

Economic Modelling of Improved Funding and Reform Arrangements for Universities

This report was prepared for
Universities Australia and updates and
extends the 2009 analysis.

30 April 2010

ADVISORY

Inherent Limitations

This report has been prepared as outlined in the contract between KPMG Econtech and Universities Australia dated 12 January 2010. The services provided in connection with this engagement comprise an advisory engagement which is not subject to Australian Auditing Standards or Australian Standards on Review or Assurance Engagements, and consequently no opinions or conclusions intended to convey assurance have been expressed.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by Universities Australia as part of the process.

KPMG Econtech have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

KPMG Econtech is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

Third Party Reliance

This report is solely for the purpose set out in contract and for Universities Australia information, and is not to be used for any other purpose or distributed to any other party without KPMG Econtech's prior written consent.

This report has been prepared at the request of Universities Australia in accordance with the terms of KPMG Econtech's contract dated 12 January 2010. Other than our responsibility to Universities Australia, neither KPMG Econtech nor any member or employee of KPMG Econtech undertakes responsibility arising in any way from reliance placed by a third party on this report.

Any reliance placed is that party's sole responsibility.

Forecasting Disclaimer

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.

Contents

Executive Summary	1
1 Introduction	10
1.1 Report Structure	10
2 Literature Review	11
2.1 Overview of the VET Sector	11
2.2 Private Returns Higher Education and VET	12
2.2.1 Implications for this study	16
2.3 Social Returns to Education	16
2.3.1 Education and Health Benefits	17
2.3.2 Other Returns to Education	18
2.3.3 Implications for this study	19
2.4 Returns to Publicly Funded Research and Development	19
2.4.1 Implications for this study	25
3 Modelling Approach	26
3.1 Modelling Approach	26
3.1.1 University and VET Funding Models	28
3.1.2 Research and Productivity Model	29
3.1.3 Educational Attainment and Productivity Model	29
3.1.4 Economy-wide impacts	30
3.2 Scenarios	31
3.2.1 Baseline	31
3.2.2 Pure Funding Augmentation Scenario	35
3.2.3 Structural Reform Scenario	36
4 Results	38
4.1 Pure Funding Augmentation Scenario	38
4.2 Structural Reform Scenario	43
4.3 State and Territory Results	49
5 Implications	51
6 References	53
Appendix A – Modelling System	57

Executive Summary

Universities Australia engaged KPMG Econtech in 2008 to measure the net economic benefits of government policies aimed at increasing university funding and adjusting education policies in conjunction with this funding increase. The funding increase modelled were broadly in line with the recommendations outlined in the Bradley Review of Australian Higher Education. The final report was publicly released in April 2009.

The economic modelling framework utilised in our 2009 report accounted for the direct and indirect benefits of increasing university funding as they accrue to the economy, including:

- 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.

Universities Australia has now engaged KPMG Econtech to update the 2009 report for the latest data and research. In addition, we have also extended our modelling framework to capture the impact of increased funding of public Vocational Education and Training (VET), in addition to the university sector alone. As such, the modelling now covers the whole publicly funded tertiary education sector. This report also presents the results at the states and territories and the national levels. Lastly, the results from our latest economic modelling is used to examine whether the Government's target of lifting the percentage of those aged 25-34 who hold a university degree to 40 per cent by 2025 is fully funded.

As this report provides updated results and extends our 2009 report, it should be read in conjunction with our earlier report, "Economic Modelling of Improved Funding and Reform Arrangements for Universities"¹.

Modelling approach

In the 2009 report, the economic impact of increasing university funding was modelled by employing a system of models to capture both the economic costs and benefits. The modelling system comprised of four models:

- a university funding model;
- an educational attainment, labour force size and productivity model;

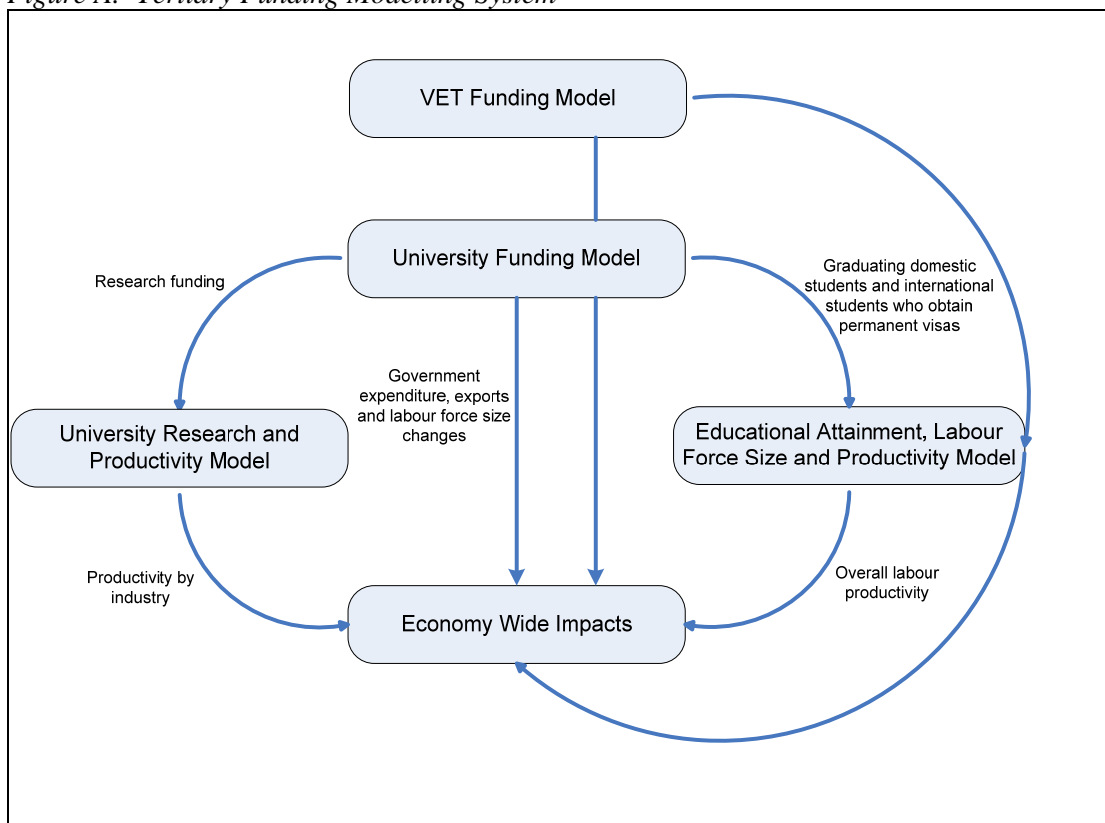
¹ This report is available on the Universities Australia website (http://www.universitiesaustralia.edu.au/content.asp?page=/news/media_releases/2009/uniaus_media_04_09.htm).

- a research and productivity model; and
- an economy wide model.

To capture the economic impact of increasing funding to the whole tertiary education sector, we have introduced a new model, the VET funding model, into the modelling framework described above. The VET funding model is based on the same methodology as the university funding model that was developed for the 2009 report.

The relationship between the system of five models employed in this report is shown in Figure A.

Figure A: Tertiary Funding Modelling System



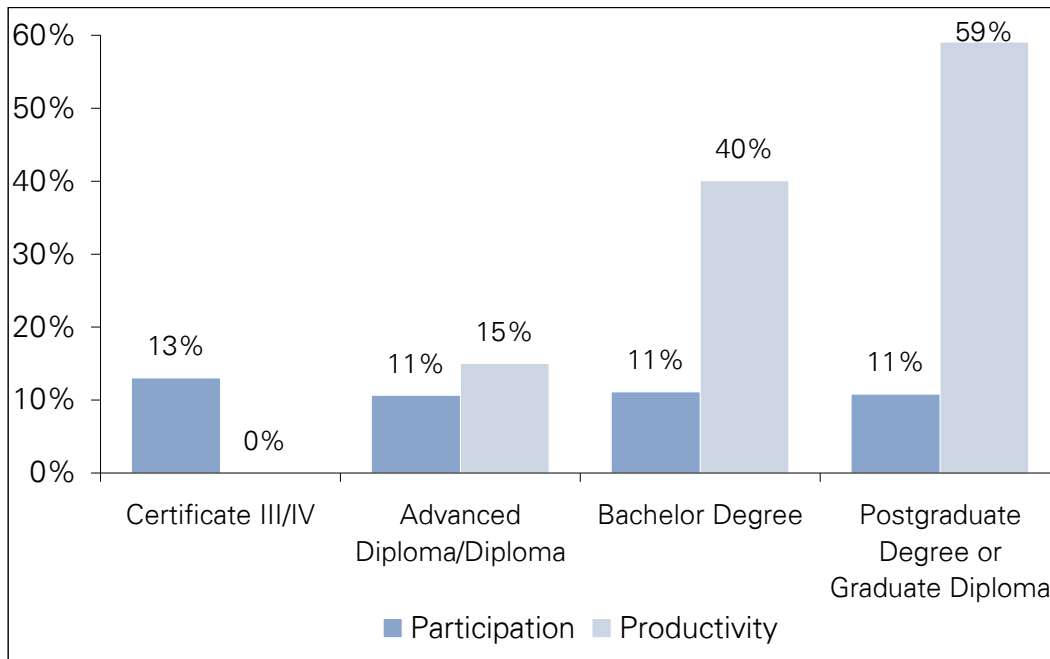
Source: KPMG Econtech.

As discussed in our 2009 report, the system of models was constructed to account for the key economic benefits of expanding the university and VET sectors. This includes:

- increased productivity, as shown in Chart A;
- increased labour force participation, as shown in Chart A;
- 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.

Chart A: Payoffs from tertiary qualifications (per cent pay-off compared to a year 12 qualification for a male)



Source: Participation – ABS; Productivity - Leigh (2008) with 20% discount.

Figure A shows that the outputs from the university funding model, the VET funding model, the university research and productivity model and the educational attainment and productivity model are introduced into the economy-wide model. The economy-wide model employed in this report is a growth accounting model, which demonstrates the main economic implications, including the costs, of expanding the university and VET sector. These costs include:

- the costs of university research and teaching;
- the costs of VET; and
- the reduction in the size of the labour force for the period that students are studying.

Economic Implications of Tertiary Attainment for an Individual

For ease of explanation, it is useful to consider the main economic implications accounted for in the modelling when an individual successfully completes a tertiary qualification.

While studying, the individual will spend less time in the workforce than would otherwise be the case. This effect would be stronger for an individual undertaking full-time study rather than part-time study. In addition, there are also the costs of providing University and VET education, which are shared between the individual in the form of fees and the government in funding these educational institutions.

At the completion of their tertiary studies, the individual will be more employable than a comparable individual without a tertiary qualification, with a boost to labour force participation of over 10 per cent². In addition, those tertiary students who complete a University qualification are also more productive, and thus benefit from a wage premium of about 40 per cent for a Bachelor Degree and higher for a Post-graduate Degree³.

Turning to the economy-wide implications, the net economic impacts of changes to university and tertiary funding arrangements are analysed by modelling two scenarios relative to the baseline.

Baseline Scenario

The Baseline scenario simply maintains funding at its existing share of GDP throughout the projection period.

Government and students both contribute to the funding of tertiary education. Government funding is important because students may under-invest in education as a result of:

- limited access to finance; and
- a near-sighted approach.

In addition, government funding of education is important because there are social benefits to education as well as private benefits. While the social benefits have not been included in the modelling, they potentially range from spill-over gains in productivity to other members of the workforce to better health outcomes.

Based on 2008 data, university funding is 1.6 per cent of GDP, with the Commonwealth Government's contribution equal to 43 per cent of this amount. Turning to VET funding, based on 2008 data, the funding is 0.6 per cent of GDP and government funding is approximately 76 per cent of this amount.

As a point of comparison, these shares are maintained throughout the projection period for the baseline scenario. This is essentially a "no policy change" scenario.

² See section 3.2 for further explanation.

³ See section 3.1 for further explanation.

Pure Funding Augmentation Scenario

The first scenario is the Pure Funding Augmentation scenario. For universities, this scenario involves increasing 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 sources⁴. To achieve this, it is assumed that funding for universities in Australia increases gradually from 2010 until it reaches two per cent of GDP by 2015. Furthermore, the Commonwealth Government's contribution increases faster so that, by 2015, the Government's contribution of Commonwealth grants is 50 per cent. This scenario is broadly consistent with the funding recommendations in the Bradley Review.

For the tertiary sector as whole, in addition to the assumptions for the universities sector outlined above it is also assumed that VET funding increases to 0.7 per cent of GDP. Of this 0.7 per cent, the Government will continue to contribute approximately 76 per cent of the funding, with the remaining coming from other sources. To achieve this, it is assumed that funding for VET in Australia increases gradually from 2010 until it reaches 0.7 per cent of GDP by 2015.

Table A presents both the Baseline and Pure Funding Augmentation scenarios.

Table A: Baseline and Pure Funding Augmentation scenarios

Scenarios	Total funding as a share of GDP	Government Share
Baseline - University	1.6%	43%
Baseline - VET	0.6%	76%
Pure Funding Augmentation - University	2.0%	50%
Pure Funding Augmentation - VET	0.7%	76%

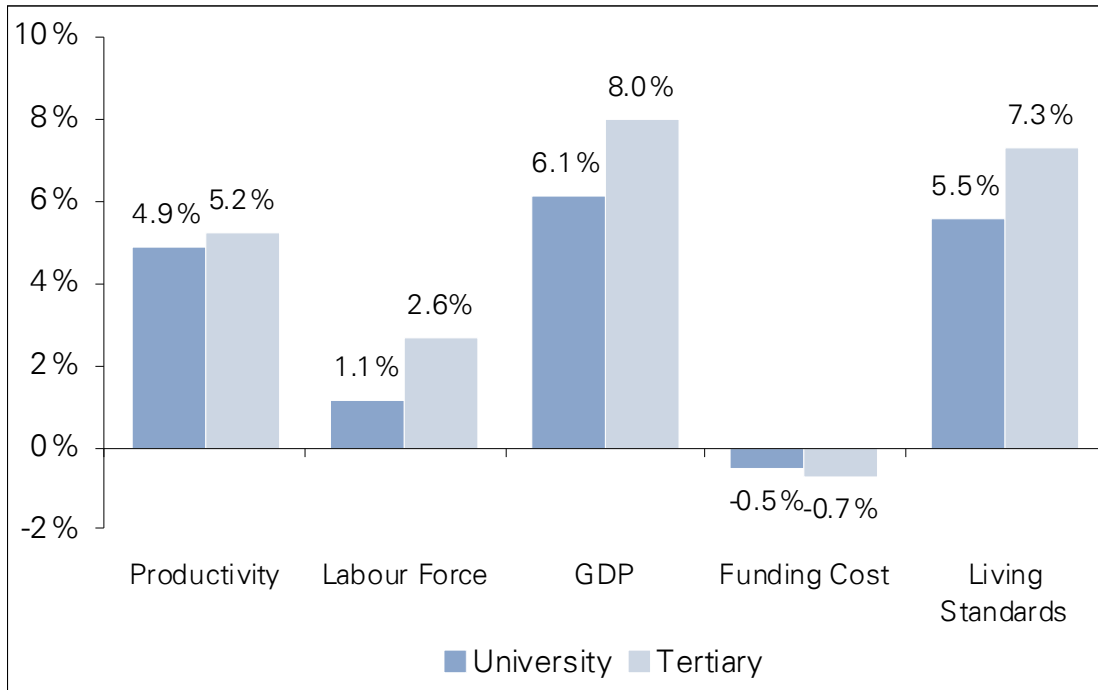
Source: Universities Australia and KPMG Econtech.

Increasing university and VET funding will lead to a lift in the education level of the workforce and a lift in research outcomes. This leads to labour productivity benefits. It also leads to labour force increases 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 at the completion of their studies.

Chart B shows how the gain in GDP and living standards arising from increased funding for universities and the tertiary sector as a whole can be decomposed into these elements. Labour productivity and the labour force will both affect GDP and living standards (proxied by private consumption). However, it is important to note that changes in GDP are not an appropriate measure of a 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.

⁴ Other sources include, for example, student fees and bequests.

Chart B: Sources of impact on living standards (private consumption) and GDP in 2040 from increased funding for universities and VET providers (% deviations from baseline)



Source: KPMG Econtech estimates.

The key findings from increasing funding for universities and the tertiary sector, as modelled in the Pure Funding Augmentation scenario, are summarised below.

