This may be because older workers tend not to increase their education levels even as their job comes to require it, and hence fall behind the younger cohort which can more easily gain appropriate education levels. These phenomena are reflected in Chart 3.2.

Chart 3.2: Under-and over-education in Australia, by years of experience (per cent)



Source: Voon and Miller (2005)

Together, negative returns to under-education and the apparent inability to correct for it later in a worker’s life suggest that under-education poses a greater problem for individual earnings in Australia than does over-education. Moreover, over-education is still associated with positive returns, reinforcing the necessity for policy to focus on under-education. That said, if the positive returns from over-education do not take into account the costs of education as discussed earlier by Heckman, Lochner and Todd, then the magnitude of the positive returns may be questionable. Again, we take these impacts into account by adjusting the size of the labour force in the modelling and accounting for the government expenditure required to fund the policy change.

3.1.2 Social returns to education

The previous discussion of private returns to education focused on the earnings rewards that *individuals* receive for an extra year of education. However, there is some thought that the *social* returns to education may be different to the private returns. This section examines:

- productivity externalities from education;
- education and health benefits; and
- education and social and environmental benefits.

3.1.2.1 *Productivity externalities from education*

Some argue that private returns tend to understate the social returns to education. These economists emphasise knowledge as a public good; it is not depleted when shared and, once shared, no individual can be excluded from its use. When knowledge is generated through investments in education and science, a positive externality is produced leading to increased productivity and expanded production possibilities for the economy. A more educated workforce contributes positively to economic growth through an increase in total factor productivity.

In contrast, other authors consider the social returns to education may be overstated. Leigh (2008) points out that, if education is merely a credential, signaling ability without raising productivity, then the social return might be lower than the private return.

Leigh (2008) provides a snapshot of the literature on the social returns to education and notes that attempts to quantify social returns to education have found them to be modest at best. Abelson (2003) points out the externalities of education are easier to list than they are to measure. For example, Acemoglu and Angrist (2000) estimate that external returns to education are around one per cent and not significantly different from zero, while a literature review by Psacharopoulos and Patrinos (2004) found mixed evidence, suggesting that social returns might be lower or higher than private returns.

Whilst the magnitude of any social returns maybe difficult to distinguish from the private returns in a quantitative sense, there are some plausible returns that are worth considering. These are health, social and environmental benefits and are discussed in the next two sections.

Education and health benefits

Investment in education and health are essential to boost human capital. The economic value is founded in the resulting changes in productivity – both education and good health make individuals more productive. There is also a mutual relation between education and health. This connection between education and health levels is well documented, but the causal relationship between them is not well tested. Positive health impacts from higher levels of education would accrue to both the individual and society.

A paper prepared by the RTI International University of North Carolina for the US Department of Health surveyed the literature to assess whether literacy skills were related to a number of health issues. The paper found that low literacy is associated with several adverse health outcomes, including low health knowledge, increased incidence of chronic illness, poorer intermediate disease markers, and less than optimal use of preventative health services. However, the literature surveyed focused on literacy levels, measured by statistics such as whether the individual's reading level was at or above the ninth grade, and thus does not really capture the social value of tertiary studies.

Several papers assessing the effects of education on health were reviewed in the proceedings of the Copenhagen Symposium (OECD 2006). There is considerable international evidence that education is strongly linked to determinants of health.

- Lleras-Muney (2005) found that an additional year of schooling for individuals born between 1914 and 1939 was estimated to reduce the probability of dying in the next 10 years by 3.6 per cent; and
- Spasojevic (2003) found that, for a cohort of Swedish men born between 1945 and 1955, an additional year of schooling reduces a standardised index of bad health by 18.5 per cent.

The 2008 Australia's Health publication by the Australian Institute of Health and Welfare discusses the impact that socioeconomic factors, such as education, employment and income, have on individual and population health. The paper emphasises that tobacco smoking is the single most preventable cause of ill health and death in Australia and, in 2004-05, the cost of tobacco use was around 1.3 per cent of GDP. The paper highlights that, in 2007, persons without post-school qualifications were more likely to be current smokers than those with post-school qualifications.

Another relevant publication is the Australian Bureau of Statistics' (ABS) 2008 Yearbook which considered data drawn from the National Health Surveys (NHS), conducted by the ABS in 1995, 2001 and 2004-05. The data from the surveys provided some useful insights into the links between some socio-demographic characteristics and excess weight. It was found that adults with a degree, diploma or higher levels of attainment were less likely to be obese than those with no post-school qualifications. The data showed that, in 2004-05, 19.3 per cent of those with other non-school qualifications and 20.1 per cent of those without a non-school qualification were considered to be obese. On the other hand, only 12.9 per cent of the populations were considered obese if they had a degree, diploma or higher level of education attainment.

Other studies have examined the relationship between education levels and knowledge of health issues. Sessa et al (2008) conducted a cross-sectional survey on 1,165 adults. Logistic regressions were used to estimate the significance of education levels on various knowledge based questions regarding colorectal cancer (CRC). The results suggested that education (measured in years with >17 years being the highest category) was significantly correlated with knowledge of the high risk factors and knowledge of tests available to diagnose CRC.

Whilst the general benefits education can provide to health outcomes appear clear, studies that quantify this relationship appear scarce. One study that does attempt to quantify this is by Groot and van den Brink (2007). Using data from the Netherlands, they test for the causality relationship between health and education. They find that education does cause an individual to have better health. The authors then use various indexes from the literature to calculate the monetary value of the increase in health stemming from extra education. Finally, they estimate that the health return to an additional return to education is 1.3 to 5.8 per cent of an individual's earnings. That is, if we accept that there is a 10 per cent earnings reward for an extra year of education, we should add around three per cent for the health dividend.

Whilst this final study provides an indication of the possible monetary benefit education can have on health outcomes, no studies isolate the specific impact tertiary education can have on above normal schooling. To be conservative, we do not add a premium to the returns to tertiary education for health for this study.

Education and social and environmental benefits

In addition to potential productivity and health externalities associated from investing in education, there may also be broader social and environmental benefits. A paper by Descy (OECD 2006) discusses the macro-social benefits associated with investment in education, such as social cohesion, income equality and reduction in crime. Descy explains that, while some of these are the aggregation of individual benefits, others are not as they either cannot be attributed to particular agents, they are positional in nature (e.g. education equity), or the benefits are at the system level (e.g. societal trust). Descy discusses the results of an empirical analysis by Green et al. (2004) where no significant correlation of aggregate skill levels and various measures of social cohesion were found across countries. However, there was a significant negative correlation between educational inequality and the level of general trust. In this instance, the level of educational inequality was measured as the ratio of literacy test scores of individuals with tertiary education relative to those without tertiary education.

There is also evidence to suggest that higher levels of education may generate environmental benefits. Dunlap et al (2000) present the results of a survey of 676 Washington State residents on their environmental attitudes using a revised version of the New Environmental Paradigm (NEP) scale. The scale is constructed using the results from 15 questions on the extent that individuals agree with statements regarding the relationship of humans and the environment. The results indicate that education is significantly positively correlated with pro-environmental orientation. However, this paper does not discuss the implications of environmental concern and whether it is likely to generate environmental benefits.

Many authors have claimed that the environment is a luxury good (Borghesi, 1999). Thus, investing in education may generate environmental benefits via the increase in income that is generated. Borghesi provides a survey of literature on the Environmental Kuznets Curve (EKC) which suggests that, as income per capita increases, environmental degradation will initially increase but then decrease. The income elasticity of environmental demand is used to explain this relationship whereby people start to care more for the environment they live in as their living standards increase. However, in Borghesi's review of the empirical evidence for the existence of the EKC, he finds a number of limitations. These include dependence on which environmental index is used and the u-shape arising from cross-country analysis rather than representing a single country's experience.

Similar to the health section, whilst it would appear that some social and environmental benefits may exist from increasing education levels, no studies quantify this impact nor separate out the specific impact of tertiary education. To be conservative, we do not add a premium for these benefits.

3.1.3 Implications for this study

Considering all of these factors, and the the difficulty in estimating social effects, we adopt the approach taken by Leigh (2008) as a starting point. That is, we assume that the total (private and social) return to education is equal to the average increase in pre-tax earnings from an extra year of education. Under this assumption, estimates from the Mincer equation described in Table 3.5 are considered as indicators of the social return to education. Given this, we use Leigh's estimates to construct a labour productivity index for the Australian economy, to

determine the change in Australia’s productivity from increasing the education of its workers. Leigh’s estimates are chosen as they are:

- derived from high quality data;
- corrected for upward bias;
- provide separate estimated effects for different levels of education; and
- specific to Australia.

In addition, the wage premiums estimated by Leigh have been discounted by 20 per cent to ensure that the productivity returns from expanding the university sector are not overstated. To some extent, the existing wage premiums earned by those with a university education reflect higher innate ability rather than the university education itself. Further, expanding the university sector is likely to involve easing admission requirements so that the additional places are filled by students whose ability is below the average of existing students. Leigh uses a 10 per cent discount to allow for these factors. However, this study adopts a deeper discount of 20 per cent to ensure that our results are on the conservative side.

Table 3.5: University qualifications and earnings premiums with KPMG Econtech discount

Educational level	Earnings premium relative to those without a post-school qualification
Diploma or Advanced Diploma	15%
Bachelor Degree	40%
Graduate Diploma or Graduate Certificate	37%
Masters or Doctorate	59%

Source: Leigh (2008) Table 4, but with discounting of 20 per cent rather than 10 per cent.

3.2 Economic impacts of publicly funded research

This section examines the economic theory behind investing in research, in both the Australian and international contexts. The theory underpinning the source of returns from greater expenditure on research are discussed, followed by a discussion of the parameter estimates for this study. Much of this research was previously presented by KPMG Econtech in a study for the former Commonwealth Government Department of Education Science and Training (DEST) in 2006. However, for this study, the review has been updated to capture further studies on the returns to public investment in research.

3.2.1 Return to research and development

Much of the econometric literature shows consistent findings of a significant and positive rate of return to publicly funded research investments. Martin et al. (1996) present a comprehensive survey of early literature in this field. The authors show that most of the studies in their review

reach the same conclusion: that there is a positive and relatively high rate of return to research investments at the public level. Their literature survey also shows that there is great variation in the estimated rates of return by sector and by study. In spite of this variation, many studies place the economy-wide social rate of return on overall publicly funded research in the order of 20 to 40 per cent a year (e.g. Mansfield et al., 1977; Nadiri, 1993; President's Economic Council of Economic Advisors, 1995; Martin et al., 1996; NIH, 2000; The Allen Consulting Group, 2003).

Industry specific studies within this area have tended to focus on the impacts of publicly funded research within the manufacturing sector and the agricultural sector. A number of studies have also examined the link between publicly funded research and the output of pharmaceuticals and health related industries. Such studies have generally found that publicly funded research contributes significantly to productivity by improving production processes and lowering production costs, and also by underpinning product innovation and development. This in turn implies a high rate of return to publicly funded research and development.

In an early attempt to quantify the economic benefits of publicly funded academic research, Mansfield (1991) conducted a survey of 76 US firms within seven manufacturing industries – information processing, electrical equipment, chemicals, instruments, drugs, metal and oil. The survey found that roughly 11 per cent of new products and nine per cent of new processes could not have been developed in the absence of recent academic research (research conducted in the 15 years prior to 1991). These new products and processes were estimated to account for three per cent and one per cent of all industry sales respectively, from which Mansfield estimates a rate of return to academic research of 28 per cent. Using a similar methodology, but a much larger sample size (2300 firms), Beise and Stahl (1999) found that roughly five per cent of new product sales in the German manufacturing sector would not have taken place in the absence of academic research.

In a study of 12 US manufacturing industries, Nadiri and Mamuneas (1994) found that government funded research and development produces significant productivity gains by lowering the costs of manufacturing firms. Using a production function approach to estimate the cost elasticity of firms to publicly funded research and development, the authors estimated a social rate of return of between six to nine per cent. A later study by Mamuneas (1999) used a similar approach to estimate the social rate of return to publicly funded research and development within high-tech manufacturing industries in the US. The results of that study found the social rate of return to publicly funding research and development capital to range between 12 to 21 per cent, with an average rate of return of roughly 16 per cent.

Studies into the impacts of publicly funded research within agriculture have typically found high rates of return. Early studies by Griliches (1958, 1964) estimated the rate of return on public investment in agricultural research to range between 21 to 40 per cent. More recent work by Scobie and Everleens (1986) and Scobie and Hall (2006) estimate the return to publicly funded agricultural research in New Zealand to be around 30 per cent. Further, the literature survey contained in the OTA (1986) report finds consistent evidence of very high internal rates of return on public sector agricultural research. Of the studies included within the literature review, the estimated rate of return varies between 21 and 100 per cent, with the vast majority of estimates in the 33 to 66 per cent range.

Recent analyses of publicly funded health research provide evidence of strong positive rates of return to public research and development investments. A study by Toole (1999) of the US pharmaceutical industry examined the relationship between public research and the production of new commercially available chemical compounds. Toole found that a one per cent increase in the stock of public research results in a 2 to 2.4 per cent increase in the number of commercially available compounds. This was estimated to result in a rate of return to public science investments of between 11 to 32 per cent. Similarly, a literature review by Cockburn and Henderson (2000) found the rate of return to publicly funded research in the pharmaceuticals sector to be roughly 30 per cent.

A joint research paper by the Health Economics Group of Brunel University, the Office of Health Economics and RAND Europe (2008) estimates the economic benefits of publicly funded research into cardiovascular disease (CVD) in the UK. This study adopted a cost-benefit approach to measuring the impacts of CVD research, measuring the economic benefits of research as the value of quality adjusted life years gained through CVD research plus the contribution of research to GDP by reducing the burden of disease. Compared to the value of public and charitable funding invested in CVD research, the total return was found to range up to 39 per cent. This estimate is comprised of an internal rate of return from health benefits of 9.2 per cent plus a GDP return of 30 per cent.

More general studies have also found high rates of return to publicly funded research. Dowrick (2003) undertakes a literature review on the rates of return to public research carried out in government labs and universities. This review pays particular attention to studies that focus on the relationship between research expenditures and productivity growth across countries of the OECD. The estimates on the social rate of return to public research presented in Dowrick's survey range from 5.8 per cent to 8.7 per cent. Nonetheless, the survey indicates that these are under-estimates of the true social rate of return because studies measure the cost savings only for a sub-set of the economy.

Johnson (2000) estimated the rates of return from public and private investment in research in New Zealand for the agriculture, fishing, forestry, processing, manufacturing, energy, building, transport and service sectors as well as the total market sector. Johnson uses a total factor productivity approach to test whether changes in sector productivity can be wholly or partly explained by changes in private and public research in New Zealand. The results varied across industries ranging from -21.7 per cent return to public research for manufacturing to one per cent for forestry and services. Johnson notes that both private and public non-industry research act as substitutes for own-industry research supporting the public pool concept of research.

