Chapter 17

WHAT HAPPENS WHEN FUNDING IS LINKED TO PUBLICATION COUNTS?

Linda Butler

Research Evaluation and Policy Project, Research School of Social Sciences, The Australian National University, Australia
E-mail: linda.butler@anu.edu.au

Abstract: Many countries are placing a greater emphasis on public accountability for government research funding and are starting to use quantitative performance indicators for the distribution of funds. In Australian universities the use of quantitative formulas to allocate the research component of university block grants to institutions has been in place for a decade, and thus the system provides fertile ground for using bibliometrics to examine the effects of such policies on academic output. An analysis of Australian data from the Institute for Scientific Information's major citation indexes clearly demonstrates the academic response to the linking of funds, at least in part, to productivity measures undifferentiated by any measure of quality — publication numbers jumped dramatically, with the highest percentage increase in the lower impact journals. The trends were apparent across all fields of research in the university sector, but were not present in other sectors active in research (such as hospitals or government research agencies). The trends were not, however, uniform across all institutions.

1. INTRODUCTION

In most OECD countries increasing emphasis is being placed on greater public accountability, with a need to demonstrate the effectiveness and efficiency of government supported research. A workshop held by the OECD in 1997 characterised the recent evaluation of basic research as "a rapid growth industry"(OECD, 1997).

This new demand for research evaluation cannot be fully serviced by the finite capacity of traditional peer review. Researchers, particularly the more

H.F. Moed et al. (eds.), Handbook of Quantitative Science and Technology Research, 389-405.

senior ones, have many calls on their expertise, such as reviewing journal articles, assessing grant applications, sitting on selection and promotion committees, being co-opted to national or institutional review bodies. They can only devote a limited proportion of their time to such activities before their own research begins to suffer. Partly as a consequence of the pressures on peer review, there has been an increased use of quantitative performance indicators as an alternative method for evaluating research performance, which has the added advantage of being more cost efficient. There is also an increasing trend to link such measures directly to the distribution of research funds.

For Australian universities the allocation of funds earmarked for research is based on a formula encapsulating a number of performance measures (graduate student numbers or completion rates, research income, and publications). Spanish scientists are directly rewarded with a salary supplement for increasing their output in the major English language international journals (Jiménez–Contreras, Anegón and López–Cózar, 2003). In Finland part of the funding for university hospitals rests on publication points, weighted according to the impact factor of the journals carrying the work (Adam, 2002). While in the British Research Assessment Exercise the link between research rankings and performance measures, and hence funding, is less direct, they nevertheless play an important role in the deliberations of the review panels.

The link between research funding and quantitative performance measures has now been in place in Australian universities for a decade, and thus provides fertile ground for using bibliometric data to examine the effects of this policy on academic output. Since performance measures relating to publications are limited to aggregate productivity counts, the expectation would be that Australian university publication output would increase significantly in response to the signals embodied in the funding formula. As there is no attempt to weight for the quality of either the output itself, or the publication in which it appears, there would also be an expectation that any increased journal output is likely to be concentrated in lower ranked journals where it may be easier to place additional articles. Both these anticipated outcomes are clearly visible in the data for Australian universities in a number of major journal citation indexes.

2. POLICY BACKGROUND

The Australian government has a dual system for funding research in universities. A significant amount of money is distributed by the two research councils, the National Health and Medical Research Council and

the Australian Research Council, via a peer reviewed assessment system. Both agencies distribute the bulk of their funding support in the form of project grants, which can vary in length from one to five years, with three years being the most common duration. Secondly, a proportion of the block operating grant to universities (of the order of 5%) is earmarked for research and research training, and since the beginning of the 1990s this has been distributed via a formula. The formula aimed at taking account of a broad range of measures of research performance when making allocations to universities. Initially this formula was based only on external earnings, but subsequently student and publication components were added.

Australian universities began supplying details of their research output to the Department of Education, Science, and Technology (DEST[1]) and its predecessors in 1993, initially through the Australian Vice Chancellors Committee (AVCC), and more recently directly to the department. The research funding formula was expanded in 1995 to include output measures — publication counts and higher degree loads and completions — and was also used in the allocation of postgraduate awards. The components of the formulas, the funding schemes they were applied to, and the weighting given to each element, are shown for a sample of years in Table 17.1.

