GROUP OF EIGHT

Go8 Backgrounder 30

World University Rankings: ambiguous signals

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Contents

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Key points

Australia's position

Australia's universities are doing reasonably well on the published world rankings. That is a cause to celebrate because it signals to the world that we have several high quality universities whose presence underpins a national system of generally good quality higher education. Being placed among the top universities in the world on a range of rankings has reputational and strategic positioning advantages for individual universities and their home countries, and status benefits for the students and alumni of institutions.

While the specific positions of universities on the rankings may vary, the clustering of the same institutions within the top band on multiple measures cross-validates a leading group of Australian universities. From these various sources it is evident that while there are changes in the position of some universities on different measures there is a common group of around 20 Australian universities positioned in the top 1,000 on several of the measures. All of the Australian universities in the top 200 on any measure are Go8 universities. Field-specific rankings reinforce the impressions of the major institutional rankings but also reveal greater degrees of variation among institutions.

Australia's leading universities position reasonably well against the US land-grant public four-year colleges, the UK's Russell Group, Canada's U15, and the top universities of Europe and Asia.

The danger of complacency

The indicators used in all of the major rankings are necessarily lagged. Many Asian institutions are recipients of substantial increases in government investment in higher education and university research. The rate of growth in academic publications output from Asia is far outstripping that of Australia and the quality of Asia's research outputs is rapidly improving.

In contrast, several former leading universities in the US and the UK are experiencing the effects of disinvestment as government funding falls and annual returns from university funds under investment deteriorate. The shift of relative input strength in favour of Asian universities will show through first in the rankings that make use of input measures and later in those that feature output measures.

Efforts by the university rankers to improve their methods, including efforts to reduce country bias in reputational surveys, and to expand the country markets for their rankings, suggest that the earlier dominance of universities of the developed economies of North America, Britain and Europe will decline over time. Australian universities may appear to be improving against this backdrop of decline, whereas they may well be slipping behind the emergent Asian leaders.

The underlying concept of rankings

University rankings fill a void. Simple guides are wanted by people having to make choices faced with an ever increasing complexity of university functions, organisational arrangements and a proliferation of data including marketing hype. The rankings are a means to serve commercial ends – both for the rankers and the ranked, but with the latter captured by the imperative of upholding and enhancing reputation, the currency of academic value. Rankings appear to be based on 'objective' assessments which are independent from the universities being ranked. They resonate in an academic culture of fierce individual competition and status seeking.

World university rankings in particular are selective and norm-referenced within a zero-sum game. Rankings are also reductionist and disproportionately value what is comparably measureable on the basis of available data. They have not only a descriptive or analytical role but a normative function in assigning universities in vertical relation to one another without accommodating horizontal diversity.

Even if the rankings suggest something about elite institutions in the top 3% of the world's 17,000 higher education institutions, they suggest nothing about the relative claims of the other 97% and the criteria by which they ought to be judged. Indeed, the 'exclusion' of the majority, or their implied relegation, generates inappropriate pressures for them to emulate those that are ranked and to distort or compromise their own missions in so doing.

Methodological deficiencies of the rankings

The rankings are largely shaped by the limited availability of comparable data. The rankings have a validity problem – the lack of alignment between the evaluative criteria and the measures used – which is most troublesome for comparisons relating to teaching and learning. The data sources for compiling some of the indicators used to derive world university rankings do not capture important outputs of different universities in different fields.

The weights assigned to different indicators within the rankings are arbitrary. There is also no correction for redundant measures – the interactions among the variables. There is no standardisation of the distribution of scores. Several of the indicators in some of the rankings are prone to subjectivity and manipulation. The processes by which the survey data are collected and reported are opaque. The volatility of the rankings reflects their lack of statistical reliability, arising from poor aggregation, without prior standardisation, of different performance indicators for the rankings.

An important implication of these methodological concerns is that shifts up or down in institutional positions do not necessarily reveal substantive changes in institutional performance.

Institutional responses to rankings

The major uses of rankings are:

i. influencing consumer choice, including information and guidance for prospective students, and institutional marketing

ii. benchmarking for improvement, including setting targets and introducing process changes based on practices of highly-ranked institutions

iii. partner selection, including recognition of qualifications or prior study for credit, and choice of institutions for collaboration in research and research training

iv. informing investment decisions, including institutional actions to attract industry and benefactor funding, and government decisions to allocate funds for special programs and centres or to skew allocations through performance incentives linked to rankings.

Some universities have dedicated staff for managing their rankings but one university's position on the rankings cannot be managed simply by its own efforts. This is because of constant change in the operating environment, the efforts of others to improve their positions, and aspects of the rankings tools themselves – both changes in methods of counting and inherent methodological deficiencies – which render year-on-year results volatile and unpredictable.

Public policy implications of rankings

World university rankings have given rise to three relatively new phenomena in public policy: governments targeting the availability of scholarships for their nationals to highly ranked universities internationally; governments limiting the partnering of their home universities to only those foreign universities that are highly ranked; and governments aspiring to have a number of their universities highly ranked or otherwise designated 'world class' institutions through concentrated investments or structured collaborative arrangements, such as clusters and mergers.

As they are currently structured, world university rankings do not relate well to the missions of universities whose principal mission is not research, or at least not internationally-referenced basic research. There are important roles for universities that focus on producing quality graduates for Australian labour markets and providing services, including research translation, testing, survey and other services for businesses and community groups. In this regard, institutional positioning strategies pulled by the current suite of world university rankings which privilege academic research can limit institutional vision and distort mission, and reinforce sameness in aspiration and benchmarks of success.

An important challenge is to develop diverse reference points. For that to happen, three developments will be necessary. First, there will need to be sharper clarity of mission orientation on the part of different universities and other higher education institutions. Second, work will need to be done on developing a richer array of education and service oriented indicators of university capacity and performance. Third, attention will need to be given to describing the array of research orientations.

Australia's relative improvement in several of the world university rankings reflects the plateauing of inputs to US and UK universities, the lagged accounting for the emergent Asian universities, alongside some recent absolute lifts in funding inputs for Australian universities.

The apparent rise of some Australian university positions on the rankings cannot be attributed simply to increased government funding in recent years. A major capital injection was made into research infrastructure in 2009-10, the indexation of Commonwealth payments has been improving since 2009 and there had been an important increase in funding the indirect costs of research, but that has now stalled. Given the lagged nature of rankings indicators, current positions reflect the previous Government's doubling of funding for competitive grants administered by the Australian Research Council and the National Health and Medical Research Council, and growth in revenue from international fee-paying students, alumni and industry. Funding for the Research Training Scheme (RTS) funding per Domestic HDR EFTSU has fallen by over 23% between 2001 and 2012. Block funding through the Institutional Grants Scheme/Joint Research Engagement scheme (IGS/JRE) has declined in real terms over the same period.

The ERA evaluative process itself from 2009 and subsequently has provided incentives, reputational as well as financial, for universities to address areas of weak research performance and build on their research strengths. This sharper focus on research performance may well have influenced factors taken into account by the world university rankings.

For the global reputation of Australian universities to be sustained, within a more diversified higher education system responsive to varying domestic student needs, there will need to be a sharper focus on building on our demonstrable strengths. Diluting the national investment in research will inevitably see Australia falling off the international league ladder.

Australian universities can hold or improve their ranked positions chiefly by strengthening their capacity, performance and visibility in long-term basic and applied research, especially by raising the volume of high quality, highly cited research outputs, including through international co-authoring.

The world university rankings use research metrics linked to the outputs of basic research. On the one hand, concerns arise that the pressure to align institutional behaviours with the rankings measures will lead to a reduction of more socially relevant and commercially useful research. Such concerns imply a need to develop indicators to capture the contributions to innovation through human capital development and knowledge generation and application that are not captured by the metrics used in the current set of world university rankings. On the other hand, we are seeing a convergence internationally in a public policy emphasis on the utility of publicly-funded research, its demonstrable 'impact' and commercialisability, and some spurning of basic research.

Whereas in 1969 basic research represented 76.7% of university research in Australia by 2010 it had fallen to 45.2%. Over the same period applied research increased its share from 19.7% to 46.7%, making it the dominant type of activity. In contrast, the basic research share of all research conducted in US academic institutions has been reasonably stable at around three quarters over the same period (76.7% in 1970 and 74.6% in 2009).

The combination of inadequate investment, social levelling and narrow instrumentalism in policy for higher education and university research is inimical to sustaining internationally-benchmarked excellence.

The rankings phenomenon

Arguably it all started in 1925 when Professor Raymond Hughes, the then President of Miami University in Ohio, initiated a ranking of US graduates schools on the basis of the reputational judgements of a selected group of academic peers across 20 disciplines in 36 institutions. However, it was not until 1983 that the first ranking of national institutions was undertaken by the *US News and World Report*, making inter-institutional comparisons based on metrics derived largely from administrative data reported by institutions for public accountability purposes. *Macleans Guide to Canadian Universities* rankings began in 1991, and the annual issue of that publication which includes the rankings now makes sufficient profit to sustain the entire journal. In Australia, *The Good Universities Guide*, currently published by Hobsons, was initiated in 1991 by Dean Ashenden and Sandra Milligan but it chose to rate rather than rank national institutions and provided indicators by field of education as well as at the whole of institution level, drawn largely from the accountability-based administrative data sets of the central government and with a focus on the teaching function of universities, including student access and equity, retention and completion, student satisfaction and graduate destinations and starting salaries.

It is the rise of global or 'world rankings' that has gained most attention since the appearance of the *Asiaweek* magazine's rankings in 2000, the Swiss Centre for Science and Technology's 2002 'champions league' of research universities, and the Shanghai Jiao Tong rankings in 2003 (later to be called *Academic Ranking of World Universities – ARWU*). The latter captured a surprising level of attention, not least because its methodology was based on objective research-related indicators and the ranking of the top 40 or so institutions had reasonable face validity, even if skewed in favour of US institutions by virtue of their scale of post-World War II Nobel Laureates and highly cited publications (see Table 1).

In 2004, an alternative set of rankings was published by the London Times Higher Education Supplement with a view to providing a European (or at least a British) counterbalance to ARWU by including non-research indicators such as in-bound international students and reputational survey data. These rankings were published until 2009. In 2010 the Times Higher broke off its relations

with Quacarelli Symonds over concerns about bias in its methodology (e.g. low response rates from its surveys, and under-reporting of Humanities and Social Sciences disciplines). QS continued its rankings as a separate exercise but adopted Elsevier's *Scopus* data base. The Times Higher created a new method with Thomson Reuters, using the *Thomson ISI* data base alongside a wider range of reputational and other indicators. In 2008 another set of research-related indicators for a range of disciplines had been initiated by Leiden University. As shown in Table 1, there is a general convergence of the top ranked group of universities, alongside some curious deviations even within that group, e.g. Cambridge ranks vary from 2 to 31, and Rice from 4 to 139.

Table 1. Non-Australian universities on the five main world university rankings, 2012

University	Academic Ranking of World Universities Shanghai JT 2012	World University Rankings THE 2012-13	QS World University Rankings 2012	Leiden Ranking 2011/12	Webometrics July 2012
Harvard	1	4	3	3	1
U Cal Berkeley	4	9	22	8	4
Stanford	2	2	15	5	3
MIT	3	5	1	1	2
Cambridge	5	7	2	31	20
CalTech	6	1	10	6	24
Princeton	7	6	9	2	35
Columbia	8	14	11	17	12
U Chicago	9	10	8	14	18
Oxford	10	2	5	36	25
Imperial	24	8	6	54	
Yale	11	11	7	11	16
UCL	21	17	4	59	43
U Pennsylvania	14	15	12	22	7
Rice U	91	79	120	4	139
U Cal Santa Barbara	34	35	118	7	49
Carnegie Mellon	51	22	49	9	19
Cornell	13	18	14	40	5
Johns Hopkins	17	16	16	38	53
ETH Zurich	59	12	13	18	29
U Michigan	22	20	17	30	13
Duke	36	23	20	28	28
Edinburgh	51	32	21	66	64
U Toronto	27	21	19	87	32
McGill	63	34	18	140	74
U British Columbia	39	30	51	103	35
University of Hong Kong	151-200	35	23	182	108
National University of Singapore	101-150	29	25	83	75
U Auckland	151-200	161	82	299	115

There have been some interesting shifts also in the ranked position of various institutions over time. According to the QS metrics, with only a few exceptions US institutions have fallen at the expense of British, European, Asian and Australian institutions over time. UC Berkeley fell from 2 in 2004 to 22 in 2012 and Stanford from 7 to 15. Berkeley's fall is attributed to input factors: its relatively unfavourable faculty/student ratio and relatively low proportion of international students and faculty (Ince, 2012). The former reflect fiscal constraints in the State of California and the latter is a consequence of the rapid internationalisation of higher education in many countries, except for the US until very recently.

Importantly, albeit regrettably, when institutions have looked good on the rankings they have made unashamed marketing use of them, even where they know at least some of them to be questionable. That usage, whether on billboards on the approaches to major airports or in university media statements, brochures and advertisements, has given even the dubious rankings a veneer of respectability. More than that, such usage has generated pressure for others not so highly ranked to emulate those at the top. While there seems no limit to the creativity of universities to position themselves at or near the top of some set of rankings, the sudden dominance of a few global rankings based on a narrow range of metrics has forced many universities to assess themselves against those metrics and set targets for raising their scores even where it is inappropriate and unreasonable for them to do so. The problem is, however, that there are few available metrics, beyond a basket of research indicators, which can be used for the purposes of international comparisons of universities. This fundamental deficiency in the context of increasing reference to the published rankings puts undue pressure on universities whose missions are less research oriented and makes more urgent the need to develop a wider and more balanced set of indicators.

Interestingly, the ARWU rankings developed by the School of Education at the Shanghai Jiao Tong University (one of the universities given special funding by the Government of China under its 985 and 211 programs in an effort to raise the standing of China's leading universities to 'world-class' status) were initially conceived as a means of exposing how large a gap China had to close to achieve the Government's goals of having world-class universities (Liu, 2009). That is, those rankings were intended as a body of evidence to caution against unrealistic expectations. Ironically, they have become a vehicle for universities and governments around the world to raise their aspirations, in many cases, unrealistically.

Today there is a proliferation of mostly commercial guides, including national and international rankings, many of which report on whole institutions and some on parts of institutions or disciplines (see Table 2 for an indicative but by no means exhaustive list). As Simon Marginson has noted, the number of university rankings is expected to continue increasing but (hopefully) they will become more specialised (Marginson, 2011).

