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Access Economics



## Universities New Zealand

Assessing returns on  
international collaboration

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# Executive summary

Deloitte Access Economics was commissioned by Universities New Zealand to develop an evidence-based, consistent framework and model to assess the benefits of international collaboration opportunities for New Zealand universities. This research and analysis answer the following questions:

- What are the economic (and social) benefits from international collaboration initiatives, and how do they transmit through the economy?
- How do the returns differ by type of collaboration initiative?
- How are the benefits of international collaboration distributed between universities, private participants, and the broader economy?

The analysis draws on a review of international literature in this field and a custom developed model to understand the economic benefits of four different, but related, collaboration activities. The relative benefits of each initiative are based on the best evidence from the available literature. For some of the initiatives considered here, the benefits of international collaboration had only been explored in a handful of overseas studies.

Figure 1 summarises the modelled results on the average returns to the New Zealand economy. The returns are measured through increases to Gross Domestic Product (GDP) in Net Present Value (NPV) terms over 15 years, from investing \$1.00 in collaborating with a country for each of the four broad initiatives.

**Figure 1. Distribution of benefits from international collaboration by initiative**

(Net present value of increases in GDP after 15 years for every \$1.00 dollars invested, annual discount rate of 7%)

	 <b>International research collaboration</b>	 <b>Academic staff exchanges</b>	 <b>Student exchanges</b>	 <b>Work placements</b>
<b>Benefit to the university</b> (increased enrolments, patents and licenses)	\$0.25	\$0.06	~\$0	~\$0
	+	+	+	+
<b>Benefit to the individual</b> (higher post-tax wages and better employment outcomes)	~\$0	~\$0	\$0.43	\$2.94
	+	+	+	+
<b>Benefit to the public</b> (benefits for other businesses and Government)	\$2.21	\$0.55	\$0.63	\$2.94
	+	+	+	+
<b>CUMULATIVE BENEFIT TO THE ECONOMY</b>	<b>\$2.46</b>	<b>\$0.61</b>	<b>\$1.06</b>	<b>\$5.87</b>
<b>COUNTERFACTUAL</b> (what are the benefits relative to)	Government and university does not invest in research. The return on investing in domestic research is \$2.28.	Academics targeted by the programme do not otherwise undertake academic exchanges.	Students do not otherwise participate in study abroad programs or longer term study overseas.	Targeted students do not otherwise participate in work placement.

Source: Deloitte Access Economics

The results suggest that there is **generally a sound economic rationale for engaging in international collaboration activity**, as it allows resources and expertise to be shared between international fellow universities and increases the value that these resources generate. However, the analysis indicates that benefits differ across initiatives, and are dependent on how specific collaboration agreements are structured. For example, the benefits of student exchanges depend on the length of the exchange and the proportion of inbound to outbound students.

The disaggregation of benefits should be seen as a high level indication of the relative flow of benefits to individuals, universities and the public respectively. For example, some of the benefits to universities may flow to individual academics whose careers benefit from being involved in international collaborations. Academics may also gain some of the broader public benefits if they are able to work with industry partners to commercialise their research.

Not all of the benefits of each of these types of international collaboration are currently amenable to direct quantification. As such, it is also important to take into account broader social and economic benefits through a separate assessment of qualitative factors.

Nevertheless, the results indicate that **a large share of the benefits accrue to the public** (i.e. beyond those directly participating in the activity), with only a relatively small proportion accruing to the university or private participant.

The results suggest that there could be a more significant role for government in supporting international collaboration opportunities. The analysis in this report provides evidence to support the identification of opportunities where the returns to international collaboration, and the justification for government support, are likely to be greatest. Further analysis- tailored to the specific initiative under consideration – will in many cases be required to support final investment decisions.

# 1 Purpose and introduction

The key activities of universities – research, teaching and learning – have become internationalised, with a growing share of research undertaken across national borders, and a large number of students studying abroad globally.

New Zealand universities are increasingly taking part in this internationalised context, and are expected to reciprocate and contribute, whether financial or in-kind, to initiatives proposed by international partners. Consequently, Universities New Zealand commissioned Deloitte Access Economics to investigate the economic benefits arising from international collaboration initiatives involving universities.

The analysis in this report is based on research informed by a review of international literature on international collaboration and a custom developed model to understand the economic benefits of different, but related, collaboration activities. Deloitte Access Economics used the key inputs from the international literature, and created a model that estimates the economic benefits of a user-defined international collaboration activities. In particular, the user can specify the type of initiative, partnership country, cost of activity and funding arrangements, and number of participants taking part in the activity. The key inputs to the model are summarised in **Appendix A**.

Not all of the benefits of each type of international collaboration are amenable to direct quantification. As such, it is important to take into account these broader social and economic benefits through a separate assessment of qualitative factors. **Appendix B** highlights some of the broader benefits associated with international collaboration.

## Defining international collaboration initiatives

International collaboration between universities can take a variety of forms. This report focusses on the following forms of international collaboration:

- **International research collaboration** refers to initiatives that relate to the joint production of academic research. These initiatives may take the form of different activities, which have been grouped into co-authorship or other types of less formal working relations (research collaboration). It may occur with or without the physical relocation of academics (academic mobility).
- **Academic mobility** refers to the physical movement of academic researchers. In this context, mobility specifically refers to movement across national borders, inclusive of both inbound and outbound migration. We have not defined a period of mobility and so academic mobility may refer to short-term exchanges right through to migration.
- **Student flows** refers to a range of international collaboration initiatives that can impact student flows between countries. Such initiatives include student exchange programmes and scholarship programmes that may provide support for longer period of study overseas. Student flows cover both short-term exchange programmes (typically ranging from six to twelve months), and long-term study for the duration of the degree.
- **Work placement programmes** involve work assignments (internships) for students that are already studying abroad. In this respect, they can be thought of as a supplement to the benefits associated with student flows.

We now discuss the benefits of each of the international collaboration initiatives, and **Appendix A** provides a summary of the sources we used as inputs to our model to estimate the economic benefits.

# 2 Benefits of international research collaboration

## Summary of our results

Additional funding for international research collaboration initiatives contributes to GDP<sup>1</sup> by increasing both the total number of researchers who undertake research (allowing additional researchers to be hired or existing academics to devote more of their time to research), and improving the *quality* of research completed by those who receive funding.