From 2001, as a result of a review of higher education research, the amount of funds allocated on the basis of formulas has nearly trebled, and now accounts for more than half the funding specifically targeted to research and research training through the education portfolio (DEST, 2002a). The Small Grants scheme, not previously funded by this method, was rolled in with the Research Quantum (RQ) and became the Institutional Grants Scheme. Postgraduate awards continued to be funded under this arrangement and, in addition, a new Research Training Scheme was introduced which more than doubled the funds distributed via formulas. None of the more recent changes represented 'new' money, merely a change in the method by which some of the funds were distributed, and a greater reliance on formula driven schemes.

Australia's approach in this area of higher education policy is not common. A recent survey of 14 countries by Geuna and Martin only identified two that used ex-post quantitative evaluation for allocating core research funds, Finland and Australia (Geuna and Martin, 2003) Unlike Australia's mechanistic system of quantitative measures, Finland employs a

[1] The Australian Government department which encompasses the education portfolio has had several name changes in the period referred to in this paper — the Department of ... Employment, Education, Training, and Youth Affairs; Employment, Education, and Training; and Education, Science, and Training — but I will use the acronym for the department in its current form (DEST) throughout this chapter

series of agreed indicators focusing on the quality and impact of teaching and research. The Australian experience is not mirrored in other countries, and may well be part of the explanation for the publication trends seen in Table 17.1.

Table 17.1. Formulas that distribute research funds to Australian universities through block grants

	Weight given to each element (percent)				
Funding Scheme	Total funds ($mil)	Publica-tions	Higher degree load	Higher degree completions	Research income
1996					
Research Quantum	218.6	12.50		5	82.50
Postgraduate awards (2 schemes)	91.7	5.26	40	20	34.74
2000					
Research Quantum	223.0	10.00		10	80.00
Postgraduate awards (2 schemes)	96.2	4.44	40	20	35.56
2002					
Institutional Grants Scheme	271.3	10	30		60
Postgraduate awards (2 schemes)	102.0	10		50	40
Research Training Scheme	515.6	10		50	40

Source: Australian Vice Chancellors' Committee (AVCC), 2002.

3. THE REWARDS FOR PUBLISHING

Determining the 'value' of a publication unit to a university is a simple calculation and it was not long before figures became commonly referred to in the sector. Taking the data given in Table 17.1, together with the publication counts on which the distribution of funds was based, Table 17.2 details the calculations for the three sample years. The distribution of funding for the publications element was based on data for the most recently available two years.

Table 17.2 demonstrates the effect that adjustments to the coverage of publications in the collections, and/or the amount of funding distributed in this way, can have on calculations of the unit value. For example, the 1996 distribution was based on 1993 and 1994 publications. The 1993 data covered 8 publication types; the 1994 data covered 22. After a sample audit of the universities' lists of 1994 publications, the number of categories

covered was reduced to just four for subsequent collections: books, book chapters, refereed journal articles, and refereed conference papers[2]. As a result the number of publication units in subsequent collections dropped significantly, with a consequential increase in the value of each unit. This occurred despite a reduction in the weight given to publications in the formula from 12.5% to 10%, and a reduction in the amount of funds distributed on this basis.

Table 17. 2. Value of a publication unit: 1996, 2000 and 2002

Funding year	*Funds tied to publication counts (AUD$million)*	*Publication counts**	*Value per publication unit*
1996	32.1	42,259	$761
2000	26.6	24,390	$1,089
2002	88.9	26,877	$3,307

Source: Department of Employment Education and Training, 1996; Department of Education, Training and Youth Affairs (DETYA), 2000; Department of Education, Science and Training (DEST), 2002b.

* Weighted by type of publication

From 2001 the funds distributed via the formulas were increased significantly, leading to a three-fold increase in the value of a publication unit. Every refereed journal article is now 'worth' over AUD$3,000 to a university, and a book is now 'worth' AUD$15,000.

