

# An analysis of collaborative journal article authorship at New Zealand universities

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# AN ANALYSIS OF COLLABORATIVE JOURNAL ARTICLE AUTHORSHIP AT NEW ZEALAND UNIVERSITIES

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## KEY FINDINGS

Concerns have been raised that the Performance-Based Research Fund (PBRF) Quality Evaluation has had a negative impact on research collaboration between researchers in New Zealand universities.

This report examines a number of analyses of research collaboration as well as presenting a new analysis of inter-institutional collaboration during the period the PBRF has been in operation.

The analysis shows that:

- the rate of inter-institutional collaboration in indexed journal publications by New Zealand university authors has increased since the PBRF was introduced
- the rate of increase has broadly matched that of other sectors in New Zealand (such as Crown Research Institutes), or rates of increase in universities in other countries
- although we cannot tell what would have happened to inter-institutional collaboration if the PBRF had not been introduced, the PBRF does not appear to have hindered growth in inter-institutional collaboration
- a feature of inter-institutional collaboration in New Zealand universities is a low rate of overall collaboration, but high relative rates of international collaboration.

## Introduction

Since its inception in the early 2000s, concerns have been raised about the impact of the Performance-Based Research Fund (PBRF) on the extent of research collaboration in tertiary education. Commentators argue that collaboration in research is beneficial and leads to better quality research.

This paper summarises the findings from previous studies of research collaboration in New Zealand and presents a new analysis of collaboration in New Zealand universities. We focus on collaboration in the authorship of journal articles, which is analysed using bibliometric data.

In this paper we present:

- an outline of the different types of collaboration
- background on how the PBRF Quality Evaluation operates and how this might impact on collaboration
- a synthesis of previous analysis of research collaboration in the New Zealand tertiary education sector
- a new analysis of the rate of collaboration at New Zealand universities between 1999 and 2012, including an examination of collaboration with CRIs.

## Types of collaboration

In this paper we measure collaboration by the extent of co-authorship in indexed journal publications. This picks up much research collaboration, but misses collaboration that leads to publication in monographs and other non-indexed research outputs.

There are several types of collaboration; these are defined in Table 1 below. In this paper we focus on inter-institutional and international collaboration.<sup>1</sup> Note that international collaboration is a subset of inter-institutional collaboration.

**Table 1**  
Types of collaboration

Type of collaboration	Definition
Intra-institutional	Where two or more people at the same institution carry out collaborative research
Inter-institutional	Where people from at least two institutions carry out collaborative research
Intra-sectoral	Where people from at least two institutions within the same sector carry out collaborative research (tertiary education organisations are an example of a sector)
Inter-sectoral	Where people from institutions in different sectors carry out collaborative research
International	Where at least one person involved in collaborative research is based in another country

## The Performance-Based Research Fund

The PBRF was established in 2002 and is intended to ensure that excellent research in the tertiary education sector is encouraged and rewarded. Under the PBRF, research performance of participating tertiary education organisations (TEOs) is assessed and then funding is allocated on the basis of their performance.

The PBRF funding formula is based on three indicators which together assess both quantity and quality of research:

- **Quality Evaluation:** the assessment of the research quality of TEO staff, based largely on peer review of a researcher's Evidence Portfolio (EP), accounting for 60 percent of the fund
- **Research degree completions:** the number of postgraduate research-based degrees completed in the TEO, accounting for 25 percent of the fund
- **External research income:** the amount of income for research purposes received by the TEO from external sources, accounting for 15 percent of the fund.

In this paper our focus is on the Quality Evaluation. The EPs that are submitted by TEOs contain a range of evidence for peer review. This includes information on four nominated research outputs and up to 30 other research outputs. An EP is required to outline the contribution of the researcher to each nominated research output where there is more than one author.

An EP also contains information on the contribution to the research environment of the researcher and the esteem in which the researcher is held by his/her peer researchers. The contribution of the research environment component is where researchers can describe activities such as: contributions to the research environment inside and outside the TEO, facilitating discipline-based and research networks, and membership of research collaborations or consortia.

<sup>1</sup> We include international collaboration in this study as there is data available to measure how this has changed over time and not because we favour international collaboration over other forms.

So there is an attempt to recognise and reward collaborative activities within the Quality Evaluation.