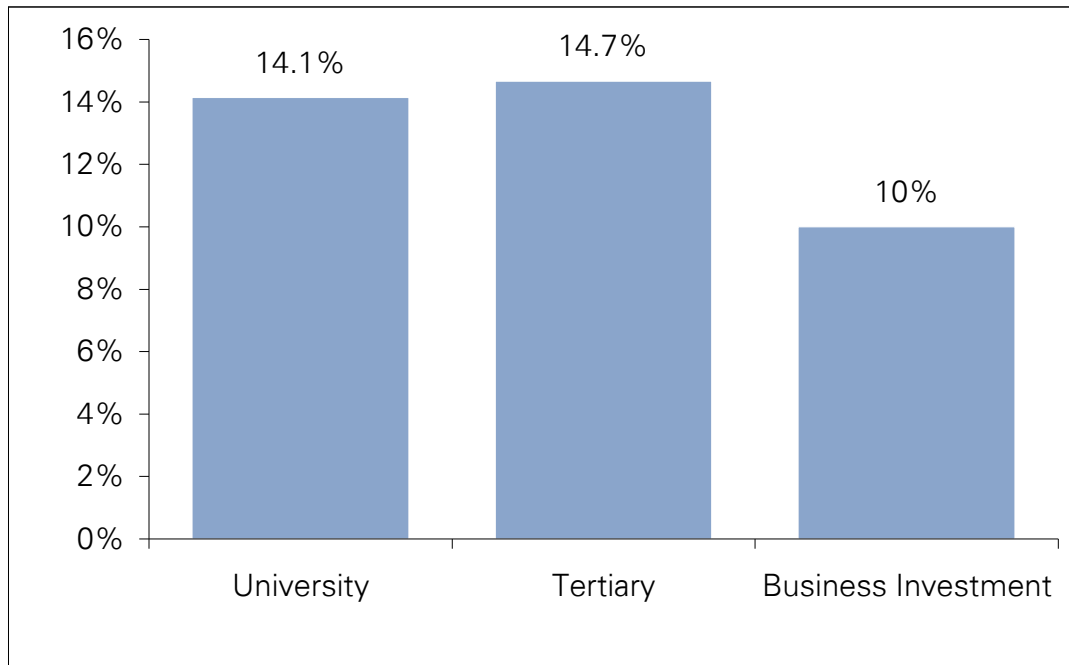
- The first source of gain is labour productivity from higher educational attainment, mainly from university degrees. By 2040, labour productivity is expected to be 3.8 per cent higher than in the baseline scenario in the same year as a result of the increase in the number of individuals in university education. For the tertiary sector as a whole, the increased funding is expected to lead to a lift in labour productivity of 4.1 per cent above the baseline by 2040.
- The second source of gain is a lift in productivity from university research. By 2040, the ongoing research productivity boost exceeds 1.1 per cent. These benefits gradually build as the knowledge base expands from sustained research.
- The third and final source of gain is an increase in the labour force both from gains in labour force participation (from the greater employability of those with a tertiary education) and an increase in population from international students who stay in Australia. By 2040, the labour force is expected to be 1.1 per cent larger than under the baseline scenario in the same year. For the tertiary sector, the increased funding is expected to lead to the labour force being 2.6 per cent larger than under the baseline by 2040.
- These three effects combined lead to a GDP boost of 6.1 per cent in 2040 for university funding and 8.0 per cent for tertiary funding. This result can be seen in terms of the labour force and productivity gains also noted in Chart B. This GDP boost does not take into account the costs to taxpayers of the higher government funding of tertiary education.

- The cost to taxpayers of higher government funding is equivalent to 0.5 per cent of GDP for Universities and 0.7 per cent of GDP for the whole tertiary sector.
- Taking into account both GDP gains and the taxpayer cost, by 2040, the boost to consumer living standards amounts to 5.5 per cent for increasing funding for Universities and 7.3 per cent for increasing funding for the tertiary sector. This shows the final net benefit of increased funding as measured by the impact on living standards, proxied by private consumption.
- Besides this impact on living standards, the effects of the pure funding augmentation scenario on educational attainment can also be considered. The results show that the Government would exceed its target higher education attainment rate for 25-34 year olds of 40 per cent⁵.
- It is important to compare the gain in living standards from further investment in tertiary education with the gains from other investments. This is usually done using the concept of an internal annual real rate of return (IRR), which is a useful tool for comparisons across different investment options. The IRR for investment in universities and the tertiary sector is 14 per cent and 15 per cent respectively. This is higher than IRRs for business investment of around 10 per cent⁶. This is shown in Chart C below.

⁵ Assuming the age structure of those currently enrolled in degree-level qualifications remains unchanged over the period to 2025, the results of the pure funding augmentation scenario suggest that there will be an approximate additional 430,000 graduates by 2025. This is well in excess of the additional graduates 217,000 required (2009-10 Budget Statement) to achieve the 40 per cent target.

⁶ In various submissions to the ACCC, market risk premiums for Australia have been estimated at around 6-7 per cent. Coupled with a real risk-free bond rate of around 3 per cent, this brings IRRs for typical business equity investment to around 10 per cent.

Chart C: Internal Annual Real Rate of Return (per cent)



Source: KPMG Econtech.

For ease of explanation, an IRR for investment in universities of 14 per cent means that for every dollar invested, an annual return of \$1.14 is expected, on top of the inflation rate.

These annual rates of return for University and VET are well in excess of the benchmark return for business investment. Further, there is a worthwhile rate of return for undertaking the modest investment involved in a VET qualification; this return largely takes the form of increased employability. There is also a worthwhile rate of return for undertaking the larger investment in a University qualification; with a similar gain in employability to VET but with the added benefit of a large boost to productivity and hence earnings arising from the larger investment.

These rates of return take into account that the benefits gradually diminish as the sector expands. This is because as the tertiary sector becomes larger, it must cast a wider net for eligible students.

Structural Reform Scenario

Similar to the 2009 report, 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;
- higher productivity gains from university education;
- reducing attrition rates; and
- increasing completion rates.

Table B presents a summary of the results from all scenarios modelled in the year 2040.

Table B: Summary of results for each scenario in 2040 (% deviations from baseline)

	Labour Force (% deviations)	Student productivity (% deviations)	R&D productivity (% deviations)	Real GDP (% deviations)	Living standards (% deviations)
Pure Funding Augmentation - Universities	1.1%	3.8%	1.1%	6.1%	5.5%
Pure Funding Augmentation - Tertiary	2.6%	4.1%	1.1%	8.0%	7.3%
Reform	0.8%	4.2%	1.4%	6.4%	5.8%

Source: KPMG Econtech estimates.

This table shows that all scenarios provide positive benefits to the economy. This result suggests that any investment in universities by the government will yield benefits for the economy, in terms of GDP and, more importantly, living standards.

1 Introduction

Universities Australia engaged KPMG Econtech in 2008 to measure the net economic benefits of government policies aimed at increasing university funding and adjusting education policies in conjunction with this funding increase. The funding increase modelled was broadly in line with the recommendations outlined in the Bradley review. The final report was publicly released in April 2009 and was used to inform the education policy debate.

Universities Australia has now engaged KPMG Econtech to update the 2009 report for the latest data and research. In addition, we have also extended our modelling framework to capture the impact of increased funding of public VET provision, in addition to the university sector alone. As such, the modelling now covers the whole publicly funded tertiary education sector. This report also presents the results at the states and territories and the national levels. Lastly, the results from our latest economic modelling will be used to examine whether the Government's target of lifting the percentage of those aged 25-34 who hold a university degree to 40 per cent by 2025 is fully funded.

As this report provides updated results and extends our 2009 report, it should be read in conjunction with our earlier report, "Economic Modelling of Improved Funding and Reform Arrangements for Universities"⁷.

1.1 Report Structure

- Section 2 presents a literature review on rates of return to education, public research and participation rate effects from increasing funding for the university and VET sector.
- Section 3 presents the modelling approach employed to extend our modelling to capture the VET sector, in addition to the university sector alone.
- Section 4 presents the scenarios modelled and the results at the state and territory and national levels.
- Section 5 presents the policy implications of the results.

⁷ This report is available on the Universities Australia website
(http://www.universitiesaustralia.edu.au/content.asp?page=/news/media_releases/2009/uniaus_media_04_09.htm).

2 Literature Review

This section begins by presenting a brief overview of the VET sector. The remainder of this section presents an update on the literature review contained in the 2009 report. Specifically, this section examines the economic theory and key empirical studies on:

- the private and social returns to education; and
- economic impacts of publicly funded research.

2.1 Overview of the VET Sector

Australia has developed a national VET system to replace the state based systems. The process to develop a system of nationally recognised training began in the 1990s and is now nearing completion. The resulting national framework, the Australian Quality Training Framework (AQTF), is a national set of standards that aims to assure nationally consistent, high quality training and assessment services for the VET sector. Under the AQTF, nationally recognised VET is delivered and assessed by registered training organisations. Each registered training organisation has an approved scope of registration that specifies the qualification and units of competency that it can assess (NCVER, 2009).

For the VET sector, individuals are able to access a variety of programs and these can be accredited (formal) or unaccredited (informal). Notably, there are now a variety of organisations that deliver VET programs, these include:

- secondary schools that deliver VET programs to students in their final years of schooling;
- Institutes of Technical and Further Education (TAFEs);
- universities that are dual-sector institutions that deliver both VET and high education programs;
- private for-profit and not-for profit Registered Training Organisations;
- public and private organisations that operate a Registered Training Organisation primarily to assist with their own staff development; and
- adult and community education (ACE) providers that deliver VET programs.

The public institutes of TAFE comprise the largest single provider of VET and obtain the majority of their funding from government. Supplementary revenue is sourced from fee-for-service initiatives, student fees and charges, and ancillary trading and other services. Other providers offer different mixes of public and private student places. This report does not consider those VET providers that exist wholly outside the publicly funded system (e.g. those focussed on offering qualifications to international students or offering training within a single company funded from its internal budget).

2.2 Private Returns Higher Education and VET

This section presents an update to the literature review on the returns to education contained in our 2009 report. Our 2009 report extensively reviewed past studies on the rates of return to university education and as a result, this section focuses on the rates of return to the other main form of tertiary education, namely VET.

As noted in our 2009 report, investing in education leads to gains in the level of education of the workforce. This results in gains in productivity, higher levels of labour force participation and a lift in the population from international students that remain in Australia at the conclusion of their studies. Productivity growth, labour force participation and population growth are key drivers of long-term growth in the economy. In addition to the benefits for driving growth in the economy, education has substantial benefits for individuals.

A key study discussed included in our 2009 report was the research completed by Leigh in 2008. The Leigh (2008) study estimates the returns to different forms of education, such as Certificates, Diplomas and Bachelor Degrees, using the Mincer equation. This approach allows the returns to education to be different across different levels of education. Leigh (2008) 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 HILDA data set.

The annual returns relative to individuals with no post-school qualifications are reported in Table 2.1.

Table 2.1: Post-school qualifications and earnings

Educational level	Earnings premium relative to those without a post-school qualification
Certificate III/IV	-3%
Diploma or Advanced Diploma	17%
Bachelor Degree	45%
Graduate Diploma or Graduate Certificate	41%
Masters or Doctorate	67%

Source: Leigh (2008) Table 4.

Note: The estimates for Certificate III/IV are included in the above table but they were not found to be statistically significant. Hence it is assumed that there is no wage premium from a Certificate III/IV qualification. This assumption is in line with the results of other studies into VET returns.

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. The Mincer equation used by Leigh (2008) has been subject to criticism. For example, Heckman, Lochner and Todd (2008) criticise the Mincer equation and argue that it oversimplifies the education-earnings relationship in the context of the US economy. Specifically, 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.

A study by Ryan (2002) found that individuals with VET qualifications receive higher wages on average compared to individuals without VET qualifications, and that this effect is more pronounced in males than in females. The estimation of the rates of return to VET qualifications was undertaken by using data from the 1997 ABS Survey of Education and Training. The author's methodology involves first identifying the effects of a VET qualification on wages using regression equations. These wage effects are then used, together with the costs of obtaining such a qualification (e.g. course fees, foregone wage income) to calculate the after-tax rate of return to VET qualifications. The resulting estimate of the rate of return depends on the type of VET qualification and the particular characteristics (such as their gender and work status) of the student. Furthermore, individuals with higher VET qualification levels such as associate diplomas tend to have higher wages than ones with skilled or basic vocational qualifications. The author emphasises that the rate of return is higher for students who work while undertaking their VET. This is because their indirect costs to education, namely foregone wages, are lower. They also gain valuable work experience which also tends to increase the return on education.

Table 2.2 summarises some of the key estimates from this study.

Table 2.2: Selected estimates of returns to VET qualifications in Ryan (2002) (%)

	Basic vocational	Skilled vocational	Associate diploma
Males			
School leaver who undertakes their course full-time and works part-time	21.7	24.0	3.9
School leaver who undertakes their course full-time, does not work, but receives AUSTUDY	13.6	15.8	2.1
School leaver who undertakes their course part-time and works full-time	67.9	38.1	22.3
Females			
School leaver who undertakes their course full-time and works part-time	23.7	12.9	<0
School leaver who undertakes their course full-time, does not work, but receives AUSTUDY	17.5	10.6	<0
School leaver who undertakes their course part-time and works full-time	45.1	17.4	19.7

Source: Ryan (2002) Table 4.

Studies on the returns to education often mention factors such as ability, family background and measurement error as potential causes of bias in the estimates. Using empirical data from various surveys in Britain, Dearden et al. (2002) showed that the biases tend to offset one another, making simple Ordinary Least Squares (OLS) estimates similar to estimates obtained from estimation processes controlling for these factors. The estimated average annual returns for various scenarios lie mostly within the range 8 - 10 per cent, and unlike the abovementioned study by Ryan (2002), the authors here did not find the estimates to differ significantly across genders.

A related study by Cully (2005) employed data from the 2001 ABS Survey of Education and Training to estimate the wage premium associated with having a VET qualification. However,

the author did not proceed to calculate the rate of return to VET, which would take into account the direct and indirect costs of such education. The author found significant wage premiums for individuals with higher VET qualifications such as advanced diploma or diploma. However, individuals with only certificate-level qualifications tend to have lower wage premiums than those who have completed Year 12 but no further education.

Long and Shah (2008) estimated the rates of return to various levels of VET qualifications, using data from the 2005 ABS Survey of Education and Training. The authors estimated returns to students of different characteristics such as their VET qualification, gender, age, years of full-time equivalent study and cost of tuition fees. The authors found that with the exception of certain cases for students with Certificates I and II, the rates of return to VET students generally provide them with enough incentive to enrol. Furthermore, returns are not consistently higher for males, and age only has a small impact on returns. The authors also found the rate of return to be higher for part-time students compared to full-time students as the latter face higher costs due to foregone wage income. Table 2.3 depicts some selected rates of return estimated in this study.

Table 2.3: Selected estimates of returns to VET qualifications in Long and Shah (2008) (%)

Educational level	Male	Female
Advanced diploma or diploma (compared with Year 12)	27.8	24.6
Certificate Level III or IV (compared with Year 12)	14.5	10.2

Source: Long and Shah (2008) - Table 18.

Note: The education level assumes 1.5 years of full-time equivalent study; studying full-time and medium tuition costs.

Coelli and Wilkins (2009) conducted a study on the relationship between credential changes and education earnings premia in Australia. Earnings premia in Australia have not been rising as fast as those in the US. The authors attempted to explain this observation in terms of the relabelling of credentials amongst tertiary qualifications. The authors concluded that certain changes in labelling of education credentials, such as the switch from TAFE to university qualifications of degrees like nursing and teaching, may underestimate earnings premia by approximately 6 per cent for women, and by a smaller percentage figure for men.

In a very recent study, Lee and Coelli (2010) found that relative to individuals with only a Year 12 qualification, individuals with certificate level qualifications receive little earnings premia. However, similar to previous studies, the authors found positive employment and earnings effects associated with obtaining a diploma-level qualification. Relative to Year 12 completers, males with a VET qualification at diploma level earn roughly 7.1 per cent more per week, whereas females with such a qualification earn 11.3 per cent more per week. The estimates for individuals with only Certificates III, IV are less favourable, with males and females both earning roughly 3.6 per cent less per week than Year 12 completers. However, for those who have not completed year 12, undertaking certificate levels course was found to have a positive impact on wage premia. Notably, the study concludes that for those who obtain certificate level qualifications relative to those completing Year 12, the estimated impacts are negative (Lee and Coelli, 2010, p. 22). Table 2.4 presents some selected rates of return estimated in this study.

Table 2.4: Selected estimates of returns to VET qualifications in Lee and Coelli (2010)

Type of VET Qualification	Relative to Year 12 Completers		Relative to Non-completers of Year 12	
	Male	Female	Male	Female
Bachelor Plus	27.8	32.1	45.4	43.6
Associate Diploma/Advanced Diploma or Diploma	7.1	11.3	28.5	24.0
Skilled Vocational/Certificates III, IV	-3.6	-3.6	12.5	11.0
Basic Vocational/Certificates I, II	-7.0	-2.1	5.0	9.2

Source: Lee and Coelli (2010) Tables 3 and 7.

Marks (2008) adopted a multi-level regression analysis to estimate the effects of obtaining various tertiary education qualifications on occupational status and earnings. These effects were calculated net of impacts of other influences such as previous work experience, socioeconomic background and ethnicity. University bachelor degrees were found to lead to the largest increases in such status. Other university qualifications were also found to increase occupational status. On the other hand, the study found little increase in occupational status in the early career of individuals with VET qualifications. The author stated one of the possible explanations to be that individuals in such programs were probably already working in a similar occupation. In regards to the impact on wages, VET diploma qualifications were found to increase earnings by approximately 14 per cent, compared to a 20 per cent increase due to a university education. Bachelor degrees again had the strongest impact of increasing weekly earnings by 30 per cent. Furthermore, completion was found to be more important for occupational status and earnings for most types of tertiary education than participation. Finally, other factors such as social background tend to have weak impacts on occupation and earnings.