4. IDENTIFYING THE EFFECTS OF INTRODUCING FUNDING FORMULAS

As the categories covered by the Australian collection have been refined and reduced in number, the importance of journal publications indexed by the *Institute for Scientific Information* (ISI) has increased. The collection is externally audited, and universities must prove, among other things, that the journals carrying the articles they are claiming are peer reviewed. A journal that is indexed by ISI is accepted as peer reviewed without question, but universities must prove that any other journal meets the definition. Publishing in ISI-indexed journals is obviously the easiest course of action to take. The data contained in ISI's three main indices, the *Science Citation*

[2] In recent collections books receive a weighting of five in the calculations, while the other three categories are all given the base weighting of one

Index (SCI), the Social Sciences Citation Index (SSCI), and the Arts and Humanities Citation Index (A&HCI), therefore provide fertile ground for examining the impact that introducing the funding formulas had on Australian university output.

The Research Evaluation and Policy Project (REPP) maintains a database which contains all Australian publications in these ISI indices. Considerable effort is expended in standardising the addresses listed for each publication, thus enabling accurate analysis to be undertaken at the sectoral (university, hospital, government, etc), institutional, and even lower levels of aggregation, such as faculties and departments.

4.1 The University Sector in Aggregate

An analysis of Australia's presence in the SCI was the first step taken to investigate whether it was possible to demonstrate the apparent effect of the introduction of the funding formulas in the 1990s. In the analysis SCI journals were allocated to quartiles based on the average citation per publication rates of the publications they carried. Mean journal citation rates were calculated for each five year window from 1981–85 through until 1996–2000. For both publication counts and citation totals, the calculation was limited to publications classified by ISI as articles, notes, reviews and proceedings papers, and to the specified five year period. As a separate calculation was made for each period, journals were free to move between quartiles over time.

Australian universities' presence in these four quartiles was then tracked over the full twenty year period. Their share of total publications in each of the four quartiles is shown in Figure 17.1.

The response of the academic community appears very clear, and in line with expectations. Until the period 1989–93 there had been virtually no movement in the institutions' presence in the SCI journal set, with the exception of an increase in the third quartile. Since that period university output has jumped dramatically, particularly in journals allocated to the bottom two quartiles. The sector's share of publications in journals allocated to the top two quartiles increased by 28% and 15% respectively; their share of publications in the third quartile rose at double those rates, i.e., by 55%; and in journals allocated to the bottom quartile their share doubled.

With no attempt made to differentiate between the quality, visibility or impact of the different journals when funding is allocated, there is little incentive to strive for publication in a prestigious journal. Whether a publication reports ground breaking research or is a more pedestrian piece; whether it appears in a highly visible journal such as *Nature* or a lower impact outlet, the rewards are identical.

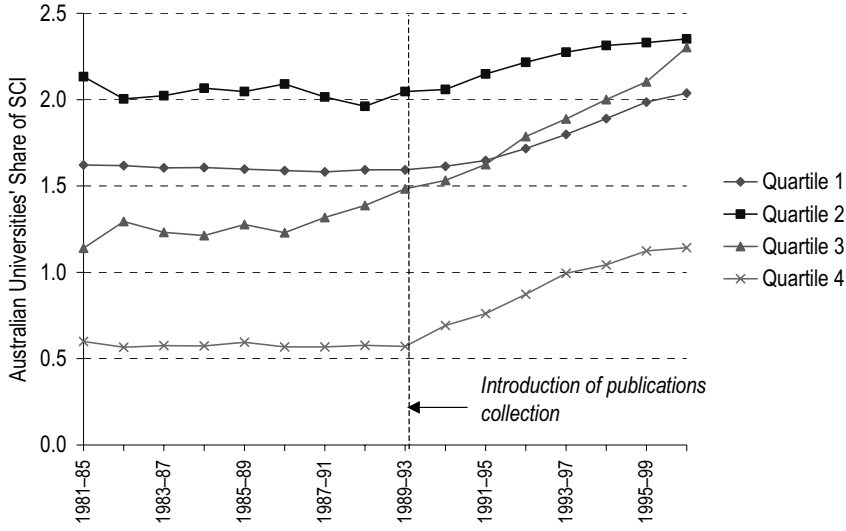

Figure 17 1. Australian universities' share of publication in the SCI, by journal impact quartile: five year windows, 1981–1985 to 1996–2000.