This information in the EP is used to assign a quality category. A score is generated as part of the assessment, where 70 percent is based on the research output score, 15 percent on the peer esteem score and 15 percent on the contribution to the research environment score.

In its 2002 report, the PBRF Working Group considered the potential impact of the PBRF on collaboration. It noted that some stakeholders had questioned whether evaluating research quality at the individual level might discourage collaborative research and collegiality. The Working Group's view was that the PBRF was designed to evaluate a number of activities, including the contribution to an academic unit's research environment. It also didn't see encouraging collaboration for collaboration's sake as necessarily being desirable.

A review of the PBRF by Adams (2008) found mixed views on the impact of the PBRF on collaboration. Some who provided feedback via focus groups and interviews suggested the PBRF actually encouraged collaboration, while others considered it would lead to less collaboration. Adams' view was that determining the contribution of a researcher to a multi-researcher piece of work was a requirement for evaluation, but it might be seen as a potential negative if overemphasised, especially if it was perceived that a single-authored article was more valuable than a collaborative work.<sup>2</sup>

Quantitative analysis of these perceptions is limited. Anderson et al (2013) studied the treatment of multi-authored publications and PBRF performance. The authors examined the correlation between PBRF research output component scores and bibliometric performance of researchers who submitted to the economics panel in the 2006 PBRF Quality Evaluation. This research found a higher degree of correlation between the PBRF research output scores and the bibliometric measures when a researcher was assigned full credit for a multi-authored research publication than when the multi-authored status of the publication was taken into account. The authors concluded that this might show a preference for team-based research in the PBRF or it might indicate double counting of contributions.

## Previous studies of collaboration

Several previous studies have looked at collaboration in the New Zealand tertiary sector. We summarise the key findings of these studies below.

### *1. National Bibliometric Reports 1997-2001, 2002-2007*

The Ministry of Research, Science and Technology (MoRST)<sup>3</sup> produced a series of national reports that used bibliometric data to assess the collaborative activities of New Zealand researchers. The 1997-2001 report examined rates of inter-institutional collaboration during those years by analysing journal publications in the Thomson Reuters ISI database. The report showed that the rate of inter-institutional collaboration (the percentage of indexed publications with at least one author from a different institution) for the New Zealand tertiary education sector<sup>4</sup> was 32 percent during the period 1981-1986, 59 percent during the period 1991-1996 and 52 percent during the period 1997-2001.

So collaboration fell in the last period, but was still significantly above that observed in 1981-1986. This compares with the Crown Research Institutes (CRIs), which had collaboration rates

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<sup>2</sup> Adams (2008) suggested that the greatest negative impact might be on less experienced researchers. He suggested improved awareness and professional development was a solution to this issue.

<sup>3</sup> MoRST is now part of the Ministry of Business, Innovation and Employment.

<sup>4</sup> In bibliometric studies, universities produce the overwhelming majority of indexed publications in the New Zealand tertiary education sector.

of 35 percent during 1981-1986, 61 percent during 1991-1996 and 66 percent during 1997-2001.

The study also found that the vast majority of collaborations in the tertiary sector were with authors at overseas institutions, while the rate of collaboration within the tertiary sector was relatively low. In 1997-2001, 70 percent of tertiary collaborations had international co-authors, while just 5 percent had New Zealand tertiary co-authors.<sup>5</sup>

The 2002-2007 report used bibliometric data from SCOPUS to analyse collaborative activities of New Zealand researchers. The SCOPUS database contained a significantly larger set of journals than the Thomson Reuters database, especially in terms of social sciences and humanities. This change in dataset means that comparison with earlier bibliometric reports should be made with caution.

The 2002-2007 National Bibliometric Report examined trends in inter-institutional collaboration and showed that collaboration in the tertiary education sector increased over the period of analysis from around 53 percent in 2002 to around 75 percent in 2007. The upward trend in collaboration was similar in other sectors of the New Zealand research community. For example, the rate of inter-institutional collaboration at CRIs increased from around 58 percent in 2002 to around 82 percent in 2007. So during the period in which the PBRF was introduced, the rate of collaboration in the tertiary sector was found to have increased, and at a rate broadly similar to other sectors<sup>6</sup> in New Zealand, such as the CRIs.

