Economic impact of universities

An analysis of the contribution of New Zealand universities to economic activity

NZIER report to Universities New Zealand - Te Pōkai Tara

31 August 2016

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice to clients in the public and private sectors, throughout New Zealand and Australia, and further afield.

NZIER is also known for its long-established Quarterly Survey of Business Opinion and Quarterly Predictions.

Our aim is to be the premier centre of applied economic research in New Zealand. We pride ourselves on our reputation for independence and delivering quality analysis in the right form, and at the right time, for our clients. We ensure quality through teamwork on individual projects, critical review at internal seminars, and by peer review at various stages through a project by a senior staff member otherwise not involved in the project.

Each year NZIER devotes resources to undertake and make freely available economic research and thinking aimed at promoting a better understanding of New Zealand's important economic challenges.

NZIER was established in 1958.

Authorship

This paper was prepared at NZIER by Mike Hensen and Daniel Pambudi.

It was quality approved by John Yeabsley.

NZIER
NEW ZEALAND INSTITUTE OF ECONOMIC RESEARCH

L13 Grant Thornton House, 215 Lambton Quay | PO Box 3479, Wellington 6140
Tel +64 4 472 1880 | econ@nzier.org.nz

Key messages

The university sector had domestic revenue of $3.2 billion (excluding international student fees) and accounted for about 1 percent of GDP in 2014. Universities employed 20,000 full time equivalents (FTE), about 0.8 percent of the labour force.

Beyond their direct transaction-based activity, universities contribute to the New Zealand economy through the improvement in productivity attributable to university research, the improved productivity of the university graduates (reflected in the higher incomes they earn) and the attraction of overseas students to New Zealand.

The focus of this report is on the economic activity generated by university outputs – gains that would not have occurred without the university. The main sources of these gains are:

- 'Export' income - university fees paid by international students ($340 million in 2014) and the living expenses of international students (estimated at about $300 million in 2014)
- Economy-wide productivity gains that are generated by the application of the skills taught to graduates and the application of university research to innovation.

Modelling in this report has used two methods: growth accounting and computable general equilibrium (CGE) modelling. The body of the report explains how these approaches were applied.

We have estimated three types of economic contribution from the New Zealand university sector:

- International education earnings by universities
- University-related expenditure in the New Zealand economy
- The long-term contribution of university education and research.

These are described below.

International education earnings by universities

This is an assessment of the additional economic activity that international education generates for the New Zealand economy, through earnings from direct and indirect expenditure by international students and their visitors. At a headline level, the findings are:

- International education generates at least $1,040 million per year for New Zealand:
  - International students pay $340 million a year in fees to study at university in New Zealand
  - International students spend an additional $300 million a year in New Zealand on accommodation and other living expenses
  - Visits by the friends and relatives of international students potentially generates another $30 million a year

- The flow-on effects of international students equate to another $370 million a year
  - This equates to an average contribution[1] of approximately $56,000 per year per student or approximately $168,000 per student completing a three year programme of study.
- New Zealand universities' earnings from export education represent 1.7 percent of all New Zealand's exports
- For every $1 million spent in New Zealand by international students, GDP is increased by $1.6 million.

There are other potential benefits from international education that could not be quantified or estimated. These include:

- The value generated by the international students who settle in New Zealand as skilled migrants after graduation
- The longer-term benefits to New Zealand after international students return to their home countries. These benefits range from graduates who encourage other students to study in New Zealand through to graduates who use their knowledge of this country to drive trade and tourism.

University-related expenditure in the New Zealand economy

This is an assessment of the direct and indirect impact of the expenditure of all eight universities on the overall economy. It uses Computable General Equilibrium (CGE) modelling to estimate how much smaller the economy would be without universities. Flow on effects appear relatively modest, but this is because CGE modelling assumes people currently employed in the university sector would be employed in other parts of the economy if universities did not exist.

At a headline level, the findings are:

- The university sector spent $3.4 billion in 2014 on staff, capital and the purchase of goods and services. This equates to approximately 1 percent of GDP (direct effects)
- Flow on (indirect effects) of university expenditure add another 0.1 percent to 0.2 percent of GDP. University activity therefore represents between 1.1 percent and 1.2 percent of GDP (direct plus indirect effects)
- Universities account for as much as 24,000 jobs in the wider economy (about 1.02 percent of all people in employment):
  - Universities employed around 20,000 staff in 2014 (about 0.8 percent of New Zealand's total labour force)
  - The flow-on effect of university employment accounts for another 3,000 to 4,000 jobs in the wider economy.

[1] Based on a 18,600 international students enrolled at universities in 2014 as reported in the Export Education Levy Key Statistics (Full Year) available at https://www.educationcounts.govt.nz/statistics/international-education/international-students-in-new-zealand

Long-term contribution of university education and research

This is an assessment of the long-term direct and indirect impact of university graduates and university research on GDP.

At a headline level, the findings are:

- Graduates and human capital:
  - graduates with bachelors level qualifications earn about 60 percent more than people with a secondary school education only. This premium rises to 85 percent for an honours level qualification, 95 percent for a masters level degree and 150 percent for a doctorate
  - New Zealand's GDP is 3 percent to 6 percent higher because of the impact that a university education has had on the productivity of the workforce with university qualifications (28 percent of the workforce in 2014)
  - In addition to being more productive themselves, graduates lift the productivity of other employees in their workplaces. This accounts for around 0.8 percent of GDP
  - Workers without a degree earn 1.6 percent to 1.9 percent more as a consequence of working with graduates
  - There are a range of other health, standard of living, wellbeing and intergenerational benefits that appear to accrue to graduates. These were not assessed in this study, but international research suggests the benefits to graduates are typically worth about double the graduate's actual annual earnings[2]
- Research and the transfer of knowledge:
  - The stock of all knowledge generated by universities and adopted over time across the wider economy accounts for around 8.2 percent to 9.7 percent of GDP
  - Expenditure from university research over just the last six years (2010 to 2015) accounts for 0.3 percent to 0.4 percent of GDP
  - A 10 percent increase in higher education research spending will eventually increase GDP by 1.75 percent to 1.84 percent.

---

[2] For example, McMahon, Walter W (2009). Higher Learning, Greater Good: The Private and Social Benefits of Higher Education. Baltimore: The Johns Hopkins University Press. assesses benefits such as being able to live in nicer neighbourhoods, making better purchasing decisions, having better health, having healthier more successful children, etc. as increasing annual income by 122%. Other studies, such as Wolfe, Barbara L., and R.H Haveman. Social and non-market benefits from education in an advanced economy. In Yolanda Korzycki ec., *Education in the 21st Century: Meeting the Challenges of a Changing World.* Boston. Federal Reserve Bank. 2003. estimate benefits as being around 100% of annual income.