Modelling by Deloitte Access Economics finds that:

- A \$1.00 investment in international research collaboration is estimated to yield an economic return, as measured through increases to GDP in NPV terms, of \$2.46 after 15 years.<sup>2</sup> This compares to a return of \$2.28 for an 'average' domestic research project.<sup>3</sup>
  - This indicates that \$0.18 is specifically attributable to the higher quality of international research collaborations.
- Deloitte Access Economics (2015a) estimate that of the returns from international research collaboration, 10% accrue to the university (through increased student enrolments, patents and licenses) and 90% to the public (as business, government and industry apply and benefit from improved knowledge). The split of benefits from research collaboration is likely to vary under different research projects, and these figures are indicative.
  - This would imply that a \$1.00 investment by a university in international research collaboration has a NPV return of \$0.25 after 15 years and a \$1.00 investment by the public has a NPV return of \$2.21 over the same period.
- The returns to investing in international research collaboration are higher over the long-term as the productivity benefits from research takes time to manifest and flow through the economy. After 20 years, the increase to GDP, in NPV terms, reaches \$7.46.

## Understanding the benefits of international research collaboration

### Research output, productivity and GDP

The research activity of universities supports economic growth through generating knowledge and new ideas and through the transfer of these ideas to business, government and industry, which improves economic productivity (Lucas Jr, 1988; Salte and Martin 2001).

The Australian Productivity Commission (2007) found that estimates of the responsiveness of GDP or multifactor productivity to a 1% change in R&D typically fall between 0.05% and 0.45%. Deloitte Access

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<sup>1</sup> The benefits of international collaboration are expressed in terms of their ultimate impact on GDP. As a result, increased student expenditure is adjusted to account for the fact that some student spending will be on imported goods. The model makes no adjustment to account for the opportunity cost associated with increasing tax revenue as it assumes that funding of specific international collaboration initiatives is being compared to other potential uses of government funding. The benefits also do not generally account for potential 'crowding out' as some sectors draw in additional capital and labour to meet the needs of additional international students. These 'crowding out' effects are not generally considered in a standard Cost Benefit Analysis but are considered in economy-wide models such as Computable General Equilibrium models.

<sup>2</sup> In the modelled example, it is assumed that each academic receives \$500,000 in research funding for their project, with 50% funded by New Zealand, and 50% by the 'average' partner country. An equal number of New Zealand and partner country researchers participate.

<sup>3</sup> This draws on the modelling approach used by Deloitte Access Economics for a number of Australian universities (2015a, 2015b).

Economics (2015a, 2015b) estimates that a 1% permanent increase in higher education research and development expenditure per capita would lead to an increase in GDP of 0.18% in the steady state or long-run.<sup>4</sup> This is consistent with past research by Guellec *et al.* (2001), which estimated an impact of 0.17% based on cross-country analysis of 16 OECD countries over the 1980-1998 period.

The impact on GDP is not immediate as it takes time for research outcomes to flow through the economy. The speed of convergence i.e. the lag between the initial research and the full productivity impact ranges between 7.5 years and 15 years as indicated by the international literature. A central case of 11 years has been adopted in this report (Adams, 1990; Mansfield, 1991).

### **Impact on research quality**

The literature suggests international research collaboration produces higher quality research compared to the average research project, and is likely to lead to higher economic benefits. This is because international collaboration allows researchers to access and share knowledge, techniques and skills, access foreign facilities and equipment, and create broader networks (Lasthiotakis *et al.*, 2013).

In particular, research by He *et al.* (2009) isolated the impact of international collaboration on research output. This is done through a longitudinal dataset of 65 biomedical scientists, which controls for the underlying differences in research productivity across scientists, and their propensity to collaborate. It found that papers with international collaboration had 7.7% higher impact compared to papers without any collaboration. However, it also found that international collaboration did not have a significant impact on the quantity of research completed by each researcher. Tang (2011) similarly found nanotechnology papers co-authored by authors from the United States and China were 7% more impactful than papers authored by only Chinese authors.

### **Impact on university rankings and student flows**

A small share of the increase in GDP results from increased international student expenditure as higher quality research improves institutional rankings, thus encouraging more international students to attend New Zealand universities.

Porter and Toutkoushian (2006) indicates that a 10% increase in the average number of publications per faculty member increases the reputation score of university by 0.04 points, or just under 2% of the average reputation score. It is assumed that higher *quality* has a similar impact on the reputation of universities as higher output. Based on the weighting of Times Higher Education and QS rankings on research quality, a 1% improvement in researcher quality leads to a 0.28% increase in rankings.

Controlling for the underlying quality of universities, Luca and Smith (2013) show that a one-place improvement in the US News and World Report rankings leads to a 1% increase in applicants. Research by Chevalier and Jia (2016) suggest that the effect could be more pronounced amongst international students, as they have more limited knowledge of the local higher education sector and place greater importance on rankings.

### **Beneficiaries of economic benefits associated with university research**

While part of the gains from research will be captured by universities, such as through patents and attracting additional international student enrolments, the majority of the gains are likely to accrue to broader society as university research is openly disseminated and used (Stiglitz, 1999). New Zealand universities have relatively low levels of patents and commercialisation activity and, instead, as publicly funded research universities, tend to make their knowledge publicly and freely available for others to use.

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<sup>4</sup> It is important to note that this relationship is based on historical data. It is possible that globalisation and digitisation may make research findings more accessible across countries. It is unclear to what extent this may impact the relationship between research and development at a national level and GDP, which may impact the findings of this analysis.