The 2002-2007 report noted that the rate of inter-institutional collaboration in the tertiary education sector was the lowest of the various sectors analysed. However, different subject disciplines have different rates of collaboration, especially in the social sciences (which have lower rates of collaboration than the sciences). So the lower figure for tertiary institutions is likely to reflect the relatively higher degree of publication in these areas.

The 2002-2007 report also examined trends in international collaboration. The analysis showed that the rate of international collaboration increased in tertiary organisations (to reach around 48 percent in 2007), as it did in other New Zealand sectors.

## *2. CoREs and effect*

A study by the Ministry of Education<sup>7</sup> analysed networks of collaboration in Centres of Research Excellence (CoREs). This analysis used data from Thomson Reuters' Web of Science to compare networks of collaboration in a period close to when the CoREs were first established (around 2003/04) with a period around six years later (around 2009/10). The analysis showed that collaboration and networking had increased at the CoREs.

While the CoREs are relatively small, they were selected in areas where there was a track record of excellent research. And CoREs were given an explicit mandate to ensure there was networking and collaboration among researchers. So the presence of the CoREs is likely to have had a significant influence on research collaboration in the universities as a whole.

## *3. Leiden rankings*

Rates of university inter-institutional collaboration are also published in university rankings conducted by the Centre for Science and Technology Studies at Leiden University in the Netherlands. These rankings analyse the rate of collaboration in the 500 largest universities (in terms of indexed publications). They present rates of inter-institutional collaboration and

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<sup>5</sup> CRIs had a similarly high proportion of international collaborations.

<sup>6</sup> The sectors in the study included: CRIs, District Health Boards, central government agencies and private New Zealand-based firms.

<sup>7</sup> See Smyth et al (2013).

international collaboration. Three New Zealand universities are listed in the Leiden rankings: the University of Auckland, the University of Otago and Massey University.

Table 2 presents the rates of inter-institutional collaboration in journal articles and reviews. The results are for articles published in the two periods where collaboration was evaluated – 2005-2009 and 2008-2011. So there is an overlap of two years (2008 and 2009) in the analysis.

We are particularly interested in how the rate of collaboration has changed over time. Table 2 shows that the rate of inter-institutional collaboration increased at each of the New Zealand universities. The rate increased from 63.2 percent to 66.2 percent at the University of Auckland, from 63.8 percent to 66.0 percent at the University of Otago, and from 66.6 percent to 68.3 percent at Massey University.

The scale of the increase in rates of collaboration was similar to that of the overall average and the average at Australian universities in the assessment. So the rate of growth in inter-institutional collaboration in the three New Zealand universities appears to be broadly in line with that of universities outside of New Zealand. However, the rate of overall collaboration at the three New Zealand universities remains below the average of the Australian universities.

**Table 2**  
Proportion of inter-institutional collaborative publications

<b>University</b>	<b>2005-2009</b>	<b>2008-2011</b>
University of Auckland	63.2%	66.2%
University of Otago	63.8%	66.0%
Massey University	66.6%	68.3%
<b>Average of Australian G8 universities</b>	<b>71.5%</b>	<b>74.9%</b>
<b>Average of Australian non-G8 universities</b>	<b>68.7%</b>	<b>71.1%</b>
<b>Average of all 500 universities</b>	<b>69.0%</b>	<b>71.0%</b>

Source: [www.leidenranking.com](http://www.leidenranking.com)

The Leiden rankings also measure the rate of international collaboration. This is where at least one of the journal publications contains an author at an institution in another country. Table 3 shows the rates of international collaboration for the three New Zealand universities, along with the average rate of collaboration for Australian Group of Eight (G8) universities, Australian non-G8 universities and also all 500 universities listed in the Leiden rankings.

The results in Table 3 show that the increase in the rate of international collaboration at each of the three New Zealand universities is broadly in line with the average increase at all top 500 universities, as well as the Australian G8 universities. The average rate of international collaboration actually fell fractionally at the Australian non-G8 universities.

