



**FOOT AND ANKLE**



## Chapter 12: Research in the tertiary education sector

The research performance of the tertiary education sector improved in several areas in 2007. In the area of research training, enrolments in doctoral degrees increased substantially. This was driven by a significant increase in international enrolments, which occurred in response to a change in government policy to fund international doctoral students on the same basis as domestic students.

In the area of research output, the universities showed improvement in a number of areas. Overall, the amount of research contract income earned by the universities per academic staff member rose in real terms between 2005 and 2006. Total research output dropped slightly at two out of the three universities that reported research output in 2007. The academic impact of research by the New Zealand universities relative to the world average increased between 1998-2002 and 2003-2007 in eight out of the 10 broad subject areas monitored. Three of those 10 subject areas – health, medicine and public health; mathematics; and information sciences and technology – had an academic impact above the world average in 2003-2007.

Included later in this chapter is a study that compares the New Zealand universities' pattern of research performance across four dimensions. The article also examines the performance of selected Australian universities across similar performance measures and makes comparisons between the two countries funding in a few research-intensive universities.

### 2008 year

The Ministry of Education released a report – *Trends in measured research quality* – that contained an analysis of the change in research quality of around 2,000 staff who participated in both the 2003 and 2006 Performance-Based Research Fund quality evaluations. The report findings indicate that although all three research component scores increased, on average, for the participating staff, the scores for peer esteem and the contribution to the research environment increased much faster than the average research output score. The study also found that the prior performance of these staff in the 2003 Quality Evaluation was a key factor associated with the improvement in their measured research quality, controlling for other factors. Staff with lower measured research quality in the 2003 Quality Evaluation were more likely to improve their research quality in the 2006 Quality Evaluation.

The University Commercialisation Office of New Zealand released statistics on the performance of New Zealand universities in the commercialisation of research findings. The figures show that:

- the university commercialisation offices applied for 303 new patents and received 97 patents and 156 licences between 2003 and 2006
- the country's eight universities earned more than NZ\$60 million in cash and shares from the licensing of their academics' research in the four years up to and including 2006, and
- New Zealand universities raised more than \$155 million for start-up companies between 2003 and 2006, forming 29 new start-ups. The value of those companies rose from \$76 million in 2003 to \$1.1 billion by the end of 2006.

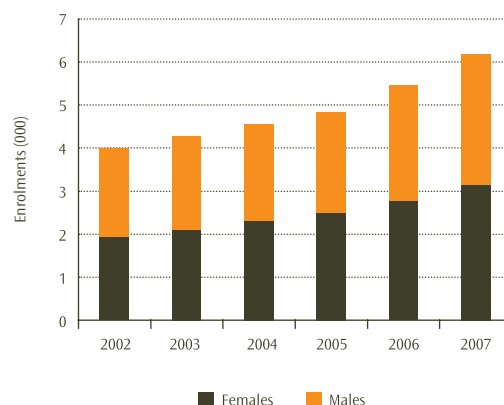
## DOCTORAL ENROLMENTS

The number of doctoral enrolments continued to rise in 2007. Women represented 51 percent of doctoral enrolments.

### Doctoral enrolments in 2007:

Total	6,173	(up 13% on 2006)
Females	3,144	(up 13% on 2006)
Males	3,029	(up 13% on 2006)

Figure 12.1: Doctoral enrolments by gender



## DOCTORAL ENROLMENTS BY SELECTED GROUPS

There was significant growth in the number of international and Māori students enrolled in doctorates in 2007. The increase in international students is partly a result of a change to the funding regime for new international doctoral students in 2006.

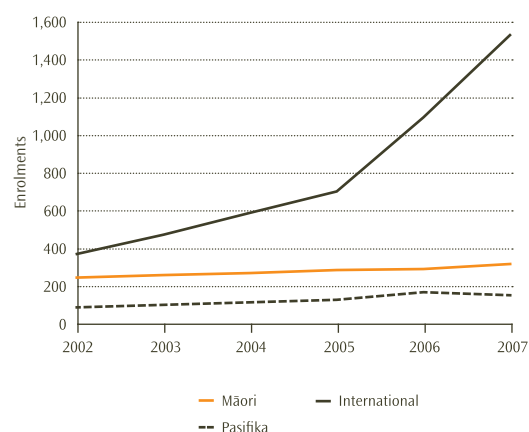
### Doctoral enrolments by selected groups in 2007:

Māori	311	(up 10% on 2006)
Pasifika	145	(down 9.9% on 2006)
International	1,523	(up 40% on 2006)

#### Notes:

- Each student is shown in each ethnic group he/she identifies with.
- Pasifika enrolments include domestic and international students.

Figure 12.2: Doctoral enrolments by selected groups



## DOCTORAL COMPLETIONS

The number of doctoral completions fell slightly in 2006, mainly as a result of a fall in the number of men completing doctorates. The fall in the number of men completing doctorates reflects a fall in men starting doctorates in 2000 and 2001.

### Doctoral completions in 2006:

Total	639	(down 1.1% on 2005)
Females	319	(up 0.6% on 2005)
Males	320	(down 2.7% in 2005)

Note: Due to a change in the Ministry's data collection the completion rates to 2007 are not yet available.