A summary of these econometric studies on rate of return to publicly funded research is shown in Table 3.6. It shows that the rate of return to publicly funded research generally varies from 28 to 67 per cent (apart from a few outliers) depending on the subject of the study and the methodology. It is important to note that all authors point out that, in order to be able to use the results of these studies, it is important to understand the difficulties associated with measuring the economic returns to research and the limits to this approach.

Table 3.6: Published estimates of the rate of return to publicly funded research

Author (s)	Subject	Methodology/ Framework^{a,b,c,d}	Annual rate of return to public R&D^e
Griliches (1958)	Hybrid corn	Economic surplus approach	21-40%
Griliches (1964)	Aggregate agricultural research	Production function approach	35-40%
Peterson (1967)	Poultry	Production function approach	21-25%
Schmitz-Seckler (1970)	Tomato harvester	Economic surplus approach	16-46%
Bredahl and Peterson (1976)	Cash Grain	Production function approach	36%
	Poultry		37%
	Dairy		43%
	Livestock		47%
Knutson and Tweeten (1979)	Aggregate agricultural research	Production function approach	28-47%
Mansfield (1980)	Industrial R&D	Total factor productivity approach	12%
Davis and Peterson (1981)	Aggregate agricultural research	Production function approach	37%
Norton (1981)	Poultry	Production function approach	27-33%
	Dairy		56-66%
	Livestock		30%
	Cash grain		44%
Scobie and Everleens (1986)	Aggregate agricultural research (New Zealand)	Total factor productivity approach	30%
Mansfield (1991)	All academic science research	Return on investment approach	28%
Huffman and Evenson (1993)	Aggregate agricultural research	Production function approach	43-67%
Nadiri and Mamuneas (1994)	Twelve manufacturing industries	Production function approach	6-9%
Mullen and Cox (1995)	Agricultural research: broadacre (Australia)	Total factor productivity approach	15-40%
Mullen, Cox and Hu (1997)	Agricultural research: broadacre (Australia)	Total factor productivity approach	12-20%
Health Economics Research Group, Office of Health Economics, RAND Europe (2008)	Cardiovascular research	Return on investment approach	39%

Author (s)	Subject	Methodology/ Framework ^{a,b,c,d}	Annual rate of return to public R&D ^e
Mamuneas (1999)	Six high-tech manufacturing industries	Production function approach	12-21%
Toole (1999)	Pharmaceuticals	Return on investment approach	11-32%
Cockburn and Henderson (2000)	Pharmaceuticals	N/A – study presents a literature review	30% +
Johnson (2000)	Nine industries	Total factor productivity approach	-27-1%
Scobie and Hall (2006)	Agriculture	Multifactor productivity approach	0-32% ^f

Source: Martin et al. (1996), OTA (1986), Mansfield (1980), Industry Commission (1995), and Scott et al (2002).

- a The economic surplus approach evaluates productivity changes that can be attributed to research. Productivity changes are interpreted as shifts in the supply function.
- b The production function approach relies on the estimation of production functions that contain research expenditures as an explanatory variable.
- c The total factor productivity approach is a variant of the production function approach where, instead of relating research to output, research is related to the growth in total factor productivity (TFP).
- d The return of investment approach estimates the rate of return that makes the discounted flow of costs and social benefits of research add up to zero.
- e Figures in this table are average values.
- f Annual average rate of return.

In the Australian context, a study was recently conducted to measure the delivered benefits of a major government research funding program in Australia. The Allen Consulting Group's study (2005) makes an assessment of the economic impacts of the Cooperative Research Centres (CRC) Program. The key finding of this study is that, over the period 1992-2010, the Australian economy's overall performance has been considerably enhanced when compared to the performance that would have occurred in the absence of the investment on the CRC Program. Over the 1992 to 2010 period, results from the economic impact assessment indicate that gross domestic product, real consumption, real investment and taxation revenues are higher than what would have occurred had the money spent on the CRC Program instead gone to general government expenditure. Specifically, GDP is cumulatively (in 2005 dollars) \$1,142 million higher, real consumption is cumulatively \$763 million higher, real investment is cumulatively \$417 million higher, and Commonwealth taxation revenue is cumulatively \$66 million higher.

A study conducted in 2006 by Insight Economics provided an update of the Allen Consulting Group study by assessing the impacts of round one to eight of the program as well as new from existing CRCs in round nine (compared to the 2005 study which focussed only on rounds one to seven). The results found that the cumulative impacts (in 2005 dollars) ranged from \$1,157 million to \$2,697 million for GDP, \$2,264 million to \$2,877 for total consumption and -\$4 million to \$436 million for investment. These figures were relative to the funding being used for tax cuts. The range of impacts reflect three levels of accounting for the benefits: level one includes benefits directly attributable to the program, level two includes additional benefits with an attribution rate, and level three includes additional benefits from the program which are only now commencing.

The positive impacts of the CRC Program highlights the role that partnerships between universities and the private sector can play in commercialising research opportunities. A report by Smith and O'Brien (2008) presents the results of a company level survey of innovation activity in Tasmania. The survey covers all sectors of the economy and firms with five or more employees. The results showed that 45.5 per cent of the innovating firms (507 firms) were involved in some form of collaboration. Of these 142 firms, 12.7 per cent of all innovating firms were collaborating with a university in Tasmania. Mansfield (1990) further supports the notion that links with universities are associated with higher levels of innovation. He observes that research intensive firms are more likely than others to carry out innovations based on recent academic research as they are more closely abreast of such research.

The relationship between universities and businesses may also suggest that there exist extra benefits from university linkages with business, possibly leading to above normal rates of return for research. However, this research is preliminary, and further research is required to clarify the nature of this relationship. Hence, we do not try to estimate any extra benefit from business linkages for this study.

3.2.2 Implications for this study

While the estimates for the return to research vary, the majority of studies have estimated a return of between 20-40 per cent. To be conservative, we will assume an average return of 20 per cent for university research. This allows us to determine investment returns from public research funding which can be converted into expected labour productivity benefits. This is explained later in Section 4 and Appendix A.

3.3 Workforce participation rates

Education and training contribute to higher living standards for individuals by increasing not only labour productivity but also labour force participation (Commonwealth of Australia, 2007). There is evidence to suggest that higher education levels are associated with higher rates of labour force participation. This section examines evidence from both the Australian and international contexts.

A report by the OECD (2002) provided the labour force participation rates across a number of countries for different levels of educational attainment. The report found that educated workers are more likely to participate in the labour market, and their active working life is generally longer than that for those with lower educational attainment. In most cases, participation rates for males with tertiary education was markedly higher than the participation rate for males with upper secondary qualification. This result was even stronger for women.

While several papers discuss the difference in participation rates among different skilled workers, a useful study by the ABS in 2005 quantifies these differing rates. Table 3.7 shows the results of the study for 15-64 year olds in 2003. The study shows that participation rates increase with levels of education. In particular, university bachelor degrees attract 91.8 per cent participation rates for men and 82.6 per cent for woman. This is significantly higher than for unskilled workers and marginally higher than the participation rates for other post secondary

skilled workers. As can be seen, the participation rates for men are higher than for women as is common from most studies.

Table 3.7: Australia workforce participation rates, 15-64 (2003)

	Males	Females
With non-school qualifications	90.7%	78.1%
Degree or higher	91.8%	82.6%
Advanced Diploma/Diploma/Certificate III/IV	90.4%	77.3%
Other qualification	88.8%	71.3%
Without non-school qualification	75.8%	59.1%
Total	83.6%	67.8%

Source: ABS (2005)

3.3.1 Implications for this study

For this study, we use these estimated ABS labour force participation rates to determine the net change in the size of the labour force as workers exit the workforce to study and re-enter the workforce as graduates.

3.4 Other impacts on the benefits of university funding

Increasing funding to universities will provide additional funds for both education and research. Sections 3.1 to 3.3 discussed the theory underpinning the parameters used to estimate the impacts of an increase in university funding. However, there is scope to manipulate these parameters and the other model inputs to assess the impact of allocating funds to specific areas.

This section discusses some of the literature around two key issues regarding the allocation of funding:

- the impact of the student to staff ratio on the returns to education and ability of academic staff to undertake research; and
- the impact of increasing administration expenses.

3.4.1 Student to staff ratios

There is evidence to suggest that student to staff ratios will have a bearing on the returns to university funding. Even in the absence of comprehensive studies on the effect of student to staff ratios, student to staff ratios are widely used as a proxy for educational quality, for example in the Times Higher Education University Rankings. An increase in the ratio may result in:

- poorer education outcomes and thus lower productivity returns from education; and

- academic staff having less time to undertake research and therefore lower productivity returns from research.

Stanley (1972) conducts a review of the early literature on optimal class size and finds that it is important to identify what is driving the outcome in education, i.e. is it class size, quality of instruction or teacher load. Stanley reported that a study conducted by Columbia University found the impact of reducing class size was difficult to measure as it depends on many factors including what the criteria of success is, the subject being taught and the teachers' feelings and attitudes. While the principles would apply across all forms of education, a shortcoming of these early studies is the focus on school class size rather than higher education.

Focusing on the aggregate student to staff ratio may not provide the most valuable insight into the quality of education as it hides the different ratios across disciplines. Taylor et al. (2004) discuss the implications of increasing student numbers for Pharmacy education. The paper notes that, in the UK, the student to staff ratio had increased from 8.5:1 in the 1980s to more than 20:1 thus threatening the quality of the learning experience. The paper emphasises the importance of professional socialisation in this discipline and the need for student contact with practitioner teachers. While practitioner teachers do not have a full-time presence within the pharmacy schools, this paper highlights the importance of student contact with their educators and the critical role that this can play in ensuring high quality education outcomes.

Student to staff ratios are part of the education experience for students and thus may influence the likelihood of completing a degree. Astin (1984) examines the implications of student involvement in their college experience. Student involvement is defined as the amount of physical and psychological energy devoted to the academic experience such as the energy devoted to studying and frequency of interactions with faculty members and other students. Astin discusses the results from an earlier longitudinal study of college dropouts that he conducted in 1975. The results from the 1975 study indicated that factors contributing to a student's involvement would lower their likelihood of dropping out. Astin found that frequent interaction with faculty is more strongly related to satisfaction with college than any other type of involvement. The work by Astin may indicate that improving student-staff ratios would have a positive impact on both attrition rates and the quality of education as it would provide greater opportunity for student contact.

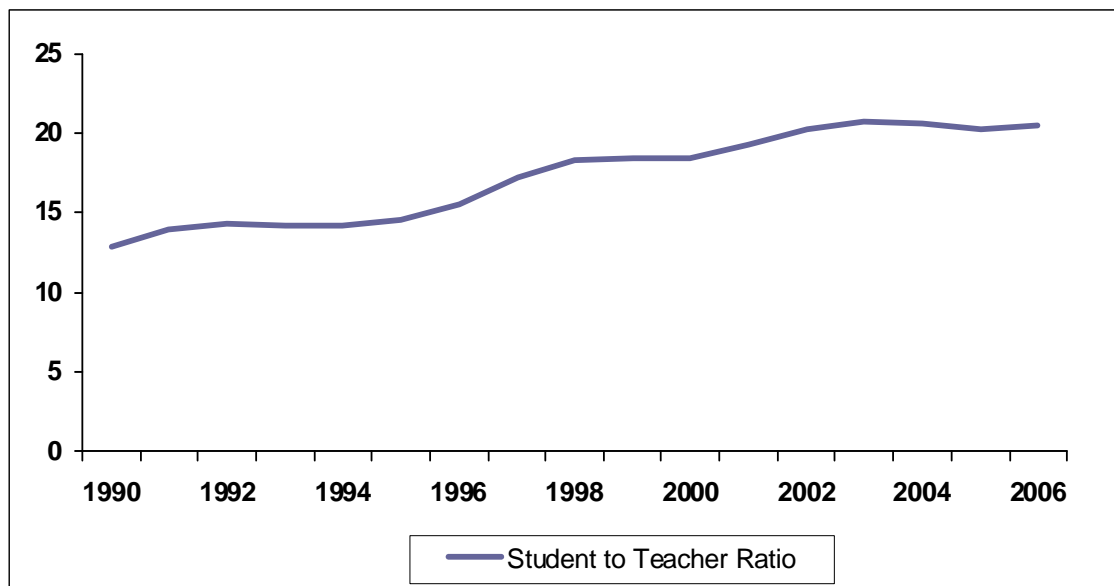
The impact of the level of student to staff ratios should be considered from the staff's perspective. Fowler (2005) considers the impact of the dramatic changes of the higher education in the United Kingdom (UK) over the last 20 years and their effect on staff working in higher education. The changes in the UK involve numerous factors and many of them are inter-related. These include: increasing number of students; a decrease in the staff/student ratio; a widening of participation; an increase in workloads and a change of management style. Importantly, these changes are not unique to the UK. Similar changes have occurred in Australia, and the impact on staff has been negative. To examine the impact of these changes, Fowler (2005) analysed published papers, student experience surveys and interviews with representatives from the two main lecturers' unions: Association of University and National Association of Teachers in Further and Higher Education. Fowler (2005) found that, without changes to higher education, the morale of staff is likely to fall, and difficulty will arise when trying to attract well-qualified, young staff. If this occurs, the result will be a core of experienced older staff supported by part-time teachers. To avoid this, Fowler (2005)

recommends that the first step should be to reduce the student to staff ratio. This is expected to result in a reduction in stress on staff by way of reduced marking and administration requirements and, as a result, provide better educational experiences for students.

3.4.2 Impact of administration expenses

Increasing administration costs and worsening student-staff ratios are inherently linked. There is evidence to suggest that there has been an increase in both administration expenses and an increase in the student to staff ratio at universities in Australia. Corden (2005) quotes student-staff ratios increased from about 13 in 1988 to 19 in 2000. This is confirmed by Universities Australia, as indicated in Chart 3.3. In addition, Corden notes the shift away from academic staff to non-academic staff and “other expenses”. This shift was driven by new administrative tasks related to income-generating activities, in particular costs associated with marketing other activities connected with foreign students, administrative costs associated with the amalgamations in the late 1980s and early 1990s, and the demands of bureaucracy. As a result of these changes between 1991 and 2000, the number of teaching staff fell by 11 per cent, while the student number rose 31 per cent and non-academic staff numbers rose 16 per cent.

Chart 3.3: Student to teacher ratio for academic staff with teaching function



Source: Universities Australia based on DEEWR data.

These figures indicate that increasing administrative expenses are detracting from the funds allocated to education and research and are therefore likely to be lowering the rate of return to university funding. Reducing these expenses by streamlining regulation and compliance requirements would likely increase the returns to additional university funding.

3.4.3 Implications for this study

For this study, we developed a scenario to assess the impacts of allocating additional funds to specific areas. This Reform scenario includes the impact of varying student-staff ratios and reducing administration costs. However, we also consider the implications of varying other policy settings such as the impact of attrition rates and completion rates. These scenarios are explained in more detail in Section 5.