The trends shown in Figure 17.1 are not proof in themselves of a direct link between funding formulas and increased productivity. However, they did occur at a time when funds to the sector are extremely tight. A detailed analysis was undertaken when these trends first became apparent to determine whether the increased output could be explained by either the entry of new institutions into the sector, or an increased number of researchers (Butler, 2001a) Results showed that while the new institutions had increased the sector's research capacity, they accounted for less than one third of the expanded output — the bulk came from the older, established universities. Nor were increased staff numbers the explanation. They had risen in the period after the introduction of the publications collection, but the increase was no greater than it had been prior to this time.

To be more confident that the trends are a result of the introduction of funding formulas it is necessary to examine the data in more detail in order to determine whether the following three scenarios also exist:

1. The trends are specific to the university sector. No other Australian research sector is faced with the same funding drivers, so the trends for other sectors should not mirror that for universities.

2. The trends are present in all fields of research. The formulas are applied across the university sector, so all fields of research, including those less traditionally reliant on journal outlets for their research, should exhibit similar trends.
3. Another university system faced with similar incentives, exhibits similar trends. The Spanish research system is subject to funding drivers based on journal output, and the effect of this should also be apparent in ISI data.

The results of these analyses are given in the following sections.

4.1.1 Comparison of sectors

The three largest sites of research in Australia outside the universities are the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the hospitals, and government research agencies. None of the institutions comprising these sectors are subject to funding formulas of the type present in the university sector, although all have strong collaborative links with it. Figure 17.2 shows the trend in publication output for these three sectors using an identical analysis to that applied to the university sector.

It is quite clear that the 1989–93 period does not mark a turning point in trends for any of these sectors. CSIRO, with an increasing emphasis on seeking external funds for a significant share of its operating costs, has seen its overall share decline (although actual publication numbers have remained steady). The hospital sector's share of output in the top quartile has been increasing steadily across the whole period, while its presence in the journals allocated to the bottom quartile has increased but remains very low. There are considerable fluctuations in its share of the other two quartiles, and the mirror image in movement between these quartiles suggests some journal movement between the two sets. The government sector's share of output in the top and bottom quartiles has remained relatively steady across the twenty year period covered by our data. As with the hospital sector, their presence in quartiles 2 and 3 is more volatile, and presents a mirror image in movement.

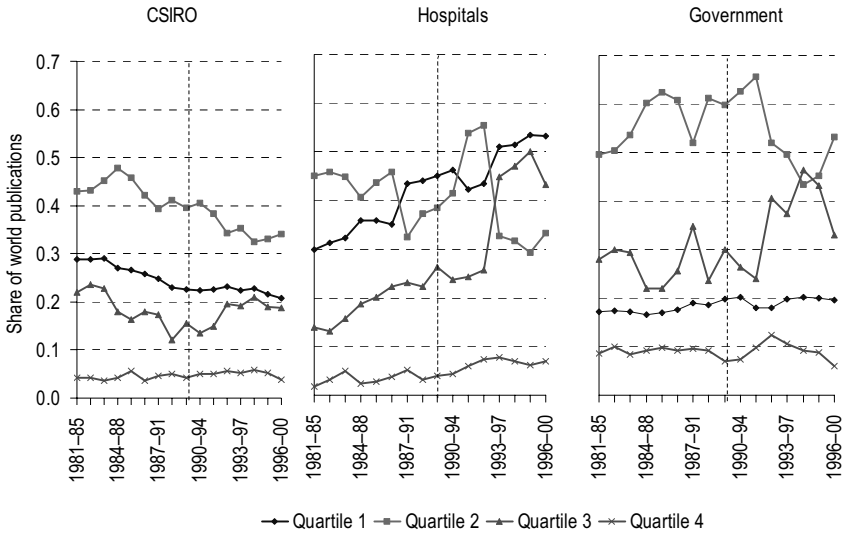

Figure 17. 2. Share of publications in the SCI by other Australian sectors, by journal impact quartile: 1981–1985 to 1996–2000.