Contents

Appendices

Figures

Tables

1. Approach

1.1. Introduction

The objective of this report is to estimate the economic contribution of universities to New Zealand in a form that is useful for a variety of purposes, from funding and other policy discussions with government through to public explanation of the role of universities. To meet these requirements, we suggested the approaches used need to:

- Be regarded by the intended audience as credible and evidence-based
- Explain how the contribution is made as well as its estimated size
- Indicate how the contribution could be changed over time.

Based on these criteria, our approach is to define sources of benefit from university education (mainly higher productivity), estimate their magnitude and then estimate their impact on economic activity using two complementary approaches:

- Growth accounting, based on the model developed by Deloitte Access Economics[3] – to estimate long run average contribution of tertiary education and research and development spending to economic activity (GDP)
- Computable general equilibrium modelling – to assess the impact of changes in university activity at the margin and disaggregate the sectors of the economy that are affected.

These two approaches focus on the future stream of benefits that arise from the teaching and research outputs of universities.

These are the two of the three main types of approach that we have identified in our review of the literature on the assessment of the economic impact of universities. A third approach – economic impact analysis – considers the economic activity and employment that is directly and indirectly generated by the spending of universities and the students they attract. The main drawback of this approach is that it relies on a multiplier analysis which is regarded with scepticism by analysts including government officials. We discuss this method in Appendix A Impact studies but do not recommend its use.

In the following sections we identify the main drivers of the benefits from the universities' outputs on economic activity, and discuss the available literature on how to quantify the size of those benefits.

1.2. Estimating benefits

Universities affect the level of economic activity through three main channels:

- Research that provides access to new technologies that boost productivity in the economy

[3] Deloitte Access Economics, 2015. The Importance of Universities to Australia's Prosperity. A Report Prepared for Universities Australia. https://www.universitiesaustralia.edu.au/news/commissioned-studies/The-Importance-of-universities-to-Australia-s-prosperity#.V8diYZh96Uk.

- Education of domestic students which increases the productivity of both those with tertiary qualifications and the workforce in general
- Export income from the education of international students and potential benefits to immigration.

In addition to these benefits, universities also help to improve social cohesion and equity. A university education is empirically correlated with an increased ability to adapt to technological change in the workplace, preservation of cultural values and lowering criminal behaviour, improved health outcomes, better quality of life and positive intergenerational effects. We have not been able to quantify these benefits and therefore we have not included in our quantitative estimate of the economic contribution.

1.3. Modelling the benefits

Quantifying the benefits of university education and research is difficult because of the long lead times and variation in the strength of causality between the university activity and economic activity. As universities have been an integral part of the economy for a long period of time, it is almost impossible to create credible models of the economy with and without universities. To address this issue we have applied two of the complementary modelling approaches that we have identified in the literature:

- Growth accounting – a framework that attributes economic growth to the quantity and quality of the factors of production – effectively a top-down approach. University activity influences the quality of the factors of production through both the innovation enabled by research and the increased productivity of workers from the skills that they acquire
- Computable general equilibrium (CGE) modelling – based on an industry by industry model of the economy focused on how resources are allocated between industries – effectively a bottom-up approach. Changes in university activity are translated to productivity shocks and the CGE simulations of economic activity with and without the shock are compared. The difference between the simulations is a measure of the effect of the shock.

1.3.1. Growth accounting

For the growth accounting framework we have used a 'cross-country' model estimated by Deloitte Access Economics that 'allocates' changes in gross domestic product across factors of production that include physical capital, human capital, labour and measures of efficiency. The average long-term contribution of universities to economic activity is modelled through two mechanisms:

- Effect on labour efficiency of 'higher education'[4] research and development spending
- Effect on human capital as measured by the proportion of the population aged over 15 with a tertiary education.

[4] The model also considers 'other research and development spending' and 'exposure to trade' as variables that can explain improved efficiency.

The reliability of the growth accounting framework model for estimating the economic impact of New Zealand universities depends on both the extent to which the specification of the model includes all of the major independent variables and the similarity between the New Zealand economy and universities with the other countries used in the model sample. (The growth accounting model is not used to estimate the economic impact of international students as it is not designed for this purpose.)

1.3.2. CGE model

For the CGE modelling we have used the NZIER model of the New Zealand economy and simulated the effect of the estimated productivity gains from an increase in university research spending and an increase in university teaching. The estimates of the productivity gains from these two shocks are based on our review of the recent economic literature.

The reliability of the CGE model estimates is heavily dependent on both the specification of the productivity shock and the validity of scaling-up the productivity shock to assess the overall contribution of universities to improvement in productivity.

We have also used the CGE model to estimate the economic impact of international students by comparing the level of economic activity with different rates of growth in international student numbers and then used this change to estimate the overall impact of such student volumes.

1.4. What the results mean

The use of two approaches addresses the difficulty of not being able to directly observe and separate the influence of university research and education from other factors that affect productivity. However, each approach has its own limitations.

The growth accounting model provides a broad estimate of the effect of R&D spending and implicitly assumes that the increase in R&D spending is permanent and that the historical returns to R&D will remain constant. As this approach involves cross-country data, its applicability to New Zealand is dependent on the similarity between New Zealand and the average of the sample of countries used in the analysis. (The model includes short-run adjustment and long-term steady-state elements that allow the estimate to adjust for temporary departures from the long-run equilibrium in individual economies.) Also the growth accounting model does not explicitly consider the contribution of international students to economic activity.

The CGE modelling indicates how a change in university activity will affect the rest of the economy, recognising resource constraints within the economy and allowing for resource reallocation. However, the modelling period is short compared to the long lags in the effects of the productivity changes caused by university activity.

Neither of these models are well suited to allowing for the long-term changes in the structure of the economy caused by technology or explaining the exact mechanism by which university teaching and research alters productivity.

2. Benefits of universities

2.1. Introduction

Universities contribute to increased levels of economic activity through education of students and completion of research that may enable or directly support innovation that increases productivity.

Higher education provides graduates with skills and knowledge that make them more productive. Graduates can have ongoing access to this source of knowledge and advice through a range of services: for example by attending seminars and short courses or obtaining consulting advice from university staff. The increased productivity is reflected in the income premium earned by graduates which seems to peak when people reach their mid-forties (or later for higher qualifications).

The basic research completed by universities both informs the content of the higher education they offer and provides the basis for applied research and commercial innovation in the economy. The basic research activity also provides an attractor for agglomeration and development of relationships with other specialist researchers and commercial enterprises in New Zealand. In addition, the research capability at New Zealand universities provides a locally oriented access point to international academic research and funding.

In this section we discuss how these effects can be described and then quantified.

2.2. Graduate income premium

Tertiary graduates earn higher incomes than people with lower-level qualifications and also have a higher likelihood of earning an income. Analysis of the Census data provides an indication of the size of the premium, how it changes over the working lives of people and how the premium and composition of the workforce have altered over the past 10 years.

