



MINISTRY OF EDUCATION

Te Tāhuhu o te Mātauranga

Research measures

Comparing the new with the old

Report

Research measures: Comparing the new with the old

Authors

Warren Smart and Roger Smyth

Tertiary Sector Performance Analysis & Reporting, Tertiary Education Group, Ministry of Education

Email roger.smyth@minedu.govt.nz and warren.smart@minedu.govt.nz

Telephone 64-4-463-8035

Fax 64-4-463-8526

Acknowledgements

The authors gratefully acknowledge the support of Jonathan Boston and Brenden Mischewski in their role as peer reviewers.

Published by:

MINISTRY OF EDUCATION

© Crown Copyright

All rights reserved

All enquiries should be made to the publisher

June 2005

This report is available from the Ministry of Education website

www.minedu.govt.nz/goto/tertiaryanalysis

ISBN (Web) 0-478-13315-4

Contents

TABLES AND FIGURES	3
1 INTRODUCTION	4
2 BACKGROUND – A NEW RESEARCH FUNDING APPROACH	4
3 EARLIER MEASURES OF RESEARCH IN TERTIARY EDUCATION	6
4 COMPARING OLD RESEARCH MEASURES WITH PBRF MEASURES	6
5 DISCUSSION AND CONCLUSION	11
APPENDIX	12
BIBLIOGRAPHY	13

Tables and figures

Figure 1: PBRF quality evaluation score 2003 vs total research outputs 1997 - 2002	7
Figure 2: PBRF research output score vs total research outputs.....	8
Figure 3: PBRF quality evaluation score 2003 vs research contract income 1997 - 2002.....	9
Table 1: Correlation coefficients: annual report research publications 1997-2002 against PBRF 2003 quality evaluation scores – quality score, research output score, peer esteem score and contribution to the research environment score	10
Table 2: Correlation coefficients: annual report research contract income 1997-2002 inflation adjusted against PBRF 2003 quality evaluation scores – quality score, research output score, peer esteem score and contribution to the research environment score	10
Table 3: Research publications, external research income and PBRF quality scores by university and polytechnic.....	12

1 Introduction

The quality of research is inevitably difficult to measure. Even if people can agree on what counts as research, there are differences in publishing conventions and practices between fields of study that make comparisons difficult. In addition, it is by no means simple to assign a quantitative measure that takes account of the *quality* of research.

This note discusses the new Performance-based Research Fund (PBRF) system of measurement of research quality in tertiary education providers and compares the results of those new measures with earlier measures of research performance.

2 Background – a new research funding approach

Until 2003, the government's funding for the research activities of tertiary education providers was based on student enrolments in degree and postgraduate level courses. The funding for all domestic degree and postgraduate level enrolments was supplemented by a research 'top-up'. The rationale for the linkage between research funding and degree enrolments was that the Education Act 1989¹, which governs tertiary education funding, states that degrees must be primarily taught by those active in research. The rationale was that if tertiary education providers are to teach degrees, it follows that they need to be conducting research and that research should be funded.

In developing a new integrated funding framework for tertiary education in 2002, the government has moved to reorganise research funding so as to separate funding for research from funding for enrolments and tuition and to align research funding with the research performance of providers. The government reasoned that, in aligning research funding to research performance, it will be creating a climate that will reward excellence in research.

Thus, the PBRF is shifting the basis of research funding to a system based on research performance, with most of the PBRF funding coming from the progressive transfer to the PBRF of the research top-up component of the tuition subsidy. By aligning the allocation of the funding for research with research performance, the PBRF aims² to:

- increase the average quality of the research conducted in the sector
- ensure that research continues to inform and shape the teaching and learning of degree and postgraduate students
- ensure funding is provided to support postgraduate research students and new researchers in the sector, and
- underpin the existing strengths in tertiary education research.

¹ Education Act 1989 section 254 (3) (a).

² Ministry of Education and transition Tertiary Education Commission (2002).

Fostering and enhancing the tertiary education sector's research capability and performance would be more likely to contribute to the nation's economic and social advancement³.

Allocating funding on the basis of research performance assumes a rigorous means of assessing and quantifying performance, ensuring that the system is both fair and seen to be fair. Therefore, the introduction of the PBRF has been accompanied by the development of a new measurement and assessment system for research – based on measures of research performance at an individual and institutional level⁴. One consequence of the shift to the PBRF has been the collection of more and better information on research in tertiary education. An important component of that shift has been the standardisation of the sector's understanding of what counts as research through an agreed definition of research.