More broadly, the literature also discusses other benefits of further VET education, including labour market outcomes. For example, Cully (2005) examined the impact of VET on recruitment and employment. The author noted that qualification is often a necessary condition of appointment in occupational labour markets. Furthermore, qualifications may be used as proxies for productivity on the job during the recruitment process. In regards to qualification and employment, the study found individuals with VET qualifications tend to have superior employment outcomes to those without qualifications, in the sense that they enjoy higher likelihood of being employed, lower unemployment rate, and better chances of working full-time once employed. The findings were most robust for individuals with diploma level qualifications, followed by Certificate III/IV holders. There were only small gains to Certificate I/II holders compared to those with no non-school qualifications.

In a related study, Long and Shah (2008) also acknowledged the non-earnings benefits associated with VET qualifications. Higher levels of employment was cited to be a main benefit to having a VET qualification, as increased likelihood of full-time employment can contribute as much or more to lifetime income as higher wages. Some findings from previous studies were referenced in this report. For example, Ryan (2002) showed that compared to early school leavers, having a basic vocational qualification increases rate of full-time employment by 14 per cent and 6 per cent for males and females respectively.

2.2.1 Implications for this study

From the literature discussed above, most of the studies conducted have concluded that increasing levels of education provide positive private returns. However, some of the studies did note that the returns for qualifications at the Certificate I/II are at times not large enough to provide an incentive to enrol. In this report we assume that the private return to education is equal to the average increase in pre-tax earnings from an extra year of education.

The literature review outlined the key findings of Lee and Coelli (2010) and these estimates differ to the Leigh (2008) earning premium estimates. This report continues to utilise the Leigh (2008) earning premium estimates (as shown in section 3.1.3). It is important to note that both Leigh (2008) and Lee and Coelli (2010) both use data from 2005. Hence, while the Lee and Coelli study was completed more recently, the underlying data from both studies are from the same time period. Importantly, Leigh (2008) breaks down the earning premium estimates for bachelor and post-graduate qualifications, and Lee and Coelli (2010) does not. This breakdown between bachelor and post-graduate qualifications is required for the modelling framework used in this report.

In a competitive labour market, labour is paid its marginal product. The earnings premia estimated by Leigh measure average as opposed to marginal returns to education. In a homogenous labour market, average returns are equal to marginal returns. In such an instance, the earnings premium would reflect the gain in productivity from higher education. However, the labour market is not homogenous, and expanding the tertiary sector is likely to involve easing admission requirements so that students whose ability is below the average of existing students fill the additional places. In addition, to some extent the wage premiums earned by those with tertiary education are a reflection of an individual's higher innate ability rather than the tertiary education itself. This report uses Leigh's estimates of earnings premia for different post-school qualifications to determine the change in Australia's productivity from increasing the education of its workers. However, to account for diminishing returns a deep discount has been applied to the estimates. In line with the 2009 report, the Leigh estimates used in the modelling have been discounted by 20 per cent to ensure that the returns are not overstated. An even deeper discount would need to be applied for a larger expansion of the tertiary sector to account for the diminishing returns.

2.3 Social Returns to Education

The previous discussion of private returns focussed on the earnings and other labour market rewards received by individuals for attaining higher qualifications. However, there is some thought that the social returns to education may be different to the private returns.

As indicated in our 2009 report, some argue that private returns tend to understate the social returns to education. These economists emphasise knowledge as a public good; which 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.

2.3.1 Education and Health Benefits

This section extends the literature review in our 2009 report on the relationship between health and education. As noted in our 2009 report, 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. The connection between education and health levels is well documented. However, the causal relationship between them is not well tested.

As noted in our 2009 report, 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 emphasised 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.

A related study by Scollo and Winstanley (2008) identified that in Australia and many other countries, smoking behaviour is inversely related to socioeconomic status. Notably, Scollo and Winstanley (2008) also found that increasing education levels are associated with decreased likelihood of smoking. For instance, the smoking rates of the following groups have fallen between 1980 and 2004:

- Year 10 and 11 completers;
- Trade qualification;
- Year 12 or post secondary qualifications; and
- University graduate or attended some university.

The largest decline in smoking rates was seen among those who had graduated from university or had some university education, those who finished secondary school and for those who stayed at school up until Year 9. For people with a trade qualification and those staying in school until Years 10 or 11, most of the decline in their smoking rates occurred in the 1980s. For these education groups, their smoking rates in 2004 had not changed much since the 1990s. The association between education level and smoking rate was stronger for men than women. In 2004, smoking rates were similar between the sexes among those with higher education, while men with lower education levels (year 11 and below) had higher smoking rates than women with lower education levels.

In a more recent study by Aizer and Stroud (2010) considered the impact on smoking habits in the United States before and after the widespread publication of the effects of smoking on health

in 1964. In 1964, the Surgeon General Report on Smoking and Health was released. Aizer and Stroud (2010) used a historical database that captured smoking habits of pregnant women from 1959-1966 and the analysis considered the immediate impacts of the publicising the information and the long-run impacts. Aizer and Stroud (2010) found that after the release of the 1964 report, more educated mothers immediately reduced their smoking levels and the relative health of their babies increased when compared to less educated mothers. The Aizer and Stroud (2010) analysis also found a strong peer effect in response to the 1964 report. That is, more educated mothers that were surrounded by other educated women were more likely to reduce their smoking levels compared to less educated mothers. The Aizer and Stroud (2010) research shows that higher levels of education leads to better health outcomes for the individual and also the wider social group.

As noted in our 2009 report, another relevant publication is the Australian Bureau of Statistic's (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 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.

This updated literature review and the literature review presented in the 2009 report canvassed various articles that considered the link between education and health. The general benefits education can provide to health outcomes appear clear, but studies that quantify this relationship are scarce. However, the importance of the benefits of improved education leading to improved health outcomes can be illustrated by the following studies. These two studies provide an indication the magnitude of the additional social benefits which may stem from higher university funding if a causal link between higher education and health can be established.

- KPMG Econtech (2010) estimated the total direct and indirect cost of obesity in Australia to be \$37.7 billion (or 3.1 per cent of GDP) in 2008/09.
- KPMG Econtech (2008) estimated the total cost of physical inactivity in Australia in 2008 at \$13.8 billion (or 1.3 per cent of GDP).

2.3.2 Other Returns to Education

Much is known about private returns to education but little is known about the social value, over and above the private value. The association between education and socially desirable outcomes can be linked but disentangling the effect of education from other potential causal factors has been challenging.

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.

Round and Siegfried (1998) discussed various external benefits associated with university education. The authors argued that individuals with university qualifications contribute positively to society through the promotion of culture (via studies of foreign culture and languages), creation of a better-informed and more tolerant society and the influence on other co-workers to accept innovation. The authors also reviewed selected university qualifications and their associated external benefits. For example, music, performing arts and art graduates improve social welfare through their contribution to a more cultured society; Asian studies graduates also impose external benefits as there is a growing awareness of the importance of Asian languages in Australian society; and medicine and certain other science degree holders often impose positive health and quality-of-life implications on society. However, the authors stressed the difficulties associated with measuring these external benefits. The fact that these external benefits might differ across disciplines makes quantifying them even harder. A study by Moretti (2004) attempted to test the relationship between education levels and other benefits to the community more generally. Moretti (2004) looked at the spill-over effects from college education by comparing wages for otherwise similar individuals who work in cities with different shares of college graduates in the labour force. Moretti (2004) found that a percentage point increase in the supply of college graduates raises high school drop-out's wages by 1.9 per cent, high school graduates' wages by 1.6 per cent and college graduates wages by 0.4 per cent.

2.3.3 Implications for this study

The studies canvassed in this report and in our 2009 report do show that there is a relationship between education and better social outcomes. However, the literature does not provide a strong foundation to be incorporated into the modelling framework employed in this study. To remain on the conservative side, we have not incorporated a premium for the social outcomes arising from higher levels of education. Hence we assume that the total (private and social) return to tertiary educational attainment is equal to the average increase in pre-tax earnings from that additional qualification.

As noted earlier, to illustrate the other potential gains for the Australian economy from higher levels of education, we have highlighted two recent studies that estimate the cost of obesity and physical activity. If there is a link between education and health, these two studies show the magnitude of the potential benefits for the Australian economy.

2.4 Returns to Publicly Funded Research and Development

This section presents an update on the literature review on the economic impacts of publicly funded research and development in the 2009 report, with a greater focus on more recent studies. It examines the economic justification behind public investment in research and development, namely the rate of return, in both the Australian and international contexts.

Empirical analysis into the effectiveness of public research and development in agriculture have generally found high rates of return, which in turn suggests that there is currently under-

investment in agricultural research and development. However, more recent literature has recognised the need to correctly classify ‘productivity’ – namely, factors such as spill-over effects and other externalities of agricultural production should be taken into account when estimating the rate of return of public research and development. Thirtle (1999) noted that as effects of private expenditure and spill-overs are treated more appropriately, estimates of rates of return (ROR) to public agricultural research expenditure are becoming lower. The author attempted to separate the effect of research and development funded by the UK’s Sugar Beet Research and Education Committee in the sugar industry from other effects in estimating the ROR. The author found the average ROR for both producers and consumers to be between 20.8 per cent and 50.3 per cent in years 1954-1992.

Similarly, Barnes (2001) adopted a ‘social’ total factor productivity (TFP) index instead of the traditional TFP index in the examination of the effectiveness of UK agricultural research and development funding. The ‘social’ TFP index in this instance takes the costs of fertiliser and pesticide pollution into account. The estimation results showed lower rates of return to public agricultural research and development compared to estimates using traditional TFP indices – the internal rate of return (IRR) for a time period from 1948 to 1995 was estimated to be 19.04 per cent using ‘social’ TFP indices, while the IRR for the same estimation period using traditional TFP indices was higher at 22.03 per cent. Schimmelpennig and Thirtle (1999) estimated rates of return to public agricultural R&D, while taking into consideration the effects of spill-overs due to internationalisation of agricultural technology. The authors found that the estimated rate of return falls from around 60 per cent in a closed economy model to around 10 per cent in an open economy model with spill-over effects.

In the local context, Mullen, Scobie and Crean (2006) reviewed trends in public R&D expenditure and productivity growth in agriculture industries in Australia and New Zealand. The authors also recognised the importance of spill-over effects. They concluded that spill-overs of knowledge created by R&D are likely to be significant for the two countries given their relatively small agricultural industries. However, it was also highlighted that Australia’s unique climate and various other agricultural characteristics make foreign spill-overs less important than they otherwise would be. The estimated IRR for the Australian agricultural industry range from 16 per cent to 21 per cent, while the estimated IRR for New Zealand range from 13 per cent to 17.9 per cent. Hall and Scobie (2006) found that the spill-in effect of foreign knowledge contributed significantly to the growth of agricultural productivity in New Zealand. The authors adopted various estimation methods including several versions of the Koyck model and the Almon model, and found that despite the lack of convergence between the results, the estimates were mostly significant. The estimation result from the authors’ preferred method, which was selected based on minimising the Akaike Information Criterion (AIC), was a rate of return of 17 per cent.

Johnson et al. (2007) adopted a production function approach to evaluate rates of return to publicly funded research in various industries in New Zealand. Their regression results found no significant benefit of public research and development expenditure on either the output of the industry or the economy as a whole. The authors attributed this finding partly to the lack of commercial value of New Zealand’s publicly provided research and development, that is, the inability of certain publicly funded research and development projects to make it to the market. However, the authors recognised that public research and development is likely to have spill-over effects at the firm level, despite the unavailability of data to confirm such hypothesis.

More recently, Onofri and Fulginiti (2008) attempted to examine the relationship between public research and development and performance of the U.S. agricultural industry. Given the sector has experienced sustained growth, the authors employed an endogenous growth model as they argued that neoclassical growth models could not explain productivity changes. The implied rate of return to public research and development expenditure from their modelling output was a substantial 190 per cent. In another recent study, Hosseini et al. (2009) sought to estimate the rate of return associated with public expenditure in sugarbeet research in Iran. Their estimation result revealed an IRR of around 32 per cent.

Alston et al. (2000) conducted a meta-analysis of 292 past analyses of returns to publicly funded agricultural research and development. Out of the regression sample of 1128 observations, the authors found the mean, median and mode of the rates of return to be 64.6 per cent, 42.0 per cent and 28.0 per cent respectively. Given the skewness in the observations, the median or mode is likely to be more reliable than the mean as the few observations in the very high end (the maximum rate of return was 910 per cent) tend to drive the mean upward. The authors also outlined a number of factors which tend contribute to any potential upward bias in the estimation process. They include failing to take into account any private research and development contribution; not counting certain costs such as costs of extension; and ignoring effects of spill-overs from other industries or the same industry in other locations.

Studies have also been conducted to determine the impacts of publicly funded research and development in other areas such as health, direct commercialisation of research and development, scientific productivity, the food and beverage industry and climate change. Literature surveys have also been conducted by several authors that summarised the economic and social benefits arising from publicly funded research in a wide variety of areas.

For example, Access Economics (2008) estimated the economic value of health research and development in Australia. The study estimated the return on investment from health research and development through gains in wellbeing. The gains in wellbeing were measured by the impact on mortality rates and associated morbidity, relative to what they would otherwise have been. Access Economics (2008) estimated that 2.5 per cent of all potential future gains in wellbeing can be attributed to Australian health R&D. Further, the study estimated that the net benefits from Australian health research and development over the period 1992-93 to 2004-05 was \$29.5 billion or approximately \$2.3 billion per year. This net benefit translates to a return on investment of around 117 per cent. The study also noted that the return on investment for health research and development was higher when compared to the manufacturing (around 50 per cent) or agricultural (around 24 per cent) sectors. However, the return on investment is lower when compared to the mining (around 159 per cent) or wholesale and retail sector (around 428 per cent).

In 2003, the Allen Consulting Group investigated the extent of economic benefits arising through the direct commercialisation of publicly funded research and development in Australia. In addition, the study explored the potential for improved economic returns to be generated over the longer term. The study noted that over a 20 year period (1982-83 to 2001-02), the Australian Government committed approximately \$82 billion in 2002 dollars to research and development. Further, the study notes that only around 50 per cent of public funding for research and development could be expected to generate some economic benefits via direct commercialisation of the research and development. The Allen Consulting Group found that

over the period considered, the total economic impacts of the research and development investment in 2002 included the creation of approximately 10,000 jobs, generation of \$2.5 billion per annum in revenue and generation of \$2.0 billion in exports. The study also found that the turnover of companies based on publicly funded research has grown from around \$300 million (2002 dollars) in 1983 to over \$1.5 billion (2002 dollars) in 2003. In addition, the study reported that 73 per cent of the science papers cited by US industry patents were generated by publicly funded research.

Public funding for research and development also has impact on scientific productivity. Applying regression analysis, Jacob et al (2007) examined the relationship of receiving a National Institutes of Health (NIH) grant on subsequent research productivity. The NIH and National Science Foundation (NSF) allocate over \$30 billion annually for basic and applied research in the sciences. The paper found that receiving a NIH postdoctoral fellowship increased research publications and citations in the years following grant application from 4.6 to about 5.3, or roughly 20 per cent. However, receiving a NIH research grant had a smaller effect on the research productivity of only 7 per cent.

Mamatzakis (2009) used the dual cost function methodology and developed a theoretical specification that assessed the contribution of public research and development capital to the productivity growth in the Greek food and beverages industries. The analysis showed that publicly funded research and development capital had a productive effect. Specifically, the analysis showed that the cost elasticity with respect to publicly funded research and development capital is negative for both the food and the beverages industries. This implies that the average short-run cost function shifts downwards as public expenditure in research and development increases. The study also concluded that the research and development capital contributed to productivity growth. For instance, over the sample period considered, 8.7 per cent and 7.3 per cent of the TFP in the food industry and in the beverages industry is due to the publicly funded research and development capital.

Popp (2010) conducted a literature survey that investigated the role of government policies and the impact on the development of technologies to combat climate change. Popp (2001) noted that both environmental and research and development policies provide incentives to encourage the development of clean technologies but the impacts are different. Technological policies such as, patent protection, research and development tax credits, and funding for generic basic research were found to influence on the overall rate of innovation. Environmental policies such as, carbon tax or cap-and-trade system and more general research and development policy mechanisms were found to affect the direction of innovation. Popp (2010) compared the long-run welfare gains from both an optimally-designed carbon tax and optimally designed research and development subsidy and found that combining both policies yields the largest welfare gain. However, a policy using only the carbon tax achieved 95 per cent of the welfare gains of the combined policy, while a policy using only the optimal research and development subsidy attained just 11 per cent of the welfare gains of the combined policy in his model. Overall, Popp (2010) reported that environmental and technology policies work best in tandem.