Based on the 2013 Census, the average income premium for graduates (over people with a secondary school education only) is about 60 percent for a bachelors degree, 85 percent for a post graduate degree, 95 percent for a masters degree and 150 percent for a doctorate. The following chart illustrates estimated average incomes by age cohort and qualification group for people in the working age population in the 2013 Census.

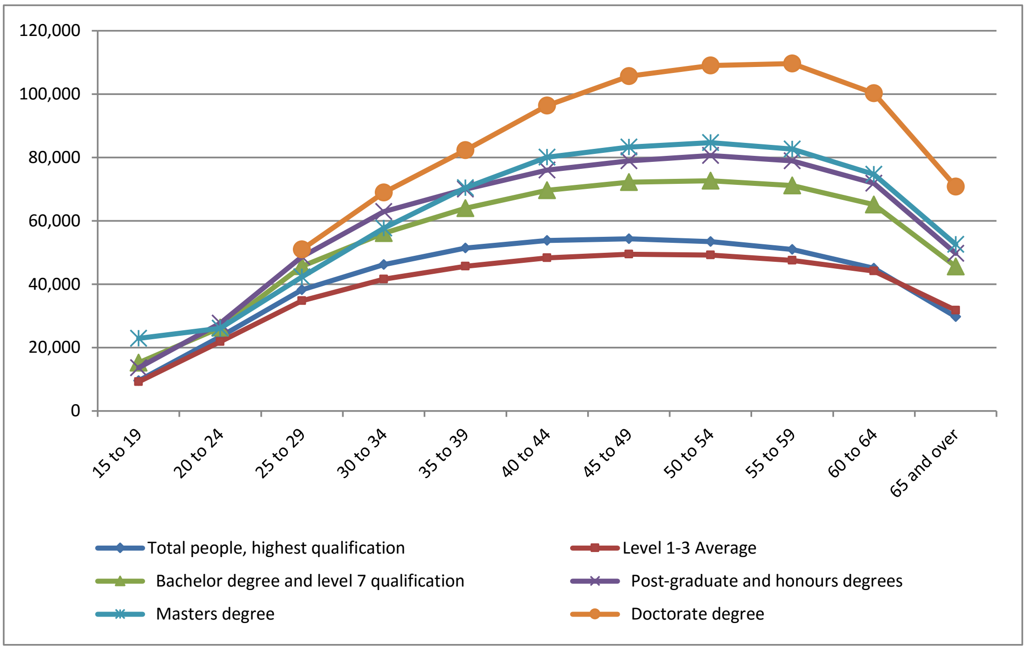
The key points from the chart are:

- Average incomes for people with secondary school qualifications only (the benchmark against which tertiary education incomes are assessed) are slightly below the average income for working population with a positive income.
- Income premia for people with a tertiary education begin to emerge at age 25 to 29, peak at age 40 to 49 and are sustained until 60 to 65.

This pattern suggests that the productivity gains from tertiary education take approximately 20 years to be fully realised and are long-lasting. The Census data also suggests that people with a tertiary education are about 10 percent more likely to be earning a positive income than those with only secondary school qualifications. This differential seems to have been stable since over the past three Censuses (2013, 2006 and 2001).

Figure 1 Average income by qualification

Census data 2013



Source: NZIER analysis of 2013 Census data

Comparison of the 2001 and 2013 Censuses suggests that the income premia for people with tertiary education have fallen by about 18 percent for bachelor degrees and about 12 percent for higher degrees since 2001. This effect seems to have been more pronounced for older individuals. Over the same period the proportion of the population covered by this analysis with a bachelor degree or higher increased by more than 90 percent from about 11 percent to about 21 percent.

We have not found any authoritative literature on how the income premium for those with a tertiary education varies with the proportion of people with a tertiary education and other factors. The literature on the changing nature of work and the effects of automation suggest that there are a number of complex processes occurring:

- Unskilled and semi-skilled tasks are being automated or outsourced to countries with lower labour costs
- Skilled workers are able to complete old tasks more efficiently and are using technology to develop new services.

Table 1 Comparison of graduate income premium

Percentage difference between average incomes of people with degrees to people with secondary school qualifications only

Age band (years)	Post- secondary school certificate or diploma		Bachelor degree		Post grad, Masters, Doctorate	
	2001	2013	2001	2013	2001	2013
All ages 15+	**30%**	**30%**	**75%**	**62%**	**109%**	**96%**
15 to 19	51%	44%	86%	65%	219%	83%
20 to 24	15%	24%	20%	20%	27%	26%
25 to 29	11%	15%	39%	31%	46%	33%
30 to 34	15%	11%	53%	35%	63%	47%
35 to 39	16%	14%	57%	40%	74%	56%
40 to 44	15%	16%	61%	44%	82%	66%
45 to 49	14%	17%	59%	46%	80%	70%
50 to 54	12%	16%	60%	48%	81%	75%
55 to 59	17%	15%	74%	50%	96%	79%
60 to 64	17%	12%	86%	48%	116%	77%
65 and over	12%	2%	77%	43%	103%	76%

Source: NZIER analysis of Census data

The analysis of the income differential is used in different ways by the two modelling frameworks we have employed to analyse the economic impacts of universities. The growth accounting framework is primarily concerned with the proportion of the population aged over 15[5] that has a tertiary education. Some of the gradual increase in income premium will be captured by the fitting of the relationships over a thirty-year period.

The CGE modelling uses the income differential and the increased likelihood of employment to estimate the productivity gain to the economy from increasing the number of people with a tertiary education and the resultant short-term (15 year) impact on economic activity.

2.2.1. Spill-over benefits for other workers

The literature on the income benefits of a university education discusses the spill-over benefits from the employment of graduates to the income and employment of workers without a tertiary education. However, there are a range of views on how to establish causation. Acemoglu and Angrist[6] applied strong controls for bias and found weak evidence for positive returns. At the other end of the scale Moretti[7] estimated

5 The growth accounting framework uses a slightly different age range – 'aged over 15' – to the age classification used in the Census data which includes those aged 15 and is described as 'aged 15 and over'.

6 Acemoglu, D., and J. Angrist. 1999. How Large Are the Social Returns to Education? Evidence from Compulsory Schooling Laws. National Bureau of Economic Research. http://www.nber.org/papers/w7444.

7 Moretti, E. 2002. Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-sectional Data. National Bureau of Economic Research. http://www.nber.org/papers/w9108.

that a 1.0 percent increase in the share of the population with a tertiary education raises overall wages by about 1.5 percent. Deloitte Access Economics refer to later work by Moretti and state[8]

> *the wage of those without a tertiary qualification has been estimated to be 1.6–1.9% higher as a result of a 1 percentage point increase in the number of workers with a university higher education degree.*

A report by Cadence Economics[9] suggests that wages for workers without a degree increased in 2014 by 1.1 percent due to new university graduates entering the workforce. (We found the methodology used in this report difficult to compare to the other studies mentioned in this section because of the narrow definition of the scenario modelled.)