There has also been standardisation of how research is to be assessed. The PBRF measures are based on:

- the quality of the research outputs produced in a provider
- the number of research degree completions the provider has achieved in the relevant time period, and
- the amount of external research income generated by the provider.

The research quality assessment comprises three sub-components. The measure is a weighted average of an assessment panel's scoring of each PBRF-eligible staff member's research outputs, his/her contribution to the research environment and the esteem of his/her research peers⁵.

When it comes to the allocation of the available funding among providers, the research quality assessments contribute 60 percent of the weighting, while research degree completions represents 25 percent and external research earnings 15 percent.

Because the allocation of the funding depends on those measures of research performance, the shift to the PBRF has entailed a different approach to the assessment and management of information on research performance; the PBRF is as much an information policy as it is a new funding mechanism.

³ Boston et al (2005) and Ministry of Education (2002). It should be noted that a number of other countries have moved to performance linked research funding systems in higher education - the United Kingdom, Australia and Hong Kong, for example.

⁴ Ministry of Education (2003) contains on pp 108 – 110 detailed information on the operation of the PBRF. Tertiary Education Commission (2004) pp 15 – 23 also explains the operation of the new system.

⁵ In each of the three components of the PBRF quality score – research output, peer esteem, and contribution to the research environment - each eligible staff member is assigned a score between 0 and 7. Those scores are then weighted by factors of 70, 15 and 15 respectively to generate the *overall quality score* (OQS) of the staff member – a score out of 700. The OQS is then used to guide the assignment of a quality category – A, B, C or R - which is then used to allocate the staff member's PBRF score – a number between 0 and 10 – that summarises the staff member's research performance over the relevant period. The process is detailed in Tertiary Education Commission (2004) pp 19 to 20 and pp 37 to 38.

3 Earlier measures of research in tertiary education

Until the creation of the PBRF, there was no agreed categorisation of research outputs nor an accepted approach to the counting of research outputs and, consequently, no widely accepted measures of research that capture both quality and quantity. The country's eight universities have all reported the number of research publications and their research contract income in their annual reports since the early 1990s⁶. Those annual reports are subject to external audit, implying that analysis of trends over time in a provider would be appropriate. However, the lack of standardisation of definition between the universities means that some doubts have been raised as to the accuracy of comparative analyses.

4 Comparing old research measures with PBRF measures

The first published systematic analysis of the research performance of the universities was included in the 2001 and 2002 editions of *New Zealand's Tertiary Education Sector: Profile and Trends*⁷. Those analyses used the annual report data as the basis of the study, complementing those with information on doctoral degree enrolments and completions and information drawn from surveys by or for the Ministry of Research, Science and Technology – for instance, of research expenditure, research staffing and the citations of research publications⁸.

Many of the other indicators used in Profile and Trends were derived from the annual reports numbers of research outputs and the annual report data on research contract income⁹. However, the annual report data on research outputs included double counting, no agreement on output categories and a lack of agreement over the reporting of outputs in the creative and performing arts. As a result, comparing the outputs of two institutions on the basis of annual report counts might be held problematic. That observation raises the question of the relationship between those measures and the PBRF measures.

Figure 1 below shows for each university and for the two polytechnics that participated in the 2003 PBRF quality evaluation¹⁰ the number of research outputs

⁶ Obviously, universities have reported their research activities in a variety of forms over many decades. The introduction of a new approach to annual reporting with the introduction of new public sector accounting and reporting concepts in the early 1990s led to some convergence of the approach to reporting of research in annual reports.

⁷ Ministry of Education (2002) pp 80 to 89 and Ministry of Education (2003) pp 106 to 118.