Martin and Tang (2006) conducted a literature survey of the economic and social benefits that flow from public funding of basic research. The survey reported:

- OTA (1986) and Griliches (1995) found that the rate of return to public research and development was between 20 to 50 per cent.
- Bilbao-Osorio et al (2004) found that both research and development investment as a whole and higher education research and development investment are positively associated with innovation and economic growth in peripheral regions of the European Union.
- Mansfield (1991) found that approximately 10 per cent of innovations may not have happened without the academic research.
- Tijssen (2002) showed that 20 per cent of private sector innovations are based, to some extent, on public sector research.
- In the biomedical industry, Toole (1999) showed that a 1 per cent increase in the public stock of public research resulted in a 2.0 to 2.4 per cent increase in the number of commercially available new compounds. In addition, Toole (1999) found that the firms approximate return on public science investment was between 12 and 41 per cent.
- Narin et al (1997) showed that patents for inventions drew significantly on the results of publicly funded basic research. Further, McMillan and Hamilton (2003) found that 75 per cent of scientific papers cited in the US industrial patents are from public research.

A summary of the above econometric studies on rate of return to publicly funded research is shown in Table 2.5. The table also includes estimation results from past literature studied in our previous report⁸. It shows that the rate of return to publicly funded research generally varies from 20 to 60 per cent (apart from a few outliers) depending on the subject of the study and the underlying 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 their approaches.

⁸Please refer to the previous report for more details in relation to these studies.

Table 2.5: 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%
	Cash Grain		36%
Bredahl and Peterson (1976)	Poultry	Production function approach	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%
	Poultry		27-33%
Norton (1981)	Dairy	Production function approach	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%
Mamuneas (1999)	Six high-tech manufacturing industries	Production function approach	12-21%
Toole (1999)	Pharmaceuticals	Return on investment approach	11-32%
Schimmelpfennig and Thirtle (1999)	Agriculture	Total factor productivity approach	10-60%+
Thirtle (1999)	Sugar	Total factor productivity approach	20-50%
Cockburn and Henderson (2000)	Pharmaceuticals	N/A – study presents a literature review	30% +
Johnson (2000)	Nine industries	Total factor productivity approach	-27-1%
Alston, Marra, Pardey and Wyatt (2000)	Agriculture	N/A – study presents a literature review	-100-900%+
Barnes (2002)	Agriculture	Adjusted (social) Total factor productivity approach	19-23%
Scobie and Hall (2006)	Agriculture	Multifactor productivity approach	0-32% ^f
Hall and Scobie (2006)	Agriculture	Production function approach	17%

Table 2.3 continued: 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
Mullen, Scobie and Crean (2006)	Aggregate agricultural research	Total factor productivity approach	13-21%
Johnson, Razzak and Stillman (2007)	Nine industries	Production function approach	statistically insignificant
Health Economics Research Group, Office of Health Economics, RAND	Cardiovascular research	Return on investment approach	39%
Onofri and Fulginiti (2008)	Aggregate agricultural research	Production function approach	190%
Hosseini, Hassanpour and Sadeghian (2009)	Sugar	Economic surplus approach	32%
Access Economics (2008b)	Health	Willingness to pay	117%
Allen Consulting Group (2003)	Direct commercialisation of publicly funded R&D	NA	NA
Jacob et al (2007)	Scientific productivity	Regression Analysis	7 - 20%
Mamatzakis (2009)	Food and beverage industry	Dual cost function methodology	7.3 - 8.7%
Popp (2010)	Climate Change	Welfare Gains	NA
Martin and Tang (2006)	Literature Survey	NA	2 - 50%

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.

2.4.1 Implications for this study

While there is a wide range of estimates on the rates of return to public R&D, the majority of studies have estimated a return of between 20-40 per cent. This is in agreement with the key findings in the literature review contained in the 2009 report. We assume an average return of 25 per cent for university research.

3 Modelling Approach

This section outlines the modelling approach employed to update and extend our earlier report. Importantly, as this report contains updates and extensions to our original report, it should be read in conjunction with our report, “Economic Modelling of Improved Funding and Reform Arrangements for Universities”⁹.

This section is structured as follows.

- Section 3.1 outlines the modelling approach employed to extend the analysis contained in the 2009 report.
- Section 3.2 outlines the three scenarios employed in this report to model improved funding and reform arrangements.

3.1 Modelling Approach

Our 2009 report for Universities Australia modelled the economic impact of increasing university funding and various policy changes in conjunction with the funding increase. To do this, 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 consisted of four models and included:

- a university funding model;
- an educational attainment and productivity model;
- a research and productivity model; and
- an economy-wide model.

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

- increased productivity;
- increased labour force participation;
- 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.

⁹ This report is available on the Universities Australia website (http://www.universitiesaustralia.edu.au/content.asp?page=/news/media_releases/2009/uniaus_media_04_09.htm).

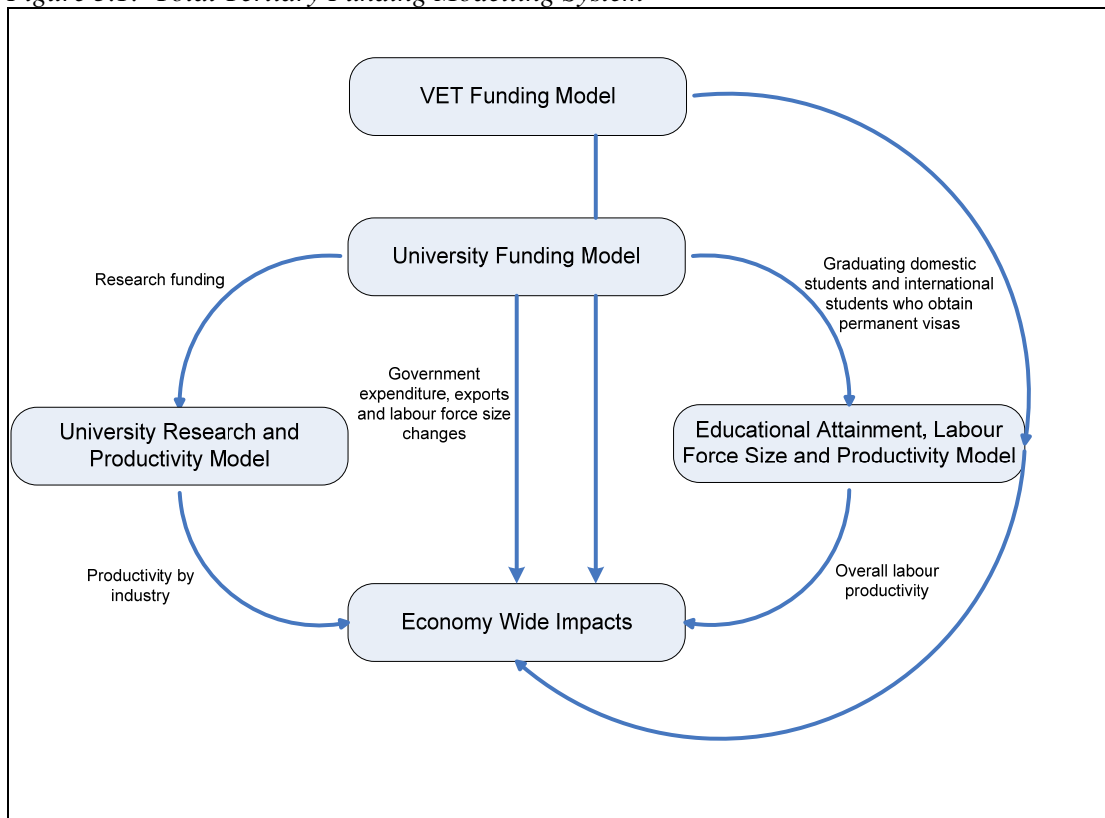
When judging a policy change, it is important to weigh the benefits up against the costs. The economy-wide model included in the modelling system is a growth accounting model, which demonstrates the main economic implications, including the costs, of expanding the university sector. These costs include:

- the costs of university research and teaching;
- the reduction in the size of the labour force for the period that students are studying; and
- increasing taxes.

To update our earlier economic modelling to capture the VET sector, we have developed a VET funding model. This model is used in conjunction with the current system of models and is based on the methodology underlying the university funding model.

The relationship between the five models employed in this report is shown in Figure 3.1.

Figure 3.1: Total Tertiary Funding Modelling System



Source: KPMG Econtech.

Like the university funding model, the VET funding model provides inputs into the other three models. The VET funding model converts funding increases into the various costs and benefits associated with an increase in VET funding. Primarily, this includes allocating any funding increase into the activities of VET and to estimate the direct costs of increased VET funding.

It was necessary to build a new model to capture the entire tertiary education sector due to the differences between university education and VET sectors. For example, VET courses are often shorter than university courses. Also it is assumed that the VET sector does not undertake any research. Like the university funding model, the VET funding model also considers attrition and completion rates and study assistance.

For ease of reference, the following subsections reproduce much of the details of each component of the modelling system from our 2009 report. Additional detail on the modelling system is provided at Appendix A.

3.1.1 University and VET Funding Models

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

In summary, the funding models provide five key outputs:

- Estimates of the increase in government expenditure (university funding, VET funding and student assistance payments). This allows for the costs of diverting resources to the tertiary sector away from other sectors in the economy and the cost of raising additional taxes to be accounted for in the modelling.
- Estimates of the increase in university research funding by industry.
- Estimates of the increase in the number of new bachelor and doctorate graduates.
- Estimates of the increase in the number of new certificate III/IV and diploma graduates¹⁰.
- Estimates of the net change in the size of the labour force.
- Estimates of the export dollars accruing from international students.

A key output provided by the university and VET funding models is the estimate of the net change in the size of the labour force as a result of the increase in 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 or VET provider. 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:

¹⁰ The VET funding model assumes that any increase in funding is directed towards certificate III/IV, diploma and advanced diploma places.

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

As indicated in Figure 3.1, government expenditure and labour force size changes are entered directly into the economy-wide model. However, the additional research funding and the additional university and VET graduates 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.

3.1.2 Research and Productivity Model

To determine the productivity benefits associated with research, KPMG Econtech estimated the returns to this type of investment. This analysis is carried out in the research and productivity model. The first step was to allocate research expenditure to the industries that ultimately benefit. This was done by separating funding into socioeconomic objectives based on ABS HERD¹¹ data relativities and then matching these socioeconomic objectives with industries in the economy based on the ABS's ANZSIC¹² 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 25 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 the economy-wide model, as indicated in Figure 3.1.

3.1.3 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 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

¹¹ Higher education expenditure on research and development.

¹² Australian and New Zealand Standard Industrial Classification.

estimates were then discounted by 20 per cent to account for diminishing marginal returns as discussed in Section 2.2.1, and these discounted estimates are reported in Table 3.1.

Table 3.1: University qualifications and earnings premiums

Educational level	Earnings premium relative to those without a post-school qualification
Certificate III/IV	-2%
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.

Note: The estimates for Certificate III/IV are included in the above table but they were not found to be statistically significant. Hence it is assumed that there is no wage premium from a Certificate III/IV qualification. This assumption is in line with the results of other studies into VET returns.

With wages held constant in constructing the index, movements in the index reflect changes in the educational mix of the labour force. For example, 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 the economy-wide model as indicated in Figure 3.1 and described below.

3.1.4 Economy-wide impacts

As indicated in Box 3.1, outputs from the university and VET funding models, the research and productivity model and the educational attainment and productivity model are introduced into the economy-wide model. The economy-wide model is a growth accounting model, which demonstrates the main effects of increasing university and VET funding in a transparent way.

For the growth accounting model, we use the key inputs mentioned above to estimate the net economic impact of increasing university and VET funding. As indicated earlier, increasing university and VET 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.

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

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 and VET.

To determine the net economic impact on living standards, the increase in government expenditure required to fund the university and VET 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.

Our 2009 report only reported the results at the national level. For the updated report, we have extended our current modelling approach to capture results for both the nation and state and territories. To do this, we have used forecasts from our highly regarded MM2 to feed into our system of models to develop the results for the states and territories.

More information on MM2 has been provided at Appendix B.

3.2 Scenarios

To analyse the impact of changes to tertiary education 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.

3.2.1 Baseline

The Baseline scenario simply maintains funding at its existing share of GDP throughout the projection period.

Currently, based on 2008 data, university funding is 1.6 per cent of GDP. In addition, the Commonwealth Government’s contribution of government grants equals 43 per cent of this contribution. Lastly, based on 2008 data, the publicly funded VET sector is 0.6 per cent of GDP and government funding is approximately 76 per cent of this.

As a point of comparison, these shares are maintained throughout the projection period for the baseline. This is essentially a “no policy change” scenario.

In addition to the unchanged funding assumptions contained in the Baseline Scenario, Table 3.2 and Table 3.3 present the other key modelling assumptions for the University Baseline Scenario and the VET Baseline Scenario respectively.

Table 3.2: Key Modelling Inputs – University Baseline Scenario

Modelling Input	Baseline - University
Funding Share - Student	66%
Funding Share - Research	34%
Attrition and Completion Rates	
Domestic Undergraduate Commencing	19%
Domestic Undergraduate Completion rates	65%
Domestic Postgraduate Commencing	27%
Domestic Postgraduate Completion rates	54%
International Undergraduate Commencing	11%
International Undergraduate Completion rates	70%
International Postgraduate Commencing	20%
International Postgraduate Completion rates	60%
Average Duration	4.0

Source: KPMG Econtech and Universities Australia

Table 3.3: Key Modelling Inputs – VET Baseline Scenario Source:

Modelling Input	Baseline - VET
Funding Share - Student	100%
Funding Share - Research	0%
Attrition and Completion Rates	
Domestic Certificate IV/III Commencing	30%
Domestic Certificate IV/III Completion rates	54%
Domestic Adv Diploma/Diploma Commencing	30%
Domestic Adv Diploma/Diploma Completion rates	67%
International Certificate III/IV Commencing	30%
International Certificate III/IV Completion rates	54%
International Adv Diploma/Diploma Commencing	30%
International Adv Diploma/Diploma Completion rates	67%
Average Duration - Adv Diploma/Diploma	2.0
Average Duration - Certificate IV/III	2.0

Source: KPMG Econtech and NCVER

In addition to the key modelling assumptions outlined above, the participation rates for males and females assumed in the Baseline Scenario are presented in Tables 3.4 and Table 3.5.

Table 3.4: Key Modelling Inputs – Participation Rates – Males

Participation Rates - Males	15-64
With non-school qualifications	92%
Postgraduate Degree or Graduate Diploma	92%
Bachelor Degree	92%
Advanced Diploma/Diploma	92%
Certificate III/IV	94%
Other qualification	88%
Without non-school qualification	83%
Total	89%

Source: ABS, Survey of Education and Work, 2009

Table 3.5: Key Modelling Inputs – Participation Rates – Females

Participation Rates - Female	15-64
With non-school qualifications	82%
Postgraduate Degree or Graduate Diploma	85%
Bachelor Degree	83%
Advanced Diploma/Diploma	80%
Certificate III/IV	82%
Other qualification	74%
Without non-school qualification	72%
Total	79%

Source: ABS, Survey of Education and Work, 2009

Table 3.4 shows that Males aged 15-64 years without a non-school qualification have an assumed participation rate of 83 per cent. Whereas, Males in the same age group with a Bachelor Degree have an assumed participation rate that is approximately 11 per cent higher at 92 per cent. Similarly, Table 3.5 shows that Females aged 15-64 years without a non-school qualification have an assumed participation rate of 72 per cent. Whereas, Females in the same age group with a Bachelor Degree have an assumed participation rate that is approximately 15 per cent higher at 83 per cent.

Table 3.4 and Table 3.5 also show that there is a similar differential in participation rates when comparing those without a non-school qualification with a VET qualification (Advanced Diploma/Diploma or Certificate III/IV).

As discussed earlier, 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 to account for diminishing marginal returns as discussed in Section 2.2.1, and these discounted estimates are reproduced below for ease of reference.