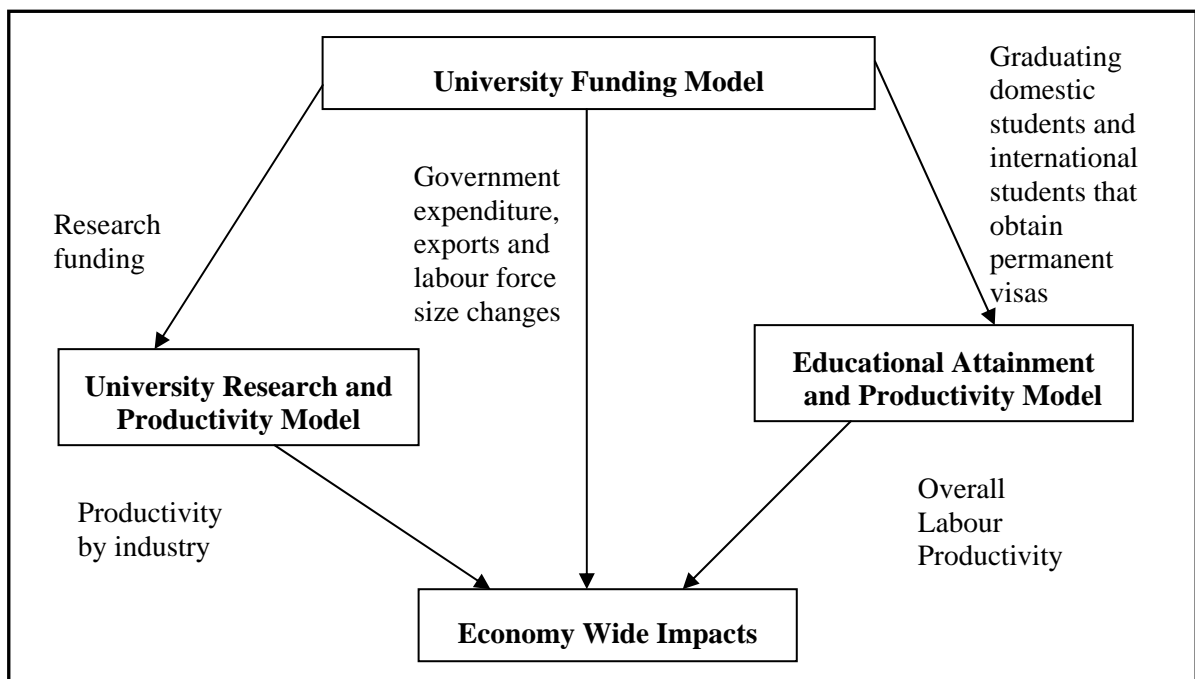
4 Modelling approach

As outlined earlier, to model the economic impact of increasing university funding, KPMG Econtech developed a system of models to capture both the economic costs and benefits of improved funding and reform arrangements for universities. The modelling system consists of four models and includes:

- a university funding model;
- an educational attainment and productivity model;
- a university research and productivity model; and
- an economy-wide, computable general equilibrium model as shown in Box 4.1.

To our knowledge, this is the first attempt anyone has made to estimate the net economic benefits of university funding in such a comprehensive manner.

Box 4.1: University Funding Modelling System



The key economic implications of expanding the university sector that are captured in the modelling framework include:

- increase in government funding;

- changes in the size of the labour force;
- increases in productivity from having a more highly educated workforce; and
- increases in productivity from the additional research funding.

In addition, there are two smaller economic implications of expanding the university sector, including:

- increases in export dollars (from international student fees); and
- increases in student assistance payments.

This section is structured as follows. Section 4.1 describes the **university funding model**. Section 4.2 describes the **educational attainment and productivity model**. Section 4.3 describes the **university research and productivity model**. Finally, section 4.4 discusses the main features of the economic model (MM2) that is used to estimate the economic contribution of the university funding. In all sections, the key inputs and outputs are also described. Note that this section provides a brief summary of the modelling framework used in this analysis. More detailed information can be found at Appendix A and Appendix B.

4.1 University funding model

The university funding model is the base model that feeds inputs into the other three models. It is used to convert funding increases into the various costs and benefits of university funding. Primarily, this involves allocating any funding increase into the student and research arms of universities and to estimate the direct costs of increased university funding. However, it also provides estimates of changes in exports and the size of the labour force.

In summary, the university funding model provides five key outputs:

1. Estimates of the increase in government expenditure (university funding and student assistance payments). This allows for the costs of diverting resources to the university sector away from other sectors in the economy and also the cost of raising additional taxes to be accounted for in the modelling.
2. Estimates of the increase in research funding by industry.
3. Estimates of the increase in the number of graduating students.
4. Estimates of the net change in the size of the labour force.
5. Estimates of the export dollars accruing from international students.

A key output provided by the university funding model is the estimate of the net change in the size of the labour force as a result of the increase in university funding. This is because the main economic benefits from having a highly educated workforce are higher participation rates and higher productivity. In addition, the key opportunity cost of increasing student places is a

reduction in the labour force as individuals opt out of the labour force and enrol in a university. Hence, it is crucial that all the factors affecting the net change in the size of the labour force are accounted for.

One important factor to consider when estimating the net change in the size of the labour force is the fact that:

- not all new students would have been part of the labour force;
- some new students would still work during their time at university; and
- a number of international students remain in Australia at the completion of their studies.

For the first two dot points, KPMG Econtech utilised data from Universities Australia to account for these two factors and estimate a full-time equivalent net change in the labour force. A more detailed exposition of the methodology used to develop this estimate can be found in Appendix A.

For the last dot point, KPMG Econtech allowed for an increase in Australia's population as a direct result of international students obtaining permanent work visas at the completion of their studies. An increase in the population from skilled migration has important economic benefits such as boosting expenditure on goods and services, increasing the demand for housing, increasing participation rates and boosting productivity. The last two effects arise because the newly graduated migrants have a higher skill level than the average Australian resident, by virtue of their university education. There are also beneficial demographic impacts of higher migration, migrants are usually younger than the existing resident population. However, the additions to the population as a result of international students choosing to remain in Australia at the completion of their studies are quite small. This is because the majority of the increase in university funding is channelled towards supporting new domestic student places. Thus, the benefits of higher immigration are dwarfed by the benefits accruing from having a more highly educated domestic labour force. Further details on how this aspect was modelled can be found in Appendix A.

As indicated in Box 4.1, government expenditure, labour force size changes and export dollars are entered directly into the economy-wide model. However, the additional research funding and the additional university students need to be converted into labour productivity increases before they can be introduced into the economy-wide model. These conversions are calculated in the **university research and productivity model** and the **educational attainment and productivity model** described in the next two sub-sections.

4.2 University Research and Productivity Model

To determine the productivity benefits associated with university-based research, KPMG Econtech estimated the returns to this type of investment. This analysis is carried out in the **university research and productivity model**. The first step was to allocate university research expenditure to the industries that ultimately benefit. This was done by separating funding into socioeconomic objectives based on ABS HERD data relativities and then matching these

socioeconomic objectives with industries in the economy based on the ABS’s ANZSIC classification.

The second step was to estimate the rate of return of this research funding by industry. This was done by using international estimates of the likely rate of return and then applying this to these expenditures. Based on our literature review, most studies show a real rate of return of between 20 and 40 per cent. To be conservative, we assume that the real rate of return for university research is 20 per cent.

Finally, the returns were converted into gains in labour productivity on an industry-by-industry basis. This was done by dividing each return by the wage bill of each industry. The returns can be viewed as cost savings that are improvements in labour efficiency (the same amount of output can be produced with less input – labour). The annual cost of labour input for each year for each industry are estimated by KPMG Econtech’s labour costs model. Once the annual labour efficiency improvements are measured, these changes are then introduced into KPMG Econtech’s macro-CGE model, MM2, as indicated in Box 4.1 and described in section 4.4.

4.3 Educational Attainment and Productivity Model

To measure the benefits from improving the education level of Australians, an index showing the contribution of education to aggregate labour productivity was constructed. The **educational attainment and productivity model** calculates the index. To construct the index, each level of educational attainment is assigned a productivity score based on prevailing wages in a base year for that level of education. The estimates of wage premiums for different levels of education were obtained from Leigh’s estimation of the so-called “Mincer equation” (Leigh 2008). These estimates were then discounted by 20 per cent, and these discounted estimates are reported in Table 4.1.

Table 4.1: University qualifications and earnings premiums

Educational level	Earnings premium relative to those without a post-school qualification
Diploma or Advanced Diploma	15%
Bachelor Degree	40%
Graduate Diploma or Graduate Certificate	37%
Masters or Doctorate	59%

Source: Leigh (2008) Table 4, but with discounting of 20 per cent rather than 10 per cent.

With wages held constant in constructing the index, movements in the index reflect changes in the educational mix of the labour force. In particular, an increase in university funding leads to a higher percentage of the labour force with university qualifications (which attract a wage premium), resulting in a gain in the index. These changes are then introduced into KPMG Econtech’s macro- CGE model, MM2 as indicated in Box 4.1 and described below.

4.4 Economy-wide impacts

As indicated in Box 4.1, outputs from the **university funding model**, the **university research and productivity model** and the **educational attainment and productivity model** are introduced into the two alternative economy-wide models. The first is a basic growth accounting model, which demonstrates the main effects in a transparent way. The second is KPMG Econtech's economy-wide model, MM2, which provides a more developed dynamic dimension.

Prior to incorporating the output from the **university funding model**, the **university research and productivity model** and the **educational attainment and productivity model** into MM2, the model was updated to reflect the most recent changes in the national and international economic environments.

For the first model, the basic growth accounting model, we use the key inputs mentioned above to estimate the net economic impact of increasing university funding. As indicated earlier, increasing university funding will lead to an increase in the education level of the workforce and an increase in research outcomes. This leads to labour productivity benefits, and labour force gains arising from both gains in labour force participation rates from a more employable labour force and population gains from those international students that remain in Australia after graduation.

These two factors, labour productivity and the labour force, will both affect GDP and living standards, proxied by private consumption. To demonstrate this, GDP can be decomposed into five components using the following accounting identity.

$$\begin{aligned}
 GDP &= GDP/employment \text{ (labour productivity)} \\
 &\times employment/labour \text{ supply (1 - unemployment rate)} \\
 &\times labour \text{ supply/working age population (participation rate)} \\
 &\times working \text{ age population/total population (working - age share)} \\
 &\times population
 \end{aligned}$$

This decomposition is useful because the individual components can be directly related to the modelling inputs. Thus, the decomposition provides a means of understanding how the modelling inputs impact on the estimate of gains in GDP.

However, it is important to note that changes in GDP are not an appropriate measure of policy change. This is because it does not capture the costs associated with the change in policy. To properly assess the impact of policy change and capture the costs, changes in living standards, proxied by private consumption, should be examined. This is because the government will need to raise revenue, through raising taxes, in order to fund the increase in government expenditure on universities. An increase in taxes lowers disposable income and hence consumption. To determine the net economic impact on living standards, the increase in government expenditure

required to fund the university sector is subtracted from the estimated increase in private consumption. Note that the modelling inputs flow through to living standards in the same way as GDP, hence the percentage change in real GDP is mirrored by the percentage change in living standards. This simple decomposition is used to illustrate the impact of increasing university funding on GDP and more importantly on living standards.

These results are further supported by using our economy-wide CGE MM2. MM2 is a fully integrated macro-industry econometric model which can be used to fully capture both the direct and indirect impacts of increased university funding on the Australian economy over time. MM2 is designed for macroeconomic forecasting and policy analysis and also contains broad industry detail.

There are two further smaller economic implications of expanding the university sector, which are accounted for in MM2, including:

- increases in export dollars (from international student fees); and
- increases in student assistance payments.

This means that, in total, the following inputs are introduced into MM2:

- increase in government funding;
- increase in student assistance payments;
- changes in the size of the labour force;
- increase in export dollars;
- increases in productivity from the additional research funding; and
- increases in productivity from a having a more highly educated workforce.

MM2 has the following important features that make it well suited for the analysis in this report.

- MM2 is a macro Computable General Equilibrium (CGE) model that fully recognises the interrelationships between the supply and demand sides of the economy. The model recognises that the demand side is important in influencing economic activity in the short term but, at the same time, they converge to the long term of a CGE model.
- The MM2 has been developed to be consistent with Australian data. Equation dynamics were developed by applying the general to specific approach in an error correction framework. The equations were subjected to a battery of diagnostic testing.
- For consistency with economic theory, the MM2 has long-run properties of steady state growth, profit maximisation, external balance, fiscal balance, and equilibrium rates of inflation and unemployment. The theory-related dynamic properties of the MM2 include rational expectations in financial markets, and a hierarchical adjustment process featuring a

Keynesian short run, a classical medium run, and a neoclassical long run. This ensures that this is a conservative modelling representation of the economy,

- The supply side of the MM2 is just as important as its demand side. Thus, GDP on the production side is modelled in some detail, as well as the expenditure side. In fact, the modelling of production complements, and fully-integrates, with the modelling of expenditure. GDP on the production side is disaggregated into the 18 broad Australian and New Zealand Standard Industry Classifications (ANZSIC) industries, linked together through an input-output table.

MM2 is based on the common view that, while demand shocks may affect economic activity in the short term, in the long term, economic activity is supply driven. Specifically, in long-run equilibrium:

- the unemployment rate converges to a NAIRU (non-accelerating inflation rate of unemployment);
- economic growth is steady and balanced; and
- the exchange rate appreciates/depreciates at a steady rate, allowing domestic inflation to be permanently below/above foreign inflation.

More information about MM2 is presented in Attachment B.

An assumption must be made regarding the timing of the costs and the benefits flowing from the increase in university funding for both models. This is because the costs and benefits will accrue over different time periods, leading to different year on year impacts from the policy change. Based on KPMG Econtech's own research and analysis and discussions with Universities Australia, the timing of the costs and benefits for the baseline scenario are as follows:

- The increase in the government funding for universities and student assistance payments commences in 2009/10 and continues thereafter.
- An increase in exports from international student contributions commencing in 2009/10 and continuing thereafter.
- The productivity benefits from the higher university based research are assumed to commence five years after the funding is received and continue thereafter. This allows for the research to be completed and then for commercialisation of this research to commence.
- The productivity benefits from the higher number of tertiary-educated students are assumed to commence five years after the students enter education. This is a conservative estimate of the average amount of time it takes to graduate from undergraduate and PhD degrees and to find employment. Note, since the majority of the increase in funding is expected to come from the Commonwealth Government, we have assumed no increase in Masters Degrees because students are largely charged the full costs of these degrees.

- A net change in the size of the labour force each year is determined by considering the number of extra full-time students entering university, the number of full-time students that leave university before finishing their degrees and the increased participation rate effect from the new graduates. This number is dependent on the assumptions made regarding full-time students, attrition rates and the length of time it takes to complete degrees.