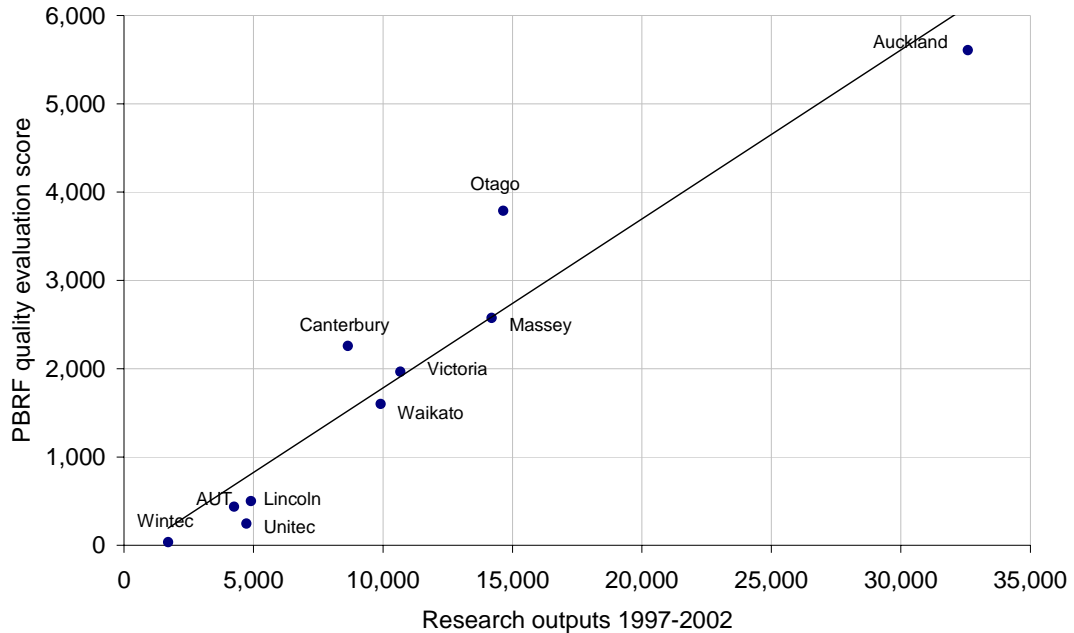
⁸ The complementary data was drawn from such reports as: Ministry of Research, Science and Technology, Foundation for Research, Science and Technology, Health Research Council and Royal Society of New Zealand (2003) *National Bibliometric Report, 1997 to 2001: International Benchmarking of New Zealand Research*; Statistics New Zealand (2003) *Innovation in New Zealand 2003*; Ministry of Research, Science and Technology, Statistics New Zealand (2003) *Research and Development in New Zealand 2002*.

⁹ Derived indicators included research contract income as a proportion of total income, research contract income per full-time equivalent (FTE) academic staff member and research outputs per FTE. In addition the report included data on PhD enrolments and completions and PhD completions per academic FTE.

¹⁰ The focus of this study is largely on the universities as they are the Tertiary Education Organisations (TEOs) that are most active in degree teaching and consequently in research. Only two of the 20 institutes of technology or polytechnics participated in the first PBRF quality evaluation – Waikato Institute of Technology (Wintec) and Unitec New Zealand. Their scores are also analysed in this study for comparative purposes.

reported in the annual reports for 1997 to 2002 against the 2003 PBRF quality score¹¹¹².

Figure 1: PBRF quality evaluation score 2003 vs total research outputs 1997 - 2002



Notes:

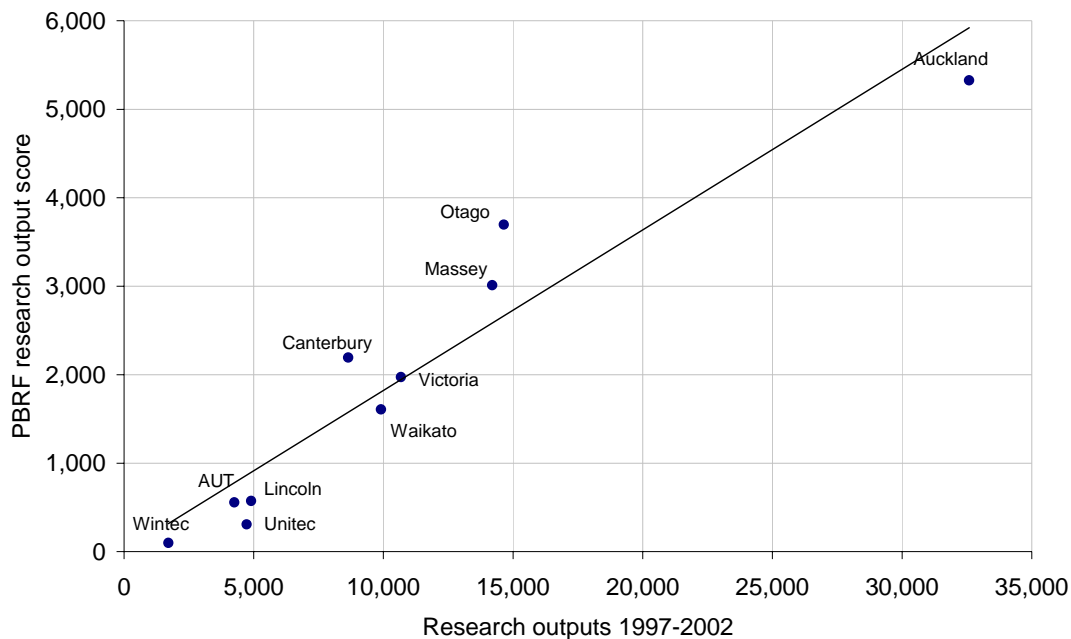
1. Refer to the appendix for the underlying data.
 2. PBRF scores are presented as aggregates and are not scaled to reflect the size of the provider.
- Sources: Annual reports of the tertiary education organisations, Ministry of Education, Tertiary Education Commission.