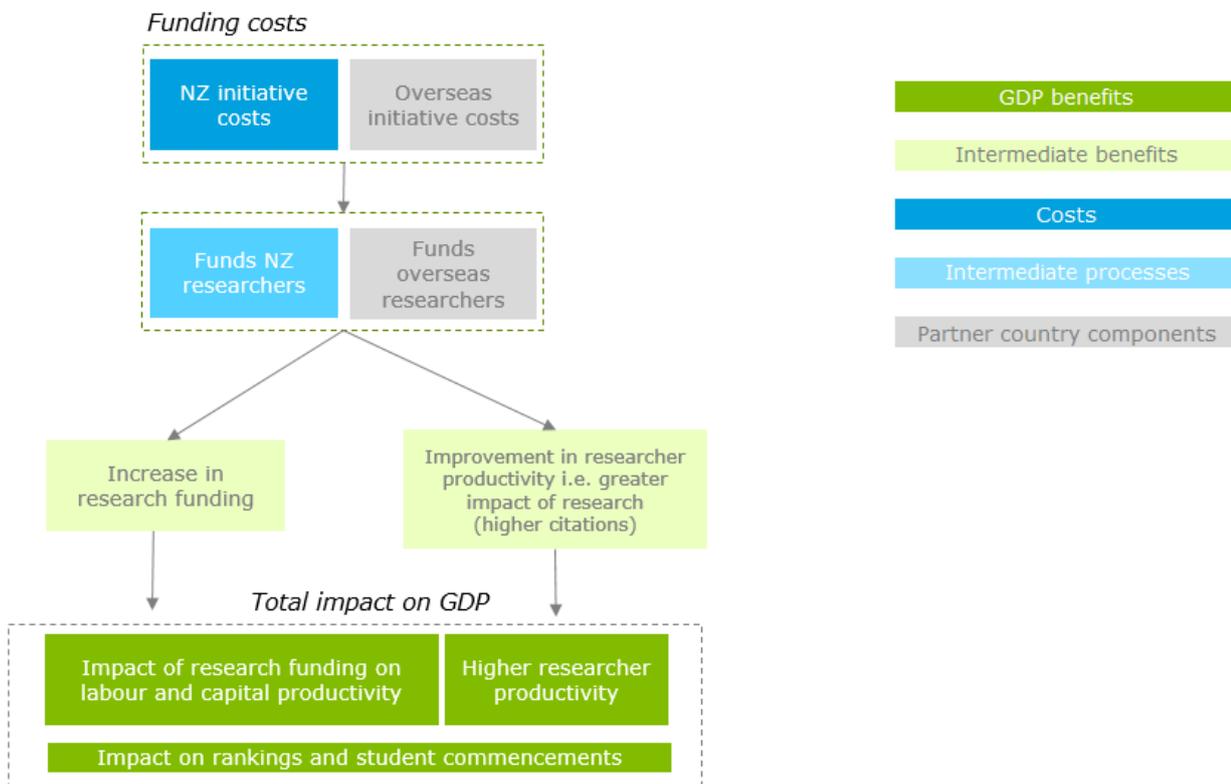
Based on estimates of the public and private returns to research investment, and the share of university research activity that is funded by private industry, Deloitte Access Economics (2015a) estimates that public market benefits likely exceed 90% of the total market benefits.

### Our approach to determine the benefits

Our model considers the benefits from international research collaboration initiatives relative to a counterfactual where no research would have taken place.<sup>5</sup> This approach implies that a portion of the total benefits can be considered the additional benefits attributable to international collaborative research above and beyond a domestic research project. In particular, 7.1% of the total economic benefits of research collaboration can be attributed to the improved quality of international collaboration relative to domestic research.<sup>6</sup>

Figure 2 below demonstrates our model logic to determine the benefits from international research collaboration.

**Figure 2. Our approach to determine the benefits from international research collaboration**



Source: Deloitte Access Economics

<sup>5</sup> This draws on the modelling approach used by Deloitte Access Economics for a number of Australian universities (2015a, 2015b). Domestic research is assumed to have a positive impact on GDP as outlined in the sections Research output, productivity and GDP, similar to international collaborations. However, it is assumed that the returns to domestic research are lower, as the papers are on average less impactful (outlined in Impact on research quality)

<sup>6</sup> The 7.1% is calculated as  $7.7\% / (1 + 7.7\%)$ , where the 7.7% represents the research productivity impact of international collaboration compared to domestic research (He *et al.*, 2009).

There is limited research that quantifies the difference in the returns from collaboration between different partner countries. However, it is possible to describe the key attributes that underpin successful research collaboration more broadly. To the extent that these attributes can be mapped to specific projects, the benefits are likely to be the greatest.

- **Research that is in an area of mutual interest** for New Zealand and the partnership country will be more productive, as countries are able to pool resources and reduce resource duplication.
- **Research that involves working with leading researchers in the field** will be more productive, as it provides access to leading knowledge and resources.
- **Projects that are driven by an internal champion** within the university are more likely to have a set goal, and be able to attract funding and resources more effectively.
- **Projects that are in basic fields and/or require interdisciplinary input** benefit more from collaborations.
- **Collaboration opportunities that arise organically** based on the needs of the research question, and the networks of researchers, are more likely to be productive.
- **Research that involve working with and/or funding from external sources**, including industry, and contestable funds, are likely to be more effective due to increased accountability.
- **Research that otherwise would not have occurred** without the partnership will have the largest net impact on the economy.

More details on each of these can be found in **Appendix C**.

# 3 Benefits of academic mobility

## Summary of our results

Academic mobility encourages academics to build their professional networks and collaborate with foreign researchers. This will have a positive impact on their home institutions upon return, as translated through the higher quality of research undertaken.

Deloitte Access Economics estimates that the return to investing in academic mobility is typically lower than investing in research collaboration. Assuming the investment was targeted towards a country with higher research capacity compared to New Zealand, a \$1.00 investment in a reciprocal international academic exchange with an 'average country' would lead to an estimated economic return of \$0.61 after 15 years.<sup>7</sup>

## Understanding the benefits of academic mobility

### Impact on research quality

Franzoni *et al.* (2012) use a cross-sectional dataset on the mobility of 15,412 academics across scientific fields to examine the relationship between international experience and research quality, as measured through the impact factor of the journal in which researchers publish in.

While controlling for researcher specific factors, such as their age, gender, and job position, they find that international mobility increases the quality of research. A researcher who visits a country with greater research capacity (as measured through the H-index) compared to their home country produce research that is 10.6% more impactful compared to researchers without international experience. However, researchers who visit a country with lower research capacity compared to their home country also produce higher quality research compared to those without international experience, albeit to a lesser extent (3.5% higher impact).

This is largely facilitated through the opportunity for participating researchers to extend their formal and informal networks, and participate in international collaboration (Jonkers and Cruz-Castro, 2013).

### Impact on university rankings and student flows

The link between improved research quality and increased student flows has been outlined in Chapter 2. Increased student flows then increases GDP through expenditure on tuition fees and living expenses during their studies. The share of students who remain in New Zealand and work, will increase the labour force capacity and contribute to GDP post-studies. The average international student contributes approximately \$0.32 million to GDP in NPV terms over a 20 year period. This is explored in more detail in Chapter 4.