Figure 12.3: Doctoral completions by gender



### DOCTORAL COMPLETIONS BY SELECTED GROUPS

The number of doctoral completions by Māori and Pasifika increased in 2006, while the number of completions by international students remained steady.

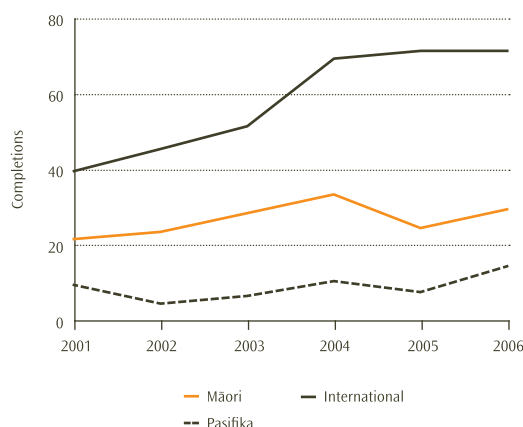
#### Doctoral completions by selected groups in 2006:

Māori	29	(up 21% on 2005)
Pasifika	14	(up 100% on 2005)
International	71	(no change on 2005)

#### Notes:

1. Due to a change in the Ministry's data collection the completion rates to 2007 are not yet available.
2. Each student is shown in each ethnic group he/she identifies with.
3. Pasifika enrolments include domestic and international students.

Figure 12.4: Doctoral completions by selected groups



### DOCTORAL COMPLETIONS BY FIELD OF STUDY

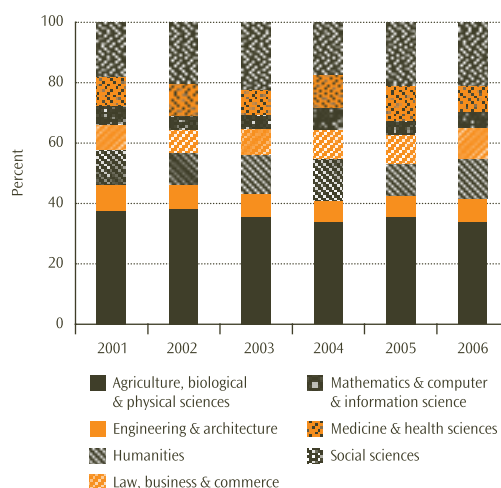
The largest proportion of students completing doctorates in 2006 studied in the areas of the social sciences and biology/biological sciences.

#### The proportions of doctoral completions by subject area in 2006:

Agriculture, food, forestry and environment	3.9%	(3.8% in 2005)
Biology/biological science	21%	(17% in 2005)
Engineering and architecture	7.7%	(7.3% in 2005)
Humanities	13%	(11% in 2005)
Law, business and commerce	10%	(9.6% in 2005)
Mathematics and computer and information science	5.4%	(4.5% in 2005)
Medicine and health sciences	9.0%	(12% in 2005)
Physical sciences	9.6%	(15% in 2005)
Social sciences	21%	(21% in 2005)

Note: Due to a change in the Ministry's data collection the completion rates to 2007 are not yet available.

Figure 12.5: Doctoral completions by field of study



### DOCTORAL STUDENTS PER ACADEMIC STAFF MEMBER

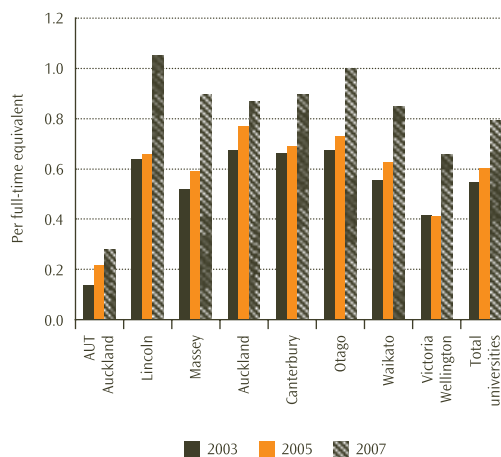
The ratio of doctoral enrolments per academic staff member rose substantially across all universities in 2007. This increase was mainly a result of the rise in international enrolments.

#### The ratios of doctoral enrolments to academic staff in 2007:

All universities	0.79	(up 14% on 2006)
Auckland University of Technology	0.28	(up 13% on 2006)
Lincoln University	1.05	(up 24% on 2006)
Massey University	0.90	(up 28% on 2006)
University of Auckland	0.87	(up 6.1% on 2006)
University of Canterbury	0.89	(up 9.9% on 2006)
University of Otago	1.00	(up 20% on 2006)
University of Waikato	0.85	(up 9.3% on 2006)
Victoria University of Wellington	0.66	(up 14% on 2006)

Note: Data for colleges of education has been merged with the universities.