4.1.2 Comparison of fields

To disaggregate the trends and examine what was occurring in different fields of research, the methodology used for the SCI as a whole was applied to subsets of journals. For this analysis ISI subject category journal sets were used, and translated into the Australian Research fields, Courses and Disciplines classification scheme. Within each field journals were allocated to quartiles on the basis of the five year average citation impact of the publications they carried. As expected, the average citation per publication (cpp) threshold varied considerably between fields. For example, to be in the top quartile in chemistry in the period 1996–2000, a journal needed a cpp rate of 3.61, while a mathematics journal required only 1.86.

Table 17.3 shows the increase in Australian universities share of world publications by field in two periods of equal length: the increase between 1981–85 and 1988–92; and the increase between 1989–93 and 1996–2000, the period after the introduction of the publications collection.

Table 17 3. Percentage increase in publication output by field — two periods

	% Change: 81–85 to 88–92				*% Change: 89–93 to 96–00*			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
All sciences	–2	–8	22	–4	28	15	55	100
Mathematical sciences	–13	–16	–3	14	1	43	34	77
Physical sciences	–8	–25	137	–32	42	63	18	85
Chemical sciences	–20	–8	47	13	24	–17	124	137
Earth sciences	7	15	38	19	4	28	31	88
Biological sciences	–7	–5	41	–17	18	25	27	74
Engineering and technology	–10	0	16	–1	37	42	75	117
Agric, vet, environ	–16	14	78	–21	14	48	52	144
Medical and health sciences	0	9	0	29	22	18	84	82
Social sciences	4	–19	56	–25	13	63	28	65

Most fields of research demonstrate relatively stable publication shares between 1981–85 and 1988–92, with movements contained within 25%. The exception is increases in the third quartile — in line with overall trends.

These data show, with the one exception of a decrease in university publications in the second quartile in chemistry, that universities have significantly increased their output in all fields and in all quartiles in the second period studied (1989–93 to 1996–00). In the medical and health sciences the increase in share of the bottom two quartiles is at a similar level; in all other fields the largest increase is in the bottom quartile, usually by a significant margin. As with trends in the preceding period, in this later time frame the fields exhibit trends similar to the aggregate ones, although inevitably there is some variation. In most cases quartile 3 accounted for the second largest increase, with those in the top two quartiles much more modest.

The increase in output in the physical sciences is more evenly spread across the four quartiles. Notably, universities increased their share of the highest impact journals by 40%, a greater margin than for any other field. The two possibilities which immediately suggested themselves as an explanation for this trend — the influence of astronomy in which Australia is particularly strong, and the movement of major Australian journals in the field between quartiles — were found to have no impact on the trends.

4.1.3 The Spanish experience

Since 1989 a research incentive system has existed in Spain, administered by the National Commission for the Evaluation of Research Activity (CNEAI). Researchers were rewarded with salary bonuses for publishing in prestigious journals, principally articles appearing in a relatively high position (approximately the top one third) in ISI's Journal

Citation Report lists by subject category. Unlike the Australian system, the focus is clearly on the individual rather than the institution. But the message is clear — it is increased productivity that is important. A recent study has clearly demonstrated the effect of this policy on Spanish publication output in the ISI–indexed journals (Jiménez–Contreras, Anegón and López–Cózar, 2003).

Their work demonstrates clearly that Spanish researchers have also responded to funding stimuli by increasing their output well above the long-term trend line for Spanish publications in the ISI indices. However, in the Spanish case CNEAI achieved its stated aims, which were to increase productivity and the internationalisation of Spanish research. In contrast, the Australian funding formulas were designed to reward quality, but in fact reward quantity.

4.1.4 Interpretation of trends

The similar trends found in university output in all fields of research, the lack of similar trends in other research sectors, and the Spanish experience, all support the hypothesis that the increased university output in Australia, and the pattern of its distribution across impact quartiles, is a direct result of the introduction of the DEST funding formulas.

There are differing interpretations which can be placed on these trends. In discussions which followed the release of the data, there were those who argued it was 'good news' — that the large jump in output in low impact journals was of little concern because the Australian presence in high impact journals had also increased. While this may be true, there is an overriding objection to the use of undifferentiated publication counts in this instance, and that is one of intent. The formulas, and in particular the publications component, were conceived as a means of distributing research funds on the basis of the quality of research in Australian universities. Publication counts are not measures of quality.