Factoring in all of the inputs and the timing of the benefits and the costs, the growth accounting and MM2 models provide annual estimates of the impact of additional university funding on key macro variables such as GDP and private consumption. Furthermore, MM2 provides detailed industry effects at the 1-digit ANZSIC level.

Finally, both models show the long-term effects of the policy change out to 2040. This means that both provide an estimate of the impact of additional university funding after the economy has fully responded to the policy change. This is useful because economic policies should be judged against their lasting effects on the economy, not just their effects in the first one or two years. So, whilst the annual impacts are useful for determining the short-term impacts of the policy, the longer-term effects are more important when assessing the merits of the policy change. This is particularly true in this instance, as the benefits from additional university funding will only be felt in the medium to long term as the new graduates enter the workforce and as the new research is completed.

5 Scenarios and results

This section contains the scenarios and results of the modelling. Section 5.1 contains a description of the scenarios modelled in the report. Section 5.2 provides the economy-wide impacts of these scenarios.

5.1 Scenarios

To analyse the impact of changes to university funding arrangements, KPMG Econtech modelled two scenarios relative to the baseline scenario. These scenarios can be separated into pure funding augmentation and structural reforms. These scenarios are discussed in turn below.

5.1.1 Baseline

The **Baseline** scenario simply maintains funding at its existing share of GDP throughout the projection period. Currently, based on 2007 data, university funding is 1.6 per cent of GDP. In addition, the Commonwealth Government's contribution of government grants equals 42 per cent of this contribution. As a point of comparison, these shares are maintained throughout the projection period for the baseline. This is essentially a "no policy change" scenario.

5.1.2 Pure Funding Augmentation

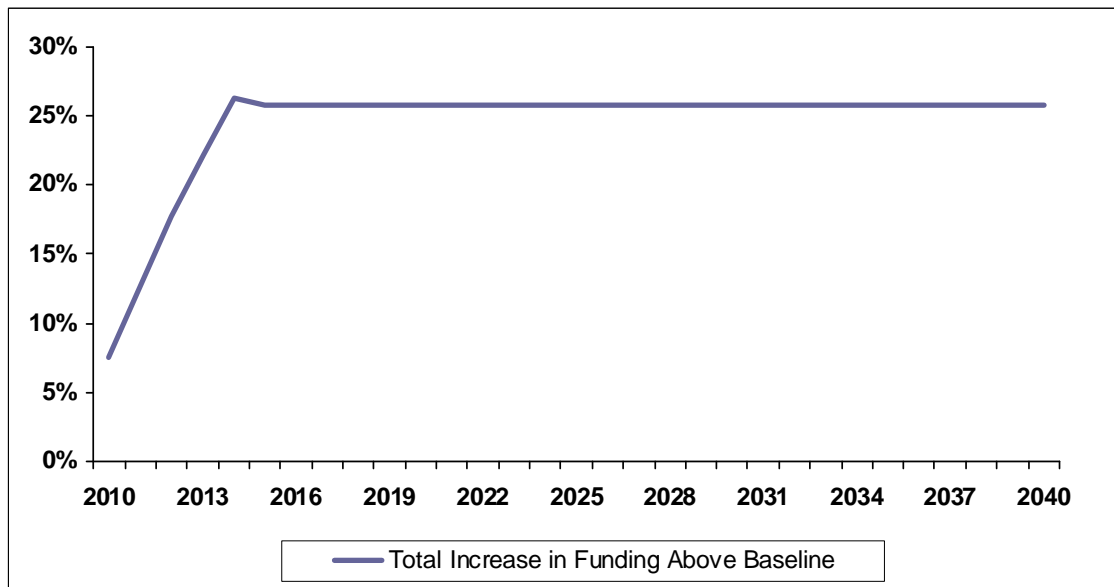
The first scenario is the **Pure Funding Augmentation** scenario. This scenario involves increasing university funding to two per cent of GDP. Of this two per cent, the Commonwealth Government will contribute 50 per cent of the funding, with the remaining coming from other sources. To achieve this, it is assumed that funding for universities in Australia increases gradually from 2009/10 until it reaches two per cent of GDP by 2014/15. Furthermore, the Commonwealth Government's contribution increases faster so that, by 2014/15, the Government's contribution of Commonwealth grants is 50 per cent. This scenario is broadly consistent with the funding recommendations in the Bradley Review. Chart 5.1 depicts this funding trajectory. Table 5.1 presents both the **Baseline** and **Pure Funding Augmentation** scenarios.

Table 5.1: Baseline scenarios

Scenarios	Total funding as a share of GDP	Government Share
Baseline	1.6%	42%
Pure Funding Augmentation	2.0%	50%

Source: Universities Australia and KPMG Econtech

Chart 5.1: Total increase in funding above Baseline



Source: KPMG Econtech

Note that, for the **Pure Funding Augmentation** scenario, no other changes are assumed, and this means that the existing split of student and research funding remains unchanged. Further, all other assumptions concerning attrition and completion rates and the number of PhD and undergraduate students remain. In this way, the **Pure Funding Augmentation** scenario allows for a straight comparison of the impact of increasing university funding. Essentially, this scenario boosts the size of the university sector without making any other policy changes.

5.1.3 Structural reform

Merely increasing the size of the sector may not be the most efficient way for the government to spend its tax dollars. To better understand this, Universities Australia would like to model the impact of implementing structural reforms that involve varying certain policy settings and market conditions to determine their impact on the economy. Hence, the **Reform** scenario involves the same funding augmentation as **Pure Funding Augmentation** scenario; however, adjustments are made to other parameters in the model to simulate the effect of additional policy changes on top of this funding. This method allows for a direct comparison of the **Reform** scenario with the **Pure Funding Augmentation** scenario.

The **Reform** scenario involves the same funding increase as the **Pure Funding Augmentation** scenario, but the impacts of reducing student-staff ratios and the impact of a reduction in the administration costs for universities are accounted for. This scenario also accounts for the fact that there may be a relationship between staff-student ratio and returns to research, returns to student productivity, as well as attrition rates and completion rates of students. As a result, this scenario also involves decreasing the attrition rates of domestic students, increasing the completion rates of domestic students, as well as increasing the returns from research and student productivity.

As noted earlier, adjustments to student to staff ratios will have a bearing on the returns to university funding. For example, an increase in the ratio may result in poorer education outcomes and thus lower productivity returns from education. Academic staff would also have less time to undertake research, and this lowers productivity returns from research. However, on the flip side, higher student staff ratios will lead to a greater throughput of students which helps to improve the skills base of the economy, although perhaps at a lower quality.

Table 5.2: Student-staff ratios

Year	Student-staff ratio
1996	15.6
2006	20.5

Source: Universities Australia based on DEEWR data.

It is not easy to model this impact since no data is available on how rates of return to research and education vary with student-staff ratios. However, if the university sector is operating at the optimal student-staff ratio, then, at the margin, any increase in funding should provide the same return whether it is allocated to more students or more staff. Hence, for illustration, KPMG Econtech has modelled the impact of reducing student-staff ratios. Table 5.2 shows that the student-staff ratio has increased from 15.6 to 20.5 between 1996 and 2006. Using these figures, KPMG Econtech simulates the results as if the student staff ratio reverted back to its 1996 level. As noted, whilst this scenario shows the impact of reforming the university sector, it does not indicate how to undertake these reforms, rather, it is an illustrative scenario.

The second part of the **Reform** scenario incorporates the impact of a reduction in the administration costs for universities. The Bradley Review has put forward several recommendations to reform the higher education system. Universities Australia in their submission to the review noted the regulatory and reporting requirements for universities and how this is adversely impacting on their ability to produce quality research and education. Unfortunately, no data is available to model the impact of specific scenarios that look at deregulating the university sector and reducing the administrative burden.

However, to provide an indication of how administration costs impact on university output, KPMG Econtech has modelled the impact of a five per cent reduction in the other expenses item of university budgets or the non-teaching expenses to university income ratio. To achieve this five per cent reduction, savings could be made by consolidating small grant programs; a reduction in the reporting requirements for higher education providers; or increasing the flexibility in the management of student places.

Currently, these other expenses take up around 30 per cent of university income each year. Hence 30 per cent of any additional university funding will be taken up by other expenses outside of teaching expenses. For this scenario, KPMG Econtech reduces this amount to around 25 per cent, hence only 25 per cent of additional funding is taken up by non-teaching expenses. This enables universities to increase their output of either research, or students, or both.

The third part of **Reform** scenario is accounting for the fact that there may be a relationship between staff-student ratio and returns to research and student productivity, as well as attrition

rates and completion rates of students. Therefore, the **Reform** scenario also involves decreasing the attrition rates of domestic students, increasing the completion rates of domestic students, as well as increasing the return to research and students.

When modelling the **Reform** scenario, the student-staff ratio was simulated assuming that the rate of return to research increases from 20 per cent to 25 per cent, which is within the range observed in the literature for the benefits from publicly funded research. This scenario also assumes attrition rates fall from 21 per cent to 16 per cent for undergraduates and from 27 per cent to 22 per cent for PhD students. Lastly, the Leigh Wage Premium discount employed of 20 per cent was reduced to 16.5 per cent to account for the impact of the other reform options modelled in this scenario. This leads to a gain in GDP which is the similar to that achieved under the **Pure Funding Augmentation** scenario. This illustrates the minimum extra return required from research and students, as well as attrition rates to justify reducing student-staff ratios.

It is important to note that this is only an illustration of the relationship between student-staff ratios. Other combinations of additional research returns and improvements in attrition rates which achieve a gain in GDP which is the same as the gain under **Pure Funding Augmentation** scenario are also possible.

The baseline attrition rates and completion rates in the model are presented in Table 5.3. Table 5.3 also presents the new attrition rates used for commencing students in the **Reform** scenario. The reduction in attrition rates for commencing students leads to a greater number of students completing their degree. This provides taxpayers with better value from their tax dollars. This is because taxpayers are contributing to the funding of thousands of students that do not complete their degrees, and hence the students and the economy do not obtain the full benefits of higher education.

Table 5.3: Attrition and completion rates

	Attrition Rates	Completion Rates	Reform scenario Attrition Rates	Reform scenario Completion Rates
Undergraduates	21%	65%	16%	69%
PHDs	27%	54%	22%	57%

Source: KPMG Econtech

5.2 Results

The results presented here follow the growth accounting presentation, to clearly illustrate how university funding can impact on the economy. These results are confirmed when we use our economy-wide CGE model, MM2, as well. We summarise the growth accounting methodology here again for ease of reference.

As indicated earlier, increasing university funding will lead to an increase in the education level of the workforce and an increase in research outcomes. This leads to labour productivity benefits, and labour force gains arising from both gains in labour force participation rates from a

more employable labour force and population gains from those international students that remain in Australia after graduation. These two factors, labour productivity and the labour force, will both affect GDP and living standards, proxied by private consumption. To demonstrate this, GDP can be decomposed into five components or channels using the following accounting identity.

$$\begin{aligned}
 &GDP = GDP/employment \text{ (labour productivity)} \\
 &\times employment/labour \text{ supply (1 - unemployment rate)} \\
 &\times labour \text{ supply/working age population (participation rate)} \\
 &\times working \text{ age population/total population (working - age share)} \\
 &\times population
 \end{aligned}$$

As noted, this decomposition is useful because the individual components or channels can be directly related to the modelling inputs, discussed in Section 4. Thus, the decomposition provides a means of understanding how the modelling inputs impact on the estimate of gains in GDP and living standards. The modelling inputs introduced into the growth accounting framework from section 4 are:

- changes in the size of the labour force;
- increases in productivity from the additional research funding;
- increases in productivity from a having a more highly educated workforce; and
- an increase in government funding.

The links from each of these four inputs to the three components of the gain in GDP are now considered in turn.

Initially, an increase in university places causes a reduction in the size of the labour force than would otherwise be the case as individuals leave the labour force and enroll in universities⁶. This has a negative effect on GDP as a reduction in the labour force causes the economy to lose productive capacity. However, over time, these students graduate and re-enter the labour force. As discussed in the literature review, high-skilled individuals such as university graduates have higher labour force participation rates than their low-skilled counterparts as they are more employable and motivated. As more individuals graduate over time, this has the steadily-

⁶ The loss in the labour force from individuals taking up study is not one to one because of two reasons. Firstly, not all new students would have been part of the workforce had they not enrolled in university. Secondly, some of the new students would be working as well as studying. Both these effects are accounted for in our modelling. Further details of our methodology can be found in Appendix A.

developing effect of boosting the labour force. These additions to the labour force lead to a mounting, favourable effect on GDP which eventually outweigh the negative effect on GDP. In the long term, the net effect is to raise GDP above baseline.

As well as improving the participation rates of the existing resident population, an increase in university funding also contributes to the labour force by increasing Australia's population. This is a result of new international students choosing to remain in Australia after the completion of their studies. Given that these new international students are more skilled than the average existing resident, and are likely to be younger than the average existing resident, this has the effect of boosting the labour force and hence GDP. The positive effect of this population boost on GDP will also compound over time as more international students choose to take up permanent residency. In addition, there will also be mounting demographic effects over time as new residents add to the number of births in Australia.

An increase in university funding also raises the skill level of the labour force above which would otherwise be the case. This raises labour productivity, and hence GDP, above baseline since an increase in labour productivity means that more output can be produced with the same amount of labour inputs. The gain to GDP from a highly skilled labour force also steadily develops through time as more and more new graduates enter the labour force, continually lifting the skill level of the labour force above baseline levels.

Similarly, the gains in productivity from additional university-based research financed by the increase in funding will also boost GDP above baseline. This gain to GDP gradually builds as the knowledge base expands from sustained research.

Finally, after allowing for the impacts of the two modelling inputs on GDP, we can translate these impacts on GDP to impacts on living standards by incorporating the costs of the policy change. As discussed earlier, it is important to note that changes in living standards are the appropriate measure of policy change because they incorporate the costs associated with the policy change. In this case, the costs include the taxes raised by the government to fund the increase in government expenditure on universities. An increase in taxes lowers disposable income and hence consumption. To determine the impact on living standards, the modelling inputs that flow through to GDP also flow through to living standards. Simply subtracting the increase in government funding leads to the net impact on living standards.