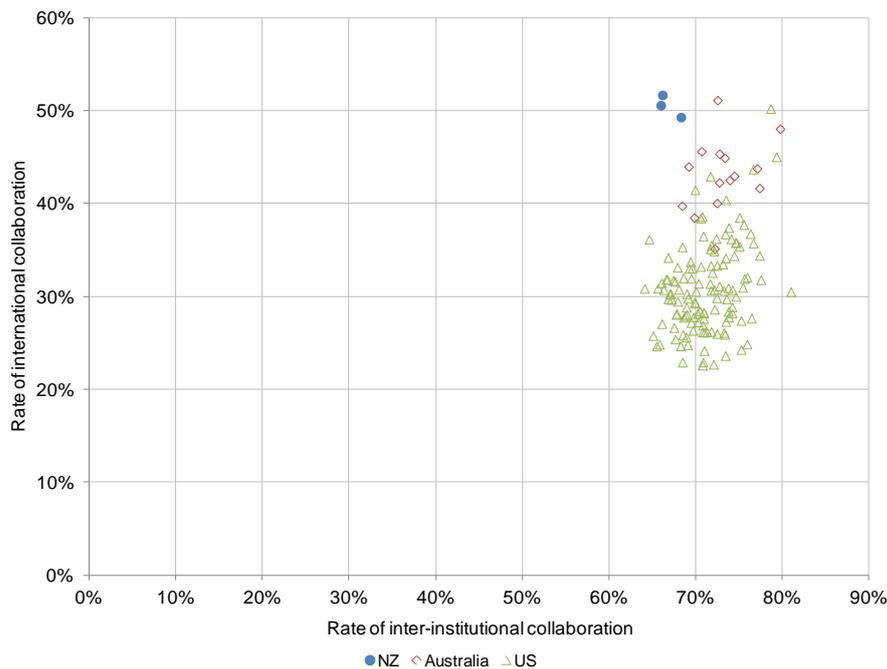
**Table 3**  
Proportion of international collaborative publications

University	2005-2009	2008-2011
University of Auckland	49.2%	51.7%
University of Otago	47.3%	50.6%
Massey University	46.8%	49.3%
<b>Average of Australian G8 universities</b>	<b>41.5%</b>	<b>44.7%</b>
<b>Average of Australian non-G8 universities</b>	<b>40.9%</b>	<b>40.4%</b>
<b>Average of all 500 universities</b>	<b>35.0%</b>	<b>37.8%</b>

Source: www.leidenranking.com

The MoRST National Bibliometric Reports detailed earlier also showed a relatively high rate of international collaboration in New Zealand tertiary institutions. In Figure 1 we compare the rates of inter-institutional and international collaboration at the New Zealand, Australian and United States universities in the 2013 Leiden rankings. The results illustrate that countries with more universities and greater opportunities for collaboration have higher rates of overall collaboration. Because they have fewer opportunities for domestic collaboration, New Zealand researchers have higher rates of international collaboration.

**Figure 1**  
Rates of inter-institutional and international collaboration at New Zealand, Australian and United States universities 2008-2011



Source: www.leidenranking.com

#### 4. Universitas 21 rankings<sup>8</sup>

Rates of international collaboration among university researchers are published at the country level in the Universitas 21 rankings. Universitas 21 used bibliometric data sourced from SCOPUS to calculate the proportion of university journal publications that have international co-authors.<sup>9</sup> The rates of international co-authorship are published for each country in the form of an index number, with the index number reflecting a country's rate of international collaboration as a percentage of the top-performing university system (which has an index number of 100). So far there have been two editions of the Universitas 21 rankings, which have calculated the relative rate of international collaboration for two periods – 2005-2009 and 2006-2010.

The results are presented in Table 4. They show that the relative rate of international collaboration has increased in New Zealand universities between the two periods of assessment. The rate of international collaboration was 78.1 percent of the top-ranked country in 2005-2009 and 79.7 percent of the top-ranked country in 2006-2010. When comparing the performance of New Zealand's universities with that of other countries, the rate of increase by New Zealand universities is in line with that exhibited by universities in the four other countries in Table 4.

**Table 4**

Universitas 21 index of international collaboration for selected countries (top-ranked country = 100)

Country	2005-2009	2006-2010
New Zealand	78.1	79.7
Australia	65.8	66.6
United States	45.9	46.4
United Kingdom	73.6	75.0
Canada	66.9	67.6

Source: [www.universitas21.com](http://www.universitas21.com)

### Our analysis of inter-institutional collaboration

Taken as a whole, the evidence in the previous section suggests that inter-institutional research collaboration has been increasing in the New Zealand tertiary education sector since the PBRF was introduced. However, the studies used different bibliometric databases and different approaches to analyse collaboration. In this section we present an analysis of collaboration at New Zealand universities using a standardised approach over time.