4.2 Institutional Analysis

While the trends in Australian publication output were similar across the different fields of research, it is perhaps not surprising that trends in individual institutions are not as uniform. This is largely because of the disparate signals which individuals within these institutions are receiving from a variety of sources, their judgment on which carry the most weight, and their subsequent reaction to these signals. Researchers face one set of performance measures when applying for grants; another when seeking promotion; yet another when applying for a job at a new institution; a series

of community standards set by the peers in their own discipline — all in addition to any sector–wide signals which their institution may be receiving and passing on down through faculties and departments. Some of the signals received will inevitably be contradictory.

Table 17.4 shows publication trends for individual institutions calculated in the same manner as for fields. To provide some indication of the nature of each institution the universities have been classified by type and by the size of their output for the two periods. Australian universities are often classified into four categories:

- 'Go8' (Group of Eight) universities are a self–selected group with a strong research focus and a wide coverage of disciplines. Most are among the oldest of the nation's universities, the first institutions to be established in the major State capital cities. The exceptions are New South Wales, Monash, and the Australian National University, although all three have been established over 50 years;
- 'pre-1988' universities are more recent, but were in existence prior to the major higher education reforms of 1988 which saw the abolition of Institutes of Technology or Colleges of Advanced Education as distinct types of tertiary institutions;
- 'ex-IT' universities are those which, prior to the 1988 reforms, were solely undergraduate institutes of technology. A few of the larger, older establishments had already been granted university status just prior to the major reorganisation of the sector; and
- 'ex-CAE' universities are those which, prior to the 1988 reforms, existed primarily as small, undergraduate institutions focusing on the professions, such as teaching and nursing, with little research capacity.

Table 17.4 has been limited to those institutions with at least a modest publication profile in the 1980s — those with less than 100 publications in the five year period 1988–1992 were excluded.

The institutions with the greatest overall increase in publication output are the 'ex-CAEs' and the 'ex-ITs'. For both groups this is to be expected, because their capacity to undertake research, and the number of staff qualified and experienced to do so, increased significantly after the change in status of their institutions.

Only four institutions showed a greater growth in publication output in the first period (1981–85 to 1988–92) than in the second period (1989–93 to 1996–00). Two were 'ex-CAEs' which started from a low publication base — University of Western Sydney and Northern Territory University. The other two institutions were 'pre-1988' universities — Deakin University and University of New England. Deakin University's publication trends are

unique among Australian universities with more growth in the earlier period, and the highest increase in the second period to be found in the top quartile.

All other institutions in the analysis showed a significantly greater growth in publication output in the second period. In fifteen instances the highest growth rate was in the bottom quartile, while in another four cases the highest growth was recorded in quartile three. In the remaining five cases four recorded their highest growth in quartile two and just one institution, James Cook University, recorded its strongest growth in the top quartile.