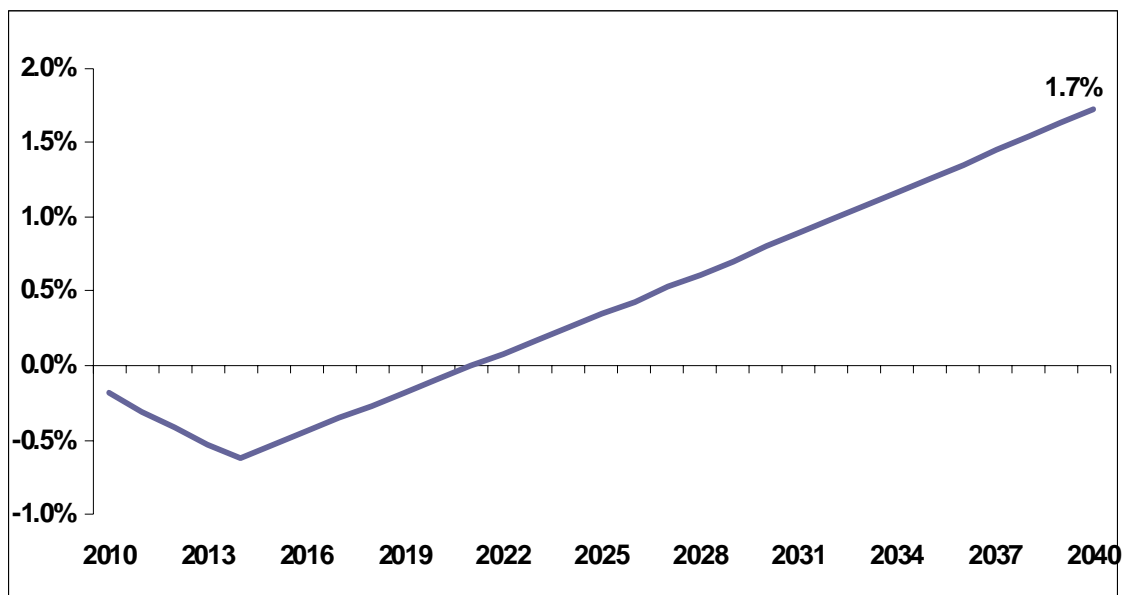
5.2.1 Pure Funding Augmentation of the university sector

Turning to the scenarios, Charts 5.2 and 5.3 show the estimated changes in the labour force size and labour productivity from the **Pure Funding Augmentation** scenario.

Chart 5.2 shows that the labour force is expected to shrink in the earlier years of the **Pure Funding Augmentation** scenario (expansion of the university sector) compared with the same years in the **Baseline** scenario. This is because a higher level of funding increases the number of university places available. Hence, more individuals enrol in universities and thus spend less time in the workforce than would otherwise be the case. This continues until 2015, when the first intake of graduates begin to enter the workforce (both domestic graduates and approximately 3000 international graduates that obtain permanent work visas over the long term). University graduates are more employable and hence have higher participation rates than

non-university graduates of the same age. This positive effect gradually outweighs the negative effects of lower participation during years in university so that, by 2022, the labour force is larger than in the **Baseline** scenario. By 2040, the labour force is expected to be 1.7 per cent larger than under the **Baseline** scenario in the same year, which translates to just under 282,000 additional people.

Chart 5.2: Labour force participation change for the Pure Funding Augmentation scenario (% deviations from baseline)

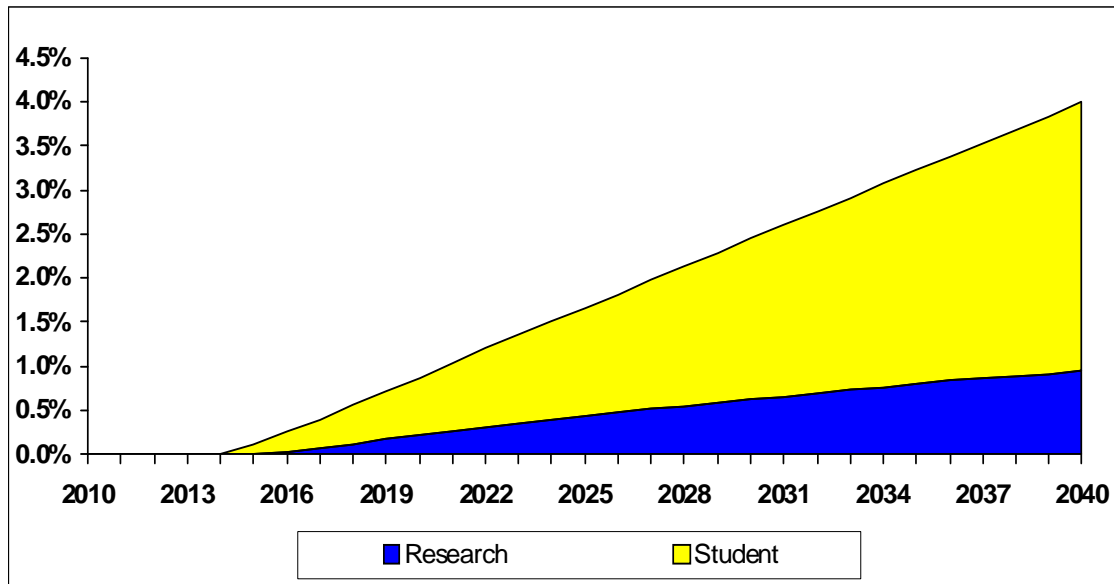


Source: KPMG Econtech

Chart 5.3 shows the estimated labour productivity effects resulting from the increase in university funding. For students, Chart 5.3 shows that the benefits of higher labour productivity commence in 2014/15. This is because the new graduates (whose places have been financed by the increase in funding) first enter the workforce in this year. Gradually, as the funding level builds up to two per cent of GDP, the student productivity benefits begin to accumulate. By 2040, labour productivity is expected to be 3.1 per cent higher than in the **Baseline** scenario in the same year as a result of the increase in the number of individuals with university-level education.

Turning to research funding, Chart 5.3 also shows its expected labour productivity benefits. These benefits gradually build as the knowledge base continues to expand from sustained research. By 2040, the ongoing productivity boost exceeds 0.9 per cent. One reason that the productivity boost from students is greater than from research is because more of the additional university funding is channelled to student education rather than research.

Chart 5.3: Productivity effects from students and research from the Pure Funding Augmentation scenario (% deviations from baseline)

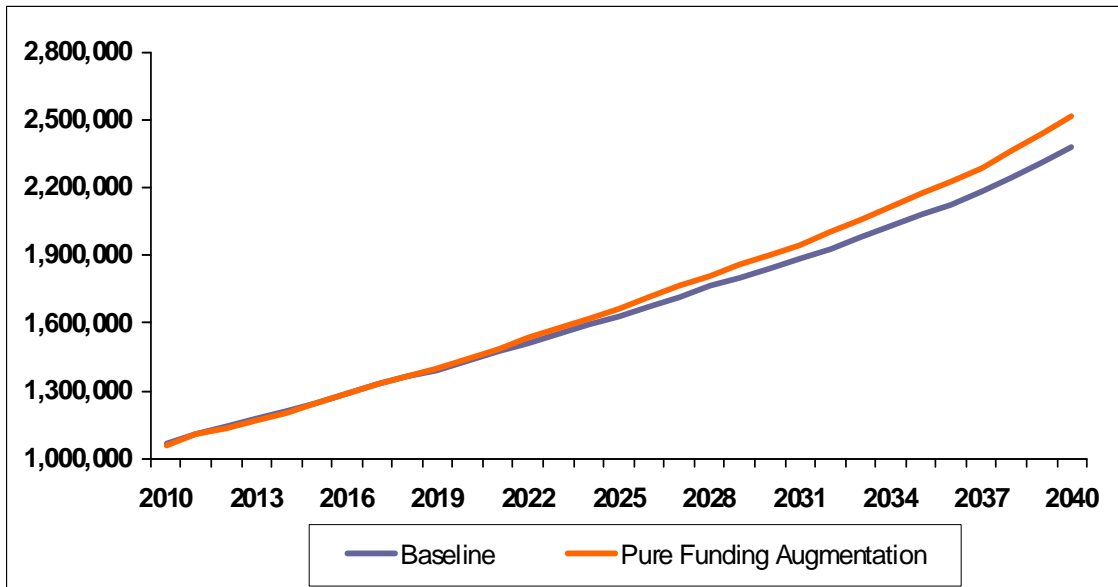


Source: KPMG Econtech

Combining the above labour force and productivity effects from Charts 5.2 and 5.3, Charts 5.4 and 5.5 show in different ways how real GDP is affected by expanded university funding. Chart 5.4 compares the paths of real GDP in the **Baseline** scenario with the **Pure Funding Augmentation** scenario. Chart 5.5 presents the percentage deviations in GDP between the path of the **Pure Funding Augmentation** scenario and the path of the **Baseline** scenario.

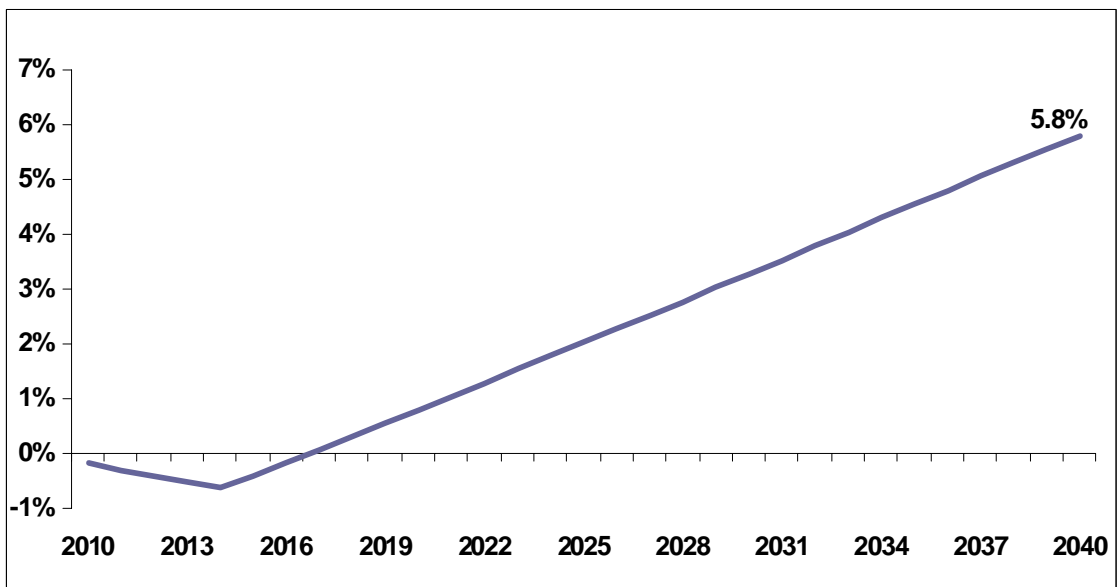
Chart 5.4 shows that, while GDP in the **Pure Funding Augmentation** scenario is initially below its path from the **Baseline** scenario, it moves increasingly above baseline from 2017 onwards. This can be seen more clearly in Chart 5.5, which presents the percentage deviations between the scenarios. Chart 5.5 shows that, by 2040, there is a gain in GDP from higher university funding of 5.8 per cent. This result can be understood in terms of the labour force and productivity gains seen in Charts 5.2 and 5.3. In particular, the 2040 GDP gain of 5.8 per cent can be attributed to the student-based labour force gain of 1.7 per cent, plus the student-based productivity gain of 3.1 per cent plus the research-based productivity gain of 0.9 per cent. So, of the total GDP gain of 5.8 per cent, 4.8 percentage points is student-based and 0.9 percentage points is research based. This percentage GDP gain in 2040 translates (in 2005/06 dollars) to around a \$138 billion gain in GDP.

Chart 5.4: Real GDP for baseline and the Pure Funding Augmentation scenario (millions, 2005-06 dollars)



Source: KPMG Econtech

Chart 5.5: Real GDP (% deviations from baseline)



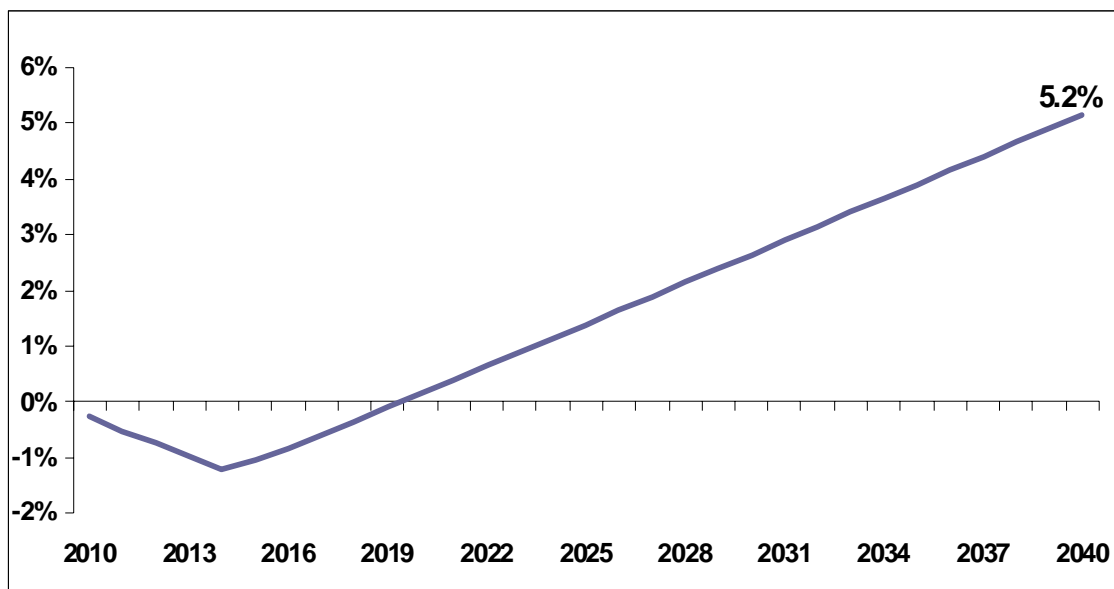
Source: KPMG Econtech

These estimated gains in GDP do not tell the full story. They show the benefits of an expanded university sector before taking into account the costs. Over time, higher government expenditure on universities would be funded by taxpayers or reallocations from other programs. This is taken into account by assuming taxpayer funding, so that higher funding is balanced by

taxes and therefore leads to lower household disposable income and consumption. Under this approach, the net benefit of an expansion in the university sector can be measured by the impact on living standards, proxied by private consumption. An expansion in university funding leads both to higher GDP, which boosts household consumption, as well as higher taxes, which reduce living standards.

Chart 5.6 shows the final net benefit of higher university funding as measured by household consumption or living standards. Importantly, the costs of expanding the university sector are incurred immediately, while the benefits take time to accumulate. Hence, a short-term sacrifice of living standards needs to be weighed against a medium to long-term gain. Chart 5.6 shows that the sacrifice extends for around 10 years before a growing gain emerges. The sacrifice incorporates the cost to the taxpayer of an expanded university sector as well as the loss in labour force while the individuals are studying at university. The gains incorporate the labour productivity gains from a more educated workforce and from more university research, as well as the labour force gains from a more employable workforce which is also expanded by foreign students who remain in Australia. By 2040, the boost to living standards will amount to 5.2 per cent.