Figure 12.6: Ratio of doctoral enrolments to academic staff



### COMPLETIONS PER ACADEMIC STAFF MEMBER

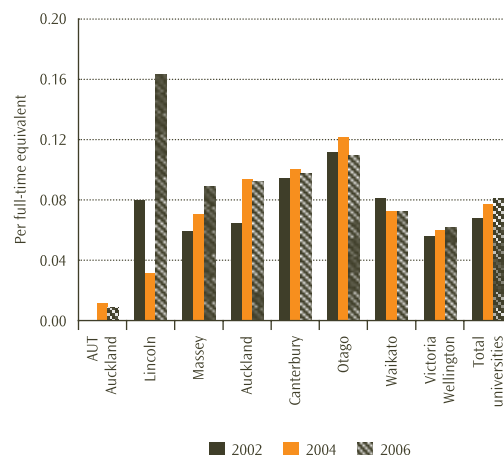
While the ratio of doctoral completions per academic staff member rose slightly overall for the universities in 2006, three universities exhibited a fall in the number of doctoral completions per academic staff member.

#### The ratio of doctoral completions to academic staff in 2006:

All universities	0.08	(up 0.8% on 2005)
Auckland University of Technology	0.01	(down 32% on 2005)
Lincoln University	0.16	(up 41% on 2005)
Massey University	0.09	(up 2.4% on 2005)
University of Auckland	0.09	(down 14% on 2005)
University of Canterbury	0.10	(down 4.0% on 2005)
University of Otago	0.11	(up 2.4% on 2005)
University of Waikato	0.07	(up 65% on 2005)
Victoria University of Wellington	0.06	(up 8.1% on 2005)

Note: Data for colleges of education has been merged with the universities.

Figure 12.7: Ratio of doctoral completions to academic staff



### UNIVERSITY RESEARCH OUTPUT

The Auckland University of Technology reported an increase in research output in 2007, while research output fell at the University of Otago and Victoria University of Wellington.

#### The number of research outputs reported for 2007:

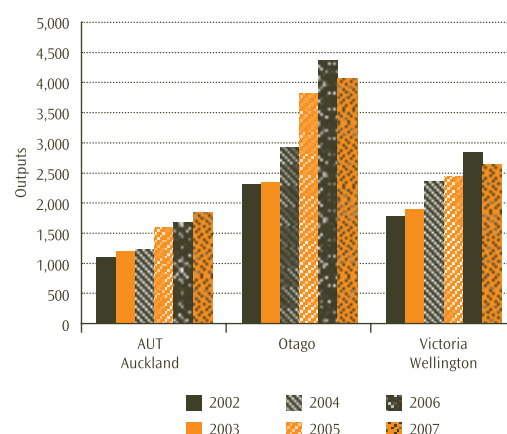
Auckland University of Technology	1,841	(up 9.7% on 2006)
University of Otago	4,078	(down 4.7% on 2006)
Victoria University of Wellington	2,640	(down 7.1% on 2006)

#### Notes:

1. Data for colleges of education has been merged with the universities.
2. Care should be used when comparing the research output of the universities due to differences in the way they count research outputs.
3. The counts of research outputs for 2007 are preliminary in some cases.
4. Not all universities are included in this table as they either do not report research output counts or do not do so in a manner that allows for trend analysis.

Source: Annual reports of the universities.

Figure 12.8: Reported research outputs of selected universities



### UNIVERSITY RESEARCH PRODUCTIVITY

The number of research outputs per academic staff member increased at the Auckland University of Technology and the University of Otago. The number of research outputs per academic staff member fell at Victoria University of Wellington.

#### Ratio of reported research outputs per academic staff member for 2007:

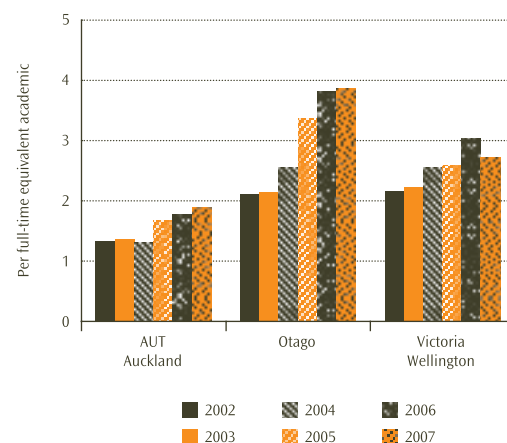
Auckland University of Technology	1.9	(up 5.9% on 2006)
University of Otago	3.9	(up 1.5% on 2006)
Victoria University of Wellington	2.7	(down 10% on 2006)

#### Notes:

1. Data for colleges of education has been merged with the universities.
2. Care should be used when comparing the research output of the universities due to differences in the way they count research outputs.
3. The counts of research outputs for 2007 are preliminary in some cases.
4. Not all universities are included in this table as they either do not report research output counts or do not do so in a manner that allows for trend analysis.

Source: Annual reports of the universities.