Evidently, there is a good match between the two. Figure 2 explores the relationship between the research output component score of the PBRF scores and the annual report numbers of research outputs for those same providers.

¹¹ The reported research outputs for each of the years 1997 to 2002 have been added. The purpose of adding the numbers of outputs for those years is to ensure that the outputs match the period covered by the quality portfolios for the 2003 quality evaluation.

¹² The data in figures 1, 2 and 3 each contain only 10 observations. To that extent, there are some limitations to the statistical analyses that can be performed on the data.

Figure 2: PBRF research output score vs total research outputs



Notes:

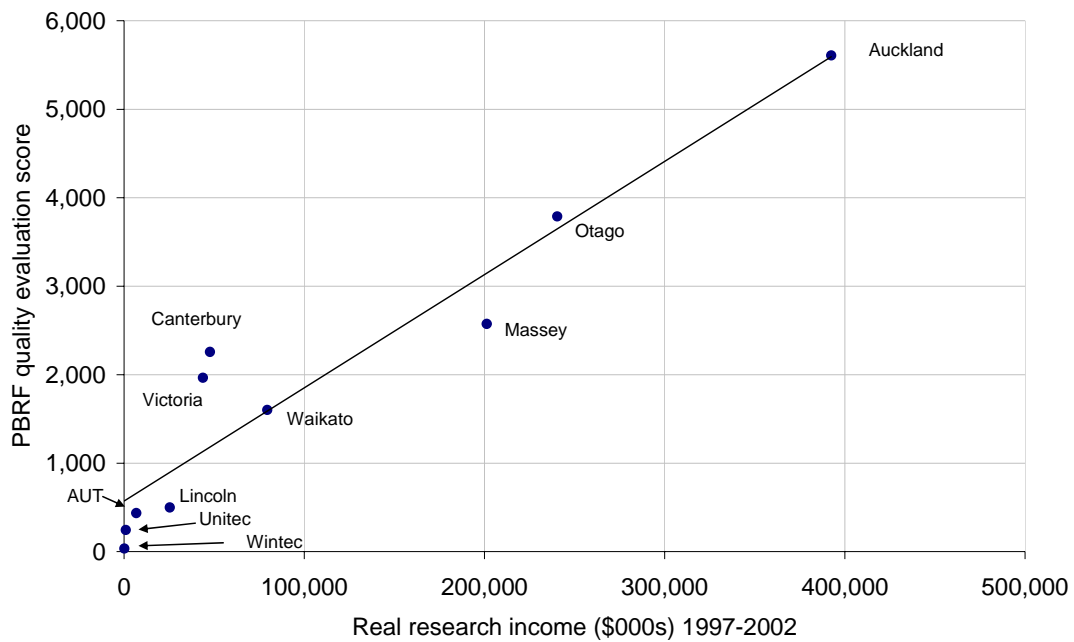
1. Refer to the appendix for the underlying data.
 2. PBRF scores are presented as aggregates and are not scaled to reflect the size of the provider.
- Sources: Annual reports of the tertiary education organisations, Ministry of Education, Tertiary Education Commission.

Unsurprisingly, the relationship is again strong – the two measures are developed from the same sources of data. The PBRF research output score, however, is about the *quality* of the outputs, whereas the annual report data is largely quantitative. It is *largely*, not purely, quantitative because each provider will have its own inclusion criteria which have quality dimensions. Where a provider’s point appears *above* the line of best fit in Figure 2 (for instance, the University of Otago, Massey University and the University of Canterbury), this indicates that the average quality of the total reported output can be considered to be slightly higher. That probably reflects narrower inclusion criteria in those institutions’ annual reports. By contrast, the criteria used by the University of Auckland may appear slightly more inclusive. The differences are marginal, however; the universities by and large would appear to be operating from shared understandings about what constitutes research – despite the reservations expressed above.