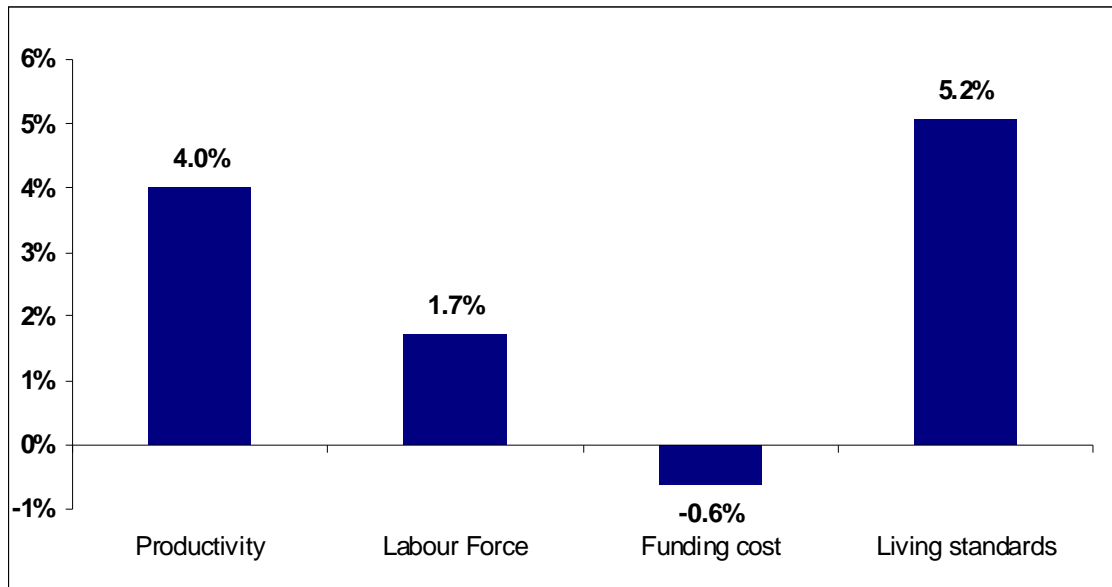
Chart 5.6: Living standards (% deviations from baseline)



Source: Universities Australia and KPMG Econtech

This 5.2 per cent gain in living standards in 2040 can be decomposed into its elements as discussed above. Chart 5.7 shows that the gains in productivity (4.0 per cent) and labour force (1.7 per cent) are only partially offset by the increase in taxes associated with this policy (0.6 per cent) by the year 2040.

Chart 5.7: Source of Impact on living standards (private consumption) in 2040 (% deviations from baseline)



Source: Universities Australia and KPMG Econtech

The usual way of balancing short-term costs against long-term gains is to calculate an internal rate of return (IRR) from investment in the policy. It is a useful tool to analyse the efficiency of investments and allows for comparisons across different investment options to determine which will deliver the highest return for each dollar of investment. The estimated IRR for this investment is 14 per cent per annum in real terms, considering the labour force benefits, productivity benefits, the cost of raising taxes and the timing of each. This high internal rate of return provides strong support for increased university funding.

However, whilst the benefits from increasing funding for universities appear clear, this applies to the particular funding expansion that is modelled in this report. This should not be extrapolated to infer that funding should be further increased to the point where all individuals are university educated. This is because, as indicated earlier, as more students are educated, it is likely that the productivity benefits will diminish. For the particular funding increase that is modelled here, this point is taken into account under our approach of applying a 20 per cent discount to the productivity benefits. A larger discount would need to be applied for a larger funding increase.

5.2.2 Structural reform of the university sector

Whilst the previous section clearly demonstrated the net benefits of increasing university funding, simply increasing the size of the sector may not be the most efficient way for the government to spend its tax dollars. To better understand this, Universities Australia is interested in modelling the impact of varying policy settings. Given this, KPMG Econtech

modelled the following **Reform** scenario that illustrates the impact of undertaking reform within the university sector in conjunction with the increase in university funding.

The **Reform** scenario illustrates the impact of undertaking reform within the university sector in conjunction with the funding increase. This scenario involves the same funding increase as the baseline scenario, but the impacts of reducing student-staff ratios and the impact of a reduction in the administration costs for universities are investigated.

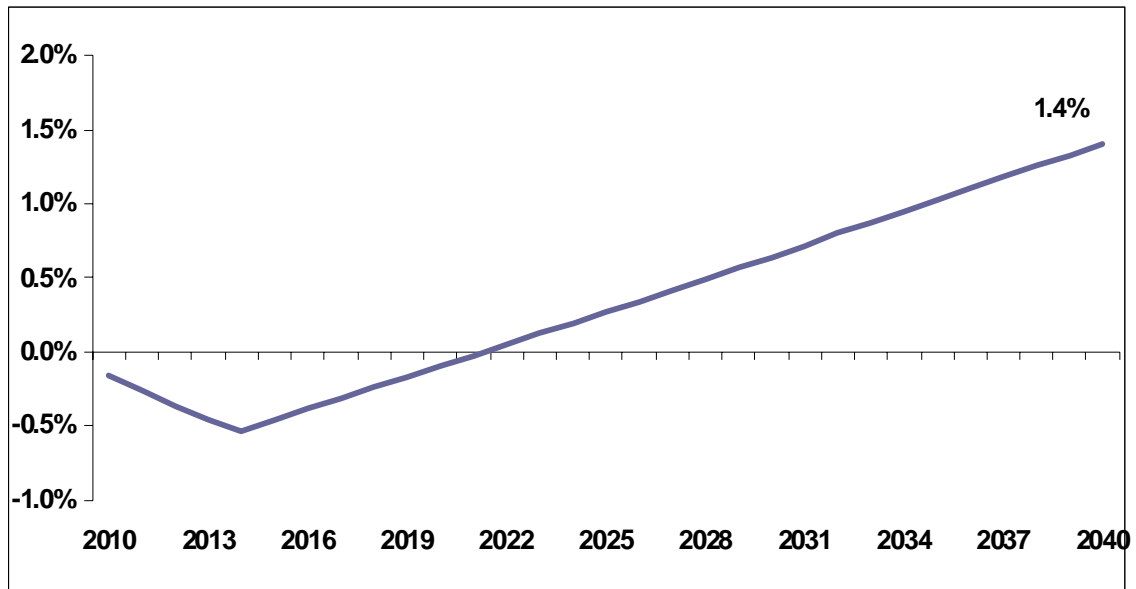
There is evidence to suggest that reducing student-staff ratios would lead to improved education and research outcomes. However, no data is available to quantify this relationship. As an illustrative exercise, KPMG Econtech has simulated how this relationship may behave by changing the student staff ratios back to the 1996 ratio. In addition to this, this scenario also assumes that non-teaching expenses fall by five percentage points. This is a proxy for government reform that leads to a reduction in the administrative burden for universities. This leads to a greater amount of funds available to the research and teaching arms of universities.

In addition to this, the **Reform** scenario also accounts for the fact that there may be a relationship between staff-student ratio and returns to research, student productivity as well as attrition rates and completion rates of students. Therefore, this scenario also involves decreasing the attrition rates of domestic students, increasing the completion rates of domestic students, as well as gains from research returns.

Chart 5.8 shows that the labour force is expected to shrink in the earlier years of the **Reform** scenario. This is because, similar to the **Pure Funding Augmentation** scenario, a higher level of funding increases the number of university places available, and hence more individuals enrol in universities and thus spend less time in the workforce than would otherwise be the case. This continues until 2015, when the first intake of graduates begin to enter the workforce (both domestic graduates and international graduates that obtain permanent work visas). This positive effect gradually outweighs the negative effects of lower participation during years in university so that, by 2022, the labour force is larger than in the baseline scenario. By 2040, the labour force is expected to be 1.4 per cent larger than under the baseline scenario in the same year, which translates to just over 230,000 additional people by 2040, compared to around 282,000 from the **Pure Funding Augmentation** scenario.

The gain in the labour force under the **Reform** scenario is below the gain under the **Pure Funding Augmentation** scenario. This occurs despite lowering attrition rates. This means that the higher student-staff ratio still results in less students graduating from university when compared to the **Pure Funding Augmentation** scenario.

Chart 5.8: Labour force participation change for the Reform scenario (% deviations from baseline)



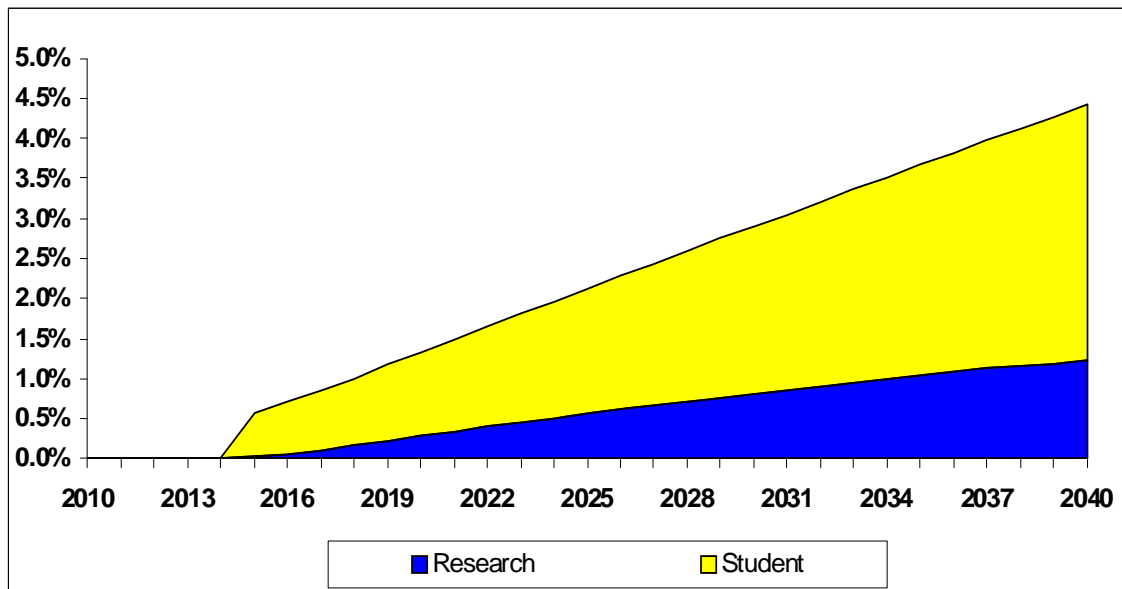
Source: KPMG Econtech

Chart 5.9 shows the estimated labour productivity effects resulting from the **Reform** scenario. For students, Chart 5.9 shows that the benefits of higher labour productivity commence in 2014/15. This is because the new graduates (whose places have been financed by the increase in funding) first enter the workforce in this year. Gradually, as the funding level builds up to two per cent of GDP, the student productivity benefits begin to accumulate. By 2040, labour productivity is expected to be 3.2 per cent higher than in the baseline scenario in the same year as a result of the increase in the number of individuals with university-level education. This compares to 3.1 per cent for the **Pure Funding Augmentation** scenario. Under the **Reform** scenario, there are less graduates as a result of the higher student-staff ratio but the quality of the graduates has increased as a result of the reforms. As the graduates are of a higher quality, the Leigh wage premium discount was reduced and this resulted in similar productivity benefits for both scenarios.

Turning to research funding, Chart 5.9 also shows its expected labour productivity benefits. These benefits gradually build as the knowledge base expands from sustained research. By 2040, the ongoing productivity boost exceeds 1.2 per cent, compared to 0.9 per cent in the **Pure Funding Augmentation** scenario. This increased productivity is a direct result of the higher return to research modelled in this scenario. This is because, with lower student-staff ratios, it is anticipated that academics will have more time to produce quality research outcomes.

The sharp increase in 2014/15 for the **Reform** scenario is a result of the reduction in Leigh wage premium discount. This discount was set at 20 per cent under the **Pure Funding Augmentation** scenario and then reduced to 16.5 per cent under the Reform scenario. This reduction is to reflect the positive impacts of the other aspects of the **Reform** scenario.

Chart 5.9: Productivity change for students and research for the Reform scenario (% deviations from baseline)

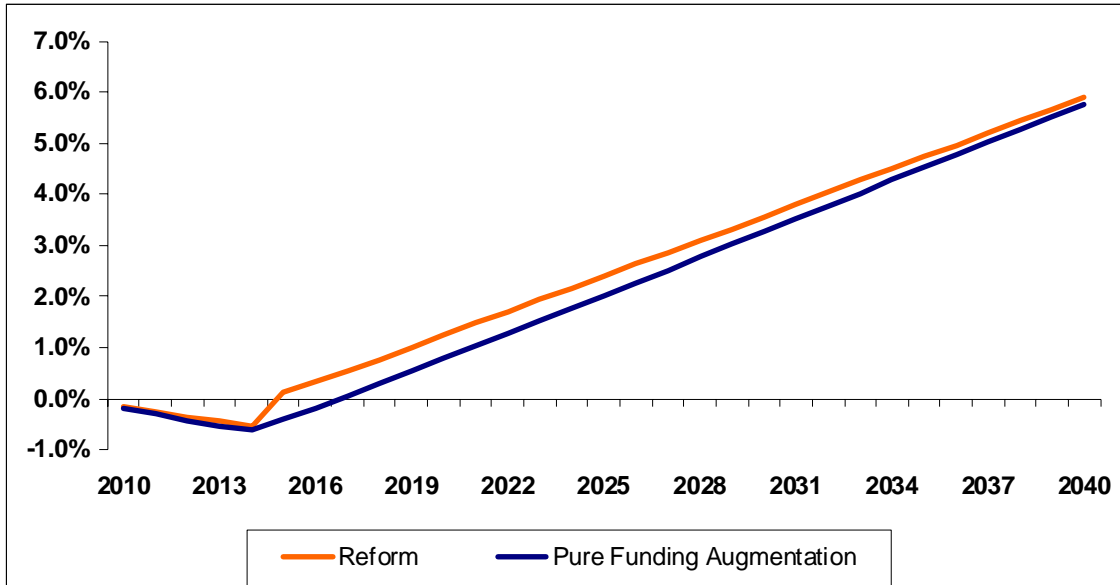


Source: KPMG Econtech

Combining the above labour force and productivity effects from Charts 5.8 and 5.9, Charts 5.10 and 5.11 show how expanded university funding, lower staff-student ratios; greater completion rates, decreased attrition rates, and increased returns from research and students effect GDP and living standards.