Table 17. 4: Publication output trends for Australian universities — two periods

	Type	*No. pubs*	*% change: 81–85 to 88–92*				*No. pubs*	*% change: 89–93 to 96–00*			
University		*88–92*	*Q1*	*Q2*	*Q3*	*Q4*	*96–00*	*Q1*	*Q2*	*Q3*	*Q4*
All Universities		37,721	–2	–8	22	–4	60,014	28	15	55	100
U Sydney	Go8	10,620	20	41	36	13	17,628	51	54	71	93
UAdelaide	Go8	6,048	1	83	12	3	8,350	23	10	64	206
Australian Natl U	Go8	5,595	–8	49	6	–3	7,536	35	24	42	71
U Queensland	Go8	3,987	33	42	20	–6	7,514	78	55	103	82
U Melbourne	Go8	5,170	22	37	28	–4	7,490	28	37	74	104
New S Wales	Go8	4,270	28	71	10	15	6,628	35	45	60	120
Monash	Go8	3,438	5	57	–6	3	5,386	49	33	67	103
U W Australia	Go8	3,054	1	70	74	26	5,052	47	60	48	112
Queensland U Tec	ex–IT	668	4	243	126	79	2,554	202	162	150	453
La Trobe U	pre1988	1,643	0	81	18	3	2,235	15	43	33	63
Flinders U	pre1988	1,930	13	17	36	–2	2,119	–3	6	77	76
U Tasmania	pre1988	1,143	16	71	14	23	2,021	60	66	69	128
U Newcastle	pre1988	1,222	12	65	7	0	1,891	17	47	89	158
Macquarie U	pre1988	1,138	35	87	18	–21	1,700	41	88	30	30
U Wollongong	pre1988	697	40	100	56	50	1,537	73	168	86	70
James Cook U	pre1988	680	1	95	7	144	1,451	115	51	95	94
Griffith U	pre1988	756	–2	116	65	100	1,250	35	66	122	76
U New England	pre1988	1,059	2	46	13	3	1,115	–5	–2	–10	17
Curtin U	ex-IT	409	36	52	50	120	1,113	56	156	154	241
Murdoch U	pre1988	805	–23	61	93	97	1,064	8	9	114	23
Deakin U	pre1988	491	44	115	142	97	880	80	75	56	68
RMIT	ex-IT	261	10	144	10	53	821	91	212	248	248
U Tec Sydney	ex-IT	250	25	116	4	40	772	97	174	168	172
U South Australia	ex-IT	170	53	15	59	–8	695	113	436	251	174
U Western Sydney	ex-CAE	155	617	180	750	375	680	275	289	197	305
Charles Sturt U	ex-CAE	113	20	157	88	29	364	226	248	173	400
Nth Territory U	ex-CAE	122	1150	2400	200	283	279	133	120	117	20
U Canberra	ex-CAE	128	21	293	58	–55	272	235	70	49	242

The universities with the most even growth across quartiles subsequent to the introduction of the funding formulas were University of Sydney, Australian National University, University of Queensland, La Trobe University and Deakin University, all with a standard deviation of less than 20.

5. DISCUSSION

Problems with the composite index, and in particular with the publications component, were raised soon after its introduction (Anderson, Johnson and Milligan, 1996). Most of the discussion concentrated on the Research Quantum (RQ) as it was the largest scheme. These concerns were taken on board in a ministerial discussion paper on higher education research and research training, issued in June 1999:

> "The publications component of the Composite Index has been subject to a range of criticisms since its implementation in 1995. These concern the reliability of the information provided by institutions, the costs of data collection and the incentives created by the inclusion of a publications component in the index. It seems likely that the publications component of the Composite Index has stimulated an increased volume of publication at the expense of quality … on these grounds, the Government proposes ... to drop the publications measure in any future indices used to allocate block research funds" (Kemp, 1999a).

Not all universities were keen to see the removal of the publications element. The notional proportion of the RQ to be distributed via the publications component was 10% in 1999. However, over half the universities, particularly smaller institutions, received more than 10% of their RQ allocation through publications. For one university the proportion was above 40%; for another five it was more than 20%. It was predominantly the research intensive older universities that were at, or even under, the 10% benchmark (DEST, 1999).

It was therefore hardly surprising that in its response to the discussion paper, the AVCC, representing all 36 institutions which received funds via the RQ, argued for the retention of the publications component:

> "… of the quality measures that might be utilised, 'publications' is the only measure able to fulfil all the requirements … for a driver of sector–wide funding" (AVCC, 1999).

The government was swayed by the submission of the AVCC and others, and in its final policy statement all talk of removing the publications component had disappeared (Kemp, 1999b).

Concerns also surfaced about the direction in which the publications component of funding formulas currently in place in the higher education sector was driving universities, when data produced by the *Institute for Scientific Information* (ISI) confirmed the marked increase in Australian output in the journal literature but pointed to a significant decline in citation impact relative to many OECD countries (Butler, 2001b).

The concerns raised back in 1999 about the use of an undifferentiated publication count are re-surfacing in the context of the latest review of the Australian higher education system. A number of submissions to the government review established to evaluate the Knowledge and Innovation reforms have suggested the removal or modification of the publications component (DEST, 2002c). Two questions stakeholders were specifically asked to address related to the publications collection:

> "Should the research publications element be removed from the formulae? Should the research publications element of the formulae include quality measures"(DEST, 2002c).