Figure 12.9: Reported research outputs of selected universities per academic



### SHARE OF WORLD INDEXED PUBLICATIONS AND CITATIONS

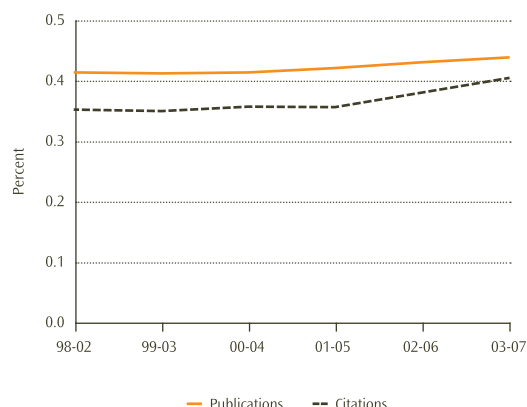
The share of world publications and citations by research from New Zealand tertiary education institutions has continued to increase. In the five-year period between 2003 and 2007, New Zealand's tertiary education institutions produced 0.44 percent of the world indexed publications and 0.40 percent of the citations. This compared to 0.41 percent and 0.35 percent in the five-year period between 1998 and 2002, respectively.

#### Share of world indexed publications and citations by tertiary education institutions 2003-2007:

Publications	0.44%	(0.41% in 1998-2002)
Citations	0.40%	(0.35% in 1998-2002)

Source: Thomson Reuters.

Figure 12.10: Share of world indexed publications and citations by tertiary education institutions



### ACADEMIC IMPACT OF RESEARCH

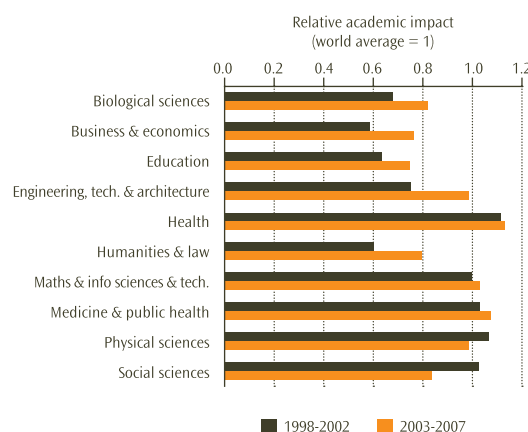
The relative academic impact of research in tertiary education institutions increased in 8 out of the 10 broad subject areas for the period 2003-2007. Research in the area of health had the greatest relative academic impact.

#### The relative academic impact of research in tertiary education institutions for the period 2003-2007:

Biological sciences	0.82	(0.68 in 1998-2002)
Business & economics	0.76	(0.59 in 1998-2002)
Education	0.75	(0.64 in 1998-2002)
Engineering, technology & architecture	0.98	(0.75 in 1998-2002)
Health	1.13	(1.11 in 1998-2002)
Humanities & law	0.80	(0.60 in 1998-2002)
Mathematical & information science & technology	1.03	(1.00 in 1998-2002)
Medicine & public health	1.08	(1.03 in 1998-2002)
Physical sciences	0.98	(1.07 in 1998-2002)
Social science & other cultural/social sciences	0.84	(1.03 in 1998-2002)

Source: Thomson Reuters.

Figure 12.11: Academic impact of research in tertiary education institutions



### UNIVERSITY RESEARCH CONTRACT INCOME

The inflation-adjusted amount of external research income per academic staff member continued to rise in the university sector in 2006. The largest increase was at the Auckland University of Technology, although this was off a low base, and the largest decrease was at Lincoln University.

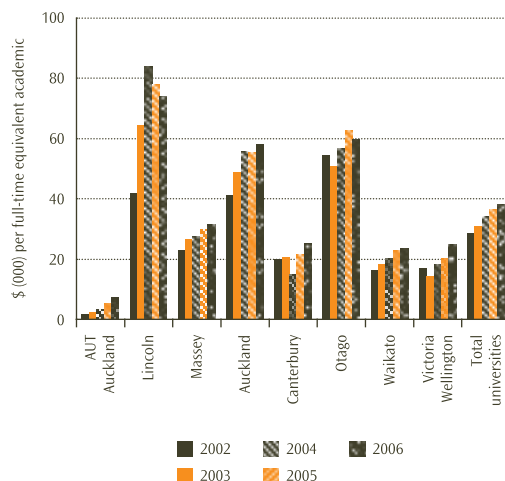
#### Inflation-adjusted external research contract income for 2006:

	\$ (000) per academic	
All universities	38.4	(up 5.0% on 2005)
Auckland University of Technology	7.3	(up 41% on 2005)
Lincoln University	73.8	(down 5.2% on 2005)
Massey University	31.3	(up 4.5% on 2005)
University of Auckland	58.2	(up 4.7% on 2005)
University of Canterbury	25.1	(up 17% on 2005)
University of Otago	59.8	(down 4.6% on 2005)
University of Waikato	23.5	(up 2.8% on 2005)
Victoria University of Wellington	24.8	(up 23% on 2005)

Notes: 1. The Performance-Based Research Fund definition of external research income has been used to calculate this ratio. 2. Data for colleges of education has been merged with the universities. 3. Academic staff were calculated on a full-time equivalent basis. 4. The Consumers Price Index has been used to deflate the external research income data into 2006 dollars. 5. External research income data for 2007 is not yet available.

Source: Tertiary Education Commission and Statistics New Zealand.