We used the Web of Science, a bibliometric database developed and managed by Thomson Reuters that contains the details of publications in over 10,000 journals, to gather data on co-authorship at six New Zealand universities. From this data, we measured rates of inter-institutional collaboration – how many times a journal article at a particular university has an author from another of these six New Zealand universities or one of the Crown Research Institutes (CRIs).

We measured the rates of collaboration prior to the PBRF (1999-2000) and in the years after it was introduced (2007-2008 and 2011-2012). The time periods selected allowed us to analyse collaboration before the introduction of the PBRF and at two periods after it was introduced.

<sup>8</sup> A network of 27 research-intensive universities. The University of Auckland is the sole New Zealand university member of the network.

<sup>9</sup> SCOPUS is a bibliometric database developed and maintained by the science information and publishing company Elsevier.

We restricted our analysis to six of the eight New Zealand universities: the University of Auckland, the University of Otago, Massey University, the University of Canterbury, the University of Waikato and Victoria University of Wellington. These universities collectively are responsible for the great majority of all indexed research publications in the New Zealand tertiary sector.

Figure 2 (a) shows the percentage of journal publications at each of the six universities that had a co-author from one of the other five New Zealand universities in this study. Figure 2 (b) shows the percentage of journal publications at each of the six universities that had a co-author from a CRI.

The overall message of Figure 2 (a) is that collaboration between researchers in the network of universities in New Zealand has risen. For example, the rate of inter-institutional collaboration of the University of Auckland with the five other New Zealand universities in this analysis increased from 6 percent in 1999-2000 to 8 percent in 2006-2007 and 14 percent in 2011-2012.

It is interesting to note the very large increase in inter-institutional collaboration by researchers at the University of Canterbury in 2011-2012 (from 5 percent in 1999-2000 to 10 percent in 2006-2007 and 20 percent in 2011-2012). This large increase may be associated with the Canterbury earthquakes, which damaged many facilities at the University of Canterbury and resulted in the temporary relocation of a number of staff and research students to other research institutions around New Zealand.

Although the rate of collaboration increased between universities, on average there has been little change in collaboration with CRIs at three of the universities and decreases at the remaining three. The absolute level of collaboration with CRIs has increased, with authors at the six universities in this study co-authoring 524 indexed papers with CRI scientists in 1999-2000, 752 papers in 2006-2007 and 843 in 2011-2012. However, the *proportion* of university papers with a CRI author has fallen slightly.