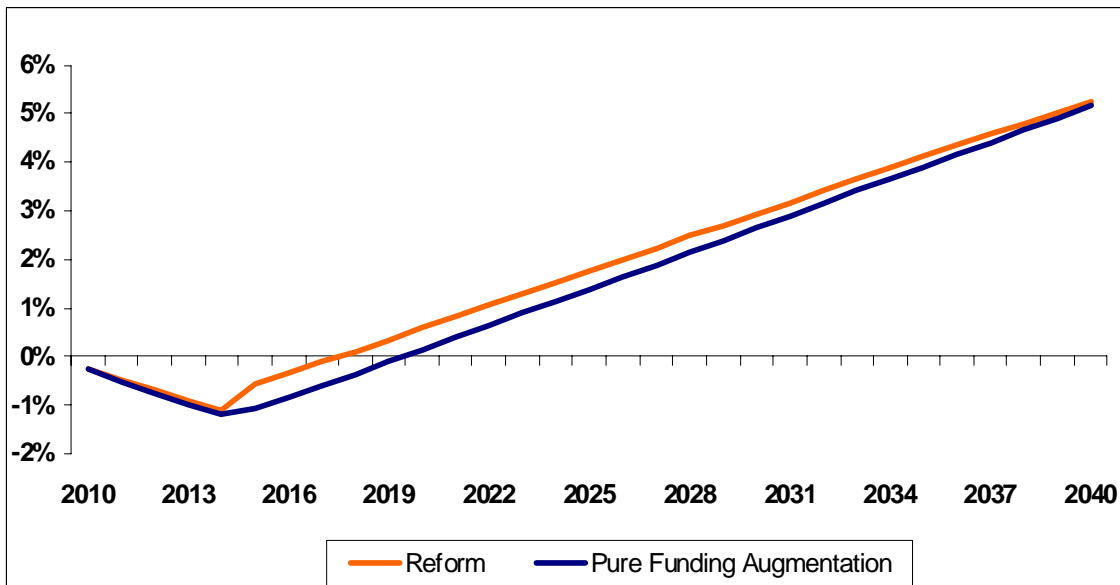
Chart 5.10 shows that real GDP for the **Pure Funding Augmentation** and **Reform** scenarios are of a similar level. As indicated earlier, this scenario included manual changes to the returns from research and students and attrition rates to illustrate how lower student-staff ratios may behave. If the student-staff ratio is reduced, as modelled in this scenario, changes to the returns to research and attrition rates have been altered to indicate the plausible extra return from research and attrition required to support this change in policy.

Chart 5.10: Real GDP for the Pure Funding Augmentation and Reform scenarios (% deviations from baseline)



Source: KPMG Econtech

Chart 5.11: Living standards for the Pure Funding Augmentation and Reform scenarios (% deviations from baseline)



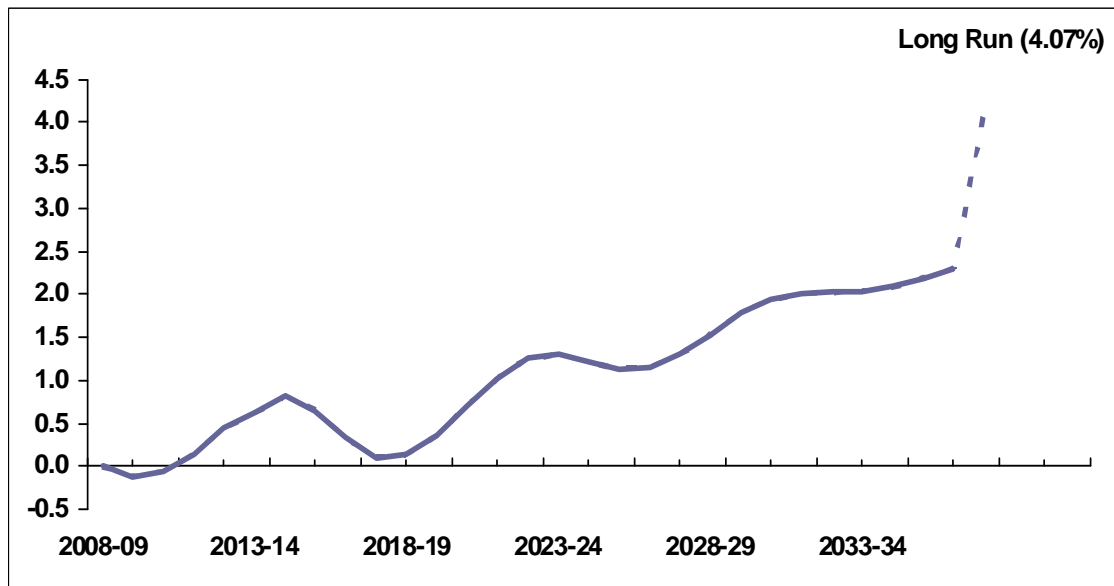
Source: KPMG Econtech

As indicated earlier, outputs from the university funding model, educational attainment and productivity model, and university research and productivity model are also introduced into KPMG Econtech’s economy-wide model, MM2, which provides a more developed dynamic

dimension. In addition, MM2 also accounts for additional exports from international student fees and the increase in student assistance payments.

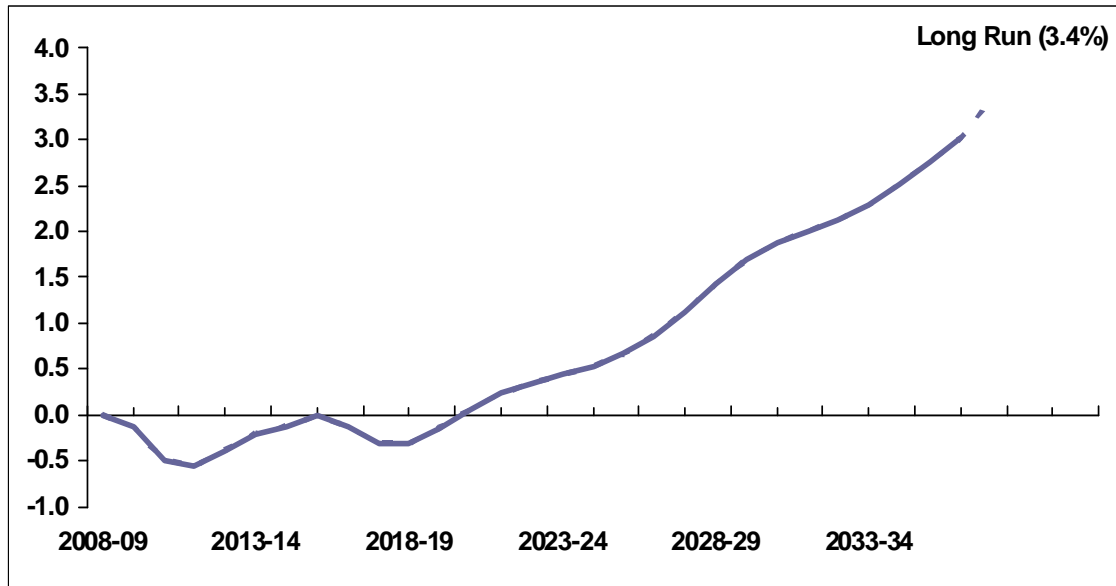
Charts 5.12 and 5.13 outline the results from the MM2 model for the Pure Funding Augmentation scenario. Charts 5.12 and 5.13 indicate that the results from the Growth Accounting Model and MM2 are broadly similar. The IRR from the MM2 model gives a return to university funding of 15 per cent, close to the return calculated from the Growth Accounting Model of 14 per cent. Charts 5.12 and 5.13 also show that there is an initial reduction in living standards as a result of lower labour force participation and the cost of financing the additional university funding through taxes. However, over time, as the gains in population, productivity and participation mount, living standards increase above the baseline scenario. By 2023, both the Growth Accounting Model and MM2 show that living standards are well above baseline.

Chart 5.12: Real GDP (% deviations from baseline, MM2)



Source: KPMG Econtech

Chart 5.13: Living standards (% deviations from baseline, MM2)



Source: KPMG Econtech

Table 5.4 presents a summary of the results from all scenarios modelled in the year 2040 using the Growth Accounting Model. Table 5.4 shows that all scenarios provide positive benefits to the economy which suggests that any investment in university funding by the Commonwealth Government will yield benefits for the economy. This is in terms of their impact on real GDP and, more importantly, on living standards.

Table 5.4: Summary of results for each scenario, 2040

	Participation (% deviations)	Student productivity (% deviations)	R&D productivity (% deviations)	Real GDP (% deviations)	Living standards (% deviations)
1 Pure Funding Augmentation	1.7%	3.1%	0.9%	5.8%	5.2%
2 Reform	1.4%	3.2%	1.2%	5.9%	5.3%

Source: KPMG Econtech

Tables 5.5 and 5.6 provide 10 year averages of each of the scenarios considered in this analysis. The first period does indicate reductions in participation, real GDP and living standards, relative to the baseline for both scenarios. As indicated earlier, reductions in participation in the short run are expected as more individuals enrol in universities and thus spend less time in the workforce than would otherwise be the case. The reductions in real GDP and living standards in the short run can be attributed to the fact that the costs of expanding the university sector are incurred immediately, while the benefits take time to accumulate. Over the longer term, it is clear that the benefits outweigh the costs of the expansion of the university sector.

Table 5.5: 10 year Averages for the Pure Funding Augmentation scenario

Pure Funding Augmentation scenario	2010-2019	2020-2029	2030-2039
Participation (% deviations)	-0.4%	0.3%	1.2%
Student Productivity (% deviations)	0.2%	1.2%	2.4%
R&D Productivity (% deviations)	0.0%	0.4%	0.8%
Real GDP (% deviations)	-0.2%	1.9%	4.4%
Living Standards (% deviations)	-0.7%	1.3%	3.8%

Source: KPMG Econtech

Table 5.6: 10 year Averages for the Reform scenario

Reform scenario	2010-2019	2020-2029	2030-2039
Participation (% deviations)	-0.3%	0.2%	1.0%
Student Productivity (% deviations)	0.4%	1.5%	2.6%
R&D Productivity (% deviations)	0.1%	0.5%	1.0%
Real GDP (% deviations)	0.1%	2.3%	4.6%
Living Standards (% deviations)	-0.4%	1.7%	4.0%

Source: KPMG Econtech

Tables 5.7 and 5.8 present 10 year averages for each of the scenarios considered in this analysis. The participation rate refers to the average participation rate for each of the three 10 year periods. The real GDP gain and living standards gain refer to the average annual increases above the baseline over each of the three 10 year periods. New graduates entering the labour force refers to the average per annum gain of new graduates entering the labour force. Under both scenarios, the average number of new graduates entering the labour force grows substantially over the long term. For instance, under the Pure Funding Augmentation scenario, the increased funding will result in:

- around 425,000 new graduates entering the labour force by 2020;
- around 975,000 new graduates entering the labour force by 2030; and
- around 1.7 million new graduates entering the labour force by 2040.

Table 5.7: 10 year Averages for the Pure Funding Augmentation scenario

Pure Funding Augmentation scenario	2010-2019	2020-2029	2030-2039
Participation rate (%)	64%	63%	63%
Real GDP gain (\$m, 2005/06 prices)	-1,933	31,487	91,828
Living Standards gain (\$m, 2005/06 prices)	-4,242	11,303	41,585
New Graduates entering the labour force (persons per annum)	42,400	54,864	70,016

Source: KPMG Econtech

Table 5.8: 10 year Averages for the Reform scenario

Reform scenario	2010-2019	2020-2029	2030-2039
Participation rate (%)	64%	63%	62%
Real GDP gain (\$m, 2005/06 prices)	1,620	37,665	96,207
Living Standards gain (\$m, 2005/06 prices)	-2,430	14,557	43,901
New Graduates entering the labour force (persons per annum)	36,452	47,142	60,161

Source: KPMG Econtech

6 Implications

The results presented in this report demonstrate that increasing university funding can have substantial impacts on productivity and participation and bring important economic benefits to the Australian economy.

Our modelling of the Pure Funding Augmentation scenario shows that increasing university funding from its current level of 1.6 per cent of GDP to two per cent of GDP, and increasing the share of Commonwealth Government grants up to 50 per cent from 42 per cent, leads to a 5.8 per cent gain in real GDP and a 5.2 per cent gain in living standards in the long term. Funding increases gradually from present levels under this analysis to reach an additional \$9.8 billion over present public funding levels by 2040, with a net gain in GDP of \$137.8 billion and \$1.5 billion in exports relative to the baseline in the long term. More importantly, living standards are \$64.3 billion above baseline in the long term. This gain in living standards occurs due to gains in the labour force and productivity of workers, which more than offsets the costs associated with increasing funding. The results from the Growth Accounting Model and MM2 are broadly similar. For instance, the IRR from the MM2 modelling provides a return to university funding of 15 per cent, close to the return calculated from the Growth Accounting Model of 14 per cent⁷.

The results in this report suggest that, if the Commonwealth Government were to consider increasing funding in conjunction with additional policy changes, the benefits of increasing university funding would not be lost. Rather, additional policy changes aimed at meeting other policy objectives could be made in conjunction with this funding increase. This suggests that the government may want to consider not only increasing university funding but also how this money is spent within the sector. This is to ensure that taxpayers obtain the best return from their tax dollars and the Commonwealth Government is meeting its broader policy objectives.

⁷ Our MM2 modelling results show that increasing university funding leads to a 4.1 per cent gain in real GDP and a 3.4 per cent gain in living standards in the long term. The results from MM2 are slightly lower than the Growth Accounting model results as MM2 reaches equilibrium over the long-run, whereas the Growth Accounting Model reaches equilibrium each year.

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Attachment A – Modelling System

This Appendix describes the modelling system in more detail that is used for this report.

University Funding Model

The university funding model is the base model that feeds inputs into the other three models. It is used to convert funding increases into the varied costs and benefits of university funding. Primarily, this includes allocating any funding increase into the student and research arms of universities and to estimate the direct costs of increased university funding. However, it also provides estimates of changes in exports the size of the labour force. The estimation of these items is described below.

Firstly, university funding is split into research and student funding based on existing relativities. Following this split, the model further separates research and student funding into various sub-components as described below.

University research funding

1. Research funding is separated into socioeconomic objective based on ABS HERD data relativities.
2. These socioeconomic objectives are then matched with industries in the economy based on the ABS's ANZSIC classification.
3. Where socioeconomic objectives do not match the industries, the funding is separated across industries based on labour force shares.
4. Other sectors, such as health, education and communications, that benefit more than one sector, were also spread across all industries based on labour force shares.
5. Following this, the increase in research funding by industry is entered as an input into the university research and productivity model.

University student funding

1. University student funding is broken into three sub-categories. These are funding for domestic undergraduate students, funding for domestic PhD students and funding for international students. Note that since the majority of the increase in funding is expected to come from the Commonwealth Government, we have assumed no increase in Masters degrees because students are largely charged the full costs of these degrees.
 - a. Undergraduate student funding is calculated as the increase in university funding less research funding and then less international student funding.
 - b. PhD students are funded through research grants provided by the Commonwealth Government. Hence part of the research funding described is also allocated for PhD students. KPMG Econtech assumed that the current percentage of this research funding does not change from its current level of

around 10 per cent. Hence for every dollar of research funding by the Commonwealth Government, 10 per cent is allocated to fund PhD students.