Figure 12.12: Inflation-adjusted external research income (PBRF) per academic



## Identifying patterns of research performance in New Zealand's universities

Under the Performance-Based Research Fund (PBRF), the research performance of New Zealand's tertiary education organisations is measured on a variety of dimensions. Funding allocations are made on the basis of those performance measures. This article uses this data to compare the research performance of New Zealand universities<sup>1</sup> and to group them into categories, based on similarities in the pattern of performance across four dimensions.

A similar analysis is then applied to selected Australian universities to see if the patterns shown by the New Zealand universities are mirrored in other higher education systems. The degree of variation in the performance of Australian universities is also compared with that of the New Zealand universities.

### Measures of New Zealand university performance

This analysis uses performance data for 2006 across the following four dimensions:

1. research quality
2. external research income
3. research degree completions, and
4. teaching load.

Research quality is based on the average PBRF quality score achieved by each university in the 2006 PBRF Quality Evaluation. This measure shows the average level of peer-assessed quality per PBRF-eligible staff member. A participating staff member could be assigned a score between 0 and 10, with the latter representing the highest level of performance.

External research income (ERI) is the amount of external research income earned by the universities per PBRF-eligible full-time equivalent staff member. This measure gives an idea of the success of the university in winning funding both from the contestable government research funds and from business and community groups.

Research degree completions (RDC) are based on the number of research degree completions per PBRF-eligible full-time equivalent staff member. To reflect differences in the scale of research, doctorates have been assigned a weighting of 3 and masters completions a weighting of 1. This measure gives a sense of the contribution made by each university to the country's research training effort.

Teaching load measures the number of equivalent full-time students at degree level or higher per PBRF-eligible staff member. This measure gives an idea of the higher education teaching load borne by each university. This can provide evidence of the intensity of research, as universities that concentrate on undergraduate teaching rather than postgraduate teaching and supervision will tend to have a higher teaching load.

The following section discusses how each of the universities performed most recently in these measures.

### New Zealand university performance

The performance of the New Zealand universities across the four research dimensions is shown in Table 12.1.

The top performing university in measured research quality was the University of Otago, which had an average quality score of 4.01. The second highest performing university was the University of Auckland, which had an average quality score of 3.85.

The average quality score achieved by the University of Otago was 2.1 times that of the Auckland University of Technology, which was the lowest performing university. The University of Otago also scored 1.4 times higher than Lincoln University, which had the second lowest average quality score. Of the four measures of performance used here, the variation among universities was lowest for the research quality measure.

Lincoln University attracted the highest amount of external research income per full-time equivalent PBRF-eligible staff member (\$76,000). It was followed by the University of Auckland (\$69,460) and the University of Otago (\$55,400).

The performance of Lincoln University was 4.2 times higher than that of the Auckland University of Technology, the lowest performing university in the external research income measure. Lincoln University's performance in external research income was 2.7 times higher than that of the University of Canterbury, which had the second lowest external research income score. The external research income performance measure exhibited the largest variation among the universities.

The University of Auckland had the highest volume of research degree completions per full-time equivalent PBRF-eligible staff member (0.72), followed by the University of Waikato (0.66) and Massey University (0.57). The performance of the University of Auckland was 2.8 times higher than that of Lincoln University, the lowest performing university, and 2.2 times greater than that of Victoria University of Wellington, the second lowest performing university in the research degree completions measure.

1. Note that, in this analysis, measures of the research performance of the former colleges of education have been merged with the measures for each respective university.

In terms of teaching load, the Auckland University of Technology clearly had the largest number of enrolments at bachelors level or higher per full-time equivalent PBRF-eligible staff member (26.6). It was followed by Victoria University of Wellington (19.9) and the University of Canterbury (18.6). The performance of the Auckland University of Technology in terms of teaching load was 2.1 times greater than that of Lincoln University, the lowest performing university in this measure, and 1.8 times greater than that of the University of Otago, which had the second lowest average teaching load at bachelors level and higher.

**Table 12.1: New Zealand university performance per PBRF-eligible full-time equivalent staff member**

	PBRF quality score	ERI	RDC	Teaching load
Auckland University of Technology	1.86	\$18,134	0.34	26.6
Lincoln University	2.96	\$76,026	0.26	13.0
Massey University	3.06	\$34,178	0.57	17.2
University of Auckland	3.85	\$69,460	0.72	17.3
University of Canterbury	3.52	\$27,667	0.48	18.6
University of Otago	4.01	\$55,392	0.53	14.8
University of Waikato	3.73	\$30,269	0.66	18.5
Victoria University of Wellington	3.42	\$29,219	0.33	19.9
University average	3.50	\$45,649	0.54	17.8

*Source:* Ministry of Education and Tertiary Education Commission.

*Note:* This table treats the colleges of education as being merged with the universities.

Overall, the variation in research performance among the majority of New Zealand universities would appear relatively moderate in terms of quality and research degree completions. More variation was evident in the amount of external research income attracted and in the student to staff ratio.

## Patterns of performance

The four measures of performance can be used to categorise the universities based on the similarities in their pattern of research performance. Figure 12.14 presents the performance of the universities compared with the average university performance for that measure. Although the graphs in Figure 12.14 do not have a scale, the university average has been set at a value of 1 for all four measures. For example, the University of Auckland achieved a PBRF average quality score that was 1.1 times the average for the university sub-sector (the University of Auckland research score divided by the all universities average research score =  $3.85/3.50 = 1.1$ ).