## Our approach to determine the benefits

Determining the benefits of academic mobility is contingent on the participating researcher returning to New Zealand following their placement abroad. To the extent that they remain abroad, it is likely that a proportion of these benefits will accrue to their placement country. Our model is based on a conservative assumption where we assumed that all participating international researchers return to their home

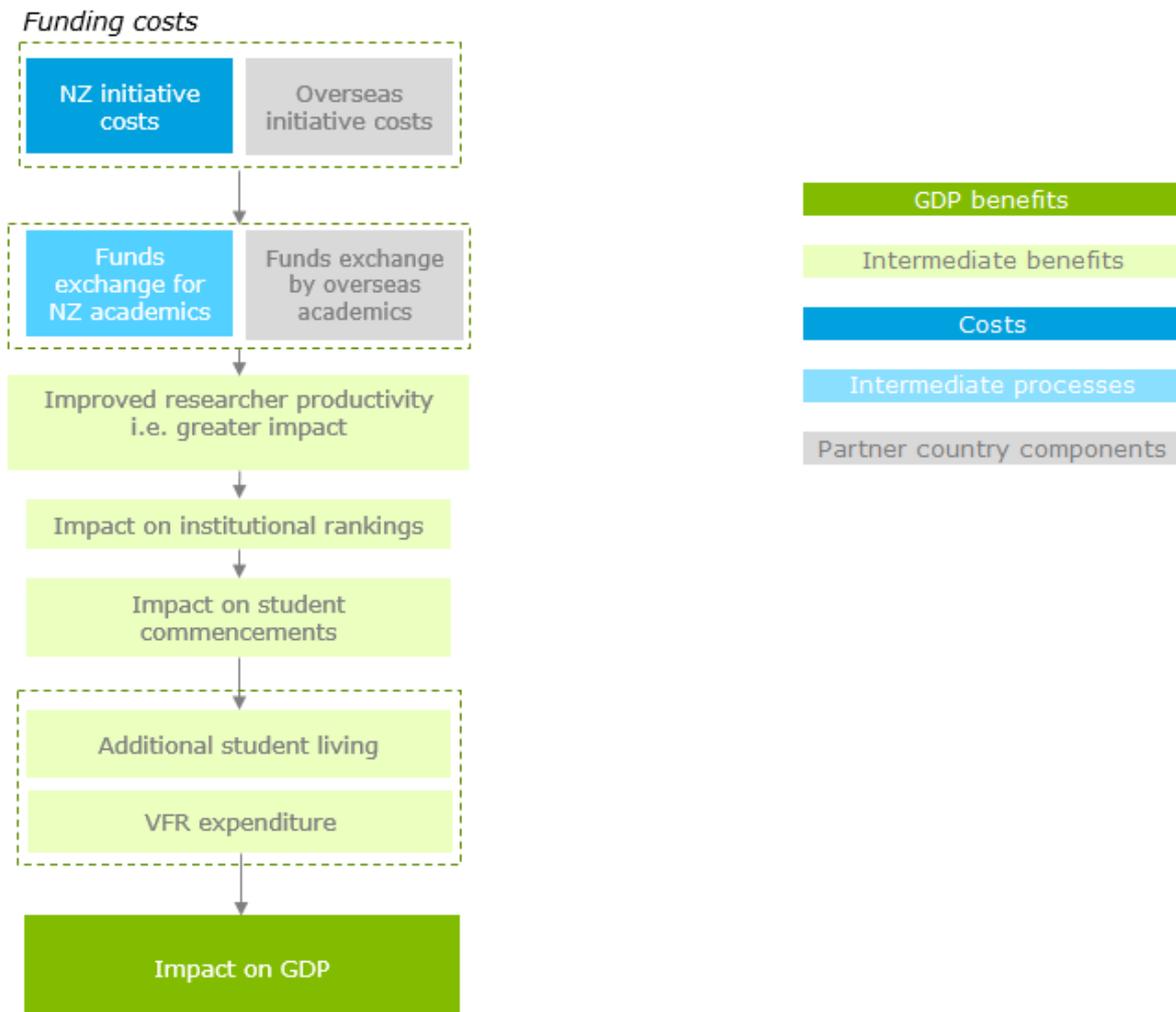
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<sup>7</sup> In the modelled example, it is assumed that each researcher receives an additional funding of \$100,000 to support their exchange abroad, with 50% funded by New Zealand, and 50% by the 'average' partner country. An equal number of New Zealand and partner country researchers participate

countries following the placement. If they choose to remain in New Zealand, the benefits would be greater than indicated by the modelling.

Figure 3 highlights how the benefits from academic mobility transmit through the economy.

**Figure 3. Our approach to determine the benefits from academic mobility**



Source: Deloitte Access Economics

# 4 Benefits of student flows

## Summary of our results

Increased student flows contribute to GDP both during their studies (through increased net expenditure) and post-studies (through increasing labour force capacity and productivity in New Zealand).

Modelling by Deloitte Access Economics shows:

- A \$1.00 investment in a reciprocal **long-term exchange programme** with an 'average' country would lead to an estimated economic return, as measured through increases to GDP in NPV terms, of \$1.06 after fifteen years.<sup>8</sup>
  - The benefits attributed to private individuals in the form of higher post-tax wages and an increased likelihood of being employed would be \$0.43. The split between the public benefit to the broader economy and private individuals has been informed by a literature review.
  - The remaining \$0.63 represents public benefits attributable to increased workforce capacity and benefits to other businesses as international students and their Visiting Friends and Relatives (VFRs) demand a range of goods and services during their studies.
- The benefits from international student flows are highly dependent on the composition of students who are encouraged to participate. For instance, if there were three inbound international students for each outbound New Zealand student, the benefits would increase to \$6.61 after fifteen years.
- A \$1.00 investment in a reciprocal **short-term exchange programme** with an 'average' country would lead to an estimated economic return, as measured through increases to GDP in NPV terms, of \$0.87 after 15 years. The key driver for a lower benefit from short-term exchange programmes compared to long-term exchange programmes is that for long-term exchange programmes the assumed net increase in tertiary educated persons (the difference between the number of inbound international students staying in New Zealand relative to the number in outbound students remaining overseas post study) is greater.

## Understanding the benefits of international student flows

### Expenditure by students during their studies

International students buy a range of goods and services during their studies. Infometrics (2016) finds that the average international student in New Zealand spends approximately \$47,624 per annum during their studies.

Domestic students in New Zealand spend slightly less on fees and living expenses compared to their international counterparts, at \$43,232 per annum. This represents 91% of international student expenditure, and is based on a survey on the expenditure patterns of international and domestic full-time undergraduate students in Australia (Universities Australia, 2013). The lower expenditure could be because a greater share of domestic students live with their parents, and do not pay rent.

Consequently, a reciprocal exchange between an international and domestic student would result in a net expenditure gain of \$4,392 for each year of study.

### Expenditure by Visiting Friends and Relatives during studies

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<sup>8</sup> In the modelled example, each student receives \$20,000 in funding per year for three years (i.e. the duration of an undergraduate degree). 50% is funded by New Zealand, and 50% by the 'average' partner country. An equal number of New Zealand and partner country students participate.

The International Visitor Survey finds that 22% of international students are visited by VFRs (Ministry of Business, Innovation and Employment, 2016). On average, they spend \$140 per night and stay for 11.5 nights.