Table 2. National and international rankings of universities, disciplines and departments

Institutional	Discipline/Sub-Categories	Specialist
International		
• Leiden Ranking – Centre for Science and Technology Studies (CWTS) (Netherlands) • Performance Ranking of Scientific Papers for Research Universities [HEEACT] (Taiwan) • Professional Ranking of World Universities (France) • SCImago Institutional Rankings • Academic Ranking of World Universities [ARWU] (China) • QS Top University (UK) • THE Thomson Reuters World University Rankings (UK) • U-Multirank (European Commission) • Webometrics (Spain)	• Business Week MBA • Economist Intelligence World MBA Rankings • Financial Times MBA • Wall Street Journal MBA	• University Systems Ranking. Citizens and Society in the Age of Knowledge (Lisbon Council) • National System Strength Rankings (QS) • Green Metric World University Ranking (Universitas Indonesia)

Institutional	Discipline/Sub-Categories	Specialist
National		
• Chamber of Commerce and Industry (Sweden) • CHE-HochschulRanking (Germany) • Forbes College Rankings (US) • Good University Guide (Australia) • Google College Rankings (Various) • Guangdong Institute of Management Science (China) • Guardian University Guide (UK) • La Republica (Italy) • Macleans On Campus (Canada) • National Accreditation Centre Rankings (Kazakhstan) • Netbig (China) • OHEC (Thailand) • Perspektywy (Poland) • Petersons College Rankings (US & Canada) • Princeton Review (US) • Sunday Times (Ireland) • Times Higher Education University Guide (UK) • University Rankings (Ukraine) • U-rank (Sweden) • USNWR College Rankings (US) • Washington Monthly (US) • Wuhan University Research Centre for Science Evaluation (China)	• Asiaweek MBA School Rankings (2000) • Brian Leiter's Law School Rankings (US) • Dataquest (India) • India Today (India) • Le NouvelObservateur (France) • Mint (India) • Outlook (India) • Sharif Magazine (Iran) • Toplawschools.com (US) • Undergraduate American universities rankings for international students (US) • USNWR Top Med Schools (US) • WPROST MBA (Poland)	• Saviors of Our Cities (US) • Washington Monthly College Guide (US) • Washington Monthly Ranking of Community Colleges (US) • Which? magazine (UK)
Regional		
• AsiaWeek – Asia's Best Universities (Hong Kong) • CHE Excellence Ranking Graduate Programmes • Ranking Iberoamericano (Pan Hispanic)		

Source: Adapted from Hazelkorn, 2011.

The focus of this paper is on the five major global university rankings:

- *Academic Ranking of World Universities* (ARWU) – of 500 universities – produced and published by a group of education researchers at Shanghai Jiao Tong University
- *THE Thomson Reuters World University Rankings* – of 400 universities – published by the London Times Higher Education Supplement
- QS World University Rankings – of 700 universities – produced by Quacquarelli Symonds and published by *US News & World Report and Chosun Ilbo*
- *Leiden Ranking* – of the scientific performance of 500 universities – produced and published by the Centre for Science and Technology Studies at Leiden University, the Netherlands
- *Webometrics* – of all higher education and research institutions worldwide – produced twice a year by the Cybermetrics Laboratory of the Spanish National Research Council.

The methodological approaches of each of these rankings are outlined in Appendix 1.

The position of Australian universities in world rankings

On the five main world rankings of universities Australia has variously 5, 6, 7, 0 and 2 in the top 100. On those same measures Australia has 19, 18, 25, 14 and 16 in the top 500. In the top 100, Australia's performance ranges from 0% to 7%. In the top 500, Australia's performance ranges from 2.8% to 5%. Except for the Leiden ranking, Australia does relatively better at the top end of the international distribution on the measures reflected in the rankings.

All of the Australian universities in the top 200 on any measure are Go8 universities. While the specific positions of universities on the rankings may vary, the clustering of the same institutions within the top band on multiple measures cross-validates a leading group of Australian universities. Table 3 shows the position of ranked Australian universities on the most recent editions of the main world rankings.

Table 3. Australian universities on the five main world university rankings, 2012

University	Academic Ranking of World Universities (Shanghai Jiao Tong) 2012	World University Rankings THE-Thomson Reuters 2012-13	QS World University Rankings 2012-13	Leiden Ranking 2011/12	Webometrics July 2012
ANU	64	37	24	114	84
U Melbourne	57	28	36	163	101
U Sydney	93	62	39	290	117
U Queensland	90	65	46	170	97
UWA	96	190	79	306	324
Monash	101-150	99	61	261	109
UNSW	101-150	85	52	250	116
U Adelaide	201-300	176	102	314	255
Macquarie	201-300	251-275	233	202	337
Flinders	301-400	351-400	342	NR	666
James Cook	301-400	NR	362	NR	681
Newcastle	301-400	276-300	268	382	461
Wollongong	301-400	301-350	264	233	597
Curtin	401-500	NR	258	NR	609
Latrobe	401-500	NR	375	NR	639
Swinburne U T	301-400	NR	496	NR	1044
U Tasmania	301-400	351-400	357	378	470
QUT	NR	251-275	281	367	398
Charles Darwin U	NR	301-350	NR	NR	1474
Deakin	NR	351-400	417	NR	445
Griffith U	301-400	NR	368	412	619
UniSA	NR	NR	293	NR	459
RMIT U	NR	NR	246	NR	387
UT Sydney	401-500	351-400	284	NR	470
Bond	NR	NR	380	NR	1688
Murdoch	NR	301-350	448	NR	793
U Western Sydney	NR	NR	618	NR	640

NR = Not Ranked

Australian universities occupy varying positions on other rankings too. Table 4 shows Australian universities ranked on the *2011 Performance Ranking of Scientific Papers for World Universities*, prepared by the Higher Education Evaluation & Accreditation Council of Taiwan, and the *SIR World Report 2012 Global Ranking*, by SCIMago Research Group using the Scopus research publications data base.

Table 4. Australian Universities ranked by Taiwan HEEAC, 2011, and the SCIMago Research Group, 2012

Performance Ranking of Scientific Papers for World Universities, 2011	SIR World Report 2012 Global Ranking
The University of Melbourne (45)	The University of Sydney (59)
The University of Sydney (70)	The University of Melbourne (62)
University of Queensland (76)	University of Queensland (74)
Monash University (113)	The University of New South Wales (83)
The University of New South Wales (128)	Monash University (112)
The Australian National University (174)	The Australian National University (185)
The University of Western Australia (190)	The University of Western Australia (227)
Walter & Eliza Hall Institute of Medical Research (203)	The University of Adelaide (289)
The University of Adelaide (243)	Queensland University of Technology (499)
Macquarie University (391)	Curtin University of Technology (509)
James Cook University (439)	The University of Wollongong (547)
University of Tasmania (448)	The University of Newcastle (568)
The University of Newcastle (452)	Macquarie University (569)
	Griffith University (576)
	University of Technology Sydney (679)
	University of Tasmania (680)
	RMIT University (708)
	La Trobe University (711)
	Deakin University (714)
	University of South Australia (734)
	Flinders University (763)
	James Cook University (766)
	University of Western Sydney (983)

See Appendix 1 for an outline of the HEEAC and SIR rankings.

Table 5 shows the position of Australian universities on the National Taiwan University Rankings for scientific papers in 2011 and 2012.

Table 5. Australian universities on the National Taiwan University Rankings for scientific papers, 2011 & 2012

University	2011	2012
University of Melbourne	41	35
University of Sydney	66	61
University of Queensland	79	72
Monash University	122	112
University of New South Wales	127	114
Australian National university	160	172
University of Western Australia	162	179
Walter & Eliza Hall Institute	219	207
University of Adelaide	236	252
Macquarie University	373	455
James Cook University	400	465
University of Newcastle	487	465
University of Tasmania	392	477
University of Wollongong	464	NR
Flinders University	486	NR

From these various sources it is evident that while there are changes in the position of some universities on different measures there is a common group of around 20 Australian universities positioned in the top 1,000 on several of the measures.

Some disaggregation of rankings is possible for particular fields and subjects, although field classifications vary by ranking agency. Table 6 shows sub-institutional rankings of the ARWU. For instance, in Life & Agricultural Sciences, UWA, Melbourne and UQ are ranked respectively 26, 42, and 45, and all Go8 universities are ranked within the top 150 in the world. ANU is ranked 30 in Physics and Melbourne 35 in Clinical Medicine and Pharmacy.

Table 6. Australia's Go8 Universities – ARWU Rankings for Fields and Subjects, 2012

Go8 University	Field				
	Natural Sciences and Mathematics	Engineering Technology and Computer Sciences	Life and Agricultural Sciences	Clinical Medicine and Pharmacy	Social Sciences
UMelbourne	101-150	51-75	42	35	101-150
ANU	37	101-150	51-75		76-100
UQ	151-200	76-100	45	51-75	101-150
USydney	101-150	51-75	76-100	101-150	101-150
UWA	101-150		26	51-75	
Monash	101-150	51-75	101-150	151-200	151-200
UNSW	151-200	51-75	101-150	101-150	101-150
UAdelaide			101-150	151-200	

Go8 University	Subject				
	Mathematics	Physics	Chemistry	Computer Science	Economics/ Business
UMelbourne	101-150	76-100	151-200	101-150	76-100
ANU	151-200	30		101-150	151-200
UQ			151-200		101-150
USydney	101-150	101-150	76-100		101-150
UWA			76-100		
Monash			51-75	76-100	151-200
UNSW	76-100		101-150	101-150	101-150
UAdelaide					

Several other field-specific rankings reinforce the impressions of the major institutional rankings but also reveal greater degrees of variation among institutions. In the 2012 *Financial Times Global MBA Rankings*, The Australian School of Business (AGSM) at the University of New South Wales was placed 37 and Melbourne Business School 54 in the top 100 institutions. In the *Economist* ranking of full-time MBA programs the University of Queensland Business School was ranked 27 and the University of Melbourne Business School 38. Two other Australian universities were ranked in the *Economist* top 100 full-time MBAs: Curtin Graduate School of Management at 46 and Macquarie Graduate School of Management at 61. The *Economist* invited 135 business schools to respond to a two-staged survey, one involved responses of students and alumni to a questionnaire (20%) and the other required the schools themselves to respond to questions about career opportunities for graduates, the educational experience of students, increases in graduate salaries and potential for graduates to network (80%).

In 2012, the IDEAS grouped ranked the Business/Economics departments of 5,858 institutions worldwide, drawing on several data bases hosted at the RePEc service of the Federal Reserve Bank of St Louis. The rankings are derived from bibliometric data collected by RePEc, citations analysis performed by CitEc and popularity data compiled by LogEc. Table 7 shows the placement of Faculties and Schools of Australian universities.

Table 7. World Ranking of Australian Business/Economics Departments, 2012

Department/Institution	Rank
Faculty of Business and Economics, Monash University	25
Crawford School, Australian National University	66
Faculty of Business and Economics, University of Melbourne	75
Australian School of Business, University of New South Wales	89
School of Economics, University of Queensland	97
Department of Economics, Faculty of Business and Economics, Monash University	98
School of Economics, Australian School of Business, University of New South Wales	107
College of Business and Economics, Australian National University	121
Research School of Economics, Australian National University	123
Business School, University of Technology Sydney	141
Department of Economics, Faculty of Business and Economics, University of Melbourne	144

In Philosophy, ANU sits within the top 20 on the Philosophy Gourmet rankings (see Table 8).

Table 8. Philosophy Gourmet Rankings of Faculties in the English-Speaking world: Top 20, 2012

School	Rank
New York University	1
Oxford University	2
Rutgers University, New Brunswick	3
Princeton University	4
University of Michigan, Ann Arbor	5
Harvard University	6
University of Pittsburgh	6
Massachusetts Institute of Technology	8
Yale University	8
Stanford University	10
University of North Carolina, Chapel Hill	10
Columbia University	12
University of California, Los Angeles	12
University of Southern California	12
Australian National University	15
City University of New York Graduate Center	15
Cornell University	15
University of Arizona	15
University of California, Berkeley	15
University of Toronto	15

Source: Philosophy Gourmet Rankings of Faculties in the English-Speaking world, 2012

Table 9 shows the position of Australian universities in the broad fields of the National Taiwan University's 2012 rankings for scientific papers. Melbourne ranks at the top of Australian universities in the fields of Medicine and Life Sciences, whereas UQ leads in Agriculture and Engineering, Sydney in Social Sciences, and ANU in Natural Sciences. The standings reflect scale of the quality outputs counted.

Table 9. Australian Universities on Broad Fields Rankings, National Taiwan University Rankings for Scientific Papers, 2012

University	Agriculture	Medicine	Engineering	Life Sciences	Social Sciences	Natural Sciences
Melbourne	41	27	87	33	50	97
Sydney	52	45	106	81	40	
Queensland	12	100	62	51	49	118
Monash	138	90	96	90	75	165
UNSW	117	110	72	108	62	130
ANU	48		236	232	85	90
UWA	55	153		162	140	256
Adelaide	64	190		247	296	
Macquarie	137					
James Cook	74					
Newcastle		276			201	
Tasmania	116					
Wollongong						
Murdoch			298		276	
Griffith	267				231	
Deakin					186	
QUT					215	
La Trobe					223	
UTS					269	
UniSA					270	
Curtin					278	

Source: National Taiwan University

To the extent that the rankings, when taken together, paint a general landscape over which universities spread, they reinforce domestic indicators of relative strengths in academic capacity, performance and reputation. Those domestic indicators (see Appendix 2) include input indicators such as institutional asset strength and annual operating revenue, entry standards of students, progression and completion rates of students, academic staff qualifications, and competitively-won income for research from government and industry, along with output indicators including graduate employment or further learning, graduate income, research publications, citations and measures of esteem, and evaluations of research quality such as the Excellence for Research in Australia (ERA) ratings (see Figure 1).