From the graphs of the universities in Figure 12.14, four categories of universities can be identified. These are: older universities with a medical school, older universities without a medical school, specialist universities and new universities. The universities that fit within each of these categories and their distinguishing characteristics are discussed in the next section.

### Older university with medical school

University of Auckland and University of Otago. The pattern exhibited by universities in this category is above average performance in the three research measures and a lower than average teaching load. The lower teaching load reflects the relatively high proportion of postgraduate to bachelors-level students at these universities and indicates their strong emphasis on research.

The presence of medical schools means that these universities have greater access to a substantial amount of Health Research Council funding, a factor contributing to their above average external research income performance.

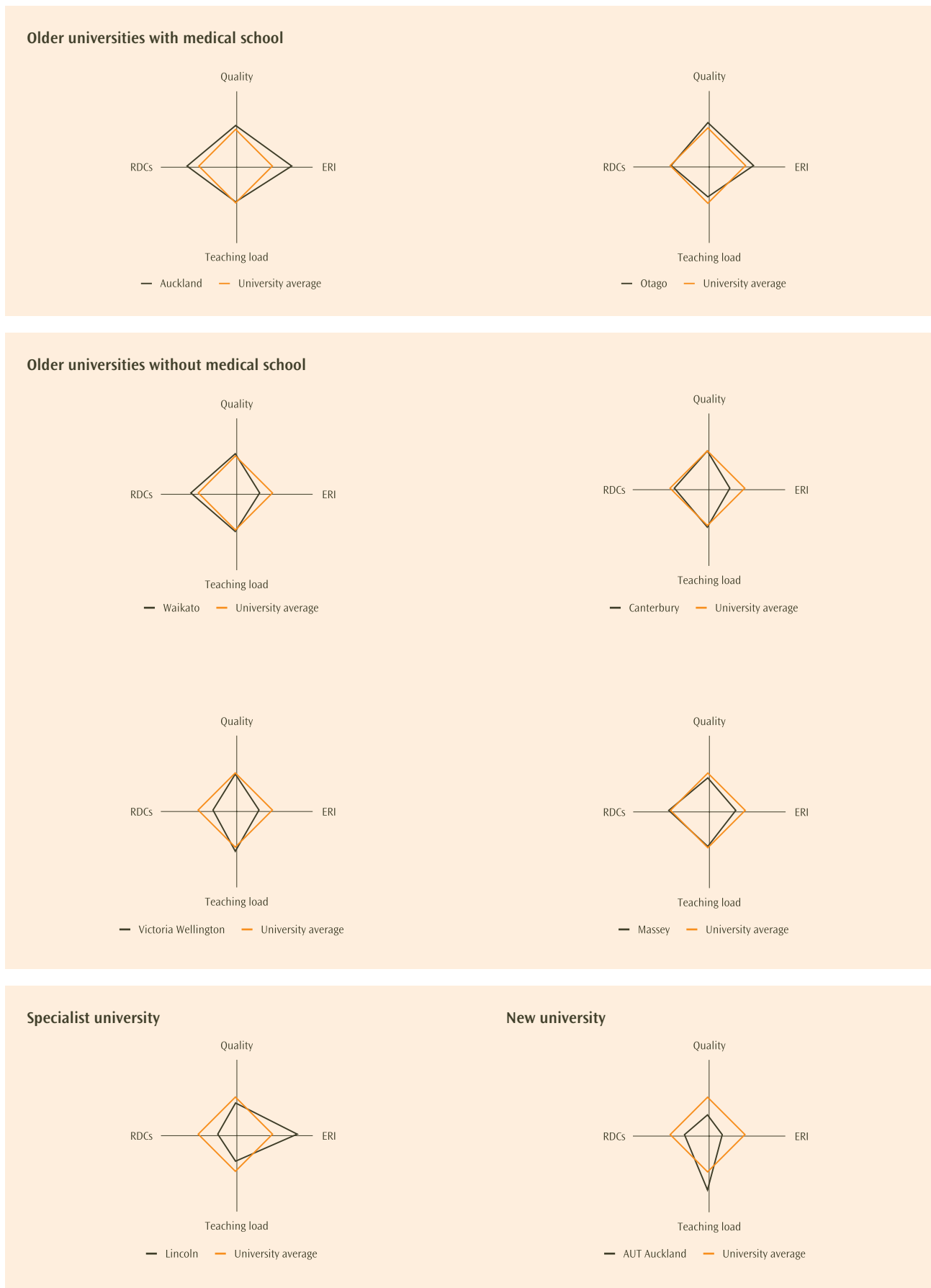
Also, both of these universities have been offering degrees for over 100 years, meaning they have a well-developed research capability.

### Older university without medical school

University of Waikato, Victoria University of Wellington, University of Canterbury and Massey University. The pattern exhibited by the universities in this category is one of around average performance in the research degree completions and research quality measures and below average performance in the external research income measure. The one slight exception is Victoria University of Wellington, which had a lower research degree completion score than average.