Table 3.6: University qualifications and earnings premiums

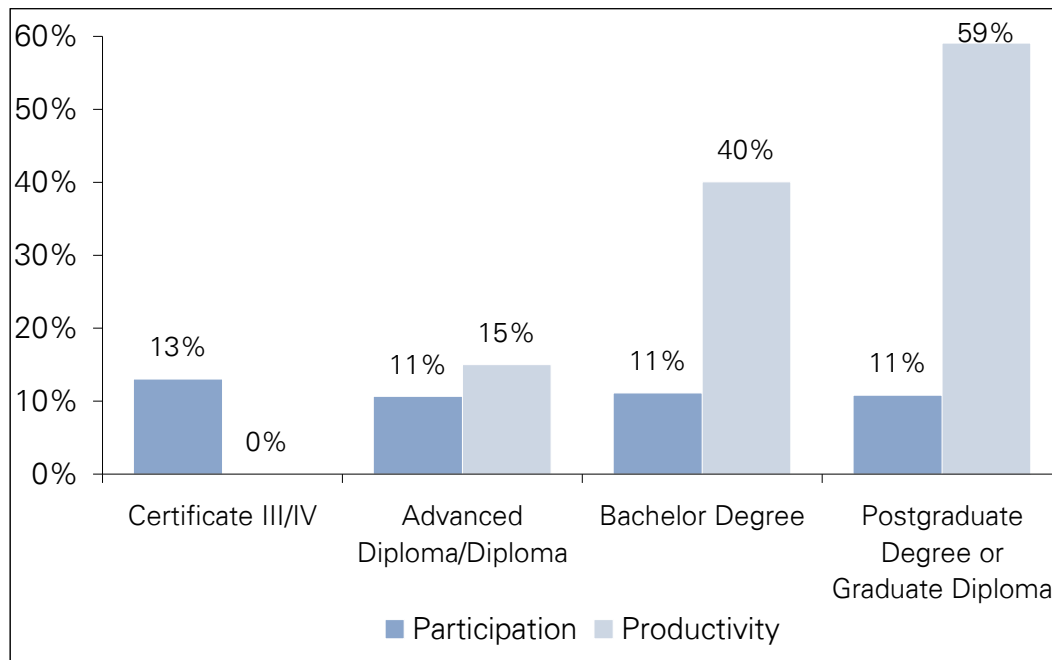
Educational level	Earnings premium relative to those without a post-school qualification
Certificate III/IV	-2%
Diploma or Advanced Diploma	15%
Bachelor Degree	40%
Graduate Diploma or Graduate Certificate	37%
Masters or Doctorate	59%

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

Note: The estimates for Certificate III/IV are included in the above table but they were not found to be statistically significant. Hence it is assumed that there is no wage premium from a Certificate III/IV qualification. This assumption is in line with the results of other studies into VET returns.

As seen above, the assumed participation rates arising from increased levels and education are similar for both VET and university level qualifications. However, when earning premiums are considered, VET and university qualifications differ greatly. The pay-offs from tertiary education for an individual is summarised in Chart 3.1 below for a Male.

Chart 3.1: Payoffs from tertiary qualifications (per cent pay-off compared to a year 12 qualification for a male)



Source: Participation – ABS; Productivity - Leigh (2008) with 20% discount.

3.2.2 Pure Funding Augmentation Scenario

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 2010 until it reaches two per cent of GDP by 2015. Furthermore, the Commonwealth Government’s contribution increases faster so that, by 2015, the Government’s contribution of Commonwealth grants is 50 per cent. This scenario is broadly consistent with the funding recommendations in the Bradley Review.

For the tertiary sector as whole, in addition to the assumptions for the universities sector outlined above it is also assumed that VET funding increases to 0.7 per cent of GDP. Of this 0.7 per cent, government will continue to contribute approximately 76 per cent of the funding, with the remaining coming from other sources. To achieve this, it is assumed that funding for VET increases gradually from 2010 until it reaches 0.7 per cent of GDP by 2015.

Table 3.7 presents both the Baseline and Pure Funding Augmentation scenarios.

Table 3.7: Baseline scenarios

Scenarios	Total funding as a share of GDP	Government Share
Baseline - University	1.6%	43%
Baseline - VET	0.6%	76%
Pure Funding Augmentation - University	2.0%	50%
Pure Funding Augmentation - VET	0.7%	76%

Source: Universities Australia and 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 university and VET students reflect the latest data. In this way, the Pure Funding Augmentation scenario allows for a straight comparison of the impact of increasing funding. Essentially, this scenario boosts the size of the tertiary sector without any other policy changes.

3.2.3 Structural Reform Scenario

As the most efficient policy for the government may involve more than simply increasing the size of the university sector, we have also modelled the impact of increasing funding while implementing structural reforms to the sector.

The Reform scenario involves the same funding increase as the 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. Adjustments have been made to:

- student-staff ratios;
- administration costs;
- returns to research;
- returns to student productivity; and
- attrition rates and completion rates of students.

These changes are discussed in more detail below.

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. On the other hand, 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. 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.

For illustration, KPMG Econtech has modelled the impact of reducing student-staff ratios from current levels (20.8:1) to 1995 levels (14.6:1). 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. To provide an indication of how administration costs impact on university output, KPMG Econtech has modelled the impact of a 5 per cent reduction in the other expenses item of university budgets or the non-teaching expenses to university income ratio. To achieve this 5 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 grant funding.

The third part of Reform scenario is accounting for the fact that there may be a relationship between student-staff 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 effect of a reduced student-staff ratio was simulated assuming that the rate of return to research increases from 25 per cent to 30 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 (2008) wage premium estimates discount employed of 20 per cent was reduced to 10 per cent¹³. It is important to note that this is only an illustration of the effects of student-staff ratios.

The baseline attrition rates and completion rates in the model are presented in Table 3.8. Table 3.8 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 and this lifts the benefits of increasing funding for universities.

Table 3.8: Attrition and completion rates

	Attrition Rates	Completion Rates	Reform scenario Attrition Rates	Reform scenario Completion Rates
Undergraduates	19%	65%	16%	71%
PHDs	27%	54%	22%	62%

Source: KPMG Econtech.

¹³ The 2009 report also modelled a Reform scenario. The 2009 Reform scenario modelled an increase in funding for universities in conjunction with various policy changes. The policy changes modelled were to illustrate that the government could increase funding for universities in conjunction with changes in education policies without sacrificing gains in GDP and living standards. Specifically, in conjunction with the other changes modelled, reducing Leigh;s (2008) wage premium estimate discount from 20 per cent to 16.5 per cent leads to a gain in GDP which is the similar to that achieved under the 2009 Pure Funding Augmentation scenario. To achieve the same GDP change as in the Pure Funding Augmentation modelled in this report, the discount on the Leigh (2008) wage premium estimate discount of 20 per cent would need to be reduced to only 12.5 per cent.

4 Results

The results presented in this section follow the growth accounting presentation, to clearly illustrate how an increase in funding for the tertiary sector can impact on the economy.

This section is structured as follows.

- Section 4.1 outlines the results for the Pure Funding Augmentation Scenario.
- Section 4.2 outlines the results for the Reform Scenario.
- Section 4.3 details the results at the state and territory level.

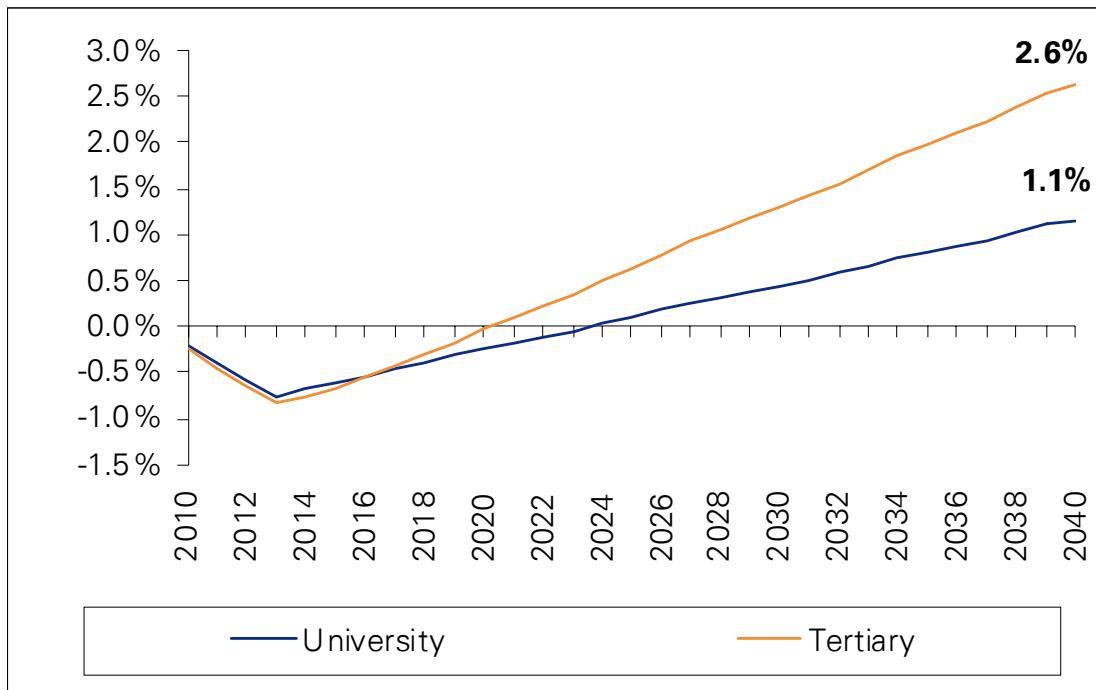
4.1 Pure Funding Augmentation Scenario

Chart 4.1 shows the estimated changes (percentage deviation from baseline) in the labour force from the Pure Funding Augmentation scenario for the university and the whole tertiary sector sectors.

Chart 4.1 shows that the expansion of the university and tertiary sector is anticipated to lead to the labour force shrinking in the earlier years of the Pure Funding Augmentation scenario compared with the same years in the Baseline scenario. The labour force shrinks in the early years of the scenario as the increased funding increases the number of places available in universities and VET. The greater number of places available means that more students enrol in courses and thus spend less time in the workforce than would otherwise be the case.

Graduates are more employable and hence have higher participation rates than non-graduates of the same age. In addition, there is an increase in the size of the population from international students who remain in Australia at the completion of their studies. This positive effect gradually outweighs the negative effects of lower participation during years in studying. By 2040, the labour force is expected to be 1.1 per cent larger than under the Baseline scenario in the same year as a result of the expanded university sector. Turning to the expansion of the entire tertiary sector, by 2040, the labour force is expected to be 2.6 per cent larger than under the Baseline scenario in the same year.

Chart 4.1: Labour force change for the Pure Funding Augmentation scenario for the University and Tertiary sectors (% deviations from baseline)



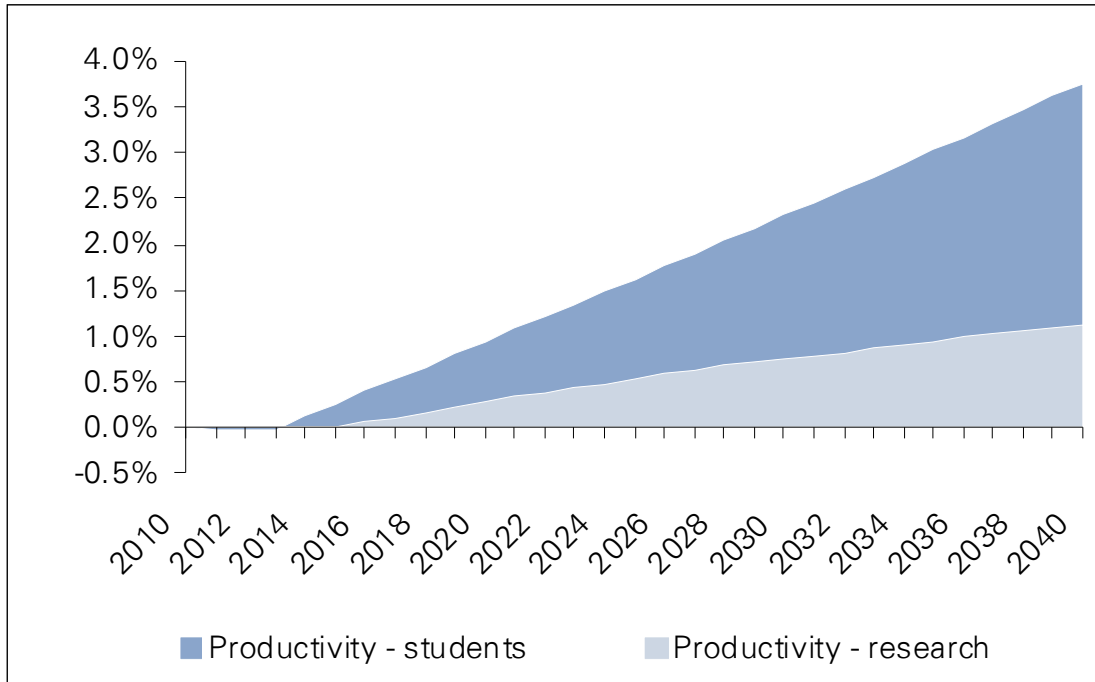
Source: KPMG Econtech.

Charts 4.2 and 4.3 show the estimated labour productivity effects resulting from the increase in funding for universities and the tertiary sector. For university students, Chart 4.2 shows that the benefits of higher labour productivity commence in 2014. This is because the new graduates (whose places have been financed by the increase in funding) first enter the workforce in this year. For tertiary students, Chart 4.3 shows that the benefits of higher labour productivity commences in 2012.

By 2040, labour productivity is expected to be 3.8 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. For tertiary students, labour productivity is expected to be 0.4 per cent higher than in the Baseline scenario in the same year.

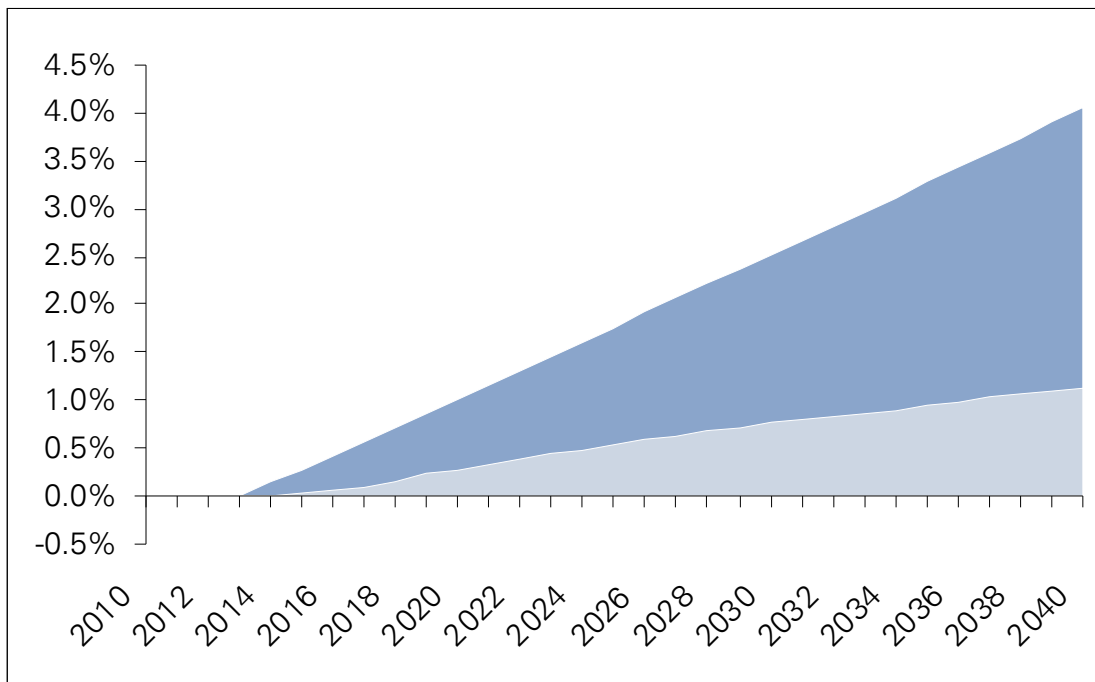
Turning to research funding, Chart 4.2 also shows its expected labour productivity benefits. These benefits gradually build as the knowledge base continues to expand from sustained research. By 2040, the ongoing productivity boost exceeds 1.0 per cent. One reason that the productivity boost from students is greater than from research is because more of the additional university funding is channelled to student education rather than research.

Chart 4.2: Productivity effects from students and research from the Pure Funding Augmentation scenario for the University sector (% deviations from baseline)



Source: KPMG Econtech.

Chart 4.3: Productivity effects from students from the Pure Funding Augmentation scenario for the tertiary sector (% deviations from baseline)

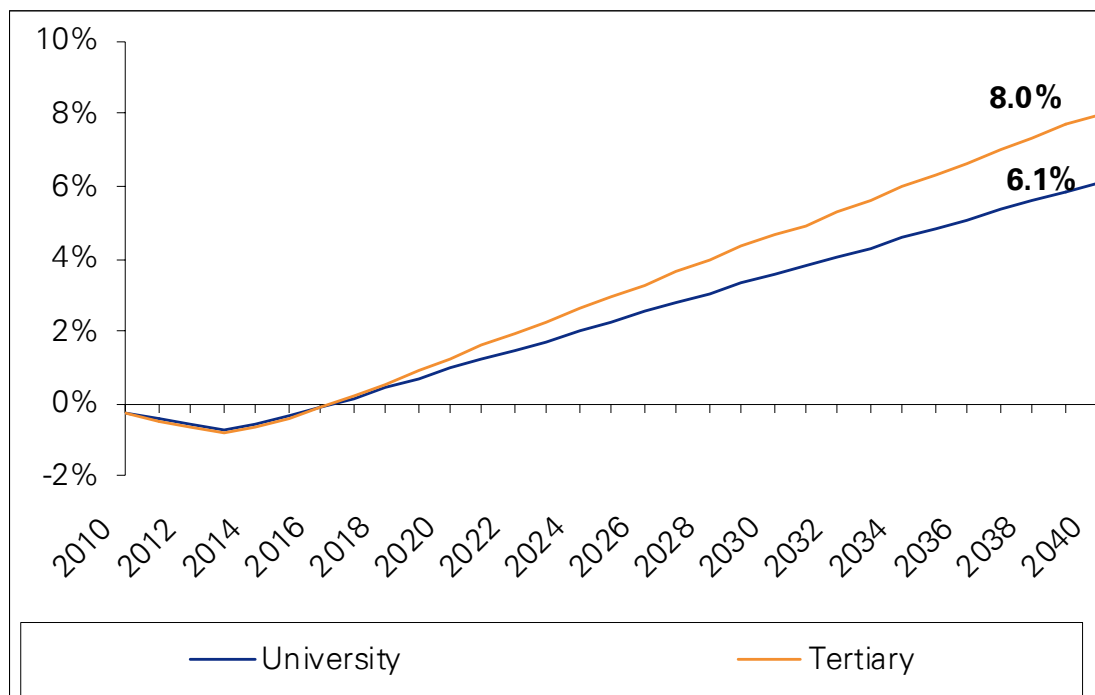


Source: KPMG Econtech.