Figure 1. ERA 2010 Research quality assessment ratings of 4 ('above world standard') and 5 ('well above world standard')

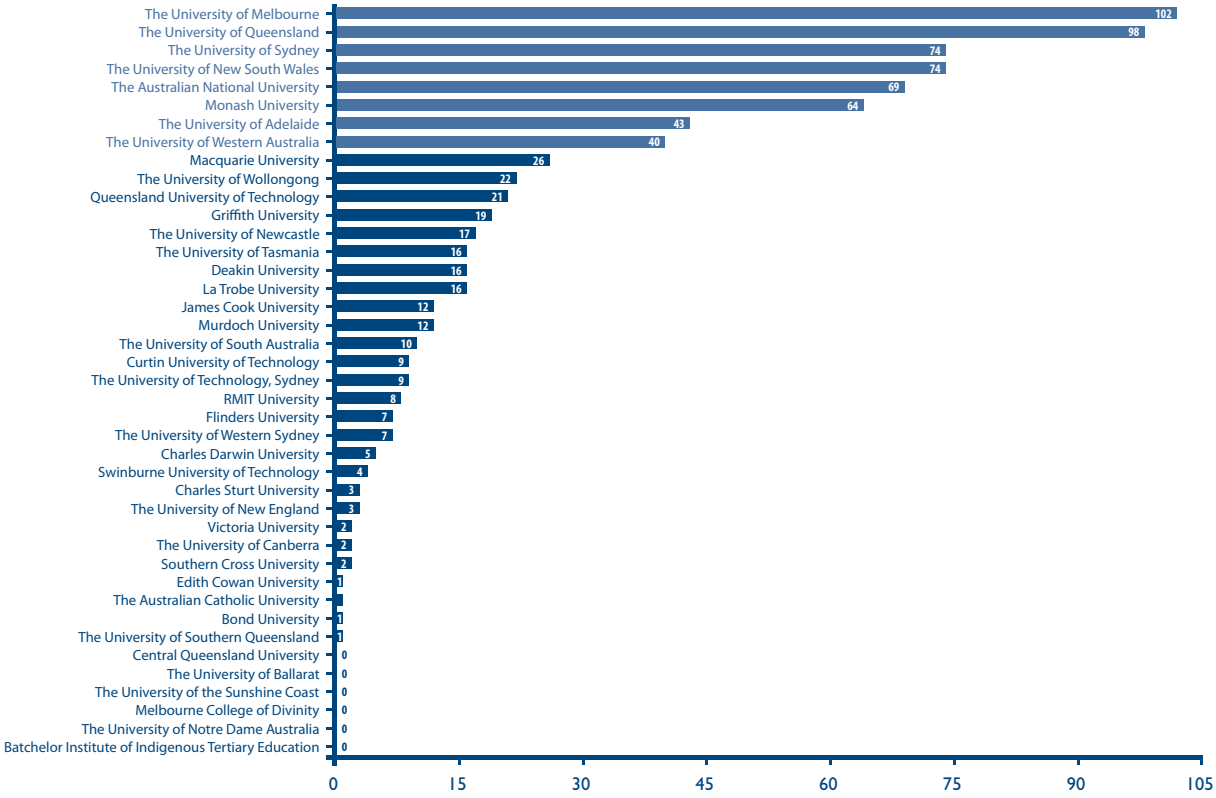

Figure 1 shows the concentration of research strengths (ERA ratings of 4 and 5) among Australian universities. There is a range within the Go8 in terms of the comprehensiveness of research strength, a wide gap between the Go8 and the next ranked universities, and a tail of universities with few if any strong areas of research performance. The concentration is even more apparent when ratings of 5 are compared. Whereas the Go8 universities had multiple fields rated 5 (e.g. 12 in the case of Melbourne and 11 for ANU) there were only nine other universities which gained a 5 rating and for each of them in only one field. Even so, the ERA results confirm the impression given by the various world rankings that there are some 20 or so Australian universities where high quality research is seen to be performed to some extent, and that is important for Australia in serving diverse needs. What differentiates the Go8 is the scale of high quality research performed. Go8 universities are more comprehensive in research, including health and medical research, and have higher numbers and proportions of research students, than non-Go8 universities.

As can be seen from comparing tables 10 and 11, over the period 2006-2010 the Go8 universities have produced ten times the volume of journal articles co-authored with international institutions that the ATN universities produced. Additionally, Go8 universities have greater intensity of co-authorship with the most highly ranked overseas universities.

Table 10. Internationally co-authored papers, Go8 universities, 2006-2010

Institution	Co-authored articles
Harvard University	1480
University of Oxford	1316
University College London	1066
University of Cambridge	1057
National University of Singapore	1035
University of Toronto	920
Imperial College London	878
University of Auckland	846
University of Otago	729
University of Edinburgh	687
University of Washington	640
University of Copenhagen	639
University of California at Los Angeles	590
University of British Columbia	587
Johns Hopkins University	586
King's College London	579
Stanford University	556
University of Bristol	523
University of California at Berkeley	516
University of Manchester	513
University of Tokyo	507
University of Glasgow	477
University of Leeds	474
University of Michigan	472
Chinese Academy of Sciences	469
University of California at Davis	465
University of Hong Kong	457
University of Hawaii	454
University of Pennsylvania	448
Columbia University	447
Nanyang Technological University	442
University of Alberta	437
Karolinska Institutet	435
CNRS	427
University of California at San Diego	406
Hong Kong Polytechnic University	400
University of Birmingham	400
University of Southampton	398
University of Wisconsin	396
McGill University	392
University of California at San Francisco	388
California Institute of Technology	387
University of Minnesota	385
University of Pittsburgh	380
Peking University	375
Cardiff University	375
Lund University	372
University of Aarhus	371
University of Zurich	361

SciVal Spotlight Co-Citation Analysis, 2012 Elsevier

Table 11. Internationally co-authored papers, ATN universities, 2006-2010

Institution	Co-authored articles
Hong Kong Polytechnic University	162
National University of Singapore	159
Chinese Academy of Sciences	114
University of Hong Kong	110
University of Manchester	107
City University of Hong Kong	105
University of Cambridge	88
University of Otago	84
Sun Yat-Sen University	78
Peking University	77
Nanyang Technological University	77
University of Toronto	76
University of Auckland	74
Harvard University	74
Eindhoven University of Technology	73
University of Calgary	69
McGill University	64
Harbin Institute of Technology	63
University of Nottingham	63
Zhejiang University	61
CAS - Guangzhou Institute of Geochemistry	61
University of California at Los Angeles	61
CAS - Institute of Geology and Geophysics	60
University of Bristol	60
University of Oxford	60
University College London	59
Tsinghua University	57
Karlsruhe Institute of Technology KIT	57
Chinese University of Hong Kong	56
Nanchang University	55
University of Copenhagen	54
University of Alberta	52
University of Michigan	52
University of Sheffield	51
University of Pennsylvania	51
University of Washington	51
Graduate University of Chinese Academy of Sciences	49
World Health Organization	49
University of Newcastle upon Tyne	48
University of Cape Town	47
ETH Zurich	47
Erasmus University Rotterdam	47
Massey University	46
King's College London	46
University of British Columbia	46
Pennsylvania State University	46
Imperial College London	45
University of Waterloo	45
Shanghai Jiaotong University	44

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The position of Australia's leading universities on world rankings may also be construed as validating judgements of relative international standing, or indications of comparable peers for purposes of collaboration or partnering. Table 12 shows the placement of Australia's leading universities on the ARWU rankings alongside the top research universities of North America, i.e. members of the Association of American Universities (AAU). Clearly Australia's public universities do not match the strength of the US Ivy League but they position reasonably well against the land-grant public four-year colleges.

Table 12. ARWU Rankings 2012: Association of American Universities (AAU) and Go8

Harvard University	1	Purdue University	56
Stanford University	2	The University of Melbourne	57
Massachusetts Institute of Technology	3	University of Pittsburgh	58
University of California, Berkeley	4	Rutgers, The State University of New Jersey	61
California Institute of Technology	6	McGill University	63
Princeton University	7	The Australian National University	64
Columbia University	8	Brown University	65
University of Chicago	9	The Ohio State University	65
Yale University	11	University of Florida	72
University of California, Los Angeles	12	University of Arizona	77
Cornell University	13	Indiana University Bloomington	84
University of Pennsylvania	14	University of Rochester	86
The Pennsylvania State University	14	The University of Queensland	90
University of California, San Diego	15	Rice University	91
University of Washington	16	The University of Sydney	93
Johns Hopkins University	17	Texas A&M University	93
University of Wisconsin-Madison	19	The University of Western Australia	96
University of Michigan, Ann Arbor	22	Michigan State University	96
University of Illinois at Urbana-Champaign	25	Case Western Reserve University	99
New York University	27	University of Virginia	102
University of Toronto	27	Emory University	109
University of Minnesota, Twin Cities	29	University of Iowa	118
Northwestern University	30	Monash University	138
Washington University in St Louis	31	The University of New South Wales	142
University of Colorado at Boulder	33	Iowa State University	164
University of California, Santa Barbara	34	Stony Brook University (the State University of New York at Stony Brook)	188
The University of Texas at Austin	35	University of Nebraska-Lincoln	197
Duke University	36	The University of Adelaide	221
University of Maryland, College Park	38	University of Kansas	230
University of North Carolina at Chapel Hill	41	University of Missouri	245
University of California, Irvine	45	University of Oregon	260
University of Southern California	46	University of Buffalo, The State University of New York	272
University of California, Davis	47	Brandeis University	276
Vanderbilt University	50	Tulane University	323
Carnegie Mellon University	51	Syracuse University	392

Table 13 compares ARWU rankings for the Go8 and Canada's U15 group of research-intensive universities. This general fit of the leading universities of two major second world powers with dominant English colonial backgrounds is not unexpected.

Table 13. ARWU Rankings 2012: Canada U15 and Go8

University of Toronto	27	The University of New South Wales	142
University of British Columbia	39	University of Waterloo	198
The University of Melbourne	57	University of Calgary	204
McGill University	63	University of Western Ontario	211
The Australian National University	64	The University of Adelaide	221
McMaster University	92	Queen's University	237
The University of Queensland	90	University of Ottawa	249
The University of Sydney	93	Dalhousie University	253
The University of Western Australia	96	University of Saskatchewan	262
University of Alberta	108	Laval University	265
Université de Montréal	132	University of Manitoba	286
Monash University	138		

Australia's research-intensive universities also compare well with the UK's Russell Group, as shown in Table 14. While Australia cannot quite replicate the special character of Oxford, Cambridge, UCL and Imperial, there is not a great distance between the next group of strong research universities, what Warwick Vice-Chancellor Nigel Thrift refers to as the 'fertile crescent' of universities "without the natural advantages of the big four which has been one of the true success stories of the British higher education sector in the years since the 1960s" (Thrift, 2009).

Table 14. ARWU Rankings 2012: Russell Group (UK) and Go8

The University of Cambridge	5	The University of Birmingham	110
The University of Oxford	10	The University of Sheffield	106
University College London	21	London School of Econ. & Pol. Sci.	120
Imperial College	24	The University of Liverpool	126
The University of Manchester	40	Monash University	138
University of Edinburgh	51	The University of New South Wales	142
The University of Melbourne	57	The University of Leeds	153
The Australian National University	64	The University of Glasgow	159
King's College London	68	Cardiff University	160
The University of Bristol	70	The University of Southampton	164
The University of Nottingham	86	The University of Warwick	177
The University of Queensland	90	Newcastle University	216
The University of Sydney	93	The University of Adelaide	221
The University of Western Australia	96	Queen's University Belfast	327

The up-sides of being well ranked and reasonably well ranked

Being placed among the top universities in the world on a range of rankings has reputational and strategic positioning advantages for individual universities and their home countries, and status benefits for the students and alumni of institutions. While the benefits may be intangible – they may motivate a university's internal community and give confidence to its external community – they can also have material effects on graduate employment and earnings, and institutional revenue from student recruitment, industry funding, philanthropic giving and government investment, as well as opening up opportunities for networking and partnering.

High positional rankings of universities, even if they are based only on a limited set of research metrics, signal capability to the world – research capacity, facilities, expertise and linkages. To the extent that they attract talent (students and staff) and investment (R&D) they can be powerful drivers of expanding capability.

Interestingly, none of the major world rankings provide direct measures of teaching and learning quality, even though they are referenced by prospective international students as a guide to relative educational quality and prestige (IDP forthcoming). Largely because they reflect, or purport to reflect, core values of the academy, world university rankings indirectly underpin the reputation of national qualifications and the international education industry. The rankings function, however obliquely, to confirm claims to international standing and indicate that graduates can take their place in work and further learning anywhere in the world.

However, it is this usage of the rankings that is the most problematic for two reasons: first, it involves inferences about educational quality that cannot be drawn necessarily from the information provided but, rather, are derived from assumed relations among academic functions of the traditional university of the period of elite participation; and second, it fails to distinguish between different orientations to teaching and learning in different institutions and the corresponding differences in attributes of graduates.

Horta (2009) distinguishes between 'prominent national universities' – those with the greatest capacity or strongest performance with regard to other institutions in a country – and 'prominent global universities' – those that are world leaders in terms of their capacity and performance. This is to acknowledge that a dominant national position may fall well short of global prominence, that "success at the top of the system is determined in the international league of champions not the national league" (Teichler, 2006). What matters most is how well the best national universities of a particular orientation compare with the world's best with a similar orientation – for that sets the peak achievement standards for the system. It is not possible for a nation to have a 'world class higher education system' without some 'world class universities'. That status is not referenced to the performance mean of the world's universities ranging from Azerbaijan to Zimbabwe but rather to those sets of institutions which define the class of world leaders in higher education and research.

Importantly, there are multiple orientations among universities and there should be therefore multiple sets of criteria for evaluating what constitutes 'leading' and who measures up.

The rankings also imply broader institutional capacities (e.g. good university governance & management) even though the efforts being captured by the rankings metrics are chiefly those of individual researchers and groups of researchers. The point of good university governance is to create the room for academic achievement – through cultural values, financial incentives, physical facilities, clear focus on strategic directions and responsiveness to changing circumstances. To

some extent the rankings can reflect, and also influence, corporate university investment priorities in facilities and talent, such as key centres in fields of knowledge. Nevertheless, one university's position on the rankings cannot be managed simply by its own efforts. This is because of constant change in the operating environment, the efforts of others to improve their positions, and aspects of the rankings tools themselves – both changes in methods of counting and inherent methodological deficiencies – which render year-on-year results volatile and unpredictable.

The danger of complacency

Australia may be seen to have advanced from 14 universities in the top 500 in 2005 to 19 in 2012 on the research-focused ARWU scale – an apparent rise for 5 universities, although some institutions have slipped in their positions over that period. However, over the same period, China has moved from 8 to 28 universities in the top 500 – an apparent rise of 20 universities. These are apparent rises because there have also been changes to the calculation of some of the metrics over the period to the relative advantage of particular institutions.