The universities in this category have all been offering degrees for at least 40 years, although in the case of Canterbury and Victoria there have been degrees offered for more than 100 years. Therefore these universities generally have a well-developed level of research capability.

Figure 12.13: Performance of New Zealand universities



### Specialist university

Lincoln University. This university exhibits a unique shape to its research performance graph, due to its above average external research income performance and lower than average research degree completions and research quality performance scores. The strong external research income performance is partly related to the specialised nature of Lincoln University – in its research, it focuses on the agricultural sciences subject area, one that attracts a considerable amount of research funding in New Zealand. It is by far the smallest of the universities and has a lower number of bachelors-level or higher enrolments per full-time equivalent PBRF-eligible staff, although this is partly influenced by its specialisation in subjects related to the land-based industries.

### New university

Auckland University of Technology. This university is a newly created university, having been granted university status in 2000. Before then, it was a polytechnic and only began offering degree programmes in 1991. As a result, its research capability is much lower than that of the other universities and this is reflected in the lower level of performance across the dimensions of research quality, research degree completions and external research income. However, it has a much higher teaching load for its staff, a reflection of a relatively small proportion of postgraduate to bachelors-level enrolments, and its focus, at this stage, on bachelors-degree teaching.

## The Australian university system

In the Australian higher education system there are 37 public universities and two private universities. Of the public universities, there is a group of eight research-intensive universities (known as the G8). Mostly, these universities are older and based in metropolitan areas.

There is also a range of public universities established in the 1960s and 1970s many of which belong to a group called Innovation Research Universities Australia (IRU Australia). Twelve universities fit within this category.

A further set of public universities was created in the late 1980s to early 1990s, mainly from mergers of colleges of advanced education and institutes of technology. These institutions are commonly referred to as 'Dawkins' institutions.<sup>2</sup> Sixteen universities fit into this category.

There is also a newer 'green fields' university, the University of the Sunshine Coast, established in 1996 in response to demographic change.

A selection of universities from each of these groupings is used in this analysis to identify patterns in the Australian university research performance.

## Measures of Australian university performance

The four measures used to assess the research performance of Australian universities are broadly similar to those used to group the New Zealand universities. One key difference is that there is no equivalent measure of peer-assessed research quality. Therefore, a measure representing research productivity is substituted in this Australian analysis.

Note that the number of research only and teaching and research full-time equivalent staff is used as the denominator in the performance measures below.

### 1. Quantity

The number of research publications per full-time equivalent staff member. This indicator gives a measure of the research productivity of each university.

### 2. External research income

External research income is the amount of external research income per full-time equivalent staff member. This gives an idea of the success of the university in winning funding both from the research funding council and from business and community groups.

### 3. Research degree completions

Research degree completions are based on the number of research degree completions per full-time equivalent staff member. This measure gives a sense of the contribution made by each university to the research training effort. Note that this data refers to 2005.

### 4. Teaching load

The equivalent full-time student load at bachelors level and above per full-time equivalent staff member. This measure gives an idea of the higher education teaching load borne by each university.

The performance of six selected universities in each of these measures is presented in Table 12.2. Note that the university average presented in this table refers to the average performance of all 37 public universities.

2. Named after the Minister who introduced these changes.

Table 12.2: Selected Australian university performance per full-time equivalent staff member

	University type	Quantity	ERI (AU\$)	RDC	Teaching load
University of Melbourne	G8	1.32	\$97,001	0.62	11.5
University of Western Australia	G8	1.22	\$97,419	0.63	10.2
Flinders University	IRU	1.26	\$50,250	0.40	14.4
Macquarie University	IRU	1.63	\$35,358	0.43	22.8
Central Queensland University	Dawkins	0.93	\$15,223	0.20	43.1
University of the Sunshine Coast	Green fields	0.99	\$8,461	0.19	27.6
Australian public university average		1.23	\$58,909	0.46	17.5

Source: Department of Education, Employment and Workplace Relations and Universities Australia.

Figure 12.15 presents the performance of the selected universities in the four measures, compared with the average for all 37 public universities. The selected Australian universities also show a number of patterns similar to those in the New Zealand universities.

The two G8 universities, the Universities of Melbourne and Western Australia, display a pattern of performance similar to that of the Universities of Auckland and Otago. Both these Australian universities perform above the Australian university average in the three research measures and have a lower teaching load than average. The presence of a medical school at these institutions boosts their external research income performance and the lower teaching load reflects a higher proportion of postgraduate students compared with bachelors-level students.