As these VFRs otherwise would not have visited New Zealand, their expenditure can be attributed to the international student. The foregone expenditure of VFRs of New Zealand students, who choose to visit them overseas, are not considered as a part of this exercise.

### **Impact on labour supply**

A proportion of students who study overseas are likely to remain in New Zealand post-studies. The Ministry of Education (MOE) (2016) finds that six years after graduation, approximately 18% of international PhD graduates and 25% of international undergraduate graduates are employed in New Zealand.

At the same time, studying abroad also increases the likelihood that New Zealand students remain overseas. Rodrigues (2013) uses data from 28,321 students in the European Union to explore the link between their study abroad experience and post-studies outcomes. The paper finds that students who study overseas for 6 to 12 months are 17% more likely to remain overseas post-studies; for students who study overseas for more than 12 months, this increases to 52%.

Deloitte Access Economics applies these findings to outbound domestic students. For the average New Zealand student, a short-term exchange experience would increase their likelihood of remaining overseas from a base 35% (MOE, 2016) to 39%. For long-term exchanges, this likelihood would increase to 53%.

Based on these parameters, for every 100 students who go on reciprocal exchange, New Zealand will get a net increase of 10 workers under a long-term exchange programme.

### **Education attainment and GDP growth**

A net increase in university graduates contributes to the development of a highly-skilled workforce as they increase the educational attainment rate of the host country population. The human capital theory of education postulates that levels of educational attainment increases the knowledge and skills of workers, which in turn improves productivity in the workforce, labour force participation and employment. As such, it plays a key role in supporting productivity growth for all nations, the primary driver of improved living standards over time (Mankiw *et al.*, 1992).

Deloitte Access Economics (2015a) found that a permanent 1% increase in the tertiary education attainment rate in Australia would increase labour productivity (measured as GDP per capita) in Australia by between 0.15 to 0.20 percentage points. This is broadly consistent with the finding by Holland *et al.* (2013) for the United Kingdom, which found that a 1% increase in the share of the workforce with a university degree raises long run productivity by 0.2–0.5%.

### **Additional premium for returning New Zealand students**

Rodrigues (2013) finds that students who have study abroad experience have a 3% wage premium compared to students who do not have study abroad experience. This is because study abroad is associated with a range of benefits, including higher graduation rates, degree progression, language skills, and cognitive development (Universities Australia, 2016).

### **Public versus private benefits**

Some of the GDP benefits associated with higher educational attainment will accrue to the private individual in the form of higher post-tax wages, and increased likelihood of being employed. The remaining benefits will be captured by the public in the form of increased tax receipts, and broader spill over benefits to other markets, such as stimulating additional capital investment.

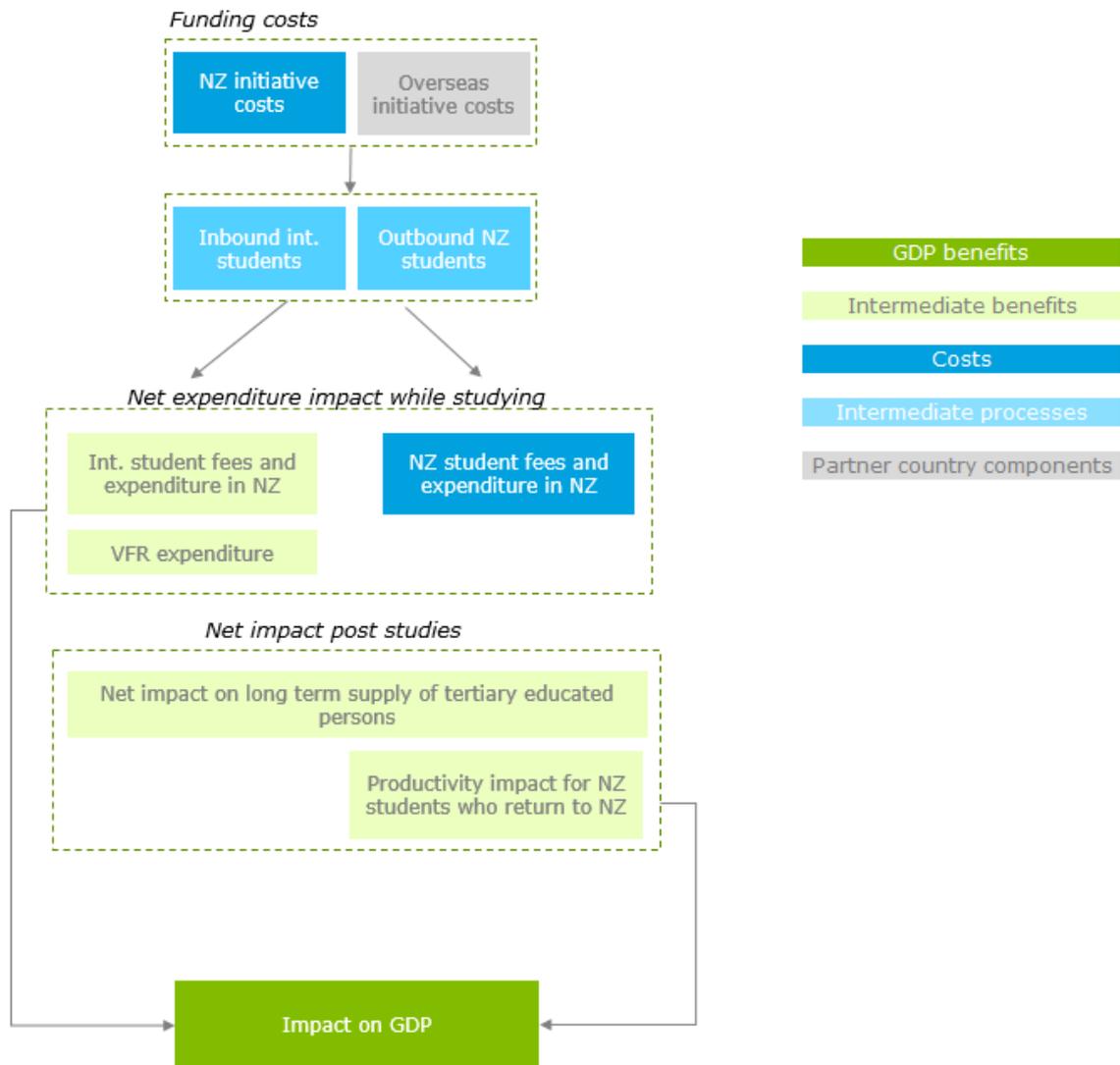
McMahon (2004; 2006; and 2009) posits that **the average ratio of public-private market benefits is approximately even** (i.e. 50:50). The bounds of these results are between 37% and 61% for the proportion of total social market benefits attributable to public market benefits. The 50%-50% split is used in the central scenario. More detail on the research can be found in **Appendix D**.