Importantly, the indicators used in all of the major university rankings are necessarily lagged. In the case of the ARWU rankings, the Highly Cited indicator is based on cited research on the Web of Science database for the period 1981-2008. Yet since 2002, India and South Korea have overtaken Australia in research output and China has outstripped Australia's output four times. Concurrently, all developed economies, other than the US, UK and Finland, have increased their number of citations per paper at a faster rate than Australia (Barlow, 2011). Thus we can expect to see Asian universities rising further in the rankings as more current indicators of research performance are factored into the rankings metrics.

It is not that Australia has a large lead on the upcoming countries. Australia is ranked 10 among 40 countries in terms of publications in the top quartile journals per million dollars GDP (OECD, 2012). Australia's performance falls below the OECD mean on the scale of international co-authorship as a proportion of total scientific articles produced, and is ranked 26 out of 46 countries. Ireland is ranked 13, New Zealand 14, the Netherlands 11, Switzerland 4 and Indonesia 3 (OECD, 2012).

Australia's apparent rise at the top end of the ARWU scale has been influenced in part by recently awarded Nobel laureates from UWA (2005) and ANU (2011). Where Nobel winners are on staff they contribute one fifth of the SJT rank score. Robin Warren and Barry Marshall of UWA made their discovery of the *Helicobacter pylori* bacterium in 1982. Brian Schmidt (ANU) produced his paper (with Saul Perlmutter and Adam Reiss) on the expanding universe in 1998. A tapered weight of 10 per cent is given for former students and staff of a university who are awarded a Nobel Prize. Peter Doherty, an alumnus of UQ, shared a Nobel Prize in Physiology with Swiss Professor Rolf Zinkernagel for work on the immune system he carried out at ANU between 1973 and 1975.

A comparison of raw rankings across countries can give misleading impressions of performance relative to scale and capacity. Figure 2 compares the number of top ranked universities on the 2012 ARWU rankings by country per million population and per USD 1,000 of Gross Domestic Product per capita. The US and China stand out as achieving a high apparent outcome relative to economic capacity but a lower outcome per head of population. Australia and the UK have commensurate outcomes per head of population but the UK achieves more than Australia relative to economic capacity.

Figure 2. Number of universities in the ARWU top 200 per million of population and US$1000 of GDP per capita, 2012, by selected country

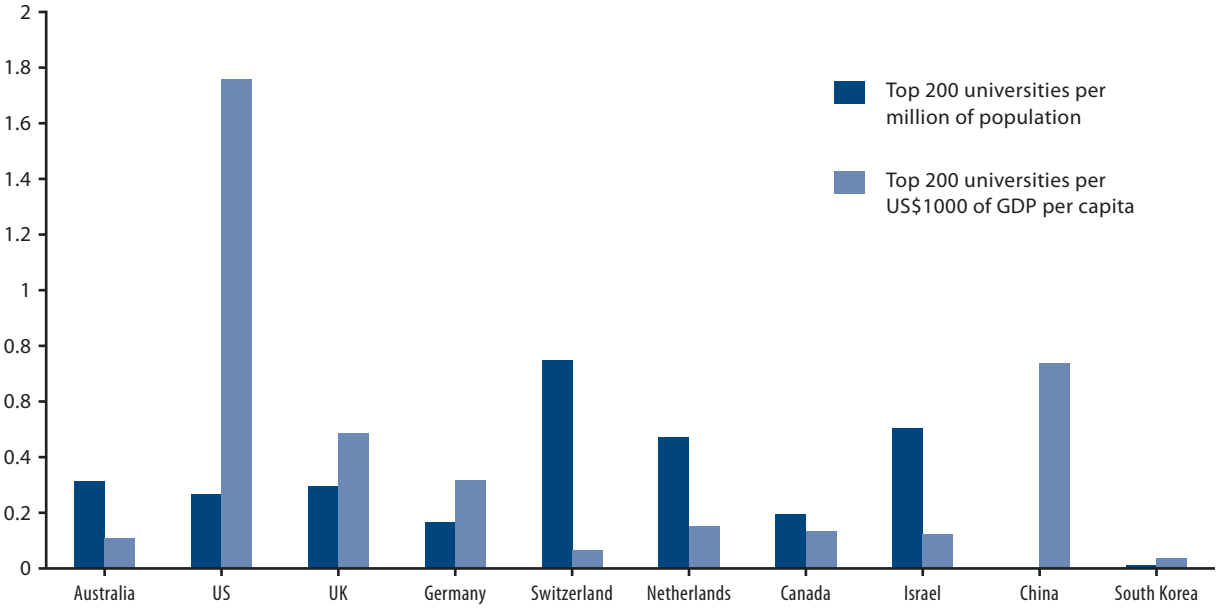
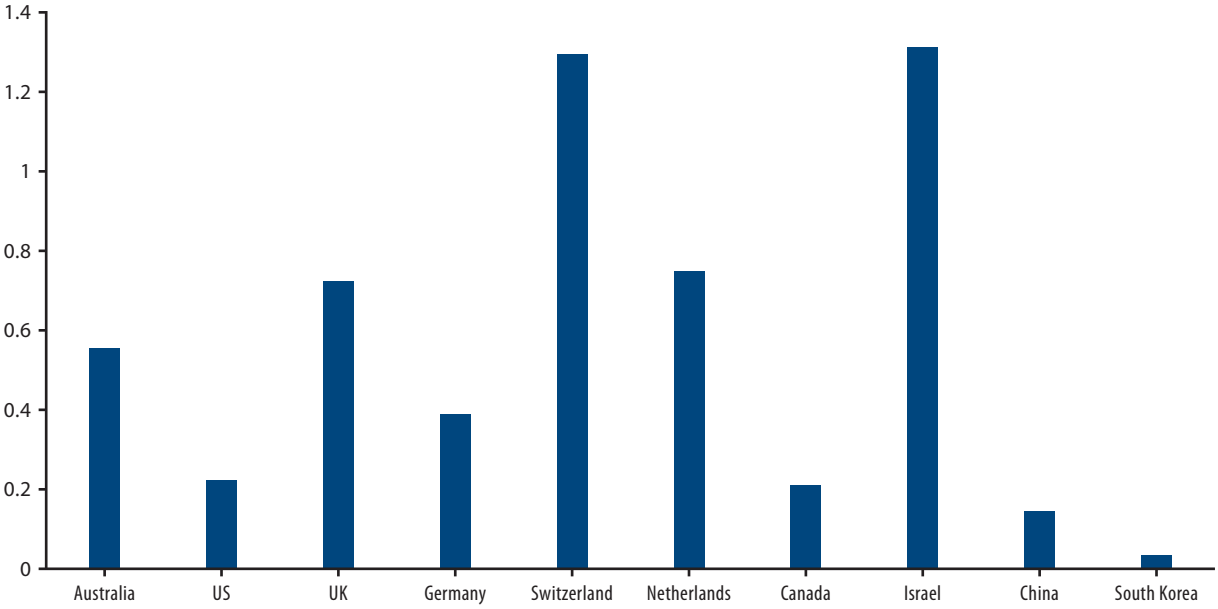


Figure 3 compares ARWU rankings per USD 1,000 million invested in tertiary education. With regard to 'return on investment', Australia appears to perform much better than some countries (including the US), but not nearly as well as Israel, Switzerland, the UK and the Netherlands. This suggests that the latter focus a higher proportion of their tertiary education funding on university research than Australia which gives priority to student participation.

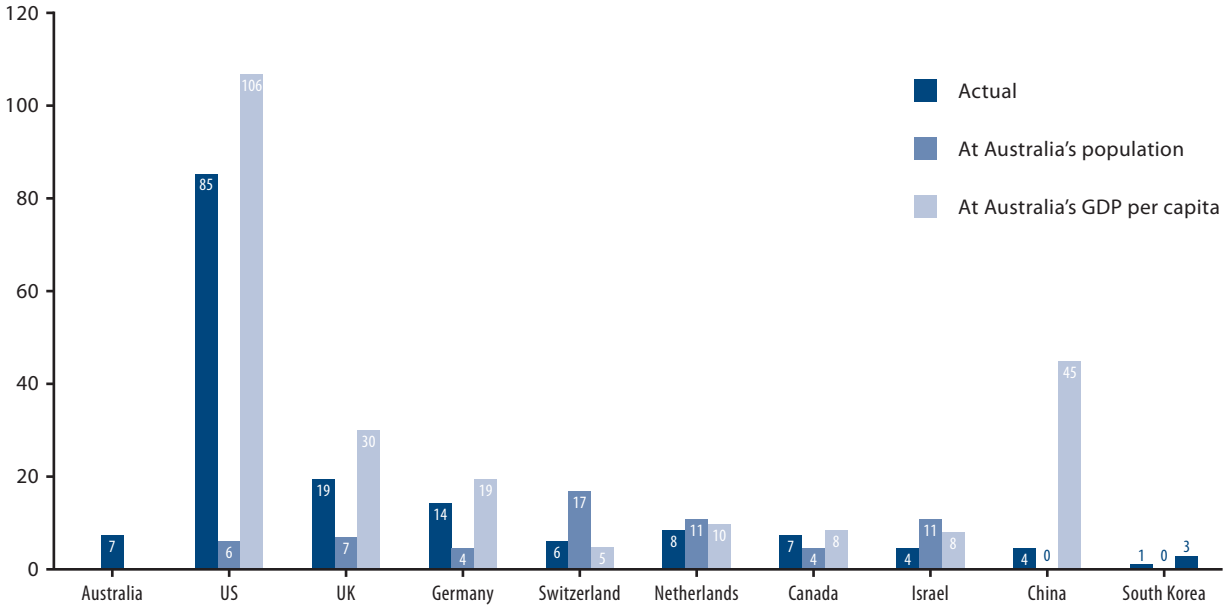
Figure 3. Number of universities in the ARWU top 200, by selected country, per billion dollars (US) spent on tertiary education institutions



Note: ARWU rankings are for 2012; expenditure data are from OECD Education at a Glance 2011 (2008 data). Expenditure includes both public and private sources, except for Switzerland, for which no private expenditure data are available. Data for expenditure on tertiary education institutions was not available for China.

Figure 4 normalises the 2012 ARWU rankings for national population size and wealth (GDP per capita) referenced to Australia. The graph shows the number of universities in the top 200 by country, plus what the number 'would be' assuming the same relationship between ARWU performance and national population and GDP, respectively, if each country had the same population and GDP per capita as Australia. In general, Australia punches above its demographic weight, getting more universities in the top 200 per million of population than several of the biggest countries with strong universities (US, UK, Germany). Several countries smaller than Australia do better on a per capita basis (the Netherlands, Denmark, Sweden and Israel). Australia's performance is not especially distinguished once our high GDP per capita is controlled for. The US performs vastly better, while the UK and Germany are also decidedly ahead of Australia. Other small, prosperous countries are comparable to Australia, while Canada is slightly ahead. Most interestingly, China is well ahead of Australia on this measure, and out-performs other advanced countries too – with the sole exception of the US.

Figure 4. Number of universities in the ARWU top 200, by selected country, 2012: actual, normalised to Australian population and Australian GDP per capita



Population data are taken from the Population Reference Bureau's World Population Reference Sheet for 2012 (i.e. 2012 estimates). GDP per capita data are 2011 figures from the World Bank, in current US dollars.

Figure 5 shows relative ranking outcomes on the THE Thomson Reuters rankings. This ranking improves the performance of the UK, European and Australian systems relative to the US and China.

Figure 5. Number of universities in the THE Thomson Reuters top 200, by selected country, 2011-12: actual, normalised to Australian population and Australian GDP per capita

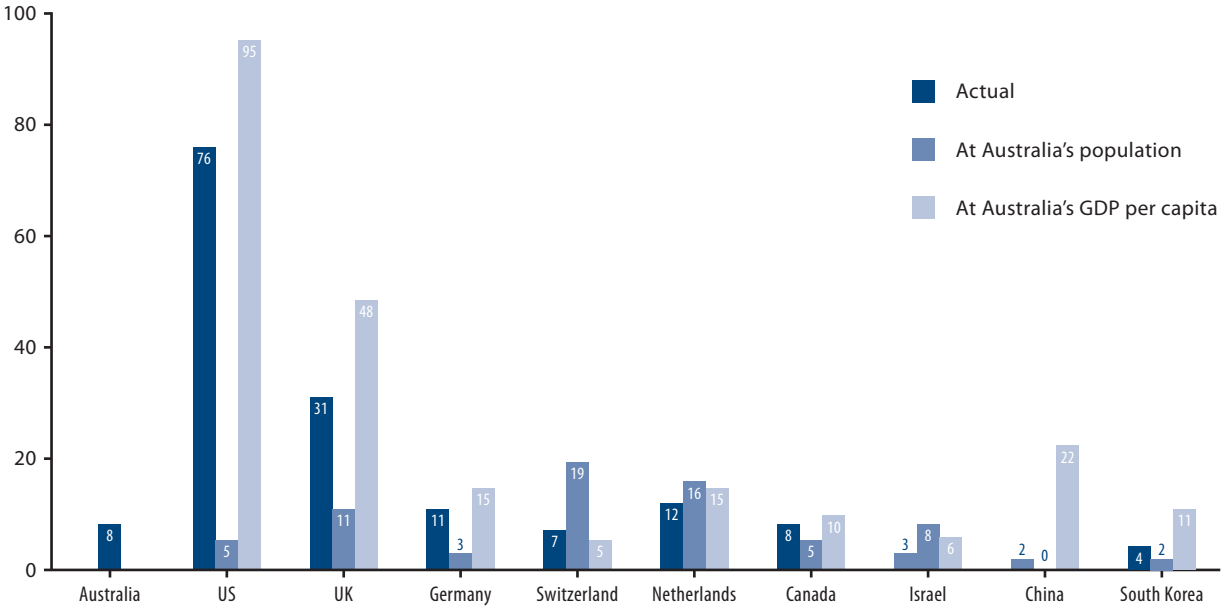
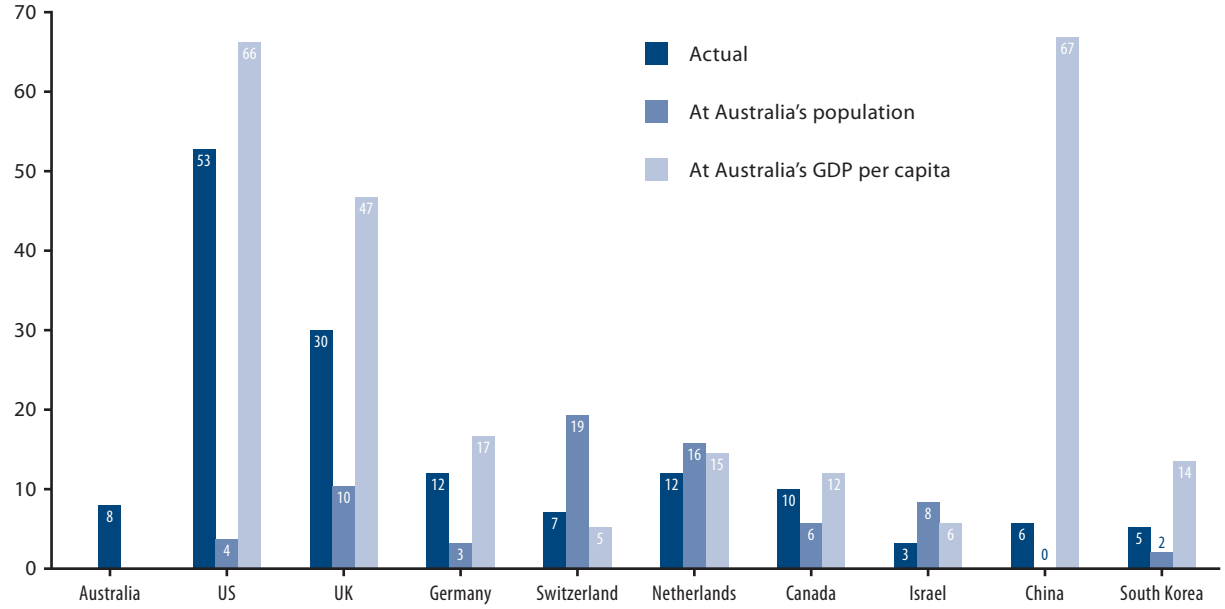


Figure 6 shows the QS top 200 in 2011 by country normalised to Australia's population and GDP per capita. Interestingly, although Australia has a slightly better actual performance on the QS ranking than on the ARWU and THE-TR rankings, Australia's relative performance is weaker than on those other measures.