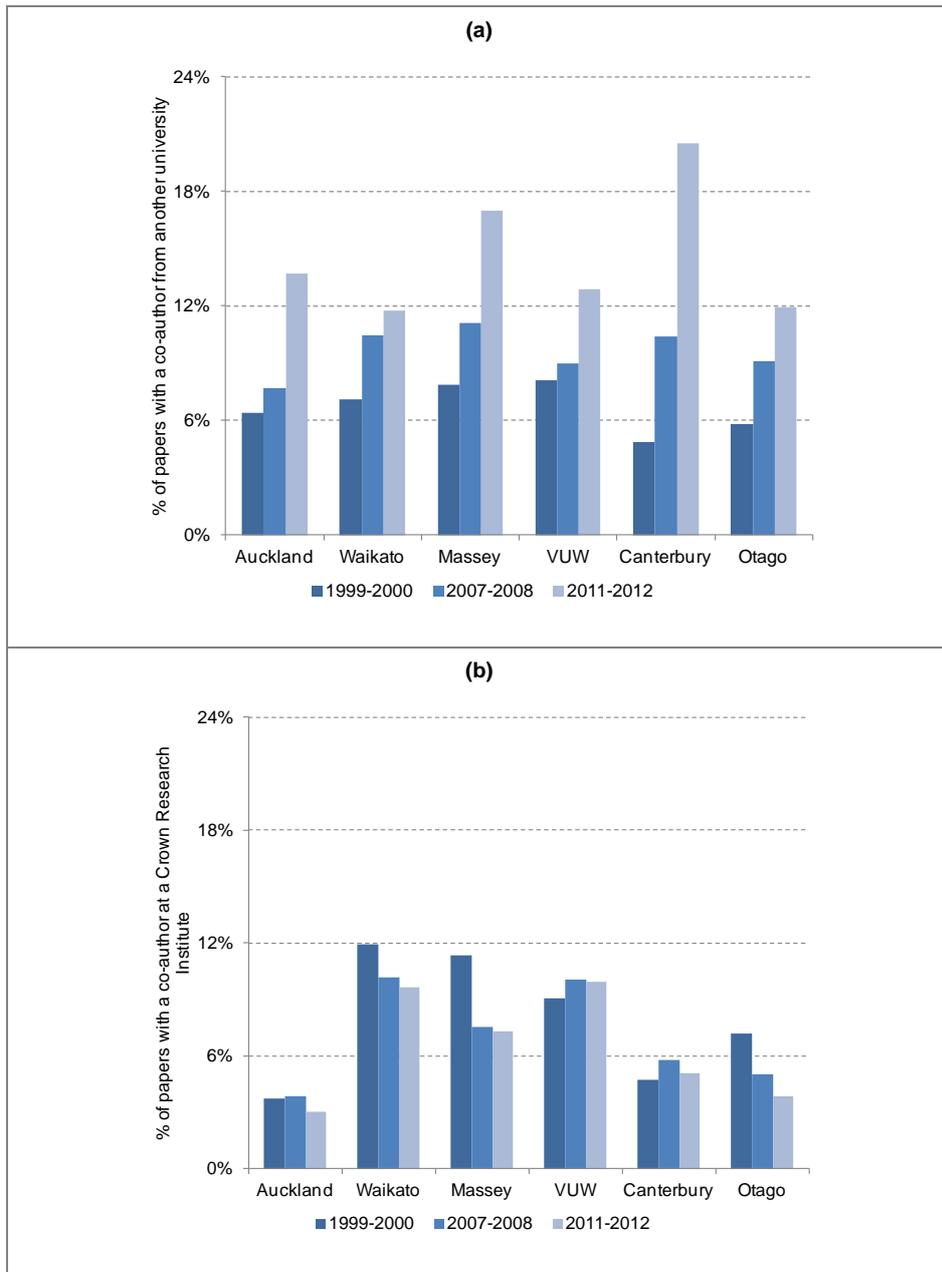
One explanation for this divergence may be the trends in journal publication in the two sectors. Over the last four or five years, the CRIs have been directed by the Government to form closer links with industry. This is likely to have shifted the CRIs' focus away from journal publications to an extent and away from collaboration with university authors. Thomson Reuters data shows that the university share of world indexed publications has risen since the PBRF was introduced, while CRI publications as a percentage of world publications have decreased.<sup>10</sup> In effect, indexed publications generated in the universities have risen faster than overall international growth, while the number of publications in the CRIs has not kept pace with the overall international growth.<sup>11</sup> So there has been increased opportunity for university researchers to collaborate with other university authors, but reduced opportunity to work with CRI authors.

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<sup>10</sup> The share of world indexed publications by universities in 1999-2000 was 0.39 percent, compared with 0.48 percent in 2010-2011. The share of world indexed publications by CRIs in 1999-2000 was 0.13 percent, compared with 0.10 percent in 2010-2011 (Source: Thomson Reuters).

<sup>11</sup> This should not be interpreted as a decline in performance by the CRIs. Although their share of world indexed publications fell, the actual number of indexed publications produced by CRI researchers increased.

**Figure 2**  
Rates of collaboration between universities and CRIs



Note: The rate of collaboration in Figure 2 (a) refers to the rate of institutional collaboration between these six universities.

Source: Web of Science

## Discussion

The evidence presented in this paper shows that inter-institutional collaboration by researchers in the New Zealand tertiary education sector has increased over the period the PBRF has been in operation. So although we cannot know what tertiary education sector research collaboration would have been like had the PBRF not been introduced, inter-institutional collaboration has continued to grow in New Zealand.

Where we can benchmark the collaboration data, either with other sectors in New Zealand or internationally, it suggests that the increase in collaboration is in line with that being exhibited

in research institutions around the world. This suggests that the PBRF may not have enhanced collaboration especially, but nor has it stifled collaboration.