In their submissions the majority of institutions remain committed to the continuation of the collection. A number would like to see the introduction of quality measures, although generally this approach has been rejected because few have any knowledge of possible performance measures that could be used to approximate the notion of quality. Most appear to assume it means weighting publication counts by ISI's journal impact factor, or using aggregate citation counts, and have no knowledge of the more complex and sophisticated bibliometric methods that have been developed in recent years.

The University of Central Queensland highlights another problem with the collection in its existing form:

> "The resources used in collecting, submitting and verifying publications by institution exceed the income received for publications at Central Queensland University".

It is clearly apparent that before any alternative could be adopted there needs to be detailed assessment of possible measures. Several questions need to be examined. Do the proposed indicators come close to measuring the aspect of the research endeavour the government is targeting? Is the measure suitable for the level of aggregation being assessed? Is the measure applicable to all fields of research? Is the necessary data readily available and independently verifiable? Is it more effective to combine a suite of

indicators, perhaps varying by field, rather than relying on a single measure? Only when these and other questions have been answered, and the effects of their introduction demonstrated, would there be any chance of gaining broad acceptance for the replacement of existing measures.

ACKNOWLEDGEMENTS

Certain data included herein are derived from the *Australian National Citation Report* prepared by the *Institute for Scientific Information*®, Inc. (ISI®), Philadelphia, Pennsylvania, USA: ©Copyright Institute for Scientific Information® 2000. All rights reserved. This chapter updates and extends research first reported in *Research Evaluation* in 2003 (Butler, 2003).

REFERENCES

OECD. (1997). *The evaluation of scientific research: selected experiences*. Paris: OCDE/GD(97) 194.

Jiménez–Contreras, E., Anegón, F.M., López–Cózar, E.D. (2003). The evolution of research activity in Spain: the impact of the National Commission for Evaluation of Research Activity (CNEIA). *Research Policy*, 32 (1), 123–142.

Adam, D. (2002). The counting house. Nature, 415, 726–729.

Australian Vice Chancellors' Committee (AVCC). (2002). Time series data relating to DEST higher education research data collection (http://www.avcc.edu.au/ australias_unis/ statistics/research/index.htm).

Department of Education, Science and Training (DEST) (2002a): (http://www.detya.gov.au/ highered/research/index.htm#funding.

Guena, A., Martin, B.R. (2003). University Research Evaluation and funding: an international comparison. Minerva, 41 (4), 277–304. http://www.sussex.ac.uk/spru/publications/ imprint/sewps/sewp71.html.

Department of Employment Education and Training. (1996). *Higher education report for the 1996 to 1998 triennium*. Canberra.

Department of Education, Training and Youth Affairs (DETYA). (2000). *Higher education report for the 2000 to 2002 triennium.* Canberra.

Department of Education, Science and Training (DEST).(2002b). *Higher education report for the 2002 to 2004 triennium.* Canberra.

Butler, L. (2001a). *Monitoring Australia's scientific research*. Canberra: Australian Academy of Science, 20.

Anderson, D., Johnson, R., Milligan, B. (1996). *Performance–based funding of universities*. Canberra: Commissioned Report No.51, National Board of Employment Education and Training.

Kemp, D. (1999a). *New knowledge, new opportunities*. Canberra: Department of Education, Training and Youth Affairs.

Department of Education, Science and Training (DEST) (1999). *Characteristics and performance indicators of higher education institutions 1999*, http://www.detya.gov.au/archive/highered/statistics/characteristics/30_researchquantum.htm.

AVCC. (1999). *Discussion paper on higher education research and research training*. Canberra: AVCC.

Kemp, D. (1999b). *Knowledge and Innovation*. Canberra: DETYA.

Butler, L. (2001b). *Monitoring Australia's Scientific Research*. Canberra: Australian Academy of Science, p.11.

Department of Education, Science and Training (DEST) (2002c). *Setting firm foundations: financing Australian higher education*. Canberra: DEST.

DEST. *Evaluation of knowledge and innovation reforms: issues paper*. http://www.detya.gov.au/highered/ki_reforms/issues_paper.rtf.

Butler, L. (2003). Modifying publication practices in response to funding formulas. *Research Evaluation*, 12 (1), 39–46.