Figure 6. Number of universities in the QS top 200, by selected country, 2011: actual, normalised to Australian population and Australian GDP per capita



An evident trend in recent THE and QS world rankings is the appearance of new universities, notably those from countries not previously represented in the rankings. This trend reflects in part the influence of demographic factors on the reputational surveys which count towards institutions' scores on the THE and QS measures. Importantly, many Asian institutions are recipients of increased government investment in higher education and university research, substantially so in China. In contrast, several former leading universities in the US and the UK are experiencing the effects of disinvestment as government funding falls and annual returns from university funds under investment deteriorate. The shift of relative input strength in favour of Asian universities will show through in the rankings that make use of input measures.

Efforts by the university rankers to improve their methods, including efforts to reduce country bias in reputational surveys, and to expand the country markets for their rankings, suggest that the earlier dominance of universities of the developed economies of North America, Britain and Europe will decline over time. This tendency will be more evident in those rankings, such as THE and QS, that put less weight on the scale of high quality research.

A comparison of the position of top ranked Asian universities on the THE-Thomson Reuters ranking shows a relatively stable group of leading Asian institutions over the last three years, with Singapore's two leading institutions rising (see Table 15).

Table 15. Asian universities in the top 200 of the THE World University Rankings, 2010, 2011 & 2012

Institution	2010	2011	2012
Tokyo University	26	30	27
National University of Singapore	34	40	29
University of Hong Kong	21	34	35
Peking University	37	49	46
Tsingua University	58	71	52
POSTECH	28	53	50
Kyoto University	57	52	54
Hong Kong University of Science & Technology	41	62	65
KAIST	79	94	68
Nanyang Institute of Science & Technology	174	169	86
Chinese University of Hong Kong	NR	151	124
Tokyo Institute of Science & Technology	112	108	126
National Taiwan University	115	154	134
Tohuku University	132	120	137
Osaka University	130	119	147
City University of Hong Kong	NR	193	182
University of Science & Technology China	49	192	NR

The more dynamic developments are within the next tier of Asian universities. Those in the top 400 in the THE 2012-13 rankings include, in order: Fudan University; City University of Hong Kong; Yonsei University; Hong Kong Polytechnic University; IIT Bombay; Nanjing University; Tokyo Metropolitan University; Kyushu University; Renmin University of China; Shanghai Jiao Tong University; Tokyo Medical and Dental University; National Cheng Kung University; Hokkaido University; Hong Kong Baptist University; National Sun Yat-Sen University; Sun Yat-Sen University; University of Tsukuba; Zhejiang University; National Central University, Taiwan; IIT Roorkee; Keio University; King Mongut's University of Technology, Thonburi; Waseda University; National Taiwan University of Science and Technology.

Australian universities may appear to be improving against the backdrop of decline in the US and the UK, whereas they may well be slipping behind the emergent Asian leaders.

Methodological concerns

Since the appearance of the Shanghai Jiao Tong (ARWU) rankings in 2003 there has been a proliferation of critiques of rankings methodologies (see for instance: van Raan, 2007; Salmi & Sayoran, 2007; HEFCE, 2008; Billaut et al, 2010), and various efforts on the part of the rankers themselves to respond to the criticisms and improve their methods (Longden, 2011).

A core criticism is that the rankings are largely shaped by the limited availability of comparable data, rather than by any concept of desirable indicators (Teichler, 2011). This criticism is not entirely fair given the considerable effort involved by the academy and publishing houses to develop serious measures of leading research. The validity problem – the lack of alignment between the evaluative criteria and the measures used – is most troublesome for comparisons relating to teaching and learning. Nor can such a criticism be levelled only at university rankings. An alternative to rankings, the U-Map project, also suffers from the same limitation (see Box 1). For example, U-Map has no indicators of quality of teaching and learning; it uses start-ups and patents as proxies for knowledge exchange, not because they inform about knowledge exchange but because there are data available. Similarly, international orientation does not include any measure of curriculum internationalisation. The appropriate response to the data-related criticism is to limit the application of research-based rankings to research-intensive universities, and to construct other measures for teaching-intensive universities and other higher education institutions.

Box 1. U-Map dimension and indicators

Teaching and learning profile	Student profile	Research involvement
• Degree level focus • Range of subjects • Orientation of degrees • Expenditure on teaching	• Mature students • Part-time students • Distance learning students • Size of student body	• Peer reviewed publications • Doctorate production • Expenditure on research
• Involvement in knowledge exchange	• International orientation	• Regional engagement
• Start-up firms • Patent applications filed • Cultural activities • Income from knowledge exchange activities	• Foreign degree seeking students • Incoming students from international exchange programmes • Students sent out in international exchange programmes • International academic staff • The importance of international sources of income in the overall budget of the institution	• Graduates working in the region • First year bachelor students from the region • Importance of local/regional income sources

Source: van Vught et al., 2010

A second basic criticism of rankings is that they are biased by favouring English-speaking, research-intensive institutions with strengths in natural sciences. One could add to the bias in that the rankings tend to favour older, well-resourced prestigious universities. However, the bias does not derive from any prior selecting of such institutions but from the choice of output indicators, such as highly cited journal articles, which some institutions produce more than others. The ARWU, for instance, gives weight to articles published in *Nature* and *Science* to the disadvantage of disciplines which publish elsewhere.

Differences in the communication channels of disciplines are generally not respected by the main world university rankings. Yet publishing practices are very diverse (Sparks, 2005). Whereas journals are important in medical and biological sciences, e-prints and technical reports are important in the physical sciences and engineering, as are peer-reviewed conference proceedings. Professional magazines are important in fields like accounting, business, commerce, law, management, and public health. Monographs, book chapters and other books are important for languages and area studies. Some specific disciplines and cross-disciplinary studies, rely more than others on publishing via artefacts, exhibitions, patent applications, performances, and software. Some fields of engineering, for instance, make substantial use of conference proceedings and other outlets which are determined according to the relevance of the research to national and international industries (Kaufman & Kasztler, 2005). In the field of Law, except for areas of international law, research and scholarship is typically context-dependent or jurisdiction-specific and referenced to legislative issues in local parliaments and case law developments in local courts. In the Australian context, scholarly publications in Law include the *Federal Law Review, Sydney Law review, Melbourne University Law Review, Australian Business Law Review, Australian Journal of Family Law*. While these may be well regarded locally their articles are not necessarily cited widely in the international literature.

Additionally, the research output measures of the world university rankings, especially citation impact, favour discipline-based over cross-disciplinary research, and basic over applied research.

Consequently, the data sources for compiling some of the indicators used to derive world university rankings do not capture important outputs of different universities in different fields. On the one hand, the rankings tend to under-rate the significance of research for local uses and under-estimate the strengths of those institutions whose outputs are not highly visible on the indicators selected by rankers. On the other hand, in the changing global context, some of the data collection biases of the current suite of world university rankings may become less potent as non-Anglo researchers increase their co-authored publications, as non-English publications gain international traction, and as open source publishing becomes more common – to the extent that it is not limited by counter-terrorism efforts.

A third criticism is that the weights assigned to different elements within the rankings metrics are arbitrary. Clearly that is so; none of the rankings has derived its weights from any conceptual framework or statistical procedure. Different institutions could well be ranked higher or lower if the weightings were varied. However, the problem is that there is no consensus on any 'best fit' set of weights. For instance, the AWRU gives 30% to Nobel Laureates. Perhaps laureates should not be included at all, as their inclusion reflects a neo-Confucian view of leadership in university research and education, and give higher weights to other indicators; but if they are to be included as a proxy for a university culture that enables exceptional performance at the peak of intellectual attainment, they must be accorded significance.

Nevertheless, there are basic statistical problems with the way world university rankings are constructed. It is not only that weights are assigned arbitrarily to different indicators. There is also no correction for redundant measures – the interactions among the variables. Additionally, while some of the rankings normalise the data for some indicators, there is no uniform or systematic standardisation of the distribution of scores. Hence, indicators with a wide spread of scores (e.g. 10-90) will have a greater influence on the final score than those indicators with a narrower spread (e.g. 40-65) – before any weights are applied (HEFCE, 2008).

A fourth (and related) criticism relates to the subjectivity of several of the indicators in some of the rankings, and their proneness to manipulation. The THE-Thomson-Reuters rankings give 15% and 18% respectively to teaching reputation and research reputation, a total of one-third. QS gives 40% to academic peer review and 10% to recruiter review, a total of one half. The reputation surveys

have experienced problems of low response rates with potential non-response bias, country sample bias and rater bias. Importantly, the processes by which the survey data are collected and reported are opaque, in terms of populations surveyed, questions asked, response rates and classification of responses. Such lack of transparency for such a high level of ranking dependency on the subjective measures undermines confidence in the published rankings, even if the rankers seek to reduce transparency in order to minimise the risk of institutional gaming.

One could argue that peer review is a longstanding basis for determining and validating quality in academic matters, and that for all its faults, like democracy, it is hard to find a better model. Nevertheless, peer review is not without its faults and much depends on which peers are involved in making judgements (Aguillo et al, 2010; Bookstein et al, 2010) and the range of criteria they apply (Scott, 2006). Additionally, there is the risk of gaming, such as through exercises to increase the number and preferences of peer reports. Other indicators, such as student staff ratios and the inclusion of publishing outputs by researchers of affiliated institutions, are also prone to institutional manipulation.

A fifth line of criticism is that there is no theorised balance between input, process and output indicators and no attempted relationship between such indicators, such as to identity value added. THE-Thomson-Reuters and QS rankings mix input and output indicators without an underlying rationale. Using only output indicators could be unfair (if fairness should be a consideration in assessing excellence) when comparisons are not made on a like-to-like basis in terms of scale. Significantly, inputs matter in higher education no less than in other systems where they function as means to control outputs. Indeed to the extent that learning is co-produced, student and teaching staff inputs matter substantively. Additionally, learning quality is influenced by the 'customer-input-technology' of bright students asking probing questions just as much as by quality teachers. Research output is dependent on the inputs of good researchers with adequate resources to do their work. Seeking measures of value added in discovery and learning assumes a purpose beyond simply ranking, including but not limited to improvement, and it would add enormously to complexity and data gathering even if any linear relationship were apparent.

The final line of methodological criticism is that the rankings are so volatile over time that their reliability must be doubted. Considerable changes have been made to the methods used by rankers as their techniques have been evolving. A greater number of institutions have been included each year as rankings become more widespread. Corrections have been made progressively to data collection and reporting errors. The last three versions of the THE – Thomson Reuters rankings illustrate the impact of these revisions, just for Go8 universities alone, blurring relative improvements in institutional capacity and performance (see Table 16). These data are subject to sampling errors, yet no variance measures or confidence intervals are reported.

Table 16. Changes in the rankings of Go8 universities on the THE rankings, 2010, 2011 & 2012

Go8 University	2010-11	2011-12	2012-13
Melbourne	36	37	28
ANU	43	38	37
Sydney	71	58	62
Queensland	81	74	65
Monash	178	117	99
UNSW	151	173	85
UWA	NR	189	190
Adelaide	73	201-225	176

The problem of volatility arises in part from poor aggregation, without prior standardisation, of different performance indicators for the rankings (Longden, 2011). Accordingly, a recent study comparing the rank order correlations of three different rankings – Webometrics, THE Thomson-

Reuters and ARWU –found weak correlations below the top 40 institutions and volatility of ranked positions over time (Sawyer, 2012). The authors concluded that the rankings are highly subject to the opinion preferences of the rankers:

> "For the rankings of universities, when we considered the three ranking measures for 2011, we found a very high rank correlation across the measures for the top ten universities. It would be difficult to imagine that any ranking measure could omit Harvard, MIT, Stanford, Oxford, Cambridge, Princeton, UC Berkeley from its top ten.
>
> But for universities ranked in the fifth decile, that is 41st to 50th, it's an entirely different story. There's a very low rank correlation across the three measures in 2011; that is, very little agreement as to the rankings, suggesting greater uncertainty and opinion dependence. But, more importantly, in the lower deciles, the volatility of rankings over time is appreciably greater, reinforcing the notion that these rankings are more uncertain.
>
> And for the lower deciles, cross-correlations over time across rankings are very low, again suggesting opinion dependence, rather than measurement. Universities are long-term institutions and their rankings should not change so quickly; nor should the divergence between measures change so quickly" (Sawyer, 2012).