2.3. University research

The main economic benefits from increased research funding identified in the literature on the contribution of universities are a combination of long-term increases in productivity from innovation based on the processes of dissemination and application of 'knowledge' created by the research, and the higher income levels of graduates with research degrees. These benefits are difficult to estimate as a return on investment because both the range and timing of productivity gains from research varies widely in comparison to the research expenditure and are realised as a long-term increase in gross domestic product.

2.3.1. Productivity gains

Universities are key providers of higher education and research excellence. They combine resources and skills that provide the domestic economy with opportunities for innovation and productivity improvement through:

- Access to overseas research with adaptation and application to local conditions that assists domestic industries to improve productivity and maintain competitiveness[10]
- World-leading research that leads to innovation and provides a competitive advantage of New Zealand industry or intellectual property that can be commercialised.

We can consider the research completed by universities as an addition to a stock of knowledge that increases productivity over time. (The nature of this stock of knowledge also depreciates over time but this is implicitly accounted for in the models.)

8 Deloitte Access Economics p. 28, apparently based on a study by Moretti E, (2004): Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-sectional Data. Journal of Econometrics, 121, pp. 175–212.

9 Cadence Economics. 2016. The Graduate Effect: Higher Education Spillovers to the Australian Workforce, p. 17.

10 New Zealand completes a very a small proportion of the total world R&D spending and as small open economy is heavily dependent on the spill-in of knowledge from overseas economies. See The Role of R&D in Productivity Growth: The Case of Agriculture in New Zealand: 1927 to 2001, by Julia Hall and Grant M. Scobie, New Zealand Treasury, Working Paper 06/01, March 2006, Abstract p. i.

This approach can then be used to model the benefit of the research either as a:

- Return on investment realised as an improvement in productivity
- Benefit from the 'stock of knowledge' estimated using cross-country regression of factors that contribute to growth.

In practice the links between research[11] and development spending, innovation, improved productivity and finally economic growth are not directly observable or mechanical and are highly variable. Therefore, applying either model to estimating the gains from research spending is subject to a high margin for error. Both models suffer variation caused by uncertainty about the actual level and mix of R&D spending and attribution of productivity changes in general let alone specific R&D. The CGE modelling based return on investment approach is suited to showing how particular industries or sectors could be affected by an R&D induced change in productivity and how these changes might encourage re-allocation of resources within the economy following the shock. The approach is to compare runs of the CGE model with and without the shock. However, this model is not well-suited to estimating the overall contribution of university research because of the difficulty of defining a model of the economy in which the universities did not exist.

2.3.2. Return on investment (CGE model)

CGE modelling is used to simulate the effect of an increase in R&D spending by using an assumed 'rate of return on investment' to translate the change in R&D spending into a change in the productivity assumed in the CGE model of the economy. The KPMG report[12] included a thorough review of the literature estimating returns from research and development, and finds average returns of 28 percent to 67 percent.

There are few studies of the returns to New Zealand research. To give a sense of the variation in the estimated returns we compare two studies Hall and Scobie[13] and Johnson, Razzack and Stillman.[14] The Hall and Scobie study estimated a return on agricultural R&D of 17 percent and noted the importance of the application of foreign knowledge in improving agricultural productivity:

> *foreign knowledge is consistently an important factor in explaining the growth of productivity. It appears that the agricultural sector relies heavily on drawing on the foreign stock of knowledge generated off-shore. …*
>
> *Having a domestic capability that can receive and process the spill-ins from foreign knowledge is vital to capturing the benefits.*[15]

---

11 Research spending is often duplicated across multiple organisations and has a wide range or returns, depending on whether the research generates a usable application, the time between the completion of the research and the application and how widely the application spreads.

12 KPMG Econtech. 2009. Economic Modelling of Improved Funding and Reform Arrangements for Universities. Report to Universities Australia.

13 Hall, Julia and Grant M. Scobie. 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.

14 Johnson, R., W. A. Razzak and S. Stillman. 2005. Has New Zealand Benefited from its Investments in Research and Development? Wellington, New Zealand: Department of Labour.

15 Op cit Hall and Scobie, Abstract, p. i.

The alternative study by Johnson, Razzack and Stillman did not find a positive return from publicly funded R&D, and while private sector R&D did earn positive returns these tended to be limited to the industry in which the R&D was conducted.

Our review of the literature published since the KPMG study did not reveal any clearer or more definitive estimates of the average return to R&D spending. For example, an extensive survey of the literature[16] on measuring the returns to R&D spending released at the end of 2009 noted that

> *This chapter has surveyed a very large literature from the past 50 years of economic research almost all of which has been directed to answering a few simple questions. What are the private rates of to investing research and development? What is the social rate of return? Are there spillovers? The questions may be simple but the answers are complex.*
>
> *… we have learned something about the rates of return to R&D. They are positive in many countries and usually higher than the returns to ordinary capital …social returns …are almost always estimated to be substantially greater than private returns…*[17]

Accordingly, for the purpose of the CGE analysis we have assumed a return on R&D of 20 percent per year on the research over the modelling period. This rate of return is below the average rate of return found by the KPMG study but is above the rate of return found by Scobie and Hall.

The rate of return is converted to a change in labour and capital productivity which is then used as an input to the CGE model. For the purpose of this analysis we have assumed a shock of about 5 percent of higher education R&D spending for a period of five years. The estimated increase in GDP peaks at about .08 percent after 10 years.

2.3.3. Return on R&D for growth modelling

The return to higher education R&D in the Deloitte Access Economics growth accounting model is expressed as the elasticity of long run per capita GDP in response to an increase in higher education R&D, and implies that a sustained 5 percent increase in higher education R&D spending per capita will increase steady-state per capita GDP about 0.85 percent.

2.4. International education

Universities attract international students which increases the level of economic activity through the fees paid by international students for their education and the goods and services that they buy while in New Zealand, and the additional tourism spending in their own right or as a result of friends or family that travel to New Zealand to visit them.

16 Hall, B. H., J. Mairesse and P. Mohnen. 2009. Measuring the returns to R&D. Chapter prepared for the *Handbook of the Economics of Innovation*, http://www.nber.org/papers/w15622.pdf.

17 Hall et al, p. 33.

The direct economic effects of international education are:

- tuition fees of $340 million per year for the estimated 15,000 students that study in New Zealand each year
- living expenses of approximately $300 million.[18]

We have not been able to estimate the related tourism expenditure for international students (as tourism statisitcs do not capture this level of detail).

Another potential benefit from international students is the extent to which those that gain New Zealand residency after completing their study adjust more quickly to the New Zealand labour market than migrants that have not studied in New Zealand.

The growth accounting framework does not explicitly consider the impact of international students. CGE modelling is used to estimate the impact of international education expenditure by simulating the effect on the economy of an expansion in the level of international education in section 3.3 CGE modelling approach.