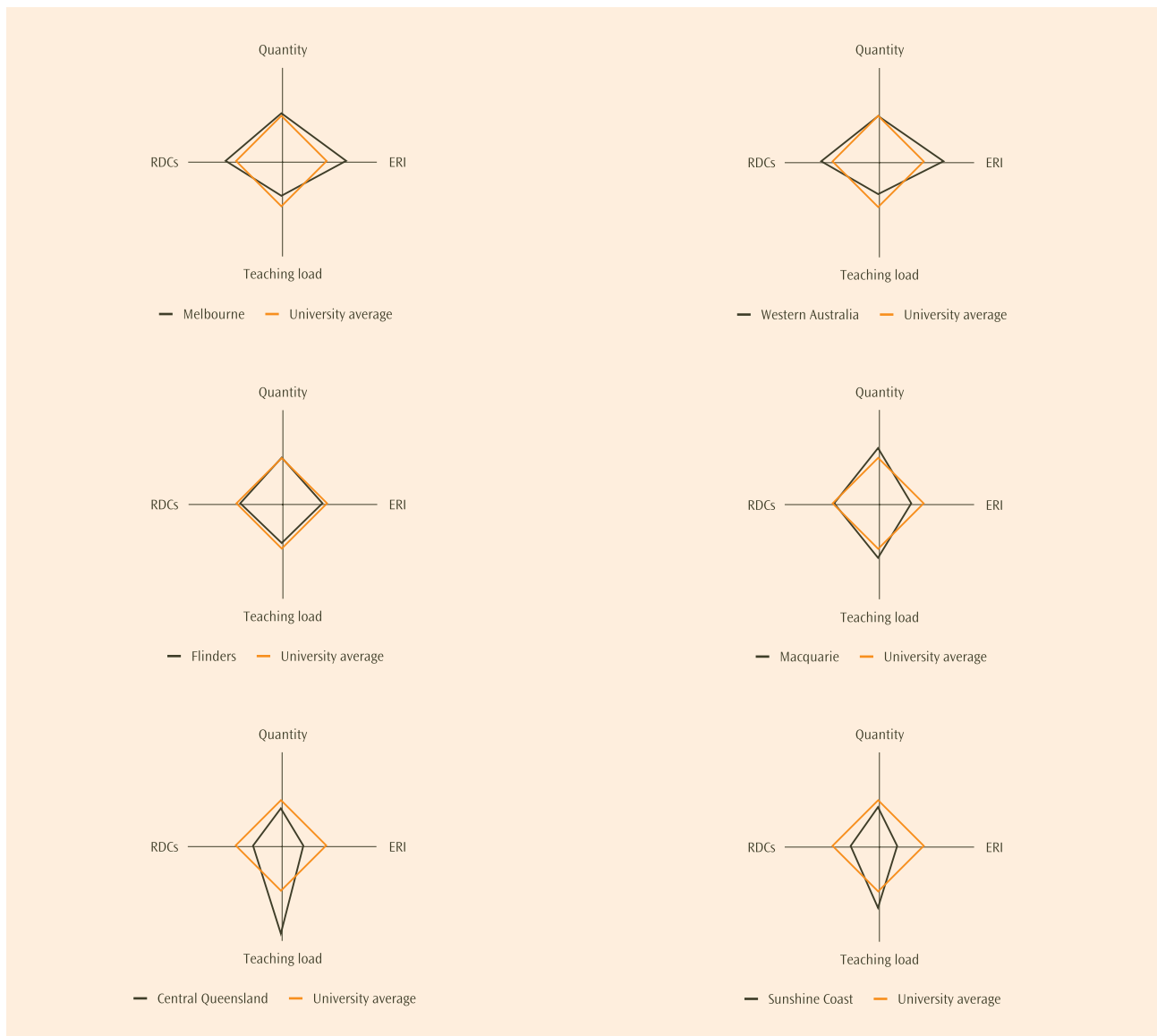
Flinders University is an older university but is a non-G8 institution. It performs at just below the university average across all four measures, with its external research income being boosted by the presence of a medical school. It doesn't fit easily into any of the four New Zealand categories, although it is probably closest in pattern of performance to the four older New Zealand universities without a medical school.

Macquarie University is also an older university but does not contain a medical school and displays the asymmetrical shape of the four New Zealand universities without a medical school. Macquarie's lower external research income performance is the cause of the asymmetry in research performance in Figure 12.14.

Of the newer universities, both Central Queensland University and the University of the Sunshine Coast display a pattern of performance similar to that of the Auckland University of Technology. The higher than average teaching load per full-time equivalent staff member reflects the greater concentration on teaching at the bachelors level. They also perform below average in the three research measures of performance. If the Australian measures included one of research quality instead of quantity, the pattern of research performance of these two Australian universities would likely be even closer to that of the Auckland University of Technology.

Given the number of newer universities in the Australian system and the more hierarchical nature of the system, there is clearly more variation in research performance exhibited than in the New Zealand university system.

Figure 12.14: Performance of selected Australian universities



## Conclusion

The patterns of research performance identified in this study offer a snapshot of the variation in performance of New Zealand universities in 2006. The variation in performance that exists among the majority of universities in New Zealand is relatively moderate and, overall, it is much less than that found in the more highly differentiated Australian university system.

However, the variation in performance and the associated groupings of the universities as they currently exist may change, depending on future developments. For example, the Auckland University of Technology has been rapidly improving its research performance since becoming a university in 2000, albeit off a lower base than the other universities. In addition, the government has also committed extra funding to help develop the Auckland University of Technology's research capability. This may result in its research performance 'catching up' to that of some of the older universities over time.

Another interesting development is the strategic decision of the University of Auckland to increase the proportion of students it enrolls at the postgraduate level and raise its research performance. How successful it is at achieving this goal, as well as how many other universities choose to embark on a similar strategy, may also impact on the relative research performance of the universities in the years to come.