An important implication of these methodological concerns is that shifts up or down in institutional positions do not necessarily reveal substantive changes in institutional performance. In this regard, two forces appear to be acting concurrently. One is a mostly upward force through gaming, whereby some institutions work to maximise their ranking scores by increasing inputs or outputs measured by the rankers. The institutions may do nothing different other than to report what they do differently (e.g. faculty/student ratios), or they may achieve a rise in an indicator value because they have paid particular attention to it (e.g. appointment of international faculty or highly-cited researchers). The other is a mostly downward force through slips in the rankings by one as a consequence of gains by others rather than as a result of its own actions. The slippage may be a factor of, in the technical language of statistics, 'noise' – changes in contributing factors to scores that are not statistically significant or are redundant. A position in the rankings may be lost because of a fall in an institution's relative mean score on one or more of the sub-indicators used to derive the rank score. As noted above, the means of the indicator scores and the sets of scores whose means are aggregated (apart from Webometrics) are not standardised. Nor are standard error bars reported.

The lay community in Australia is familiar with the error bar, or margin of error, of plus or minus 3 points used in national opinion polling; if a party gains 2 points in its primary vote, we know not to assume that must involve a real change in voter sentiment, as the apparent gain is within the ±3 points error range of the polling estimates. There is also some appreciation of the fact that the polls are backward-looking indicators rather than forward predictors. But with university rankings the noise in changes to institutional means is translated into actual shifts in rankings without caveats. Apparent year on year shifts of institutions in the rankings may be given disproportionate attention, especially as they carry a tail of legacy indicators embedded in their metrics.

Improvements to rankings methods over the last several years notwithstanding, fundamental concerns remain:

> "No clear or universally-agreed measure of quality in higher education exists. Absent any consensus, each ranking combines an available set of observable indicators – each of which serves as a rough proxy for some factor notionally tied to quality – in a formula that can be questioned both on the basis of its contributing elements and the manner in which the elements are combined" (Guarino et al, 2005).

The underlying concepts of rankings

Noting the literature on rankings Teichler (2011) identifies (or more accurately opines) a range of stances towards them. He muses on 'sub-intellectual' views, whereby rankings are seen as "elements of a peep show; they stir up feelings of shame and desires for boasting and the like", with an acceptance of "primitive and highly ideological information about higher education" to the extent of a 'law' of negative correlation: "the lower the quality and the more biased the normative base, the higher the popularity of a ranking study is likely to be." More soberly, he argues that with the exception of attention to methodological flaws, world university rankings have been received uncritically, and are under-theorised, and that there is a need for deeper consideration of the underlying rationales for rankings, and the taken-for-granted assumptions of their producers and advocates.

Such assumptions include (a) that there are common worldwide criteria for a good university, (b) that rankings induce healthy competition and stimulate improvement, and (c) that rankings contribute to greater transparency for guiding consumption and investment decisions. Alternative premises may be offered: (a) that different universities can be good at different things, and therefore evaluations of their quality should be referenced to the diversity of their missions; (b) that uni-dimensional vertical rankings can induce homogeneity, and therefore multi-dimensional ratings are necessary for reflecting and valuing horizontal differences; and (c) that different forms of information from those provided by whole-of-university rankings are required for the purpose of guiding student choice.

Some attempts have been made to theorise rankings (e.g. Marginson & van der Wende, 2007; Ishikawa, 2009). Hazelkorn (2011) identifies three explanatory foci: (i) the efforts of nation states (or supranational blocs such as the EU) to develop strategies for global competitive advantage; the adaptive efforts of higher education institutions to survive in a turbulent environment; and (iii) students and academic staff testing their self and peer perceptions of relative status. She suggests that these three foci align respectively, albeit in interacting ways, with globalisation and networks of power; organisational behavior and change; and social capital and positional goods. In part the analysis is derivative of the school of thought which regards education as social reproduction, as distinct from those schools which emphasise education as individual transformation and liberation, or as human capital formation. However, the analysis does not focus so much on students, their educational processes and their relationships, but rather on institutions and their relationships. It draws heavily on post-Marxist writers of the likes of Bourdieu, Castells, Foucault and Gramsci to such an extent that rankings are interpreted as agents of ruling class hegemony or as agents themselves preserving elite power relations. Curiously, in this world view, efforts to improve ranking methods, coverage and presentation are seen as acts of complicity in one's own subjugation. Such an analysis depends heavily on an inferential logic of inexorability and assumptions about relationships inherent to capitalist societies, even motives and conspiring drivers, which stretch the bounds of credulity and falsely imply passivity and weakness on the part of the ranked.

As outlined above, world university rankings have many deficiencies. To the extent that the rankings have some value, at least for some users in respect of some institutions, it is sensible to work to make them as valid, robust and reliable as possible for those uses. It is also prudent to work on developing other sets of comparisons to complement the rankings, even for the research-oriented universities for which elements of the current rankings may have use value, and especially for other higher education institutions which are not at all well served by the current suite of indicators. An approach to theorising rankings which sees them as inherently inimical to some undeclared set of intrinsic values about universities does not provide any basis for advancing anyone's position.

The prevailing theoretical explanations fail to distinguish, on the one hand, between the explicit intent and the underlying function of ranking designs and, on the other hand, their uses and impacts. Efforts to sew these threads into a pattern may well be counter-productive. There is no single set of forces unfolding in some fashioned way, whether through the demonised forces of 'neoliberalism' and 'new public management', nor even some less overt normalisation of behavior through 'anonymous surveillance of control'; rather, a number of dynamic often contradictory developments are underway. The contradictions have to do particularly with the operation of universities in markets and quasi-markets (Le Grand, 1991). Over-theorisation of more insidious underlying drivers of university rankings misses the main point: rankings are a means to serve commercial ends – both for the rankers and the ranked, but with the latter captured by the imperative of upholding and enhancing reputation, the currency of academic value.

The quasi-market context of contemporary university functioning derives from the centrality of knowledge to modern economies and the changing role of the nation state. Knowledge is now more widely seen as a basis for innovation in enterprises and the economic development of nations. National economies are increasingly enmeshed globally, through government policies, the operations of firms, flows of capital and the movement of people. Governments have an interest in having sites of international standing for knowledge production, transmission and translation and for the formation of advanced human capital and technical know-how. They place an emphasis on applicability, accountability and measurable outcomes, and they prefer competition as a means of promoting value for money and spurring innovation. Higher education itself is also a growing business. Participation in higher education has moved beyond 'mass' and towards 'universal' participation. Student demand on a global scale is rising faster than the capacity of governments to provide at public expense and an increasing proportion of the cost burden is shifting to the private beneficiaries.

University ratings and rankings, like Michelin guides to good restaurants and hotels, are a not unexpected feature of the growing business of higher education. Cross-national comparisons are an inevitable by-product of a more joined-up world. An increasingly competitive and globalising environment for universities – competition for talented students and staff and financial resources – necessarily puts a sharper focus on brand recognition.

Importantly, the rankings are experimental, not in the sense of scientific inquiry, but in the commercial sense of exploring what market opportunities may emerge, and shaping and re-shaping them as need be. The rankings themselves are opportunistic: they respond to a rising demand for comparable information about universities; they use modern data collection and sorting methods to bring together some of the apparently comparable data that are available; and they seek to fill a void in the supply of easily accessible information about universities.

The current main rankings are recent and not necessarily enduring. They are subject to competition from other suppliers and must maintain a threshold of credibility with their users. If they are opaque and compromised, too narrow or biased, they will quickly lose support not only from students and other users but also from the universities subject to ranking. This is to recognise that rankings are being shaped not only by their producers but also by their uses and users. Contrary to the inference of the hidden hegemony theorists, the participation of the ranked can be active rather than merely passive and represent strength of influence rather than submissive weakness. However, action to achieve better representation, balance and validity in comparisons of world universities needs to be informed by an understanding of the limitations of rankings.

Rankings in general indicate an order of position. Rankings are standings ordered hierarchically. The position on a vertical ranking defines a relationship of relative merit (superiority or inferiority)

among those ranked. Typically they equate first with best and last with worst. However, any ranking is an arbitrary scale, and can exaggerate differences and apparent similarities, as there is no scientific precision for distinguishing institutions of close rank (Stella & Woodhouse, 2006).

World university rankings in particular are selective (assessed against a limited set of criteria), norm-referenced (the score of one university is relative to the score of others rather than to pre-set quality criteria or standards) within a zero-sum game (gains and losses add to zero, a win for one means a loss for another, as those placed on top displace those below them). Rankings are also reductionist (simplistically presenting only parts of complex phenomena) and disproportionately value what is comparably measureable on the basis of available data. They have not only a descriptive or analytical role but a normative (preferencing) function in assigning universities in vertical relation to one another without accommodating horizontal functional diversity.

Typically rankings do not indicate the intervals between first, second, third, fourth and so on. They do not necessarily reveal the extent of the gap between, say, a ranking of 5 and a ranking of 50 or 500 in terms of performance standards. While some sense of measured differences can be gleaned from comparisons of mean scores on the sets of indicators comprising the aggregate ranked score, there is no test of statistical significance of the apparent differences let alone any necessary statistical validity to the aggregates themselves. Because the subjects of rankings are continuously modifying their performance, the reference points are constantly changing and judgements about quality can be inferred without clarification of the bases for judgement. Thus rankings have low heuristic utility.

There are around 17,000 higher education institutions in the world (Rauhvargers, 2011). The search for some discrimination among them on the basis of quality is not unreasonable. However it is not self-evident that a simple vertical ranking at the institutional level is an appropriate basis for qualitative discrimination, given (a) differences between institutions in their mission orientations and (b) differences within institutions in terms of capacity and performance, notably at the discipline level both for teaching and research.

In this regard, the designer of the THE-Thomson Reuters rankings has acknowledged that caveats necessarily apply to institutional rankings:

> "All global university ranking tables are inherently crude, as they reduce universities and all their diverse missions and strengths to a single, composite score. Anyone who adheres too rigidly to rankings tables risks missing the many pockets of excellence in narrower subject areas not captured by institution-wide rankings or in areas of university performance that are simply not captured well by any ranking" (Baty, 2012).

However, such an admission is somewhat disingenuous, for the rankings are designed to show relative strength, and by so doing necessarily privilege scale over niche capacity. If the purpose of distilling information about universities' capacity and performance were to point out diverse pockets of excellence then ranking would not be selected as the method of comparison.

A simple ranking on the basis of an aggregate sum of weighted available comparators also cannot properly reflect the diversity of judgements that are necessarily involved in any evaluative effort. When the focus is on the top 3%, or those institutions ranked in the top 500 (akin to the Fortune 500 rankings for enterprises), nuances are casualties. Even if such rankings might suggest something about the group of institutions that could claim to be positioned in an elite group (whether the leading 50 or 100 or 250) on a narrow range of criteria, they suggest nothing about the relative claims of the other 97% and the criteria by which they ought to be judged. Indeed, the 'exclusion' of the majority, or their implied relegation, generates inappropriate pressures for them to emulate those that are ranked and to distort or compromise their own mission in so doing.

The major world university rankings are basically defining an elite club. They are doing so in a rather circular way given the selectivity of measures including inputs which naturally are skewed towards certain types of (better endowed) institutions. Putting this circularity aside, an analogy may be drawn with Olympic athletes, or 3-Hat restaurants, that perform in a class apart from the mainstream by virtue of surpassing threshold criteria which are set and re-set by the standout achievers. That is, there is a meritocratic dimension to university rankings alongside what may be construed as foundations of relative privilege.

Yet in elite sports and fine dining, as in motor vehicles and fashion, there are marked functional delineations and separate bases for comparative assessments. Olympic athletes must pass an entry bar to competition but there are different bars for high jumpers and hurdlers, long distance runners and sprinters, swimmers and divers, gymnasts and shooters. Similarly, unless one has a peculiar palate, there is little sense in comparing Chinese, Indian, Italian, Japanese, Ottoman, Peruvian and Thai food on a single ranking to find the world's top restaurants. Nor is it sensible to compare 4-cylinder, 6-cylinder and 8-cylinder motor sedans and wagons on a single composite rank that accounts for handling, safety, design, comfort, accelerative speed, torque, energy efficiency and price.

Assessments of relative quality, performance and value for money need to be related to purpose and role. Variety in needs and tastes alongside diversity in products and services necessitate a plurality of means of comparative assessment. That is why ratings tend to be used much more than rankings in consumer guides or, at least, different rankings are used for different comparisons. To the extent that just one dominating set of rankings, which are predicated upon a strong research role for universities, imply a policy preference for a stratified view of higher education they may well function to diminish the value of horizontal diversity (Proulx, 2007, Teichler, 2011).

This is not to suggest that a ranking such as the ARWU is totally invalid or inappropriate. To the contrary, it is a reasonably useful benchmarking tool (excepting the lottery of laureates) for the set of elite research universities that seek to have their strengths acknowledged and augmented. However, like the Olympics, it is not a competition for the majority of universities worldwide, not least for high-performing universities whose strengths are to be found in their teaching and service missions rather than research.

Similarly, the Leiden rankings are useful for research-oriented universities, although they capture only knowledge discovery not its translation. The THE-Thomson Reuters and QS rankings, however, seem to have confused purposes, being neither strong enough in assessing relative research strengths nor sufficiently direct and rigorous in assessing relative strengths in education. Nor do any of them give serious attention to the 'service' or 'engagement' functions of contemporary universities.

The uses and impacts of rankings

Despite their deficiencies, world university rankings are making an impact on institutional behaviours and government policies. Why do they do so? Three basic reasons may be suggested.

First, university rankings fill a void. Simple guides are wanted by people having to make choices faced with an ever increasing complexity of university functions, organisational arrangements and a proliferation of data including marketing hype. It may be argued further that rankings facilitate the identification of important entities, highlight their principal attributes, and enable efficient search and sort operations. Indeed, rankings may be one of the few means of navigating ambiguous data sets that include a mix of cardinal and ordinal scores, have many missing information elements, lack balance in quantity and quality across entities and criteria, and rely on complex networks and sources (Xiaoye et al, 2011). Importantly, universities rely internally on tacit rather than explicit judgements of quality and have failed to communicate clearly, to the lay communities that sustain them, what they do and what they stand for. However, what is made explicit can be limiting:

> "Because it is so difficult – for insiders and outsiders – to judge the quality of a university's technology and outputs, it is often more cost-effective and useful for institutions to copy the structures and behaviors of universities perceived as being successful" (Morphew & Swanson, 2011).

Second, rankings appear to be based on 'objective' assessments which are independent from the universities being ranked. They appeal to the media and, arguably, to 'consumers' of higher education services, including students (international if not domestic) and parents, as well as 'end-users' such as employers of graduates. However, they are content-poor sources of information for students, and obscure more than they reveal about the breadth and depth of university offerings. Additionally, as the indicator-based assessments are 'over-simplified' or 'under-complex', action taken by universities in response to them may fall short of the actual challenges of increasing complexity which confront contemporary universities (Altbach, 2006).