2.5. Conclusion

The purpose of this section has been to identify and describe the main economic benefits from tertiary education and to provide an indication of how they might be incorporated into models of the effect of universities on the economy. The largest impact and the one that can be measured with the greatest certainty is the income premium received by graduates. Returns from university research are likely to be the next largest source of benefit but it is hard to find generalised estimates of the aggregate impact. Both of these mechanisms have long lasting effects on the economy.

International education income (a form of export) has a much more direct and immediate impact on the economy than the graduate income premium and productivity returns to university research which are long-term investments.

18 The estimated expenditure per student excluding fees is $15,000 to $20,000 per year and is based on suggested student budgets provided on a sample of New Zealand university websites. Infometrics completed a survey of overseas student spending by in 2013 and estimated average living costs were $17,400 per year. (See Infometrics, 2013. The Economic Impact of International Education 2012/13 for Education New Zealand, September 2013', p. 19.)

3. Modelling approach

3.1. Introduction

This section describes the application of the growth accounting and CGE modelling frameworks to the benefits identified in Section 2 Benefits of universities, to estimate their effect on the rest of the economy.

3.2. Growth accounting model

3.2.1. Model structure

Deloitte Access Economics, as part of their assessment of the contribution of universities to the Australian economy, developed a cross-country model of economic growth that seeks to disaggregate the contribution of human capital and higher education R&D on national income. The model uses a constant returns to scale production function with three inputs: physical capital, human capital and labour, that are each paid their marginal product. The labour input is modified by a function that describes technological progress and economic efficiency.

The economic efficiency function considers higher education R&D, other R&D and exposure to international trade as key drivers of the rate of change in economic efficiency. Technological progress is assumed to grow at an exogenous rate which seems especially reasonable for New Zealand, which has a share of world R&D spending of about 0.1 percent.

3.2.2. Model estimates

Deloitte Access Economics estimated two versions of the model ('steady-state' and 'short-term dynamics'[19]) using economic data from 37 countries (including New Zealand) over the period 1980 to 2010. The key coefficients for the analysis of the economic contribution of universities estimated from the model are:

- Individual and public productivity gains from tertiary learning:
  - The percentage of steady-state output that can be attributed to tertiary human capital input – between 8.4 percent (steady-state) and 16.0 percent (short-term dynamic)
  - The percentage change in steady-state output of the effect of an increase in the proportion of the population aged 15 and over with a tertiary education – between 15.2 percent (steady-state) and 23.3 percent (short-term dynamic)

[19] The transition adjustment model allows for situations where economies are not in a steady state by defining the form of an adjustment equation that includes a convergence parameter that sets the speed at which economies converge to their steady state. This equation was also fitted to the data so that the Deloitte Access Economics growth accounting model was effectively presented as two models with common independent variables but different co-efficients and a lag structure for the short term dynamic model. The convergence parameter estimated for the short term dynamic model is 0.149 which means that model forecasts that, on average, economies will reduce the gap between their steady state and current levels of output by 14. 9 percent per year.

- Productivity gains from tertiary educator research:
  - The elasticity of steady-state output to higher education R&D – 0.175 for the steady-state model and 0.184 for the short-term dynamic model.

3.2.3. Human capital contribution

The contribution of New Zealand universities to increasing the incomes of graduates can be estimated as the increased income that is attributable to the qualification held by the individual. This is a two-step process:

- Estimate the contribution of human capital to national income using the Deloitte Access Economics model (and the allocation of this income between private and public benefits using Census data)
- Identify the human capital contribution to national income that is attributable to university education.

Income difference due to human capital

Applying the parameters estimated in the Deloitte Access Economics model to the New Zealand economy suggests the following estimates of the economic contribution of tertiary education:

- For New Zealand GDP in 2014 of $230 billion, the output that can be attributed to tertiary human capital input is between $19 billion (steady-state) and $37 billion (short-term dynamics). The average of these two estimates is $28 billion or 12.2 percent of GDP. (The comparable estimate for 2013 is $26 billion.)
- We estimate that in 2013 people with income above zero[20] who held a:
  - Bachelor or higher degrees received an income premium approximately $15 billion in total above the estimated income received by people with secondary school qualifications
  - Level 4 to 6 qualifications received an income premium of approximately $6 billion in total above the estimated income received by people with secondary school qualifications
- The difference of $7 billion (about 3 percent of GDP) between the growth accounting model estimate of income attributed to human capital of $26 billion and the income premium received by holders of tertiary qualifications includes both an estimate of the productivity gain for levels of qualifications between tertiary and secondary school as well as an estimate as the spill-over productivity gains to other workers of working with graduates. We have not been able to separate these two influences. However, assuming the two influences are both positive we can interpret the difference of $7 billion is a very crude estimate of the upper limit of the productivity gain from working with tertiary graduates.

[20] Based on Census 2013 data, of those people aged 15 or over and reporting a qualification and an income above zero, 572,000 people held a bachelor or higher level degree and 540,000 people held a level 4, 5 or 6 qualification.

University education contribution to human capital

Estimating the additional national income generated by human capital that is attributable to universities requires two adjustments for:

- The proportion of degrees that are granted by universities. (This is relatively straight-forward. Graduation data provided by Education Counts indicate that universities awarded 81 percent of the bachelor or higher degrees awarded by domestic tertiary education providers over the period 2006 to 2013
- Allowance for the other factors such as cognitive ability and demographic factors which also contribute to the higher incomes to graduate income premia. This adjustment factor is more difficult to define but the limited available literature[21] suggests that about 50 percent of the income premia is due to tertiary education.

In combination these factors suggest that the appropriate adjustment factor is 40 percent, so that the estimated contribution of past university education to GDP is between $7.6 billion (steady-state) and $14.4 billion (short-term dynamics), and that a very crude upper estimate of the combined spill-over productivity gain to other workers would be just under 1 percent of GDP.

3.2.4. Research contribution

The parameters of the growth accounting model can also be used to estimate both the implied value of the knowledge stock and the potential long-term contribution of recent changes in higher education research to future national income.

The growth accounting model suggests that the share of output attributable to the knowledge generated by university research is estimated at 8.2 percent (steady-state) to 9.7 percent (short-term dynamics) of GDP.[22] In the growth accounting model this represents the implied value to the production technology of the economy of the stock of knowledge accumulated by university research.

The elasticity of national income with respect to higher education research spending estimated in the growth accounting model (17.5 percent (steady-state) or 18.4 percent (short-term dynamics)) indicates that a sustained 10 percent increase in higher education research spending will eventually increase[23] GDP by 1.75 percent to 1.84 percent. The Deloitte Access Economics study applied this analysis to Australian data on the growth in university research spending over the period 1984 to 2014, (an annual average of 4.7 percent per year from 1984 to 2009 and 4.3 percent over the period

[21] Deloitte Access Economics (2015) p. 79 concludes that "around half the observed difference in earnings (on average) … is explained by the contribution of the qualification itself with over half explained by other factors such as age, experience, demographic characteristics (such as parental education and occupation) and cognitive ability". These comments were based on the analysis in Wilkins, R., 2015. The Household, Income and Labour Dynamics in Australia Survey: Selected Findings from Waves 1 to 12, Melbourne Institute of Applied Economic and Social Research, The University of Melbourne.