## Our approach to determine the benefits

In the counterfactual scenario, it is assumed that these students would not have gone on the exchange programme. This may be a strong assumption in circumstances where some of the students may have opted to still go on an exchange to New Zealand, or in the case of New Zealand students, to a partner country. The literature on the benefits of an exchange in terms of an individual's subsequent wage premium largely draws on European studies and thus the model does not seek to model differentiated returns from an exchange with different partner countries.

Figure 4 demonstrates the way student flows are captured in the model.

**Figure 4. Our approach to determine the benefit for long-term student exchanges**



Source: Deloitte Access Economics

# 5 Benefits of work placements

## Summary of our results

Work placement programmes allow students studying overseas to gain additional work related experience in the host country. This provides students an understanding of the work culture and practices of the host country, which in turn improves their employment prospects post-study.

Modelling by Deloitte Access Economics shows that work placement programmes can enhance the value of inbound student flows:

- A \$1.00 investment in work placement programmes, will lead to a return of \$5.87 after 15 years.<sup>9</sup>
- For the economic benefits that have been quantified, none of the return will accrue to the university, while 50% of the return will accrue to private individuals (in this case, the individual student through improved employment outcomes), and 50% of the return will accrue to the public.

## Understanding the benefits of work placements

### Improved labour market outcomes

Work placement programmes have a positive impact on labour market outcomes, both in terms of earnings and the likelihood of finding employment.

The United Kingdom Department for Business, Energy and Industrial Strategy (2013) finds that relative to those with no work experience, students engaged in work-based learning earn £3,572 more per annum than those with no work experience and £2,531 more than those with only non work-based paid work experience. The mean for those with only non work-based paid work experience was £19,442, indicating that on average those who participated in work-based learning received a 13% wage premium after controlling for other factors.

Saniter and Siedler (2014) study the effect of internships on labour market outcomes and show a 6% wage premium for internships five years after graduation, mainly driven by an increased proportion of students in full-time employment and fewer PhD students.

Given the range of these two studies, Deloitte Access Economics has decided to use the midpoint of the range because both papers applied a similar approach and both results were considered to be credible estimates of improved labour market outcomes.

### Link to GDP

Higher productivity then flows through to the rest of economy as outlined in Chapter 4 above.

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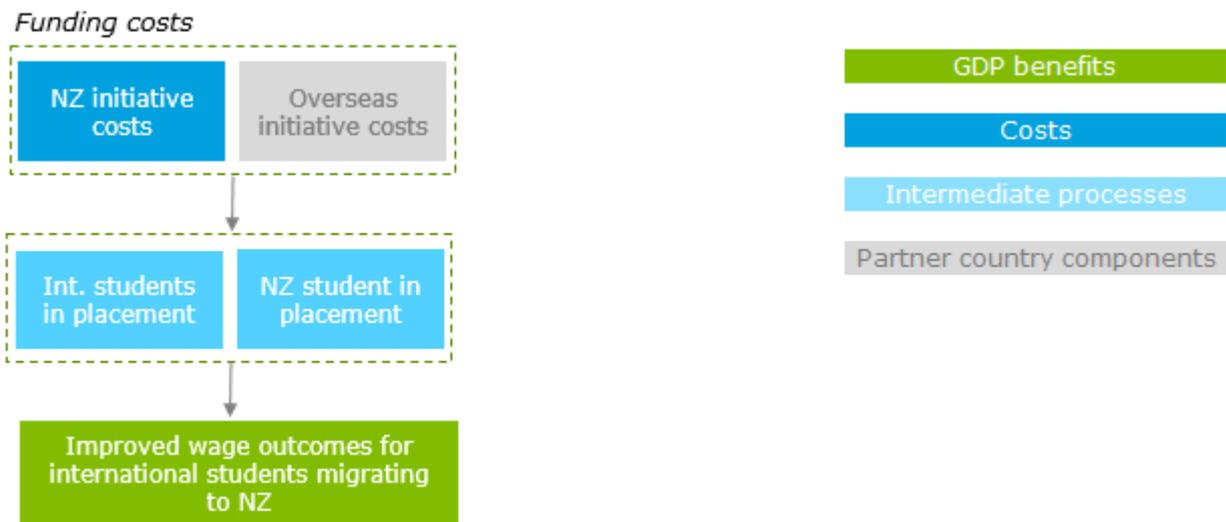
<sup>9</sup> In the modelled example, each placement costs \$5,000, with 50% funded by New Zealand, and 50% by the 'average' partner country. A higher average cost for student placements will be associated with lower benefits.

### Our approach to determine the benefits

It is assumed that international students would not have participated in work placement programmes without this initiative. It is assumed that the programme does not change the students' likelihood to stay in New Zealand, although in practice work placement programs may encourage students to stay in a country by giving them work-ready skills.

Figure 5 below illustrates how the benefits from work placement programme have been captured in the model. In this instance, the benefits are largely focussed around improved labour market outcomes for participants.

Figure 5. Our approach to determine the benefit of work placement programmes



Source: Deloitte Access Economics

The benefits attributed to private individuals is further discussed in **Appendix D**.

# 6 Conclusion

The key activities of universities – research, teaching and learning – have become internationalised, with a growing share of research undertaken across national borders, and a large number of students studying abroad globally.

Key questions related to international collaborations are what the benefits are, how the benefits transmit through the economy, and how these benefits differ between initiatives.

This report suggests that there is **generally good economic rationale for engaging in international collaboration opportunities**, as it allows for resources and expertise to be shared between partner countries. However, the benefits will differ across initiatives, dependent on how specific collaboration agreements are structured, and the type of research that is funded.

**A large share of the benefits are distributed to the public**, with only a small proportion accruing to the university or private participant. This suggests that there could be a significant role for government in supporting international collaboration opportunities. This report helps identify opportunities where the returns to international collaboration, and also the justification for government support, are likely to be greatest.

The results are based on applying findings from a range of academic studies, both from New Zealand and overseas. While this provides the best available evidence base to estimate the size of the economic benefits from international collaboration, the model should be seen as providing a high level estimate of the potential benefits of a given initiative, rather than a precise measure of its expected impact (which, as noted above, will be influenced by initiative-specific design considerations).

Moreover, there are many benefits from international collaboration (including a range of broader economic and social benefits) that are not currently amenable to direct quantification. This include benefits such as strengthening academic networks, building stronger trade, investment and people-to-people links and raising the profile of New Zealand universities internationally, which are notable outcomes in and of itself. Any assessment of the value of international collaboration opportunities for New Zealand would need to explicitly take into account these broader benefits which are a central part of the role of international collaboration in building closer links between New Zealand universities and their overseas partners.