Third, university rankings resonate in an academic culture of fierce individual competition and status seeking. Being the first to discover, to comprehend, to pioneer or even to fault – and to be credited for so doing, eventually if not immediately – that is a key driver and prize of academic achievement. Rising in the ranks becomes a motive in itself because it conveys progress and confers esteem. The rankings can become drivers by defining what quality means and shaping university mission and balance of activity (Marginson, 2007a), inflating the 'academic arms race' (Tierney & Hagedorn, 2002), inducing universities to chase ever more resources (Ehrenberg, 2004), intensifying competitive pressures, establishing as a worldwide norm the science-strong research university of the Anglo-American tradition, and giving emphasis to institutional stratification and research concentration (Marginson, 2007b).

The competition among rankers may also be seen as one of the factors shaping institutional and government responses:

> "The competition between ranking agencies is then like a tournament of portfolios, and their objective is to persuade observers to converge to their portfolio. They want observers to be anchored by their ranking. When a proposed measure becomes widely accepted, universities minimise risk by adopting practices maximising that ranking" (Sawyer, 2012).

However, institutions and governments have their own purposes and for which ends they seek to employ the rankings as means. Continuous improvement stands out as a major purpose, and the exposure that world university rankings give to local institutional performance against

international benchmarks adds impetus to the improvement agenda, both on the part of university and government executives. In this endeavor there is also the risk that the means of measurement become confused with the ends of quality higher education (Dill and Soo, 2005) and that an institution will try to succeed according to the indicators which themselves can distract it from attending to its real challenges, special opportunities and underlying problems. Additionally, the rankings game is a risky and unpredictable one:

> "Rankings are a game everyone plays, but a game with constantly shifting rules that no one can control (Morphew & Swanson, 2011).

Nevertheless, rankings may be seen as having various uses or to serve various purposes, whether designed explicitly to be used for such purposes or not. The major uses are:

i. influencing consumer choice, including information and guidance for prospective students, and institutional marketing
ii. benchmarking for improvement, including setting targets and introducing process changes based on practices of highly-ranked institutions
iii. partner selection, including recognition of qualifications or prior study for credit, and choice of institutions for collaboration in research and research training
iv. informing investment decisions, including institutional actions to attract industry and benefactor funding, and government decisions to allocate funds for special programs and centres or to skew allocations through performance incentives linked to rankings.

Institutional uses and impacts of rankings

Universities tend to have love-hate relationships with rankings; not only do they hate them when they don't look good on them but love them when they do, they also are ambivalent towards them, sceptical of their validity but intimidated by their potential to do harm: 'we know they are dubious but we have to live with them'; 'we may not like them but they're not going away'; 'we may dismiss them but others are using them and we can't afford to be missed out'.

Universities may variously make use of rankings for marketing purposes – marketing to prospective students, marketing for staff recruitment, marketing to prospective investors, benefactors and sponsors, and general brand positioning. They may also use them to evaluate quality of performance, and identify priorities for resource allocation, either building on strengths and potential or closing down poor-performing areas.

Some universities have dedicated staff for managing their rankings, correcting omissions and errors in ranker data, watching changes in ranker methods, modelling the range of effects of performance shifts on individual indicators, harnessing institutional actions to improve performance on the indicators that might have a positive impact on institutional positioning, and canvassing other institutions and possible peer reviewers with a view to raising their reputational scores.

Much attention has been given to negative behaviour associated with rankings, such as cheating and gaming. A recent article in the New York Times exposed misleading reporting and other manipulations in the US national rankings context:

> "Iona College in New Rochelle, north of New York City, acknowledged that its employees had for years provided false information not only about test scores, but also about graduation rates, freshman retention, student-faculty ratio, acceptance rates and alumni giving. Other

institutions have found ways to manipulate the data without outright dishonesty. In 2008, Baylor University offered financial rewards to admitted students to retake the SAT in hopes of increasing its average score. Admissions directors say that some colleges delay admission of low-scoring students until January, excluding them from averages for the class admitted in September, while other colleges seek more applications to report a lower percentage of students accepted" (Perez-Pena & Slotnik, 2012).

There appear to be fewer opportunities for cheating on the world rankings. Rather than cheating, there is some risk of manipulation of student/staff ratios, recording of affiliate publications, only reporting data relating to specific campuses, and canvassing of peer references. Such actions are more likely to affect results in QS and THE- Thomson Reuters than in those rankings based on more objective output measures. With regard to the current suite of international rankings, the main problem is the pressure they put on lower ranked and unranked institutions to emulate inappropriately those ranked highly.

Surveys of institutional responses to rankings suggest that many institutions are spurred to actions such as incorporating the outcomes of rankings and setting targets in strategic planning, benchmarking to identify weaknesses and eradicate problems, and structural reorganisation to achieve higher rankings (Hazelkorn, 2007). For many of the less research-intensive institutions, setting targets to achieve a ranked score may be beyond the bounds of practicality and efforts to that end may well involve counter-productive initiation or curtailment of activities. For others there may be useful performance gains to be made from rankings giving rise to a reconsideration of strategic focus, operating practices and measures of success.

A study by the Higher Education Funding Council for England (HEFCE) found that rankings could also serve as leverage to make higher education more effective and innovative (HEFCE, 2008). Rankings were seen to be helpful in the following areas:

- improved evidence-based decision making – rankings can prompt institutional discussions about what constitutes success and how the institution could better document and report that success;
- wider conversations about monitoring and reporting success – encouraging institutions to move beyond their internal conversations to participate in broader national and international discussions about new ways of capturing and reporting academic success and excellence;
- identification and replication of model programs; and
- increased institutional collaboration.

The second last finding – copying practices of highly ranked institutions – is double edged. On the one hand it can provide a benchmarked basis for institutional improvement. On the other hand it can lead an institution away from its own mission and distinctive values, and act generally to reduce diversity within the higher education system. The copying approach can lead to greater attention being given to research than teaching even where an institution has few areas of serious research. Action may include poaching of star researchers, and directed internal investment to build research capacity in particular areas.

The last finding of the HEFCE study – increased institutional collaboration – is interesting in view of the criticism of rankings as an instigator of competition among institutions to the detriment of collaboration. A study by the Institute for Higher Education Policy also suggested that rankings foster collaboration, such as research partnerships, student and staff exchange programs, and institutional or faculty alliances (IHEP, 2009). At the very least, rankings can function as starting points to identify institutions with which to collaborate and partner, and weigh up collaborative options.

The implications of rankings for public policy

In general, world university rankings give greater public visibility to higher education issues and institutional performance. They have also given rise to three relatively new phenomena in public policy: governments targeting the availability of scholarships for their nationals to highly ranked universities internationally; governments limiting the partnering of their home universities to only those foreign universities that are highly ranked, and governments aspiring to have a number of their universities highly ranked or otherwise designated 'world class'.

Rankings for scholarship funding

Mongolia, Kazakhstan and Qatar offer scholarships only to those students who gain admission to the top 100 ranked institutions. The Netherlands gives priority to immigrants with qualifications from the top 150 universities. Russia's study-abroad scholarships funded via its $150 million Global Education program are to be targeted to top-ranked universities. The scholarships provided by the Government of Brazil (*Science Without Borders*) and Chile (*Becas Chile*) are targeted to the top 150 - 500 universities on world rankings. Ecuador has two sets of scholarships: one for students accepted by institutions in the top 50 and another for institutions in the top 150. Peru and Colombia, similarly, are developing scholarship programs designed to encourage their students to study at highly ranked international universities. In the case of Peru, the Government has responded to increasing industry demand from graduates by announcing that 1,000 new postgraduate fellowships would be made available by 2016, as well as 1,500 scholarships for Peruvian students at foreign universities. The study abroad incentives also reflect a concern that none of Peru's 90 universities are ranked in the top 500 of any of the major rankings.

These decisions of 'sending' countries to target or restrict scholarships to universities highly ranked on international comparisons generate incentives for universities in 'receiving' countries to achieve good rankings. For Australian universities, which have a high level of dependency on income from international students and which are generally seeking to diversify the source countries of their international enrolments, there can be much at stake in securing growth in student flows from Latin America, Asia, the Middle East and Africa.

Limiting authorised partnering to highly ranked foreign universities

The Government of Singapore has applied world university rankings to identify foreign universities whose qualifications they will recognise in Singapore, to screen foreign universities seeking to establish campuses in Singapore and to limit authorised partnerships between their home universities and foreign universities. The Government of India has restricted joint degree programs with Indian institutions to universities ranked in the top 500 on the ARWU or THE-Thomson Reuters rankings. For Australian universities seeking a commercial presence in Asian markets it becomes necessary to achieve a threshold position on the world university rankings.

Aspiring to have world class universities

Some governments are inclined to respond to educational rankings by setting 'targets' to raise national performance – such as declaring a goal of being ranked within the top group of countries on the OECD's Programme for International Student Assessment (PISA) scales – irrespective of their merits, educational impacts and opportunity costs. In like manner, several countries have stated goals of establishing or increasing the number of universities placed on world university rankings. As Jamil Salmi has pointed out, for many developing economies such a strategy may be

misguided: "the hype surrounding world-class institutions far exceeds the need and capacity for many systems to benefit from such advanced education and research opportunities, at least in the short term" (Salmi, 2009).

At the same time, there is a noticeable trend on the part of long-developed and newly-emerging economies to shore up their capacity for advancement in knowledge and know-how at the top of their national higher education systems. Germany launched its *Exzellenzinitiative* in 2005 with the aim of concentrating investment in graduate schools, research clusters and forward-looking centres of excellence. In 2008 France announced the PRES initiative (*pôles de recherche et d'enseignement supérieur*) to develop ten internationally competitive university clusters. Denmark, India, Indonesia, Japan, Malaysia and South Korea have also taken steps to restructure their systems and institutions to align with indicators used in the rankings. In 2004, Taiwan set out detailed goals and investment priorities:

> "The specific objectives are to be set as ten elite (or Asian top-tier) universities or fields of research within five years, and at least one university to ascend to the world class (within, for example, the top 100 universities in the world, or, by comparison, the top 80 in the US) within ten years" (Development Plan for World Class Universities and Research Centers of Excellence, Taiwan, 2004).

Earlier the People's Republic of China had determined to concentrate investment in a small number of its major universities, through the 211 program announced in 1995, initially designed for 100 but now involving 106 universities and colleges, and the 985 program announced in May 1998 and involving just nine universities and institutes, with the aim of raising their research capacity, performance and international status. President Jiang Zemin declared: "China must have a number of first-rate universities of international advanced level". In 2012, the Chinese Government increased spending on science and technology by 12.4% to 229 billion renminbi ($36.2 billion).

These developments in the concentration of investment in leading research universities and clusters work to intensify the international competition for talent, ideas and innovative applications. As university capacities increase in Asia, Europe and Scandinavia and elsewhere, Australia too must intensify its efforts in order to keep up with the pace-setters. Countries needing a step-change in their research competitiveness cannot afford a step-by-step dilution of their research investment.

The importance of highly-ranked research universities

One characterisation of the class of world leading universities – the 'emerging global model' (EGM) – identifies the following eight factors: an institutional mission that transcends the boundaries of its home nation; increasing intensity of knowledge production; student and academic staff recruitment on a worldwide basis; academic roles geared to high performance and productivity; a diversified funding base; government facilitation of university-industry collaborations; complex organisational structures including semi-autonomous centres and institutes; and global collaboration through alliances and networks (Mohrman et al, 2008). Nevertheless, the strategic, cultural, and organisational factors identified for the EGM cannot be effective without sufficient scale of inputs.

Universities of the EGM are high volume producers of high quality knowledge outputs, including highly cited journal articles and other channels of communication. One might ask: 'why are the articles highly cited'? Normally the answer is because they are sources of ideas breakthroughs or discoveries, on the basis of which knowledge is gained. It just happens, by and large, that the best outcomes are produced by the best placed institutions, and that a threshold level of input resources is required typically for university to be among the best placed. One such threshold is an asset base exceeding $1 billion, alongside a scale of high quality talent in the student and staff body. Not all rich universities are outstanding but given the costs of doing breakthrough research poor ones cannot be. While there are excellent outcomes produced in some institutions which do not meet all the threshold criteria, they are not of an equivalent scale or degree of consistency.

To sustain economic competitiveness, countries like Australia must be able to generate new knowledge and understand and interpret new knowledge generated elsewhere; they cannot rely on a strategy of passive absorption of foreign technology. To benefit from the public good of world knowledge, nations have to be actively engaged in cutting edge research. Free riding on the rest of the world's research is not a realistic option – because the links between researchers are personal and they are based on informal trading in ideas, techniques and devices. To access and make sense of basic research you have to be a contributing insider to the community of international researchers in a field. The capacity to understand and use the results of basic research performed elsewhere requires a considerable investment in institutions, skills, equipment and networks (Pavitt, 2001).

The need for research concentration within national higher education systems can be understood to be driven by concerns to (a) strengthen and integrate capabilities in order to address complex and pressing national problems, including those with global dimensions; (b) increase the international visibility of national strengths for attracting talent and inwards investment; (c) open up opportunities for collaboration with universities in other countries that have similar reputation for excellence; (d) and ensure sufficient capacity for cutting-edge research for the nation through access to world knowledge developments. These motives reflect a view of contemporary universities as engines of innovation and economic development and sources of solutions to social and environmental problems.

One of the drivers of innovation is the clustering of talent and the production of new knowledge. Large research-intensive universities are among the most effective aggregators of highly qualified personnel (Usher, 2009). In many fields of research in the natural sciences there is a 'critical mass' or threshold effect, and "large, well-funded and well-led research groups produce more publications, of higher impact, and receive much higher international recognition than do smaller groups" (NBEET, 1993). There are several advantages of scale in research, as noted in a HEFCE (2000) review of research funding policy:

> "A larger group of researchers adds to overall vitality, through peer stimulus, the opportunity to exchange and develop ideas, and to be spurred by visible achievement. Second, the per capita marginal costs of research (administration, clerical support, etc) are reduced when a larger group contributes to infrastructure. This factor is significantly accentuated by the high cost of major equipment and facilities in the experimental sciences. Third, larger groups make possible the simultaneous and parallel development of research themes, leading to an overall acceleration. Fourth, group size contributes to diversity of thought and of sub-discipline, increasing the likelihood of cross-fertilisation and fruitful development. Fifth, larger groups of research students provide a more supportive atmosphere for research training" (HEFCE, 2000).