A New Zealand-based but more narrowly focused study by Scott, D. (2009) analysed observed difference in incomes three years after graduation and similarly found that about half of the difference was explained by "differences in age, sex, ethnic group, field of study, provider type, and industry and firm size of main employer". See Scott, D., 2009. What Do Students Earn After Their Tertiary Education? Wellington, N.Z.: Statistics New Zealand and Ministry of Education.

[22] The process for obtaining these estimates is explained in Deloitte Access Economics (2015) Appendix E, p. 84.

[23] The growth model predicts that the change in GDP will be a combination of the convergence rate, on average 14.9 percent between the current output and the steady state for an increase in higher education research expenditure in a given year overlaid on the ongoing adjustment to change in higher education expenditure in previous years.

2009 to 2013) and concluded that the sustained increase in university research spending was adding 0.6 percent to GDP each year.[24] The Deloitte Access Economics study also estimated that the share of output attributable to the existing stock of knowledge generated by university research was equivalent to approximately 10 percent of Australian GDP in 2014.[25]

We have not been able to find consistent long-term historical data on the level of university research spending in New Zealand and therefore have not been able to replicate the analysis of the annual contribution to GDP at this time. A survey of research and development expenditure published by Statistics New Zealand provides biennial data on higher education research spending from 2006 ($593 million, just over 0.36 percent of GDP) to 2014 ($817 million, just under 0.36 percent of GDP) indicating a compound annual growth rate of 4.1 percent (although the spending did decline between 2012 and 2014). A rough comparison of this data with the Australian estimates suggests that the change in university research spending over the past six years would be expected to contribute about 0.3 to 0.4 percent to GDP (after allowing for the slightly slower growth rate and the share of GDP spent on university research in New Zealand as opposed to Australia).

We have not been able to reliably estimate a direct 'return on investment' on university research as a comparator to the benefits implied by the growth accounting model due to both conceptual difficulties and the limited amount of research on this subject in New Zealand. It is conceptually difficult to calculate a conventional return on investment because both the numerator (increased productivity) and the denominator (cost of the stock of knowledge) are difficult to observe let alone measure for the following reasons:

- University R&D spending in aggregate is typically a precursor to innovation that can improve productivity but the timing and size of the resulting productivity gains depends on both the potential improvement associated with the research and the speed and breadth of the adoption by the relevant economic actors (businesses, public sector etc.)
- The 'cost' of the stock of knowledge can be thought of as being augmented by R&D spending (valued at cost) and depleted by 'depreciation' as ideas or processes become obsolete. In practice there is limited historical data on R&D expenditure and no reliable data on depreciation of the stock of knowledge.

In section 2.3.2 Return on investment (CGE model) we have described the assumptions we have used for the short-term CGE modelling of the effects of an increase in R&D spending.

---

24 The report does not quote the dollar amount of university research spending used in the analysis, but the statistic in the report that university research spending is 0.6 percent of GDP suggests the current level of research spending is about AUD 10 billion per year.

25 Deloitte Access Economics, p. vii. And also p. 30, p. 34 and explained on p. 84.

3.2.5. Growth accounting conclusion

Application of the Deloitte Access Economics growth accounting model to New Zealand data suggests that:

- The estimated contribution of past university education to GDP is between $7.6 billion (steady-state) and $14.4 billion (short-term dynamic)
- A reasonable starting point for the estimated contribution of past and present university research spending is probably about 0.3 to 0.4 percent of GDP.

3.3. CGE modelling approach

To complement the long-run growth accounting approach we have also used CGE modelling to consider the following scenarios:

- Increase in the number of equivalent full time students (EFTS) by about 4 percent on 2014 levels maintained for a period of four years to deliver an improvement in overall labour productivity of about 0.09 percent[26]
- Increase in research funding of $200 million spread over five years with a rate of return of 20 percent on the research after five years
- A one-off increase in the fee revenue of international students of 5 percent (comprising a 3 percent volume increase and a 2 percent increase in fees) and a 3 percent increase in their living costs.

These runs of the CGE model are focused on the long-term changes to GDP and do not consider the cost of funding the increased research or education spending.

3.3.1. Model structure

To complete the CGE modelling scenarios for the increase in student numbers and the additional spending, we have first translated these 'shocks' into changes in productivity over time and then used these changes in productivity to alter the inputs for the CGE model. The scenario with the increase in student numbers included assumes that the productivity gain for the additional students will be 10 percent lower than the observed average and emigration rates are not affected by the increased number of students.

The scenario for the increase in university research spending allocates the productivity benefit to multifactor productivity and distributes it across all industries according to shares of current production. That is equivalent to assuming that the benefits are equally spread across capital and labour over the entire economy.

For the increase in the international student revenue we assume a one-off expansion in the size of the sector based on a 3 percent increase in volume and a 2 percent increase in international student fees. (This scenario does not allow for the potential increase in tourism spending.)

The CGE model is then used to compare the profile of economic activity with the productivity change to the profile of economic activity under a business as usual

[26] The total estimated funding required for this is assumed to be approximately $360m spread over four years.

scenario the over the period 2015 to 2027. This period is chosen because 2027 is about the time that both of the impacts peak.

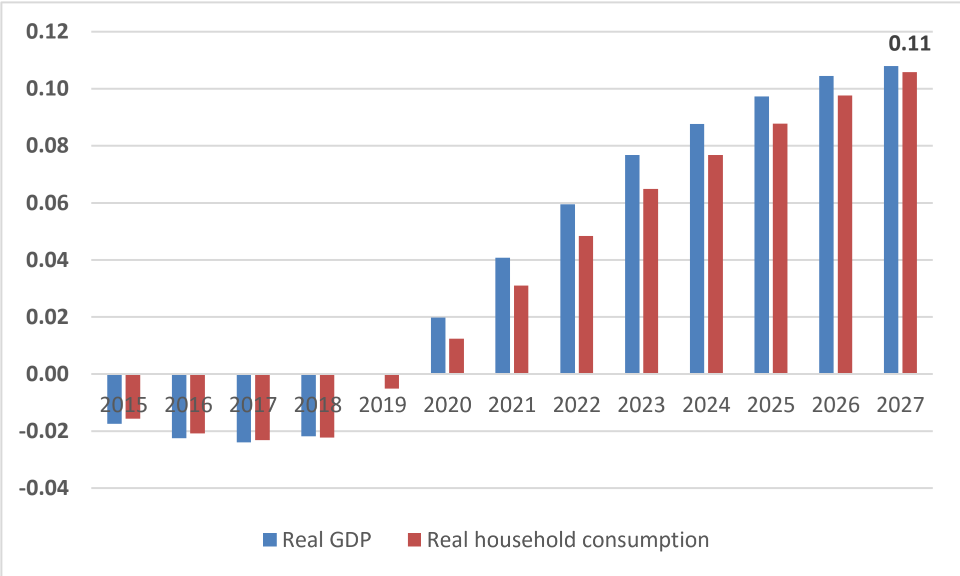
3.3.2. Model results

Increased student numbers

The increase in student numbers eventually increases labour productivity by .09 percent which increases household consumption by 0.10 percent and GDP by 0.11 percent in 2027 relative to the business as usual scenario indicated in Figure 2.