Combining the above labour force and productivity effects from Charts 4.1, 4.2 and 4.3 shows how real GDP is affected by expanded university and tertiary funding. Chart 4.4 presents the percentage deviations in GDP between the path of the Pure Funding Augmentation scenario and the path of the Baseline scenario.

Chart 4.4 shows that, while GDP in the Pure Funding Augmentation scenario is initially below its path from the Baseline scenario, it moves increasingly above the baseline. Chart 4.4 shows that, by 2040, there is a gain in GDP from higher funding of universities and tertiary institutions by 6.1 per cent and 8.0 per cent respectively.

Chart 4.4: Real GDP effects of expanding the University and tertiary sectors (% deviations from baseline)



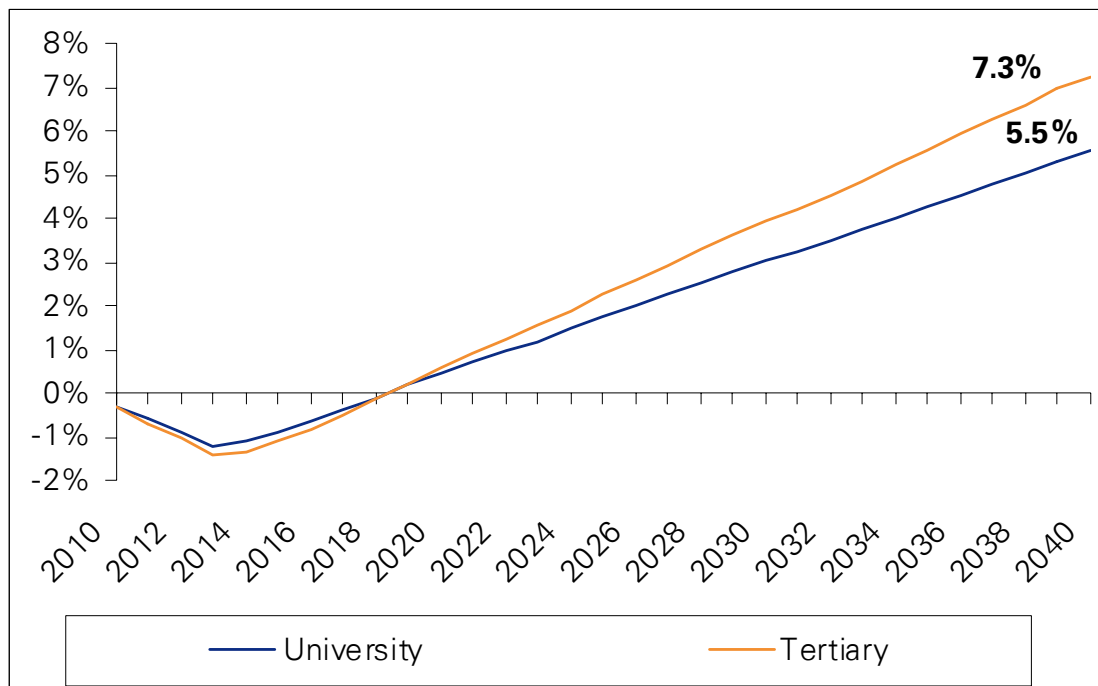
Source: KPMG Econtech.

These estimated gains in GDP do not tell the full story. They show the benefits of an expanded university and tertiary sector before taking into account the costs. Over time, higher government expenditure on universities and VET would be funded by increasing taxes or reallocations from other programs. This report assumes 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 and tertiary sectors can be measured by the impact on living standards, proxied by private consumption. An expansion in university and VET funding leads both to higher GDP, which boosts household consumption, as well as higher taxes, which reduce living standards.

Chart 4.5 shows the final net benefit of higher funding as measured by household consumption or living standards. Importantly, the costs of expanding the university and VET sectors 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 4.5 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 and VET 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 is anticipated to amount to 5.5 per cent from the expanded university sector and 7.3 per cent from the expanded tertiary sector as a whole.

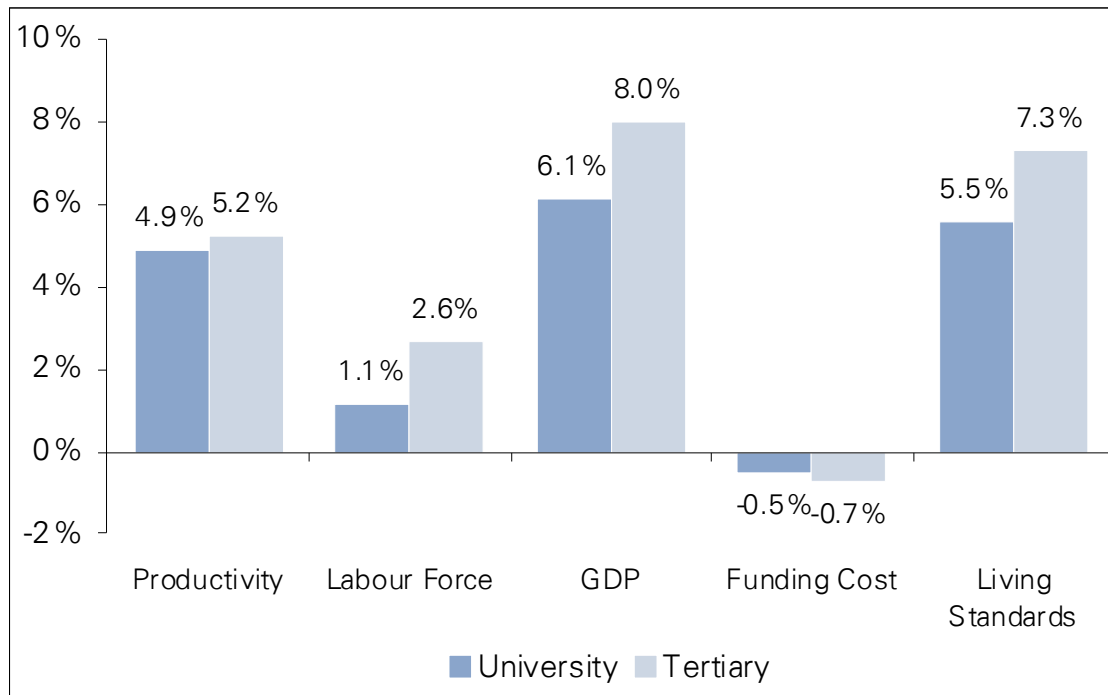
Chart 4.5: Living standards effects of expanding the University and VET sectors (% deviations from baseline)



Source: KPMG Econtech.

The above gains in living standards in 2040 driven by the expansion in the university and tertiary sectors can be decomposed into their elements. Chart 4.6 shows that for the university sector, the gains in productivity (4.9 per cent) and labour force (1.1 per cent) are only partially offset by the increase in taxes associated with this policy (0.5 per cent) by the year 2040. For the tertiary sector as a whole, the gains in productivity (5.2 per cent) and labour force (2.6 per cent) are only partially offset by the increase in taxes associated with this policy (0.7 per cent) by the year 2040.

*Chart 4.6: Source of Impact on living standards (private consumption) in 2040
(% deviations from baseline)*



Source: KPMG Econtech.

4.2 Structural Reform Scenario

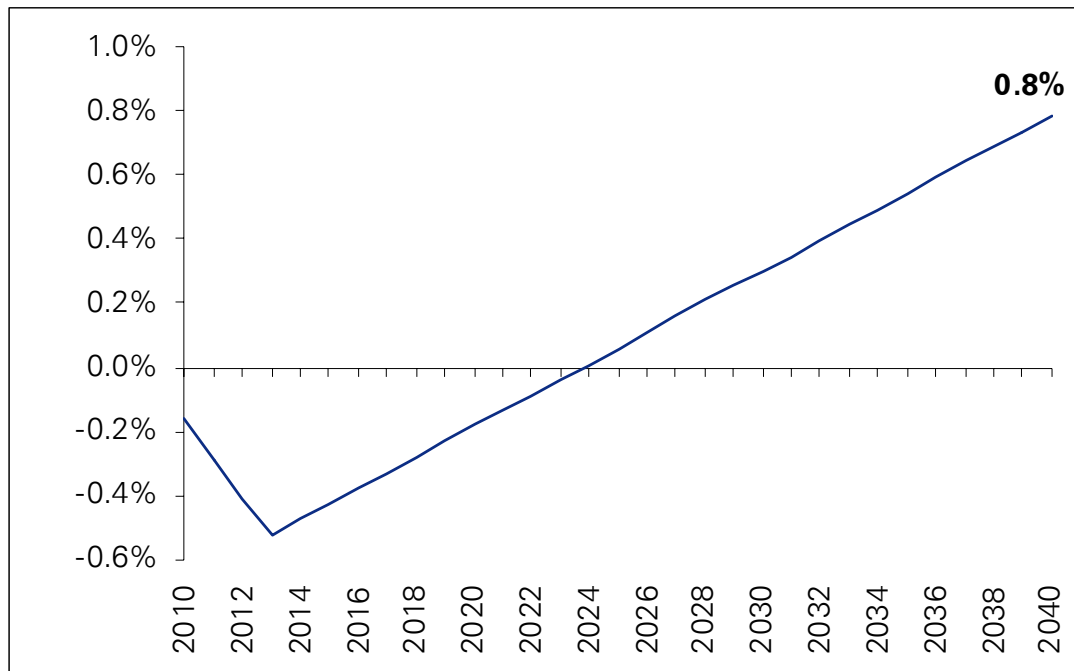
Whilst the previous section demonstrated the net benefits of increasing funding for universities and the tertiary sector, simply increasing the size of the sector may not be the most efficient policy for the government. Given this, KPMG Econtech modelled the following Reform scenario that illustrates 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 Pure Funding Augmentation scenario, but for universities, the impacts of reducing student-staff ratios and the impact of a reduction in the administration costs for universities are investigated.

Chart 4.7 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 2014, 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 the years in university so that, by 2023, the labour force is larger than in the baseline scenario. By 2040, the labour force is expected to be 0.8 per cent larger than under the baseline scenario in the same year.

The gain in the labour force under the Reform scenario is similar to 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 fewer students graduating from university when compared to the Pure Funding Augmentation scenario.

Chart 4.7: Labour force change for the Reform scenario (% deviations from baseline)



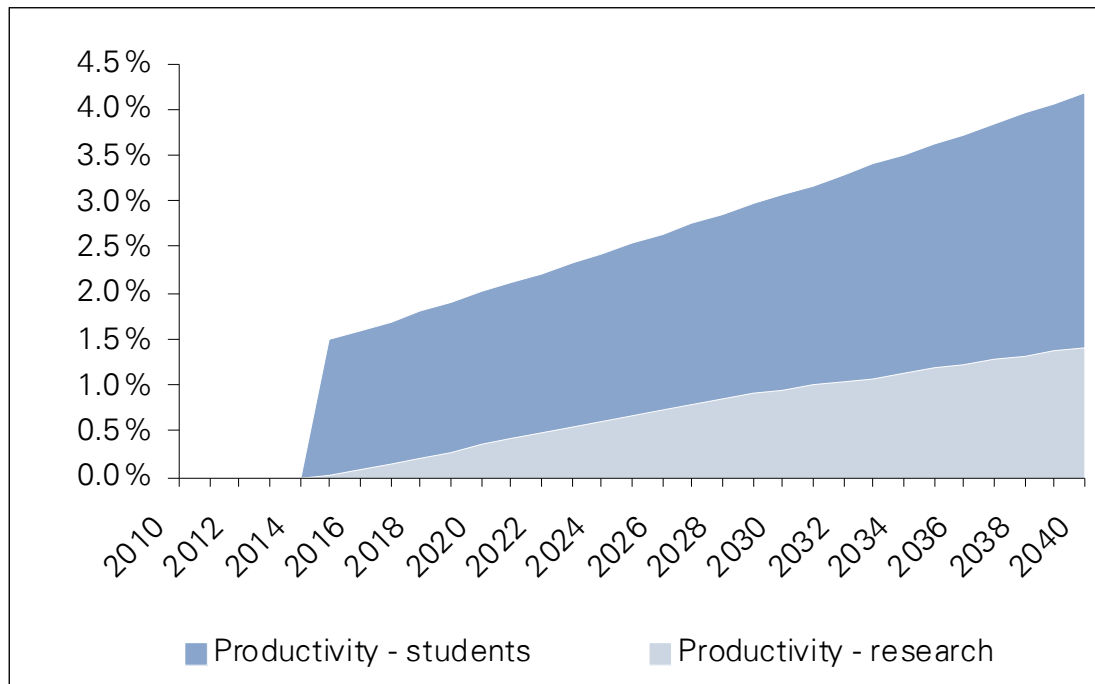
Source: KPMG Econtech.

Chart 4.8 shows the estimated labour productivity effects resulting from the Reform scenario. For students, Chart 4.8 shows that the benefits of higher labour productivity commence in 2014. 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 4.2 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 3.8 per cent for the Pure Funding Augmentation scenario for universities. Under the Reform scenario, there are fewer graduates as a result of the higher student-staff ratio but it is assumed that 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 a greater productivity benefits for the Reform scenario.

Turning to research funding, Chart 4.8 also shows the expected labour productivity benefits. These benefits gradually build as the knowledge base expands from sustained research. By 2040, the ongoing productivity boost exceeds 1.4 per cent, compared to 1.1 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 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 10 per cent under the Reform scenario. This reduction is to reflect the positive impacts of the other aspects of the Reform scenario.

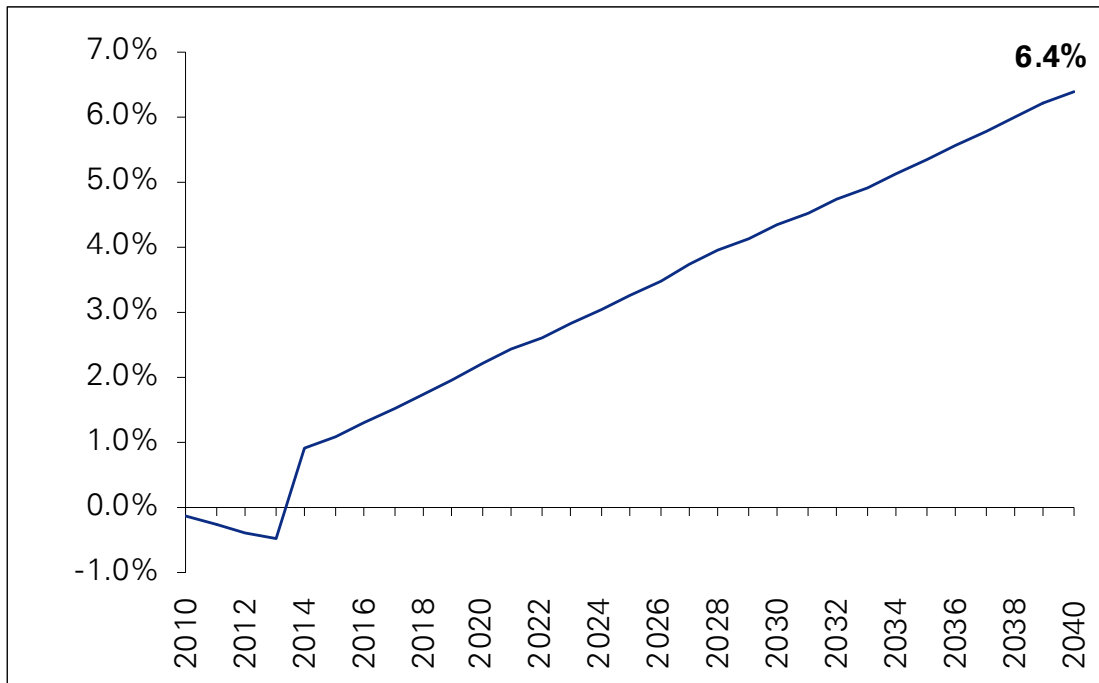
Chart 4.8: Productivity change for students and research for the Reform scenario (% deviations from baseline)



Source: KPMG Econtech.