Figure 3 shows the relationship between 2003 PBRF quality evaluation scores and the total research contract income reported for the years 1997 to 2002. Again, the reported research income for the period has been aggregated to match the period of the quality portfolios submitted for the quality evaluation. The research contract income has been adjusted for inflation before aggregation¹³.

¹³ As a means of ensuring there is no distortion between years.

Figure 3: PBRF quality evaluation score 2003 vs research contract income 1997 - 2002



Notes:

1. Refer to the appendix for the underlying data.
 2. PBRF scores are presented as aggregates and are not scaled to reflect the size of the provider.
- Sources: Annual reports of the tertiary education organisations, Ministry of Education, Tertiary Education Commission.

Again, the fit is strong. Here, the providers with a very strong record of external research contract income – Massey and Lincoln Universities, for instance – appear below the best fit line. By contrast, Victoria University of Wellington, which has specialisations in areas that traditionally attract lower levels of research contract income, appears above the line.

A similarly strong relationship exists between each of these two annual report measures and other components of the PBRF quality score – contribution to the research environment and peer esteem.

Table 1 below gives the correlation coefficients between the aggregate number of research outputs over the period 1997 to 2002 and the various components of the PBRF quality score from the 2003 quality evaluation¹⁴.

¹⁴ Note that there are only 10 observations in each calculation.

Table 1: Correlation coefficients: annual report research publications 1997-2002 against PBRF 2003 quality evaluation scores – quality score, research output score, peer esteem score and contribution to the research environment score

Measure	Annual report measure of research publications
PBRF quality score	0.954
Overall quality score (OQS) from PBRF	0.949
PBRF research output score	0.950
PBRF peer esteem score	0.948
PBRF contribution to the research environment score	0.947

Notes:

1. Refer to the appendix for the underlying data.
2. There are three components of the PBRF quality score – research output, peer esteem, and contribution to the research environment. Each eligible staff member is assigned a score between 0 and 7. Those scores are then weighted by factors of 70, 15 and 15 respectively to generate the *overall quality score* (OQS) of the staff member – a score out of 700. The OQS is then used to guide the assignment of a quality category – A, B, C or R – which is then used to allocate the staff member's PBRF score – a number between 0 and 10 – that summarises the staff member's research performance over the relevant period. It is those PBRF scores that were the basis of the rankings in the 2003 evaluation, described in Tertiary Education Commission (2004).
3. The PBRF scoring system is explained in detail in Tertiary Education Commission (2004) pp 19 to 20 and pp 37 to 38.
4. All of the scores of PBRF eligible staff are weighted by the staff member's full-time equivalent status and then aggregated to give a whole of institution measure.
5. The annual report measure of research publications is the total number of research publications reported by the providers in their annual reports over the six year period 1997 to 2002.

Sources: Annual reports of the tertiary education organisations, Ministry of Education, Tertiary Education Commission

Likewise, Table 2 gives the correlation coefficients between the total research contract income¹⁵ over the period 1997 to 2002 and the various components of the PBRF quality score from the 2003 quality evaluation.

Table 2: Correlation coefficients: annual report research contract income 1997-2002 inflation adjusted against PBRF 2003 quality evaluation scores – quality score, research output score, peer esteem score and contribution to the research environment score

Measure	Annual report measure of (inflation adjusted) external research income
PBRF quality score	0.949
Overall quality score from PBRF	0.956
PBRF research output score	0.956
PBRF peer esteem score	0.951
PBRF contribution to the research environment score	0.954

Notes:

1. Refer to the appendix for the underlying data.
2. For an explanation of the PBRF measures refer to the notes to table 1 above.
3. All of the scores of PBRF eligible staff are weighted by the staff member's full-time equivalent status and then aggregated to give a whole of institution measure.
4. The annual report measure of external research income is the total amount of research contract income reported by the providers in their annual reports over the six year period 1997 to 2002, adjusted for inflation.

Sources: Annual reports of the tertiary education organisations, Ministry of Education, Tertiary Education Commission

¹⁵ inflation adjusted.

Each of the correlation coefficients fits within the range 0.945 to 0.957. All of the correlations, therefore, are very strong.

5 Discussion and conclusion

The correlation coefficients in Tables 1 and 2 above indicate that research contract income and counts of research outputs, as reported in the annual reports of the TEOs most active in research, are good proxy measures for research quality as measured by the PBRF.