Figure 2 Impacts of labour force productivity and participation

Percentage change from 'business as usual'



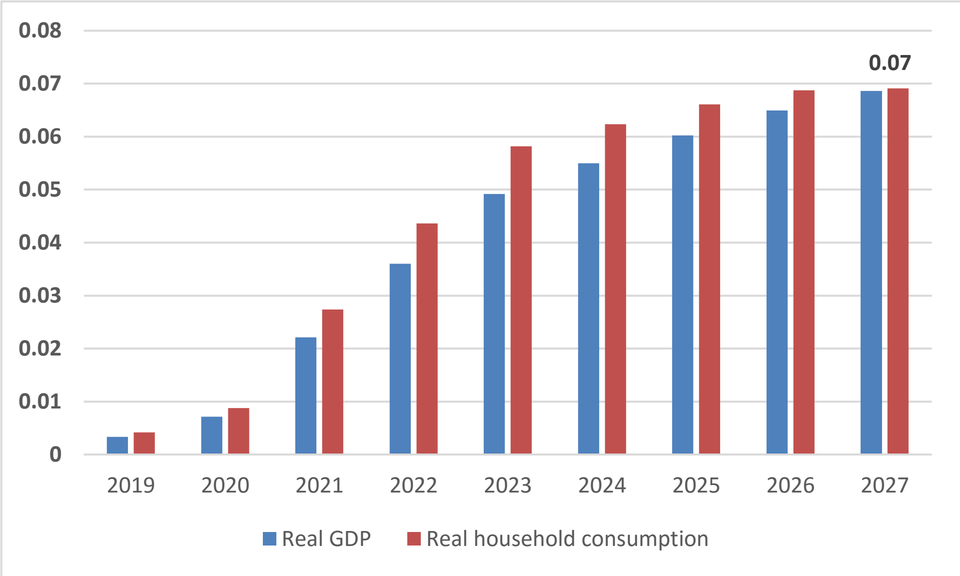
Source: NZIER

Increased research funding

The increase in research funding is estimated to increase productivity by 0.05 percent relative to the business as usual scenario resulting in household consumption and GDP about 0.07 percent above the levels for the business as usual scenario in 2027.

Figure 3 Impacts of return from university-led research on GDP & household consumption

Percentage change from 'business as usual'



Source: NZIER

Increased international student revenue

The one-off increase in international student revenue is a direct stimulus of about 0.011 percent of GDP and increases GDP and consumption by about 0.017 percent of GDP by 2027, implying a long-term multiplier of about 1.6. This means that for every additional $1 million spent by international students GDP is increased by $1.6 million (comprising the $1 million direct spending by the student plus $0.6 million of flow-on effects).

3.3.3. CGE conclusion

The CGE scenarios provide an indication of the medium-term impacts on GDP of modest changes in the existing levels of university spending. The long lead times and pervasiveness of the effects of changes in university teaching and research activity on the economy make it difficult to create realistic CGE modelling scenarios that illustrate the contribution of the universities to the economy.

Appendix A Impact studies

A.1 Introduction

As noted in the introduction to this report, economic impact studies are another approach that has been used to describe the 'contribution of universities' to the economy. Unlike the two methods described in the report (which look at how university outputs contribute to the economy), impact studies look at the direct and indirect effects of the use of resources by the university.

The report 'The impact of universities on the UK economy'[27] is an example of this approach.[28] However the approach has been widely used, often as part of the analysis of the case for central or local government funding of infrastructure or incentives to a development activity.

A.2 Method

The objective of the method is to estimate the full effect of the activity of an organisation or project on the economy (as measured by GDP, income and employment) by calculating the following impacts:

- Direct effects:
  - Direct spending by the organisation on employees, capital equipment and the operating surplus of the organisation
  - Any new direct spending attracted to the economy by the organisation. For universities in a national context this usually comprises fees and living expenses of international students
- Indirect effects:
  - Spending by the organisation on goods and services that it uses to deliver its services
  - Flow-on effects of these spending activities to other industries
- Induced effects:
  - Spending on consumption goods and services by people employed by organisation and industries supplying inputs to the organisation
  - Flow-on effects of these spending activities to other industries.

The direct effects can be calculated from the financial statements of the organisation. However, the indirect and induced effects are estimated using multipliers derived from input output matrices. The multipliers capture the supply and use of products and services by one industry from all of the other industries in the economy. These multipliers represent the recent historical average of goods and services transactions

27 Kelly, U., I. McNicoll and J. White. 2014. The impact of universities on the UK economy, Universities UK.

28 Universities UK requested submissions on the suitability of its economic impact approach at the beginning of 2016 via a survey at https://www.surveymonkey.co.uk/r/UUKCallforevidenceonimpactofukuniversities. A detailed comment on the survey question was posted by Guy Jakeman of ACIL Consulting, and this is available at https://www.researchgate.net/post/How_can_I_measure_the_economic_impact_of_universities.

between industries rather than the marginal cost, and do not consider constraints on the supply of resources or potential changes in prices.

The combined multipliers for indirect (Type I) and induced (Type II) effects can have a wide range of values but often have values between 2 and 3. A multiplier of 2 for example is shorthand for the input output relationship that on average each dollar of direct expenditure by an industry was related to another dollar of expenditure in all of the other industries in the economy.

Economic impact studies typically add the direct expenditure of the industry to the indirect and induced expenditure (estimated from multipliers) and then describe this as the impact of the industry.

A.3 Interpretation issues

There are two theoretical problems with this interpretation:

- It assumes that the goods and services purchased by the industry would not be used at all if the industry did not exist and also that the industry can be scaled up to any size without any change in the price of resources
- It does not acknowledge that the sum of the multiplier effects for each industry will exceed the total aggregate output of the economy and therefore must overstate the contribution of each industry.

In practice, central government decision-makers do not regard multiplier-based economic impact analysis as a credible measure of the contribution to economy.

At best the multiplier analysis describes the 'footprint' of an industry at a point in time.

Appendix B Regional impact

B.1 Introduction

The analysis in the body of the report is focused on the long-term income and productivity gains that can be attributed to the skills gained from university education and innovation enabled by university research and development activity (a combination of original research, improving access to international research and assisting with the application of the research to local business or public sector issues). In this section we comment on the contribution to 'city or regional' economies of direct spending that is attributable to universities.