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# Appendix A: Summary of sources used as inputs to our model

This attachment summarises the key sources used as parameters to determine the economic benefit from each international collaboration initiative.

## International research collaboration

Table A.1 below shows the parameters used to estimate the benefits of international research collaboration and the sources on which these parameters are based. The impact on GDP in NPV terms is based on an initiative that leads to a 1% increase in permanent research funding in New Zealand and involves 360 academics.

Table A.1: Parameters applied to international research collaboration

Parameter	Value	Factors that influence size	Source
% improvement in quality of international collaboration research compared to <u>average</u>	7.7%	The improvement in quality depends on the counterfactual. If domestic collaboration is going to occur in place of international collaboration, the gains are likely to be smaller.	He <i>et al.</i> (2009)
<b>Overall GDP impact</b>			
% increase in long run per capita GDP from 1% increase in <u>average</u> research expenditure per capita	0.18%		
Lag period	11	The lag period (i.e. when the research translates to higher GDP) depends on the type of research conducted, and the pace at which it can be commercialised.	Deloitte Access Economics (2015a, 2015b)
Annual convergence factor	14.9%		
% increase in GDP (NPV, 20 years)	0.044%		Calculated using the variables above.
<b>GDP impact attributable to international research</b>			
Share of gain attributable to international collaboration	7.1%		Calculated the parameters above.
% increase in GDP (NPV, 20 years)	0.003%		Calculated using the variables above.
<b>GDP impact from increased student flows</b>			
% increase in rankings from 1% improvement in <u>NZ</u> research quality	0.28%		Porter and Toutkoushian (2006) Top Universities (2016) Times Higher Education (2016)
% increase in enrolments from one rank increase in rankings	0.96%		Luca and Smith (2013)
NPV expenditure increase from an average international student (20 years)	\$0.32 million		MBIE (2016) Infometrics (2016) Deloitte Access Economics (2016)
GDP to expenditure ratio	85%		Deloitte Access Economics (2016)

## Academic mobility

Table A.2 sets out the parameters used to estimate the benefits of an academic exchange program and sources from which these parameters are derived.

Table A.2: Parameters applied to academic mobility

Parameter	Value	Factors that influence size	Source
% improvement in quality of research by researchers who go overseas to country with <u>higher H-index</u>	10.6%	The length of the academic exchange programme.	Franzoni <i>et al.</i> (2012)
% improvement in quality of research by researchers who go overseas to country with <u>lower H-index</u>	3.5%		
<b>GDP impact from increased student flows</b>			
% increase in rankings from 1% improvement in <u>NZ</u> research quality	0.28%		Porter and Toutkoushian (2006) Top Universities (2016) Times Higher Education (2016)
% increase in enrolments from one rank increase in rankings	0.96%		Luca and Smith (2013)
NPV expenditure increase from an average international student (20 years)	\$0.32 million		MBIE (2016) Infometrics (2016) Deloitte Access Economics (2016)
GDP to expenditure ratio	85%		Deloitte Access Economics (2016)

## Student flows

Table A.3 sets out the parameters used to estimate the benefits of student flows (both short and long term) associated with international collaboration agreements and the sources from which these parameters are derived.

Table A.3 Parameters applied to student flows

Parameter	Central parameter	Factors that influence size	Source
<b>GDP impact from increased inbound students – during studies</b>			
Annual expenditure per <u>international student</u>	\$47,624		Infometrics (2016)
% visited by VFR	22%		
Average VFR nights in NZ	11.5		MBIE (2016) TRA (2016)
Average VFR nightly expenditure	\$140		MBIE (2016)
<b>GDP impact from increased inbound students – post studies</b>			
% of international students working in NZ	28%	The likelihood that international student will leave NZ post-studies.	MOE (2016)
% impact on GDP from 1% additional labour supply with tertiary qualification	0.19%		Deloitte Access Economics (2015a)
<b>GDP impact from increased outbound students – during studies</b>			
Annual expenditure per <u>international student</u>	\$43,232		Infometrics (2016)
<b>GDP impact from increased outbound students – post studies</b>			
Base likelihood to not return to NZ	35%		MOE (2016)
Increased likelihood to not return to NZ	52%		Rodrigues (2013)
Likelihood to work in NZ	37%		MOE (2016) Rodrigues (2013)
Wage premium associated with <u>international experience</u>	2.5%		Messer and Wolter (2007) Rodrigues (2013)

## Key parameters for work placements

Table A.4 sets out the parameters used to estimate the benefits of a work placement program and sources from which these parameters are derived. It is assumed that the students would come to New Zealand to study anyway and thus the model estimates the incremental benefits associated with undertaking a work placement program during their studies.

Table A.4 Parameters applied to work placements

Parameter	Value	Factors that influence size	Source
% of international students working in NZ post study	28%		
% impact on GDP from 1% additional labour supply with tertiary qualification	0.19%		Deloitte Access Economics (2015a)
Wage premium associated with industry work placements	10%	Size of gain depends on whether intl students have other work experience during studies	Saniter and Siedler (2014)

# Appendix B: Broader economic benefits from international collaboration

Not all of the benefits of each of these types of international collaboration are currently amenable to direct quantification. As such, it is important to take into account these broader social and economic benefits through a separate assessment of qualitative factors.

For example, cultural and soft diplomacy benefits are applicable across all initiatives (research collaboration, academic mobility, student flows and work placements). Research undertaken by Deloitte Access Economics (2016) highlights the benefits of having a large population of returned international students abroad, creating trade and investment links as well as broader cultural understanding.

Having a large proportion of international students abroad who have studied in New Zealand is likely to have important soft diplomacy benefits for New Zealand while the local population is likely to benefit from greater exposure to students from different cultural backgrounds.

Collaboration is vital for tackling difficult scientific issues and enables intellectual and physical resources to be pooled that would be beyond an individual country's abilities (e.g. the CERN Large Hadron Collider).

Individual researcher mobility can create positive spill over benefits for their home institution and broader society. For example, this could include facilitating additional collaborative opportunities for other researchers. More broadly, the experience and knowledge gained through their placement can drive productivity improvements in the home country.

Studying abroad has a large impact on the probability of students in employment three years after graduation, with the impact particularly strong for disadvantaged students. Students who undertake study abroad programmes also graduate at higher rates than other students.