This is not to imply that the annual report measures could act as a substitute for PBRF measures. The annual report measures are performance measures whereas the PBRF measures are performance measures *that are also funding allocation measures*. When a measure is used to allocate funding, it must have a very high level of control in order to ensure the integrity of the funding mechanism. It needs also *to be seen* to have a high level of rigour and to be controlled, in order to protect the funding mechanism from criticism and in order to give confidence to stakeholders.

Furthermore, the PBRF research quality scores are assigned at the level of the individual staff member but for the purposes of the funding allocation and for this analysis, the scores have been aggregated to give an institutional assessment. The annual report measures are limited by being available only at the provider level. The use of research performance measures in other jurisdictions has been shown to be effective in raising the average quality of research in higher education institutions. Assessing performance at the level of the individual staff member, as required under the New Zealand PBRF, should be a powerful motivator for improvement in research.

What the analysis in this paper shows, however, is that we can have confidence that the annual report measures of research performance are good and effective measures of research performance.

Appendix

Table 3: Research publications, external research income and PBRF quality scores by university and polytechnic

	Auckland	Canterbury	Victoria	Otago	Waikato
Research publications	32,586	8,647	10,676	14,647	9,910
External research income (\$000s)	392,438	47,747	43,807	240,409	79,545
PBRF quality score	5,607	2,257	1,966	3,788	1,601
Overall quality score	506,142	207,580	189,136	353,896	154,042
Research output score	5,326	2,193	1,973	3,695	1,607
Peer esteem score	4,520	1,864	1,754	3,189	1,391
Contribution to research environment score	4,370	1,740	1,645	3,161	1,381
PBRF quality score per FTE	3.96	3.83	3.39	3.23	2.98

	Lincoln	Massey	AUT	Unitec	Wintec
Research publications	4,903	14,200	4,251	4,730	1,709
External research income (\$000s)	25,445	201,334	6,837	988	165
PBRF quality score	500	2,574	436	245	35
Overall quality score	54,484	281,370	52,723	28,108	9,009
Research output score	573	3,010	557	308	99
Peer esteem score	458	2,431	472	243	73
Contribution to research environment score	498	2,279	441	194	63
PBRF quality score per FTE	2.56	2.11	0.77	0.71	0.32

Notes:

1. There are three components of the PBRF quality score – research output, peer esteem, and contribution to the research environment. Each eligible staff member is assigned a score between 0 and 7. Those scores are then weighted by factors of 70, 15 and 15 respectively to generate the *overall quality score* (OQS) of the staff member – a score out of 700. The OQS is then used to guide the assignment of a quality category – A, B, C or R - which is then used to allocate the staff member's PBRF score – a number between 0 and 10 – that summarises the staff member's research performance over the relevant period. It is those PBRF scores that were the basis of the rankings in the 2003 evaluation, described in Tertiary Education Commission (2004).
2. The PBRF scoring system is explained in detail in Tertiary Education Commission (2004) pp 19 to 20 and pp 37 to 38.
3. All of the scores of PBRF eligible staff are weighted by the staff member's full-time equivalent status and then aggregated to give a whole of institution measure.
4. The measure of research publications is the total number of research publications reported by the providers in their annual reports over the six year period 1997 to 2002.
5. The measure of external research income is the total amount of research contract income reported by the providers in their annual reports over the six year period 1997 to 2002, adjusted for inflation.

Sources: Annual reports of the tertiary education organisations, Ministry of Education, Tertiary Education Commission.

Bibliography

Boston J, B Mischewski and R Smyth (2005), Performance-based Research Fund - Implications for research in the social sciences and social policy, *Social Policy Journal of New Zealand*.

Ministry of Education and Transition Tertiary Education Commission (2002) *Investing in excellence: the report of the Performance-Based Research Fund working group*.

Ministry of Education (2002) *New Zealand's Tertiary Education Sector: Profile and Trends 2001*, Tertiary Sector Performance Analysis and Reporting, Ministry of Education, Wellington.

Ministry of Education (2003) *New Zealand's Tertiary Education Sector: Profile and Trends 2002*, Tertiary Sector Performance Analysis and Reporting, Ministry of Education, Wellington.

Ministry of Education (2004) *New Zealand's Tertiary Education Sector: Profile and Trends 2003*, Tertiary Sector Performance Analysis and Reporting, Ministry of Education, Wellington.

Tertiary Education Commission (2004) *Performance-Based Research Fund: evaluating research excellence: the 2003 assessment*, Wellington.