Regional economic impact analysis studies argue that spending associated with organisations such as universities contributes to the economic activity of the cities in which they are located through their employment of staff, expenditure on capital, attraction of students from outside the city and retention of students who would arguably leave the city to study in another city. Impact studies go on to apply multipliers to these direct spending effects to calculate the 'full economic contribution' of universities to a 'city or regional' economy.

From a national perspective a substantial part of these direct spending 'impacts' are effectively transfer payments.[29]

B.2 Regional 'direct' economic impacts

However, in the following table we present estimates of both the direct spending by universities and the spending by domestic students who are either retained in the region or attracted from other regions.

The following table includes direct spending estimated as:

- Direct spending by the university on employees, capital equipment[30] and the operating surplus of the university
- Living expenses for domestic students remaining in the area and attracted to the area (based on the number of domestic students enrolled multiplied by the university advice to students on living expense budgets).[31]

---

29 Appendix A Impact studies, provides a more detailed explanation of the weakness of impact analysis.

30 We have used depreciation as a proxy for capital spending.

31 The estimated living expense per student for each university and the source of these estimates are included in the table. The university living expense budgets vary across universities but are broadly in line with the average estimate used in the body of the report.

Table 2 Direct spending attributable to universities

University spending (2014 annual reports) and student living expenses (2015 enrolments and budgets) in $ million per year

Description	University of Auckland	Auckland University of Technology	University of Waikato	Massey University	Victoria University of Wellington	University of Canterbury	Lincoln University	University of Otago	Total
University direct									
People Costs	586	204	129	263	197	169	65	375	**1987**
Depreciation	118	41	21	48	39	40	8	56	**372**
Net surplus	45	16	12	9	17	-3	-2	34	**126**
Total direct	**748**	**261**	**162**	**321**	**253**	**206**	**71**	**465**	**2485**
Student[1] spending									
Local	587	393	146	163	135	147	44	31	**1,646**
Non-local	147	98	49	295	243	141	50	178	**1,201**
Total student	**734**	**491**	**195**	**458**	**378**	**288**	**94**	**210**	**2,847**
Total direct	**1,482**	**752**	**357**	**779**	**631**	**494**	**165**	**675**	**5,332**
Note: 1. 'Student' refers to domestic students. 'Local' students come from the 'city/region' around the university and 'non-local' from the rest of New Zealand.									

Source: NZIER analysis of data provided by Universities New Zealand and gathered from university websites

Table 3 Estimated student expenses

Enrolments (number) budget per student ($)

Description	University of Auckland	Auckland University of Technology	University of Waikato	Massey University	Victoria University of Wellington	University of Canterbury	Lincoln University	University of Otago	Total
Domestic students[1]									
Local	30,639	20,523	8,123	10,182	7,027	7,114	2,466	2,913	**88,987**
Non-local	7,660	5,131	2,708	18,500	12,640	6,836	2,780	16,507	**72,762**
Total	**38,299**	**25,654**	**10,831**	**28,682**	**19,667**	**13,950**	**5,246**	**19,420**	**161,749**
Student spending									
Budget ($)	19,152	19,152	18,000	15,972	19,229	20,612	17,874	10,794	
Note: 1. 'Student' refers to domestic students. 'Local' students come from the 'city/region' around the university and 'non-local' from the rest of New Zealand									

Source: NZIER

The sources for the student expense budgets are:

- University of Auckland: ebooks.accommodation.auckland.ac.nz/students_guide_to_living_in_auckland/files/assets/common/downloads/publication.pdf
- Auckland University of Technology: see University of Auckland reference
- University of Waikato: www.waikato.ac.nz/students/international/before-you-come-to-nz/cost-of-living.shtml
- Massey University:[32] www.massey.ac.nz/massey/international/faqs/fees-scholarships-living-costs.cfm#livingcosts May2016
- Victoria University of Wellington: www.victoria.ac.nz/international/applying/cost-calculator
- University of Canterbury: www.canterbury.ac.nz/future-students/fees-and-funding/cost-of-living/#tab2
- Lincoln University: www.lincoln.ac.nz/Lincoln-Home/Apply/Whats-it-going-to-cost/Fees-Tuition/Accommodation-fees/?sti=1
- University of Otago: www.otago.ac.nz/international/otago005589.html.

B.3 Regional indirect and induced impacts

Previous economic impact studies of university spending (in the mid-2000s) estimated the value of the indirect and induced output from the university spending using multipliers calculated from input-output tables. However, multiplier analysis over-states the reliance of the flow-on activity on the initial expenditure as it does not net out alternative use of those resources. Therefore, they describe the difference between the city/region economy as it is now compared to a city/region economy without a university and also all the resources in the city/region economy that are currently linked to the university in the city/region.[33]

Dwyer et al (2005) find multiplier model estimates are 180 percent to 500 percent higher than Computable General Equilibrium (CGE) model estimates that do account for such offsetting effects. Based on our previous experience with the NZIER CGE model, more realistic multipliers are likely to be closer to 1.1 (in other words the 'ripple effect' of this type of spend is about an additional 10 percent of the initial direct spend).

At your request we have considered how a multiplier analysis could be applied to the direct university expenditure and spending by domestic students of each university on a city/region basis.

The last NZIER full economic impact analysis of a university that used multipliers was 'The University of Auckland, Economic contribution to the Auckland region', dated April 2006.

[32] Palmerston North campus.

[33] See Dwyer, L, Forsyth, P and Spurr, R., 2005. Estimating the Impacts of Special Events on the Economy. Journal of Travel Research, Vol 43, pp 351-359.

This report applied the following multipliers to the expenditure by Auckland University and students of Auckland University:

- Indirect activity; output multiplier of 1.4
- Induced activity (including indirect activity); output multiplier of 3.6.

If these multipliers were applied to our estimate of each university's direct contribution to the city/region a multiplier analysis would suggest the indirect and induced impacts listed in the following table. As stated in the body of the report and explained in more detail in Appendix A, these indirect and induced effects are at best a measure of the current footprint of the university in the city/region. They cannot be added to calculate a national total across cities/regions and they are not accepted by central government as a credible argument for increased expenditure on university education or R&D.

Table 4 Estimated region/city footprint of individual universities

Application of indirect and induced effect multipliers to university spending (2014 annual reports) and student living expenses (2015 enrolments and budgets) in $ million per year

Description	University of Auckland	Auckland University of Technology	University of Waikato	Massey University	Victoria University of Wellington	University of Canterbury	Lincoln University	University of Otago
Total direct[1]	**1,482**	**752**	**357**	**779**	**631**	**494**	**165**	**675**
Direct spending plus indirect effects	**2,075**	**1,053**	**500**	**1,091**	**883**	**692**	**231**	**945**
Direct spending plus indirect effects plus induced spending	**5,335**	**2,707**	**1,285**	**2,804**	**2,272**	**1,778**	**594**	**2,430**

Note: 1. Total direct spending includes spending from domestic students only.

Source: NZIER