- c. International student funding is set to be a constant share of total university income. This share is currently around 15 per cent.
2. These different amounts of student funding are then converted into the number of students, based on current student funding ratios for each category. This assumes, all other things equal, that the current staff student ratio remains constant.
3. The model then factors in attrition rates for students for each year of education. This includes high attrition rates for commencing students and then relatively smaller attrition rates thereafter until students graduate. Graduation or completion rates are based on data from DEEWR and discussions with Universities Australia. This allows the model to determine the number of expected graduates from each entry year of new students.
4. Finally, the model factors in the participation rates of these new graduates to determine how many of these new graduates enter the workforce. This takes into account the higher participation rates of tertiary-educated individuals compared to non-tertiary-educated individuals.
5. The model also allows for international students that stay and work in Australia after graduation. This based on the number of international students that obtain permanent visa after graduation. Data from the Australian Government Department of Immigration and Citizenship indicates that around 20,000 student visas were converted to some form of work visa in 2006-07. If all of these individuals were university students this would translate into around 25 per cent of international students obtaining permanent visas. To be conservative we have assumed 15 per cent of international students obtain permanent visas.
6. This change in the number of higher educated students is then entered as an input into the education attainment and productivity model as indicated in Box 4.1 and described in sub-section 4.3.

Changes in the size of the labour force

In addition to calculating student numbers and research funding by industry, the university funding model is also used to calculate the change in the size of the labour force from each policy change. To calculate the net change, KPMG Econtech considered the following.

1. Firstly we considered the decrease in the labour force from those individuals who leave work and become students⁸. This is done by:

⁸ Note that the discount to the labour force from students is not one for one for two reasons. Firstly, not all new students would have otherwise been part of the workforce. Hence, KPMG Econtech applied the average participation rate for unskilled workers for undergraduates and the average participation rate for skilled workers to PhD students to determine the actual amount that would have been in work. Secondly, some of these students would be still participating in some work during their studies. Using a recent survey conducted by Universities Australia on the work habits of students (see Universities Australia: Australian University Student Finances, 2007), KPMG Econtech calculated the difference between students previous work hours and current work hours, to determine a full-time equivalent net change in labour force participation for all students. This same principal is applied to students that do

- a. Taking the increased number of students and multiplying by un-skilled worker participation rates.
 - b. Separating into part-time and full-time students
 - c. Part-time students are discounted by the average amount of work part-time students conduct whilst studying.
 - d. Full-time students are discounted by the average amount of part-time work full-time students conduct whilst studying.
 - e. This provides a full-time equivalent number for the decrease in the size of the labour force.
2. Secondly we considered the additions to the labour force each year from those students that do not complete their degrees and return to the workforce. This was estimated as follows.
- a. Taking the number of attrition students and multiplying by un-skilled worker participation rates (since they did not complete university and so remain unskilled).
 - b. Separating into part-time and full-time workers.
 - c. Part-time students are discounted by the average amount of work part-time students conduct whilst studying.
 - d. Full-time students are discounted by the average amount of part-time work full-time students conduct whilst studying.
 - e. This provides a full-time equivalent number for the increase in the size of the labour force from those students that leave before completing their degrees.
3. Thirdly, we consider the additions to the labour force each year from new domestic graduates, including factoring in their expected higher participation rates. This was done as follows.
- a. Taking the number of new graduate students and multiplying by skilled worker participation rates, which are higher than unskilled rates.
 - b. Separate into part-time and full-time workers.
 - c. Part-time students are discounted by the average amount of work part-time students conduct whilst studying.
 - d. Full-time students are discounted by the average amount of part-time work full-time students conduct whilst studying.
 - e. Provides a full-time equivalent number for the increase in the size of the labour force
4. Finally, we considered the increase in the size of the labour force each year from the number of graduating international students that obtain permanent visas. This was done as follows.

not complete their degrees and to graduate students. Hence, this provides the full-time equivalent net movements in and out of the labour force each year from new students, attrition and graduates.

- a. Taking the number of graduating international students and then multiplying by the current rate of international students visa holders that obtain permanent visas.
- b. Multiplying by skilled worker participation rates (probably a conservative estimate since international individuals likely have a higher participation rate).

This provides a net change to the size of the labour force each year and factors in both the opportunity cost of the policy (lower labour force as individuals take up study) and the benefits of increased participation rates on the size of the labour force. Further, it factors in those individuals who do not complete their degree returning to the labour force early. This net change is entered as an input into the economy-wide model.

Student assistance funding

The university funding model is also used to estimate the amount of student assistance payments the government would need to make in order to ensure all university places offered are taken up. It is likely that some of the new university students will have financial difficulty in the absence of this funding and thus will require government assistance to complete their degree. Hence some of the successful applicants to the new university places will likely qualify for study assistance. KPMG Econtech has calculated the change in student assistance for both domestic undergraduate and PhD students. Note that these payments are transfer payments for the economy, hence their impact on the economy occurs via the cost of raising taxes.

For domestic undergraduate students no specific data is available so KPMG Econtech has calculated the per student assistance payments by considering the current total amount of student assistance payments the government makes, the total number of recipients and the current prevalence of university students that receive some form of government student assistance payments. Considering these factors, and the change in the number of university students resulting from the funding increase, KPMG Econtech provides an estimate of the increase in student assistance payments the government will likely make each year as a result of the policy change.

For PhD students, this calculation was more straight forward since separate data is available for the funding assistance the Commonwealth Government provides to postgraduate students. Hence to calculate the per student assistance payments, KPMG Econtech determined the current average post graduate per student payment by dividing these total payments by the current number of postgraduates. Multiplying this figure to the increase in PhD students provides an indication of the total increase in PhD assistance payment the Commonwealth would likely need to supply.

This increase in payments is entered as an input into the economy-wide model.

Exports

Finally, the University Funding model is used to provide an estimate of the increase in export dollars accruing to universities from the addition of international students.

In summary, the university funding model provides five key outputs.

1. Estimates of the increase in government expenditure (university funding and student assistance payments).
2. Estimates of the increase in research funding by industry.
3. Estimates of the increase in the number of graduating students.
4. Estimates of the net change in the size of the labour force.
5. Estimates of the exports dollars accruing from international students.

As indicated above, government expenditure, labour force size changes and export dollars are entered directly into the economy-wide model. However, the additional research funding and the additional university students need to be converted into labour productivity increases before they can be introduced into the economy-wide model. This conversion is carried out in the University Research and Productivity model, described in the following sub-section.

University Research and Productivity Model

To measure the productivity benefits from university research a university research and productivity model was developed. This involves estimating the expected investment returns from the additional research funding. This was done by using international estimates of the likely rate of return and then applying this to these expenditures.

The returns to the research funds (i.e. the cost savings achieved through the investment) were calculated for each industry, using internal rate of return estimates. Several studies place the economy-wide social rate of return on overall publicly funded research in the order of 20 to 40 per cent a year (e.g. Mansfield et al., 1977; Nadiri, I., 1993; President's Economic Council of Economic Advisors, 1995; Martin et al., 1996; NIH, 2000; The Allen Consulting Group, 2003). Although several studies place the economy-wide social rate of return on overall publicly funded research in the order of 20 to 40 per cent a year, we will use a conservative estimate of 20 per cent to avoid overestimation of the benefits.

Finally, the returns were converted into gains in labour productivity on an industry-by-industry basis. This was done by dividing each return by the wage bill of each industry. The returns can be viewed as cost savings that are improvements in labour efficiency (the same amount of output can be produced with less input – labour). The annual cost of labour input for each year for each industry are estimated through KPMG Econtech's labour costs model. Once the annual labour efficiency improvements are measured, these changes are then introduced into KPMG Econtech's economy wide models.

Educational Attainment and Productivity Model

To measure the benefits from improving the education level of Australians, an index showing the contribution of education to aggregate labour productivity was constructed. The educational attainment and productivity model calculates the index. To construct the index, each level of educational attainment is assigned a productivity score based on prevailing wages in a base year for that level of education. The estimates of wage premiums for different levels of education

were obtained from Leigh’s estimation of the so-called “Mincer equation” (Leigh 2008). These estimates were then discounted by 20 per cent, and these discounted estimates are reported in Table A.

Table A.1: University qualifications and earnings premiums

Educational level	Earnings premium relative to those without a post-school qualification
Diploma or Advanced Diploma	15%
Bachelor Degree	40%
Graduate Diploma or Graduate Certificate	37%
Masters or Doctorate	59%

Source: Leigh (2008) Table 4, but with discounting of 20 per cent rather than 10 per cent.

With wages held constant in constructing the index, movements in the index reflect changes in the educational mix of the labour force. In particular, an increase in university funding leads to a higher percentage of the labour force with university qualifications (which attract a wage premium), resulting in a gain in the index.

The wage premiums have been discounted by 20 per cent to ensure that the productivity returns from expanding the university sector are not overstated. To some extent the existing wage premiums earned by those with a university education reflect higher innate ability rather than the university education itself. Leigh uses a 10 per cent discount to allow for these factors. Although the literature provides various estimates for upward bias, Leigh uses 10 per cent based on his analysis, however acknowledges that adjustments can be made if his adjustment is thought to be conservative (or not conservative enough).

For our analysis we adopt a deeper discount of 20 per cent to ensure that our results are on the conservative side. This is because we are also considering the diminishing marginal benefit of increasing education funding. This is consistent with the theory that as more students enter the university system, it is likely that some of these students will be less capable of attaining the full benefits of education. This is because the majority of current university students would likely, on average, have more aptitude for university study and following up work. Since test scores are a large determinant of university entry, to attract new students, test scores would need to be lowered to attract some new students. Considering these factors and the size of the university funding increase to be modelled, we use a 20 per cent discount factor to be conservative.

The estimates of the proportion of the labour force with each type of education are taken from unpublished ABS data. These returns and proportions are then applied to the labour force projections from KPMG Econtech’s MM2 Demographic Model to obtain an estimate for the index through time.

The educational attainment and labour productivity model provides annual changes in the average labour productivity for the Australian economy. These changes are then introduced into two economy wide models. The first is a simple growth account model that illustrates the impact on real GDP and living standards in a transparent way. This was explained in the report.

The second is KPMG Econtech's macro- CGE model, MM2, which confirms the results of the growth accounting technique.

In summary, the key inputs from the three models discussed above that are introduced into MM2, are as follows.

- Increase in government funding
- Increase in student assistance payments
- Changes in the size of the labour force.
- Increase in export dollars.
- Increases in productivity from the additional research funding.
- Increases in productivity from a having a more highly educated workforce.

Appendix B provides a description of our CGE model, MM2.

Attachment B – Murphy Model 2 (MM2)

Econtech's forecasting tool, Murphy Model 2 (MM2), is Australia's leading national, industry and state forecasting model. It has a highly respected forecasting track record and is used by Federal and State Governments, industry associations, financial institutions and major companies. Subscriptions to forecasting reports and Windows-based forecasting software are available.

Development

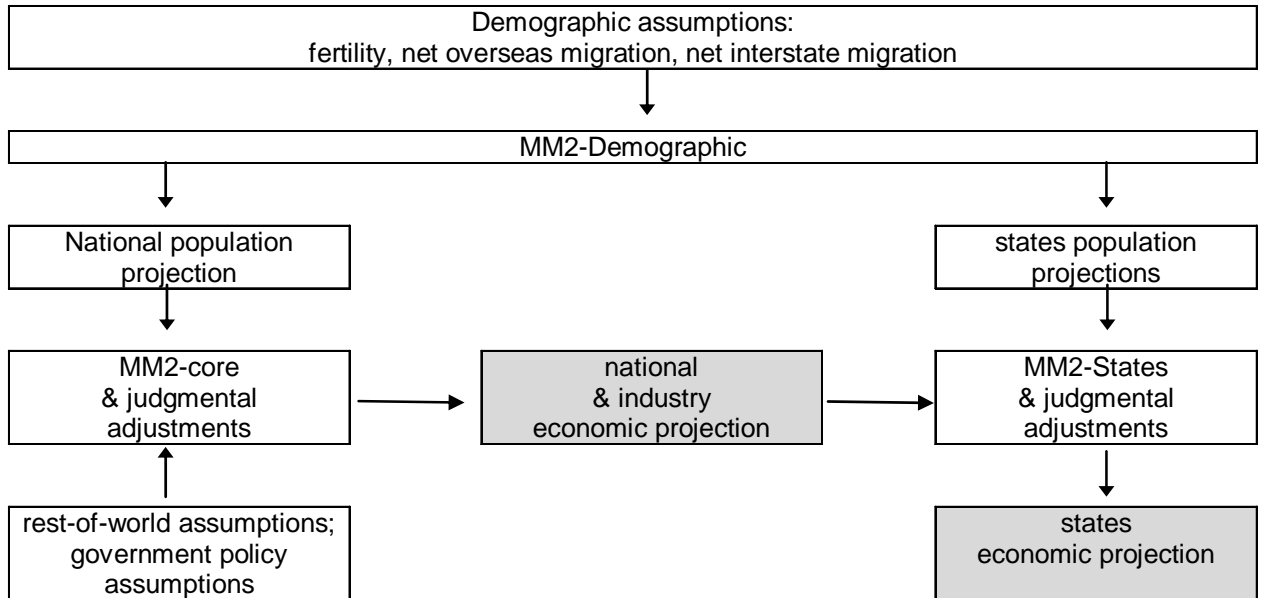
macroeconomic modelling at the Australian Treasury, Economic Planning Advisory Council, and the Australian National University. In 1988, Chris published the first version of the Murphy Model in Australian Economic Papers, and it was soon recognised as Australia's leading national or macro model.

In 1994, the first major redevelopment of the model was undertaken to distinguish 12 industry sectors. This marked the introduction of the Murphy Model 2 (MM2), a fully integrated macro and industry model.

In 1995, under contract to two state treasuries, the MM2-States was developed as an extension to MM2. The MM2-States allocates a number of MM2's key outputs across the eight Australian States and Territories.

In the same year, the current version of MM2-Demographic was developed under contract to the Australian Bureau of Immigration Research. Using assumptions for fertility, mortality, overseas and interstate migration, it generates consistent state and national population scenarios.

In 1996, the MM2 was further developed to expand the sectoral detail from 12 sectors to the 18 sectors corresponding to the Australian and New Zealand Standard Industrial Classification (ANZSIC) industry divisions. The linkages between the three models are illustrated below.



Features

MM2 is a state-of-the-art, fully-integrated macro-industry model with the following features:

- produces quarter-by-quarter nine-year-ahead forecasts;
- forward-looking financial sector for realism;
- Keynesian short-run for forecasting; and
- neoclassical long-run for policy analysis.

Documentation

Powell, A.A. and Murphy, C.W. (1997), *Inside a Modern Macroeconometric Model - A Guide to the Murphy Model*, Springer, Berlin, 2nd ed., 455pp.