Combining the above labour force and productivity effects from Charts 4.7 and 4.8, Chart 4.9 shows how expanded university funding, lower administration costs, lower staff-student ratios; greater completion rates, decreased attrition rates, and increased returns from research and students affect GDP and living standards.

Chart 4.9: Real GDP for the Reform scenario (% deviations from baseline)

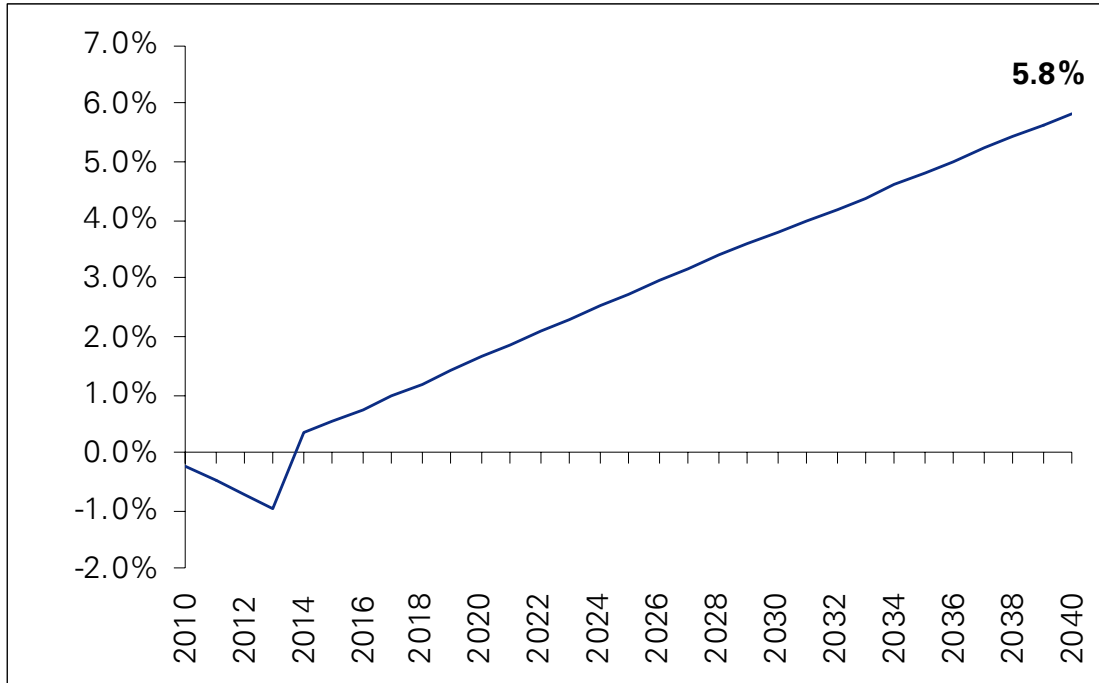


Source: KPMG Econtech.

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. It is assumed that higher funding is balanced by taxes and therefore leads to lower household disposable income and consumption.

Chart 4.10 shows the final net benefit of higher 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 4.11 shows that the sacrifice extends for around 6 years before a growing gain emerges, a shorter period than in the Pure Funding Augmentation scenario. 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 is anticipated to amount to 5.8 per cent.

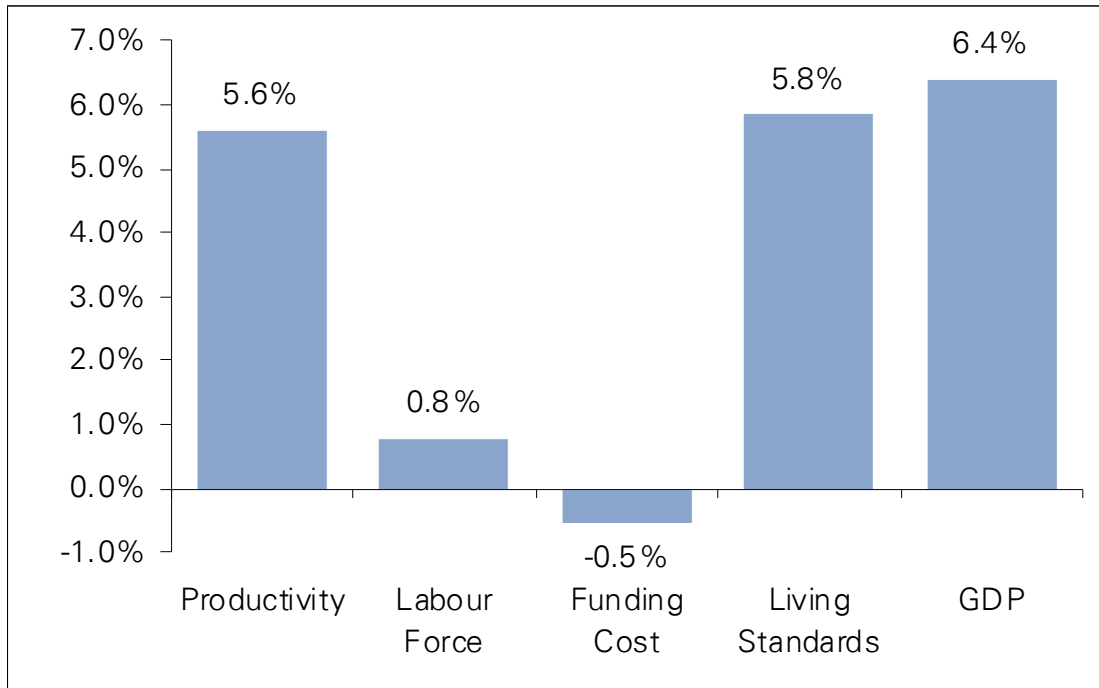
Chart 4.10: Living standards for the Reform scenario (% deviations from baseline)



Source: KPMG Econtech.

The slightly higher return than in the Pure Funding Augmentation Scenario represents an illustrative scenario of overlaying structural reforms on top of a increase in public funding. Chart 4.11 shows that this 5.8 per cent gain in living standards in 2040 can be decomposed into its elements as discussed above. Chart 4.10 shows that the gains in productivity (5.6 per cent) and labour force (0.8 per cent) are only partially offset by the increase in taxes associated with this policy (0.5 per cent) by the year 2040.

*Chart 4.11: Source of Impact on living standards (private consumption) in 2040
(% deviations from baseline)*



Source: KPMG Econtech.

Table 4.1 presents a summary of the results from all scenarios modelled in the year 2040 using the Growth Accounting Model. Table 4.1 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 4.1: Summary of results for each scenario, 2040

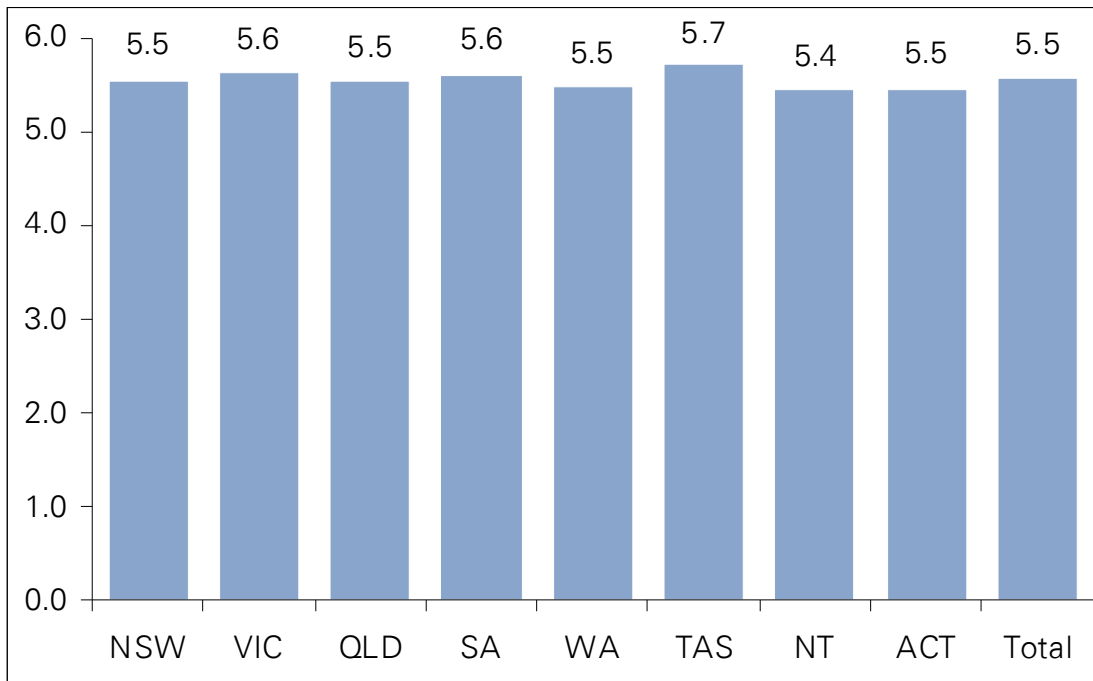
	Labour Force (% deviations)	Student productivity (% deviations)	R&D productivity (% deviations)	Real GDP (% deviations)	Living standards (% deviations)
Pure Funding Augmentation - Universities	1.1%	3.8%	1.1%	6.1%	5.5%
Pure Funding Augmentation - Tertiary	2.6%	4.1%	1.1%	8.0%	7.3%
Reform	0.8%	4.2%	1.4%	6.4%	5.8%

Source: KPMG Econtech

4.3 State and Territory Results

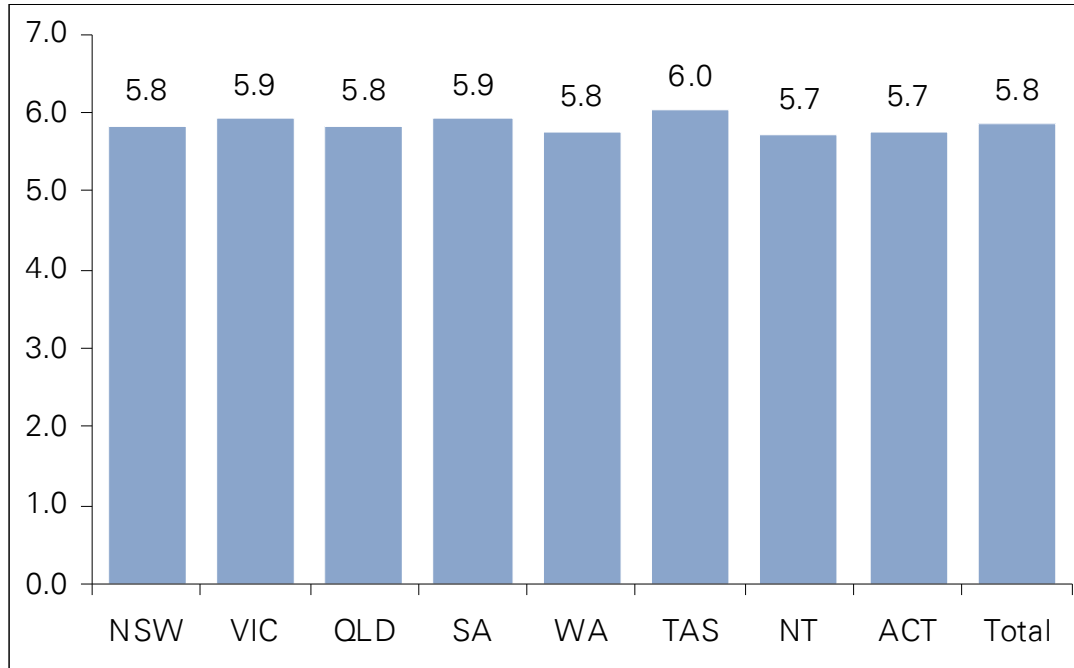
Charts 4.12, 4.13 and 4.14 show the impact of each scenario on living standards at the state and territory level. These results have been derived by using forecasts from our highly regarded MM2 model to feed into our modelling framework discussed earlier. The results indicate that, in terms of percentage deviations from baseline, the state and territory results do not differ greatly from the national results.

Chart 4.12: Living standards for the Pure Funding Augmentation scenario - University (2040, % deviations from baseline)



Source: KPMG Econtech.

Chart 4.13: Living standards for the Reform scenario - University (2040, % deviations from baseline)



Source: KPMG Econtech.

Chart 4.14: Living standards for the Pure Funding Augmentation scenario - tertiary (2040, % deviations from baseline)



Source: KPMG Econtech.

5 Implications

The results presented in this report show that increasing funding for the tertiary education sector can have substantial impacts on productivity and participation and drive important benefits for the Australian economy.

Increasing university and VET funding will lead to a lift in the education level of the workforce and a lift 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 at the completion of their studies. More specifically:

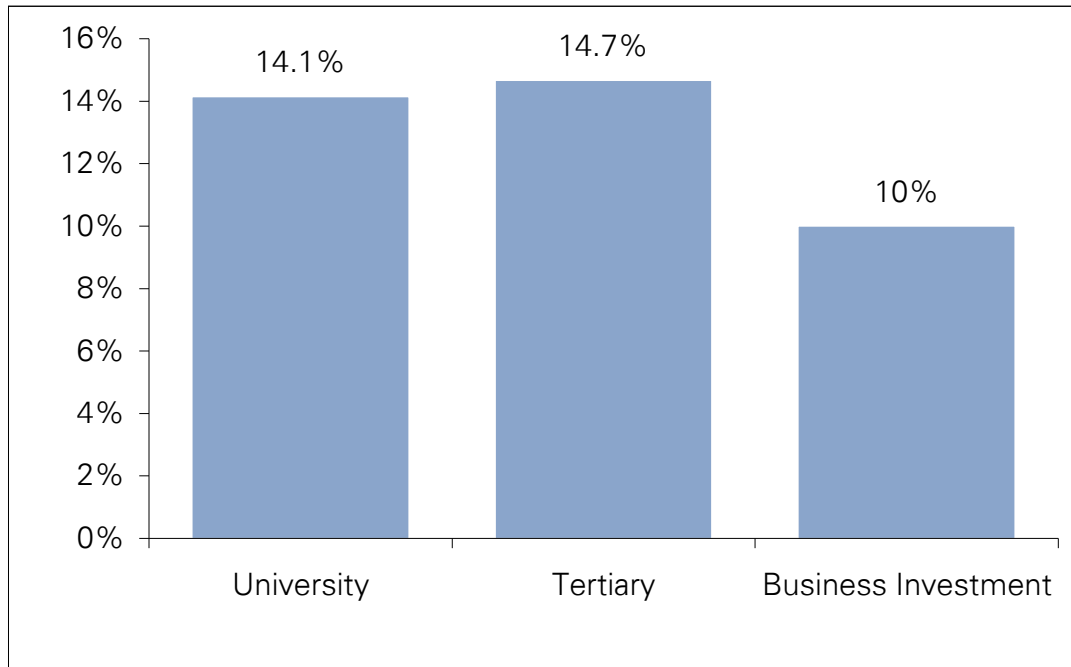
- The Pure Funding Augmentation scenario shows that increasing university funding from its current level of 1.6 per cent of GDP to 2 per cent of GDP, and increasing the share of Commonwealth Government grants up to 50 per cent from 42 per cent, leads to a 6.1 per cent gain in real GDP and a 5.5 per cent gain in living standards in the long term.
- The increase in funding under the Pure Funding Augmentation scenario would allow the government to meet its target of increasing the degree-level attainment rate of 25-34 year olds to 40%. In fact, the profile of funding under this scenario would allow the Government to exceed this target¹⁴.
- The Reform Scenario, which is an illustrative scenario, shows that increasing funding for universities in conjunction with various policy changes leads to a 6.4 per cent gain in real GDP and a 5.8 per cent gain in living standards in the long term
- Turning to the tertiary sector as a whole, the Pure Funding Augmentation scenario shows that increasing university funding as well as VET funding from its current level of 0.6 per cent of GDP to 0.7 per cent of GDP, leads to a 8.0 per cent gain in real GDP and a 7.3 per cent gain in living standards in the long term.

Overall, the results in this report suggest that further investment in universities and the tertiary sector by the government will yield benefits for the economy, in terms of GDP and, more importantly, living standards. Notably, the internal rate of return (IRR) is a useful tool to analyse the efficiency of investments and allows for comparisons across different investment options. Chart 5.1 shows that the IRR for investment in universities and the tertiary sector is 14 per cent and 15 per cent respectively. This is higher to IRRs for business investment of around 10 per cent¹⁵ and highlights that additional funding in the tertiary sector is a worthwhile investment.

¹⁴ Assuming the age structure of those currently enrolled in degree-level qualifications remains unchanged over the period to 2025, the results of the pure funding augmentation scenario suggest that there will be an approximate additional 430,000 graduates by 2025. This is well in excess of the additional graduates 217,000 required (2009-10 Budget Statement) to achieve the 40 per cent target.

¹⁵ In various submissions to the ACCC, market risk premiums for Australia have been estimated at around 6-7 per cent. Coupled with a real risk-free bond rate of around 3 per cent, this brings IRRs for business investment to around 10 per cent.