The positive effect of work placement programmes is at least partially independent of student background, and is thought to be strongest for those who come from study areas with a weak labour market orientation. Other benefits, such as the development of work-specific skills and knowledge, are likely to accrue to internship holders as well as personal development benefits from spending time abroad, similar to student exchanges.

# Appendix C: Attributes driving variation in return on investment for international research collaboration

Through a targeted literature review, Deloitte Access Economics identified the following key attributes that impact the expected returns from investment in international research collaboration.

## **Is the research in an area of mutual interest for New Zealand and the partner country?**

Research by Cakir (2010) and Wai-Chan (2017) has indicated value in engaging in research in areas of mutual interest. In particular, countries are able to pool resources, reduce resource duplication, and create economies of scale.

**Does the project involve working with leading researchers?** Tang (2011) finds that nanotechnology papers co-authored by authors from United States and China were more impactful compared to collaborations between Chinese and other countries. This suggests that international research collaboration is likely to yield the greatest benefits when conducted with countries and researchers at the frontier of their fields. This is because working with leading researchers facilitates knowledge transfer, and access to leading resources (Abramo, 2008; Beaver and Rosen, 1979).

**Is the opportunity driven by an internal champion?** In a consultation with Massey University, the university identified the importance of picking initiatives with internal champions. This is because internal champions tend to have a strategic vision for the research, an ability to obtain funding, and an ability to identify the best people to collaborate with (Carlsson *et al.*, 2014).

**Is the field of research conducive to collaboration?** Collaboration is most likely to occur in basic research, and is relatively less common in theoretical fields and applied research (van Rijnsoever and Hessels, 2011; Frame and Carpenter, 1979). Similarly, questions that require interdisciplinary input will benefit from collaboration across a range of fields and views (Abramo *et al.*, 2009). Consequently, research questions that meet these requirements are more likely to benefit more from collaboration.

**Did the collaboration opportunity arise organically?** Manville *et al.* (2015) finds that high performing collaboration tends to be initiated organically, initiated by the networks of staff in the process of finding the most suitable partners for a particular project. While specific funding can be a strategic enabler for collaborations to develop where they had not before, this could potentially create perverse incentives.

**Does the research involve an external partner or source of funding?** High performing research institutions highlighted the importance of interacting with an external partner, such as industry, public organisation, health services, museums, or schools, to their research (Manville *et al.*, 2015). Similarly, external sources of funding from industry, and contestable funds are important in driving high quality research. This could be because external collaboration promotes both engagement with the relevant stakeholders and additional accountability. Projects with industry also tend to be closer to commercialisation. A shorter lead time will have a greater impact on GDP (in NPV terms).

**Would the research have occurred otherwise?** The economic benefits from research result from activity that would otherwise not have occurred within the economy. Consequently, additional research funding is only likely to have a net impact on the economy if it is not merely displacing other forms of research that otherwise would have occurred.

# Appendix D: Private and public benefits from student flows and work placements

Increasing international student flows increase the overall workforce capacity of the New Zealand economy. This is because workers with university qualifications tend to be more productive compared to the average worker without a post-school qualification.

## Literature review

Some of the benefits will accrue to the private individual in the form of higher post-tax wages, and increased likelihood of being employed. The remaining benefits will be captured by the public in the form of increased tax receipts, and broader spill over benefits to other markets, such as stimulating additional capital investment.

McMahon (2004; 2006; and 2009) provides perhaps the most complete and comprehensive canvass of the empirical literature on education externalities. McMahon identifies the most common and accepted approach for calculating market benefits. First, they estimate the total social rates of return to educational attainment using cross-country comparisons, then estimate the private returns to education based on individual earnings data using what is known as a Mincer-type equation. As the social return is assumed to be comprehensive, the difference between these returns is, by definition, the public market benefits (McMahon, 2004).

McMahon posits that **the average ratio of public-private market benefits is approximately even** (i.e. 50:50). The bounds of these results are between 37% and 61% for the proportion of total social market benefits attributable to public market benefits.

Chapman and Lounkaew (2011; and 2015) develop estimates of the value of the public benefit from higher education qualifications in Australia. Similarly, they find that **between 40% and 60% of the benefits is attributable to the private individual.**

Other studies have used Government receipts as a measure of public benefits. The OECD (2014) find for New Zealand a 66%-34% split for the benefits from a university qualification. Note that this does not capture the indirect public effects (e.g. through labour productivity spill overs).

## Our approach

While there is likely to be some benefits that accrue to the private individual in international research collaboration and academic flow initiatives (for instance, more productive researchers may be promoted more, and be paid higher wages), there is no available literature that would allow us to capture it. We think that the majority of the benefits are still likely to be captured by the public since research outputs are publicly disseminated and there are large productivity benefits for other sectors.

Based on the findings of the literature review discussed above, we are able to estimate the benefits for private individuals from student flows and work placement. For these initiatives, we have taken a mid-point approach, and have assumed that **50% of the benefits are attributable to the private individual.** This falls in the estimated range by McMahon, Chapman and Lounkaew (2011; and 2015), and the OECD.

### **Benefits from student flows**

A \$1.00 investment in a reciprocal long-term exchange programme with an 'average' country would lead to an estimated economic return, as measured through increases to GDP in NPV terms, of \$1.06 after 15 years. This benefit is made up of:

- \$0.20, which is the benefit from student expenditure during their studies on living expenses.
- \$0.86, which is the benefit from students entering the workforce post-studies, and increasing the education attainment in New Zealand.

The existing literature suggests that there is a 50-50 private-public split in the benefits that result from more university graduates in the labour force. Consequently, this split can only be applied to the \$0.86, \$0.43 will accrue to private individuals, and \$0.43 will accrue to public benefit. For the \$0.20, this is assumed to be fully attributed to the public, since students spend on a range of goods and services that flow through to the broader economy.

### **Benefits from work placements**

A \$1.00 investment in work placement programmes with an 'average' country would lead to an estimated economic return, as measured through increases to GDP in NPV terms, of \$5.87 after 15 years. This benefit is derived for each dollar invested in work placements for international students already studying in New Zealand.

This benefit results fully from international students with higher productivity (as a result of the placement) entering the workforce. As these students are assumed to be already studying in New Zealand, there is no incremental benefit from their expenditure during studies. Consequently, the 50-50 split is directly applicable to the \$5.87 figure.

Therefore, approximately 50% of the benefits (\$2.94) will be **private** benefits to the individual through higher post-tax wages and an increased likelihood of being employed, while the remaining 50% can be considered **public** benefits through increased tax revenue for the Government, and positive productivity spill overs to other sectors.

**Work placement programmes** involve work assignments (internships) for students that are already studying abroad. In this respect, they can be thought of as a supplement to the benefits associated with student flows.

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