Several caveats apply to these findings. Our analysis used Thomson Reuters data, which means that the sciences, medicine and engineering are overrepresented in the sample. As a result, although inter-institutional collaboration has increased in these subject disciplines, we can be less sure that collaboration has increased in the social sciences and humanities. Also we haven't looked at intra-university collaboration, so we cannot say what has happened to collaboration between researchers at the same institution.

In addition, because we used Thomson Reuters' Web of Science, we have focused on relatively high-impact publications that appear in internationally recognised journals. Much New Zealand university research doesn't appear in those journals and so isn't captured in the analysis. In effect, we have used the indexed journal output as a proxy for research collaboration as a whole.

Finally, the CoRE fund was established at around the same time as the PBRF. Given that one of the explicit aims of the fund was to increase collaboration, the CoREs fund is likely to have contributed to the observed increase in collaboration.

## Appendix

**Table 5**

Proportion of inter-institutional collaborative publications by field 2008-2011

University	All fields	Biomedical and health sciences	Life and earth sciences	Mathematics and computer science	Natural sciences and engineering	Social sciences and humanities
University of Auckland	66.2%	68.9%	77.1%	64.8%	66.1%	48.2%
University of Otago	66.0%	68.4%	70.4%	76.3%	68.5%	47.6%
Massey University	68.3%	74.1%	71.4%	59.4%	77.0%	49.9%
<b>Average of G8 universities</b>	<b>74.9%</b>	<b>80.1%</b>	<b>78.8%</b>	<b>70.1%</b>	<b>72.9%</b>	<b>54.6%</b>
<b>Average of Non-G8 universities</b>	<b>71.1%</b>	<b>79.7%</b>	<b>77.2%</b>	<b>67.5%</b>	<b>72.1%</b>	<b>48.8%</b>
<b>Average of all 500 universities</b>	<b>71.5%</b>	<b>74.9%</b>	<b>76.9%</b>	<b>68.1%</b>	<b>72.5%</b>	<b>59.7%</b>

Source: [www.leidenranking.com](http://www.leidenranking.com)

**Table 6**

Proportion of international collaborative publications by field 2008-2011

University	All fields	Biomedical and health sciences	Life and earth sciences	Mathematics and computer science	Natural sciences and engineering	Social sciences and humanities
University of Auckland	51.7%	51.2%	56.2%	60.5%	58.6%	37.0%
University of Otago	50.6%	50.9%	53.4%	66.3%	59.6%	37.8%
Massey University	49.3%	55.0%	47.1%	52.3%	61.7%	36.7%
<b>Average of G8 universities</b>	<b>44.7%</b>	<b>40.8%</b>	<b>48.2%</b>	<b>54.2%</b>	<b>56.2%</b>	<b>30.6%</b>
<b>Average of Non-G8 universities</b>	<b>40.4%</b>	<b>38.6%</b>	<b>46.8%</b>	<b>49.5%</b>	<b>51.6%</b>	<b>24.7%</b>
<b>Average of all 500 universities</b>	<b>37.8%</b>	<b>35.2%</b>	<b>41.9%</b>	<b>39.1%</b>	<b>45.3%</b>	<b>28.2%</b>

Source: [www.leidenranking.com](http://www.leidenranking.com)

**Table 7**

Rate of collaboration of selected New Zealand universities with other New Zealand universities

University	1999-2000	2007-2008	2011-2012
University of Auckland	6%	8%	14%
University of Waikato	7%	10%	12%
Massey University	8%	11%	17%
Victoria University of Wellington	8%	9%	13%
University of Canterbury	5%	10%	20%
University of Otago	6%	9%	12%

Note: The rate of collaboration refers to the rate of institutional collaboration between these six universities.

Source: Web of Science

**Table 8**

Rate of collaboration of selected New Zealand universities with CRIs

University	1999-2000	2007-2008	2011-2012
University of Auckland	4%	4%	3%
University of Waikato	12%	10%	10%
Massey University	11%	8%	7%
Victoria University of Wellington	9%	10%	10%
University of Canterbury	5%	6%	5%
University of Otago	7%	5%	4%

Source: Web of Science

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