Chart 5.1: Internal Annual Real Rate of Return (per cent)



Source: KPMG Econtech.

6 References

Aizer, A. & L. Stroud (2010) “Education, Knowledge and the Evolution of Disparities in Health”, *National Bureau of Economic Research (NBER) Working Paper Series, Working Paper 15840*.

Access Economics (2008) “Exceptional Returns: The Value of Investing in Health R&D in Australia II”, A report for the Australian Society for Medical Research.

Allen Consulting Group (2003) “The economic impact of the commercialisation of publicly funded R&D in Australia”, A report for the Australian Institute for Commercialisation.

Alston, J., Marra, M., Pardey, P. & Wyatt, T. (2000) “Research Returns Redux: a Meta-Analysis of the Returns to Agricultural R&D”, *Australian Journal of Agricultural and Resource Economics, Vol. 44, 2, pp 185-215*.

Barnes, A. (2002) “Publicly-funded UK agricultural R&D and ‘social’ total factor productivity”, *Agricultural Economics, 27, pp 65-74*.

Berkman ND, DeWalt DA, Pignone MP, Sheridan SL, Lohr KN, Lux L, Sutton SF, Swinson T, Bonito AJ. (2004) *Literacy and Health Outcomes. Summary, Evidence Report/Technology Assessment No. 87* (Prepared by RTI International–University of North Carolina Evidence-based Practice Center under Contract No. 290-02-0016). AHRQ Publication No. 04-E007-Rockville, MD: Agency for Healthcare Research and Quality.

Bilbao-Osorio, B and Rodriguez, A. (2004), “From R&D to Innovation and Economic Growth in the EU, *Growth and Change*, no. 35, pp. 434-455 cited in Martin, B.R. & P. Tang (2006) “The benefits from publicly funded research”, *Science and Technology Policy Research (STPR)*, University of Sussex.

Coelli, M. & Wilkins, R. (2009) “Credential Changes and Education Earnings Premia in Australia”, *The Economic Record, Vol. 84, No. 270, pp 239-259*.

Commonwealth Budget (2009/10), Ministerial Statement: *Jobs, Productivity and Fairness – A foundation for Recovery*, http://www.ato.gov.au/budget/2009-10/content/ministerial_statements/deewr/html/ms_deewr-05.htm.

Cully, M. (2005) “What it’s worth: Establishing the Value of Vocational Qualifications to Employers”, National Centre for Vocational Education Research (NCVER).

Dearden, L., McIntosh, S., Myck, M. & Vignoles, A. (2002) “The Returns to Academic and Vocational Qualifications in Britain”, *Bulletin of Economic Research, Vol. 54, No. 3, pp 249-274*.

Hall, J. & Scobie, G. (2006), “The Role of R&D in Productivity Growth: The Case of Agriculture in New Zealand: 1927 to 2001”, New Zealand Treasury, Working Paper 06/01.

Hosseini, S., Hassanpour, E. & Sadeghian, S. (2009) “An Economic Evaluation of Iranian Public Agricultural R&D Policy: The Case of Sugarbeet”, *Research Policy*, 38, pp 1446-1452.

Jacob, B. & L. Lefgren (2007) “The impact of research grant funding on scientific productivity”, *National Bureau of Economic Research (NBER) Working Paper Series, Working Paper 13519*.

Johnson, R., Razzak, W. & Stillman, S. (2007) “Has New Zealand Benefited from its Investments in Research & Development?”, *Applied Economics, Vol. 39, pp 2425-2440*.

KPMG Econtech (2008) “The Cost of Physical Inactivity for Australia”, a report for Medibank Private.

KPMG Econtech (2010) “Economic Modelling of the Impact of Obesity and Obesity Interventions”, a report for Medibank Private.

Lee, W. & Coelli, M. (2010) “The Labour Market Effects of Vocational Education and Training in Australia”, *Melbourne Institute Working Paper Series, Working Paper No. 1/10*.

Leigh, A. (2008) “Returns to Education in Australia”, *Economic Papers*, vol. 27, no. 3.

Leigh, A., Ryan, C. (2008) “Estimating the Returns to Education Using Different Natural Experiment Techniques”, *Economics of Education Review*, vol. 27, pp149-160.

Long, M. & Shah, C. (2008) “Private Returns to Vocational Education and Training Qualifications”, NCVER.

McMillan, G. and Hamilton, R. (2003), “The impact of publicly funded basis research: an integrative extension of Martin and Salter”, *IEEE Transaction of Engineering and Management*, no 50, pp. 184-191 cited in Martin, B.R. & P. Tang (2006) “The benefits from publicly funded research”, *Science and Technology Policy Research (STPR)*, University of Sussex.

Mamatzakis, E (2009) “The Contribution of the Publicly Funded R&D Capital to Productivity Growth and an application to the Greek food and beverages industry”, *Munich Personal RePEc Archive (MPRA) Paper No. 19388*.

Mansfield, E. (1991), “Academic research and industrial innovation”, *Research Policy*, no. 20, pp. 1-12 cited in Martin, B.R. & P. Tang (2006) “The benefits from publicly funded research”, *Science and Technology Policy Research (STPR)*, University of Sussex.

Marks, G. (2008) “The Occupations and Earnings of Young Australians: the Role of Education and Training”, *Longitudinal Surveys of Australian Youth, Department of Education, Science and Training (DEST), Research Report 55*.

Martin, B.R. & P. Tang (2006) “The benefits from publicly funded research”, *Science and Technology Policy Research (STPR)*, University of Sussex.

Moretti, E. (2004) “Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data”, *Journal of Econometrics*, no. 121, pp. 175-212.

Mullen, J.D., Scobie, G.M. & Crean, J. (2006) “Trends in Research, Productivity Growth and Competitiveness in Agriculture in New Zealand and Australia,” 2006 Conference, August 24-25, 2006, Nelson, New Zealand 31965, New Zealand Agricultural and Resource Economics Society.

Narin, F., Hamilton, K. and Olivastrol, D. (1997), “The linkages between US technology and public science”, *Research Policy*, no. 26, pp. 317-330 cited in Martin, B.R. & P. Tang (2006) “The benefits from publicly funded research”, *Science and Technology Policy Research (STPR)*, University of Sussex.

NCVER (2005) “Apprentice and Trainee Completion Rates”, NCVER, Adelaide.

NCVER (2009) “An overview of vocational education and training in Australia and its links to the labour market”, NCVER, Adelaide.

Onofri, A. & Fulginiti, L. (2008) “Public Inputs and Dynamic Producer Behavior: Endogenous Growth in U.S. Agriculture”, *Journal of Productivity Analysis*, 30, pp 13-28.

OTA (1986), “Research Funding as an Investment: Can we Measure the Reforms?”, A Technical Memorandum, Office of Technology Assessment, Washington cited in Martin, B.R. & P. Tang (2006) “The benefits from publicly funded research”, *Science and Technology Policy Research (STPR)*, University of Sussex.

Popp, D. (2010) “Innovation and climate change”, *National Bureau of Economic Research (NBER) Working Paper Series, Working Paper 15673*.

Round, D. & Siegfried, J. (1998) “Discounts for Degrees: External Benefits and University Fees”, *The Australian Economic Review*, Vol. 31, No. 2, pp 167-178.

Ryan, C. (2002) “Individual Returns to Vocational Education and Training Qualifications”, NCVER.

Ryan, C. (2002) “Individual Returns to Vocational Education and Training Qualifications: Their Implications for Lifelong Learnings”, NCVER, quoted in Long, M. & Shah, C. (2008) “Private Returns to Vocational Education and Training Qualifications”, NCVER.

Schimmelpfennig, D. & Thirtle, C. (1999) “The Internationalisation of Agricultural Technology: Patents, R&D Spillovers, and Their Effects on Productivity in the European Union and United States”, *Contemporary Economic Policy*, Vol. 17, No.4, pp 457-468.

Scollo, MM and Winstanley, MH [editors]. *Tobacco in Australia: Facts and Issues*. Third Edition. Melbourne: Cancer Council Victoria; 2008. Available from: <http://www.tobaccoinaustralia.org.au>

Thirtle, C. (1999) “Productivity and the Returns to Levy-Funded R&D for Sugar Production in the Eastern Counties of England”, *Journal of Agricultural Economics*, Vol. 50, No. 3, pp 450-

467.

Tijssen, R. (2002), "Science dependence of technologies: evidence from inventions and their inventors", *Research Policy*, no. 31, pp. 509-526 cited in Martin, B.R. & P. Tang (2006) "The benefits from publicly funded research", *Science and Technology Policy Research (STPR)*, University of Sussex.

Toole, A. (1999), "The Impact of federally funded basic research on industrial innovation: Evidence from the pharmaceutical industry", *Stanford Institute for Economic Policy Research, SIEPR Discussion Paper no. 98-8* cited in Martin, B.R. & P. Tang (2006) "The benefits from publicly funded research", *Science and Technology Policy Research (STPR)*, University of Sussex.

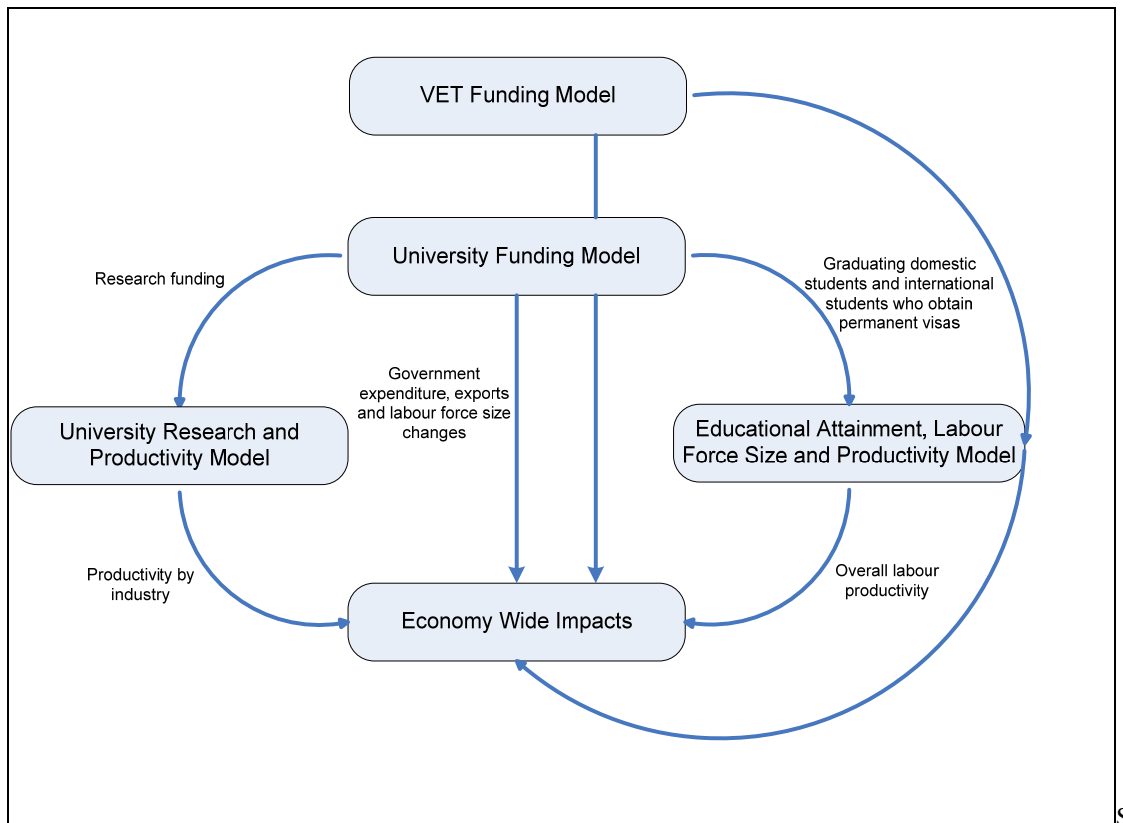
Watts, A. L. (2001) *Social Benefits of Going to College: Education and the Common Good*, pp. 9-26.

Winstanley M, White V. Chapter 1. Trends in the prevalence of smoking. In: Scollo MM, Winstanley MH, eds. *Tobacco in Australia: Facts and Issues*. 3rd ed. Melbourne: Cancer Council Victoria; 2008. <http://www.tobaccoinaustralia.org.au/chapter-1-prevalence>. Accessed January 22, 2009.

Appendix A – Modelling System

This Appendix describes the modelling system employed for this study as summarised in Figure A1 below.

Figure A1: University and VET Funding Modelling System



Source: KPMG Econtech.

University Funding Model

The university funding model is one of the base models 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 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 university funding model further separates research and student funding into various sub-components as described below.

University research funding

- Research funding is separated into socioeconomic objective based on ABS HERD data relativities.
- These socioeconomic objectives are then matched with industries in the economy based on the ABS's ANZSIC classification.
- Where socioeconomic objectives do not match the industries, the funding is separated across industries based on labour force shares.
- 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.
- Following this, the increase in research funding by industry is entered as an input into the university research and productivity model.

University student funding

- 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.
 - Undergraduate student funding is calculated as the increase in university funding less research funding and then less international student funding.
 - 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.
 - International student funding is set to be a constant share of total university income.
- 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.
- 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.

- 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.
- The model also allows for international students that stay and work in Australia after graduation.

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.

- Firstly we considered the decrease in the labour force from those individuals who leave work and become students¹⁶. This is done by:
 - Taking the increased number of students and multiplying by un-skilled worker participation rates.
 - Separating into part-time and full-time students
 - Part-time students are discounted by the average amount of work part-time students conduct whilst studying.
 - Full-time students are discounted by the average amount of part-time work full-time students conduct whilst studying.
 - This provides a full-time equivalent number for the decrease in the size of the labour force.
- 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.
 - Taking the number of attrition students and multiplying by un-skilled worker participation rates (since they did not complete university and so remain unskilled).
 - Separating into part-time and full-time workers.

¹⁶ 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 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.

- Part-time students are discounted by the average amount of work part-time students conduct whilst studying.
- Full-time students are discounted by the average amount of part-time work full-time students conduct whilst studying.
- 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.
- 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.
 - Taking the number of new graduate students and multiplying by skilled worker participation rates, which are higher than unskilled rates.
 - Separate into part-time and full-time workers.
 - Part-time students are discounted by the average amount of work part-time students conduct whilst studying.
 - Full-time students are discounted by the average amount of part-time work full-time students conduct whilst studying.
 - Provides a full-time equivalent number for the increase in the size of the labour force
- 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.
 - Taking the number of graduating international students and then multiplying by the current rate of international students visa holders that obtain permanent visas.
 - 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.

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.

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

VET Funding Model

The VET Funding Model uses the same methodology as the University Funding Model to convert VET funding increases into various costs and benefits. For the VET funding model this primarily involves translating funding increases into changes in the size of the labour force as well as tracking the direct costs of increased VET funding. This is discussed further below. Importantly, unlike the University Funding model, all of the increase in funding is directed

towards students. In other words it is assumed that VET providers do not undertake any additional research with the additional funds.

VET student funding

- VET student funding is broken into three sub-categories. These are funding for domestic Certificate III/IV students, funding for domestic Advanced Diploma/Diploma students and funding for international students. We have assumed that the additional VET funding is channelled only to these tertiary qualifications, that is, the additional funding is not supporting additional Certificate II or Certificate I places.
- Domestic student funding is calculated as the increase in university funding less international student funding. International student funding is set to be a constant share of total VET provider income.
- These different amounts of student funding are converted into student numbers, based on current student funding ratios. This ratio has been derived using the following data from the National Centre for Vocational Education Research (NCVER).
 - Government recurrent expenditure per publicly funded hour
 - Agreed hour values equivalent to a qualification.
 - Government Recurrent expenditure as a proportion of VET provider income.

This methodology assumes all other things equal, that the current staff student ratio remains constant.

- 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 NCVER (2005). Using attrition and completion rates allows the model to determine the number of expected graduates from each entry year of new students.
- 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.
- The model also allows for international students that stay and work in Australia after graduation.

Changes in the size of the labour force

In addition to calculating student numbers, the VET funding model is also used to calculate the change in the size of the labour force from each policy change. This net change in the labour force as a result of higher VET funding is calculated in the same manner as for higher

University funding. Importantly, we allow for the fact that many VET students continue to participate in the labour force while they are studying.

Exports

Finally, the VET funding model is used to provide an estimate of the increase in export dollars accruing to VET providers from international students.

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

- Estimates of the increase in government expenditure.
- Estimates of the increase in the number of graduating students.
- Estimates of the net change in the size of the labour force.
- Estimates of the exports dollars accruing from international students.

University Research and Productivity Model

To measure the productivity benefits from 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 the economy wide model.

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 A1.

Table A1: Qualifications and earnings premiums

Educational level	Earnings premium relative to those without a post-school qualification
Certificate III/IV	-2%
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 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 sector are not overstated. To some extent the existing wage premiums earned by those with a higher education reflect higher innate ability rather than the higher 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 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 students would likely, on average, have more aptitude for study and following up work. Considering these factors and the size of the 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.