It is generally accepted that new knowledge can move enterprises into leading market positions beyond the point where existing technology can be imported and adapted (Litan & Mitchell, 2008). In the quest for innovation it is the ability to marshal resources, including intellectual capability, to achieve 'significant advances' ahead of the competition that counts.

Additionally, the capacity of universities to undertake long-term research underpins their direct and indirect contributions to Australia's national innovation system. The research literature indicates that basic research is an important source of (i) the skills (particularly those based on tacit knowledge) required to translate knowledge into practice (Salter & Martin, 2001) (ii) an enhanced ability to solve complex technological problems, and (iii) the 'entry ticket' to the world's stock of knowledge, providing the ability to participate effectively in networks and absorb and exploit the resulting knowledge and skills (Martin & Tang, 2007). Importantly, basic research, or long-term research whether "curiosity-driven" or "use-inspired" (Stokes, 1997) which explores underlying issues, underpins disciplinary advancement.

The importance of excellent universities serving national and local needs

While it is necessary to strengthen the research performance peaks of the system it is not sufficient to do only that, particularly given the concurrent and larger imperative to widen higher education participation and raise the educational attainment and skill levels of the workforce. The double-edged challenge for public policy is to strengthen the leading institutions without impoverishing the core of the system which caters for mass participation, and to enlarge the system equitably without diminishing the quality of the elite performers.

There is the additional challenge of encouraging universities to contribute in varying ways to national and local objectives: economic, social, environmental and cultural.

With regard to economic objectives, discovery drivers of innovation can be paradigm-shifting but science-push innovations in business are exceptional, typically lagged and rarely linear. The great bulk of innovation, involving enterprises competitively responding to demand drivers, derives from clever modifications of existing knowledge broadly embedded in the creative, technical and organisational skills of populations (Cutler, 2008). Hence it is necessary to recognise the importance of research of national, regional and local relevance that is highly valued by end users. It is also essential to focus on the major contribution that universities make to national innovation: their graduates. This is not to suggest that the metrics used in rankings for research universities should be discarded or replaced but rather to call for them to be complemented by other sets of indicators reflecting the varying roles of different universities and other higher education institutions.

With regard to environmental objectives, for instance, the dimensions of the problems are frequently global as well as local. It is not unreasonable to expect that research oriented to solving local environmental concerns should not only satisfy local customers but also pass muster in the internationally peer-reviewed literature; otherwise there is no basis for local confidence in the quality of the research.

Universities of the EGM class undertake research comprehensively in two senses: research across the disciplines and cross-disciplinary subjects they teach – both liberal and professional courses; and research across modes and orientations of inquiry – both basic and applied research. Other universities may be narrower in the range of fields in which they conduct research, and they may orient their research in particular ways and to particular ends.

The world university rankings predominantly use research metrics linked to the outputs of basic research. In this context, some express concern that the pressure to align institutional behaviours with the rankings measures will lead to a reduction of more socially relevant and commercially useful research (Hazelkorn, 2009). Such concerns imply a need to develop indicators to capture the contributions to innovation through human capital development and knowledge generation and application that are not captured by the metrics used in the current set of world university rankings.

In the context of governments seeking to establish 'world-class universities' or strengthen their leading national institutions through concentrated investments or structured collaborative arrangements, such as clusters and mergers, questions arise about the structural balance of national higher education systems. Yet we are still awaiting answers to the question posed by Jamil Salmi:

> "Are only research universities world-class, or can other types of tertiary education institutions (such as teaching only universities, polytechnics, community colleges, and open universities) also aspire to be among the best of their kind in an international perspective?" (Salmi, 2009).

In Australia, the current Government policy on the structural design of higher education limits even such a discussion. Polytechnics were prematurely disappeared during the Dawkins' unification of the late 1980s/early 1990s. Curiously and without explanation, the Bradley panel in 2008 explicitly rejected them as a structural option for the future, whereas other countries (e.g. Finland, Singapore) have built their national innovation systems around deliberately differentiated higher education systems, including specific and separate roles for polytechnics and universities. Community colleges, to the extent their function is available at all, are a residual part of a withering vine of Technical and Further Education colleges and blurring with the bottom end of admissions to larger suburban and regional universities. Australia has favoured a mixed mode approach to the use of on-line education in contrast, for instance, to South Korea which has 18 cyber-universities. Higher education continues to be supplied predominantly (some 90% of student enrolments) by public sector institutions, with the private sector in Australian higher education one of the lowest in the world. Until there is greater diversity on the supply side of the Australian higher education system, reliance on world university rankings that place a high value on research performance, as the principal reference point, will tend to diminish diversity.

Teaching only universities – whether on the elite model of the US liberal arts colleges or larger mass higher education institutions – have been defined away by the narrow 'provider category' types and standards under the TEQSA regimen, where all universities must do some 'research'. The advantage of the TEQSA approach is that universities are distinguished from other provider types, and that distinction underpins difference of policy treatment in regulation and funding between universities and other 'higher education providers'. However, there are as yet no 'threshold research standards' setting out expectations of the university research function, and it will be difficult to pre-set such 'standards' without constraining the ways and means by which research may be performed and the purposes for which it is done. Unless work is undertaken to outline the array of research orientations there is a particular risk that TEQSA's standards for research will be based on the traditional models of basic research conducted predominantly in the research-intensive universities.

In the event that a few established universities are unable to satisfy the TEQSA criteria for research, the only option currently available would be for them to forfeit university title and become merely a 'higher education provider'. That seems a harsh outcome which could arise simply for want of diversity in the allowable nomenclature for higher education institutions in Australia. The prefix 'teaching-only' is problematic in connoting that an institution 'only does teaching'. Perhaps other titles could be explored, e.g. community university, institute, polytechnic or university of applied sciences.

As they are currently structured, world university rankings do not relate well to the missions of universities whose principal mission is not research, or at least not internationally-referenced basic research. There are important roles for universities that focus on producing quality graduates for Australian labour markets and providing services, including research translation, testing, survey and other services for businesses and community groups. In this regard, institutional positioning strategies pulled by the current suite of world university rankings which privilege academic research can limit institutional vision and distort mission, and reinforce sameness in aspiration and benchmarks of success.

An important challenge is to develop diverse reference points. For that to happen, three developments will be necessary. First, there will need to be sharper clarity of mission orientation on the part of different universities and other higher education institutions. Second, work will need to be done on developing a richer array of education and service oriented indicators of university capacity and performance. Third, attention will need to be given to describing the array of research orientations.

Martin Trow identified some time ago that it is unreasonable, unfair and inefficient to place expectations on institutions to become what they are not set up to be:

> "A central problem for higher education policy in every modern society is how to sustain the diversity of institutions, including many of which are primarily teaching institutions without a significant research capacity, against the pressure for institutional drift toward a common model of the research university – the effort alone shapes the character of an institution to be something other than what it is – a prescription for frustration and discontent" (Trow, 2003).

The problem with the Trow approach is that it sets up a negative definition for the majority of higher education institutions: they are defined as not having significant research capacity, rather than as having focused and locally relevant research capacities and highly-developed teaching capacities and focused community service capacities. This is not to suggest that research-intensive universities do not or cannot have strengths in teaching, research applications and community engagement. Rather it is to point to the failure of policy makers and institutions to come to grips with the scale and diversity of contemporary higher education and create a language for expressing its richness.

Why are some Australian universities doing as well as they are, and what will sustain their performance improvement?

The THE-Thomson Reuters rankings editor has painted a grim future for English universities (such as Birmingham, Bristol, Leeds, Newcastle and Sheffield) whose positions deteriorated in the 2012-13 THE rankings:

> "Outside the golden triangle of London, Oxford and Cambridge, England's world-class universities face a collapse into global mediocrity. Huge investment in the top research universities across Asia is starting to pay off. And while the sun rises in the East, England faces a perfect storm: falling public investment in teaching and research; hostile visa conditions discouraging the world's top academics and students from coming here; and a serious uncertainty about where our next generation of scholars will come from, with a policy vacuum surrounding postgraduate study" (Baty, 2012b).

One might point to the political nature of such a commentary, and its unabashed nationalist sentiment, to suggest bias in the construction of the rankings that give rise to the cause for such comments. Nevertheless, given the changing economic circumstances of nations, we can expect a gradual flattening in the representation of US, UK and European institutions in world rankings as public investment in higher education and university research there is diluted. Particular challenges confront US public research universities across several states which are not only cutting back on their financial support for research universities but also seeking to curtail scholarship and research in several fields. The philistines are at the door: Governors of several US States appear to be confronting the academy in a more joined-up way than previously, questioning the use-value of investment in fields of education and research which do not appear to have immediate application or which are emblematic of liberal values.

Concurrently, there is an agenda for greater intensity of research performance in France, Germany, Scandinavia, Switzerland and the Netherlands as investment in research is more concentrated in their top universities. Future growth in capacity and performance can be expected also from the leading universities in the stronger economies of Asia (notably China, Singapore, South Korea), the emergent Asian economies (notably India, Indonesia, Malaysia, Thailand and Vietnam) and Latin America (notably Brazil, Chile and Mexico).

Australia's relative improvement in several of the world university rankings reflects the plateauing of inputs to US and UK universities, the lagged accounting for the emergent Asian universities, alongside some recent absolute lifts in funding inputs for Australian universities. With reference to the 2012 ARWU rankings, with 19 of Australia's 37 public universities making the top 500, the Minister for Tertiary Education asserted:

> "This outstanding result is due in large part to the record $37 billion the Government has invested in our universities, as well as the hard work of Australia's universities," (Evans, 2012).

It is true that increased funding for universities has resulted from the present Government's decisions post-2008 to improve the indexation of payments to universities for recurrent purposes, including research activities. Additionally, the Rudd Government made a very high capital injection into universities, including for research infrastructure, as part of it economic stimulus measures in 2009-2010.

Nevertheless, the apparent rise of some Australian university positions on the rankings cannot be attributed simply to increased government funding in recent years. Indeed universities generally, and Go8 universities in particular which lead the Australian rank order on all measures, have not enjoyed real terms growth in per-student revenue from the Australian Government since 2007, the improved indexation of recurrent grants notwithstanding. A major loss to income, especially for Go8 universities, resulted from the Labor Government's decision to prohibit the enrolment of full-fee domestic undergraduate students after 2008.

Over recent years, Australian universities have experienced income growth from international student fees, philanthropy and industry funding of research. The funding from these sources is also factored into the rankings indicators.

Welcome increases in funding for the indirect costs of research, rising from 20 cents to 30 cents in the dollar, and the large capital injection in research facilities have influenced to a small degree only those rankings that give weight to input metrics, such as the THE-Thomson Reuters rankings which include industry income, research income and income per academic staff. In future years the funding increments may affect rankings indicators despite diminished discretionary income of Go8 universities in particular as a result of the Government requiring matched funding for capital projects and failing to provide for recurrent maintenance costs.

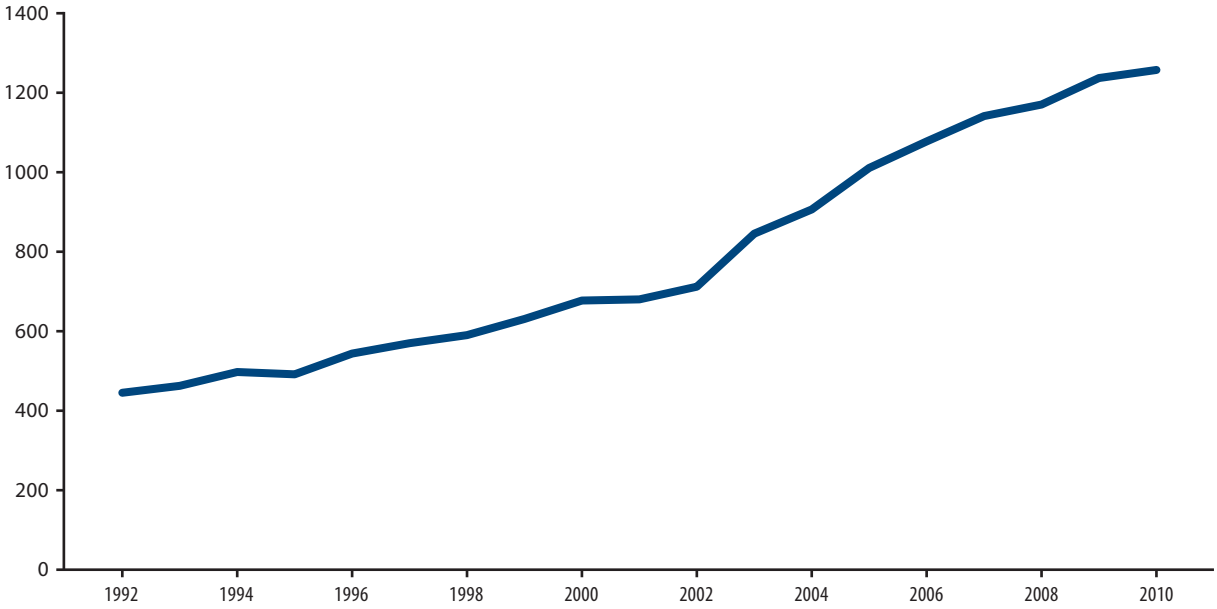
Australia's universities will still have to find at least 70 cents in the dollar for the indirect costs of the research grants they win through national competitive processes. Those grants typically pay only around 70% of the direct project costs and, unlike research funding schemes in the US and elsewhere, do not provide for principal investigator salaries.

In its October 2012 mid-year budget review, the government reneged on it prior commitment to raise funding for indirect costs to 40 cents in the dollar. Some $150 million annually will be lost, mostly by Go8 universities.

Additionally, as reports commissioned by the Government itself have found, Australia's universities continue to be impacted adversely by shortfalls in funding for domestic undergraduate students (Bradley, 2008; Lomax-Smith, 2010). Consequently, the universities have a very high level of dependency on fee income from international students – both to make up shortfalls in funding for domestic students in higher-cost disciplines and to compensate for under-funding of research.

The Howard Government (1996-2007) was a strong supporter of research. The average increase in Commonwealth competitive research grants over the period 1997-2007 in real terms was 7.1%, primarily due to significant increases in ARC and NHMRC recurrent funding via *Backing Australia's Ability* initiatives and the response to the Wills report. Figure 7 shows the increase in real terms of university income from Australian Competitive Grants over the period 1992-2010.

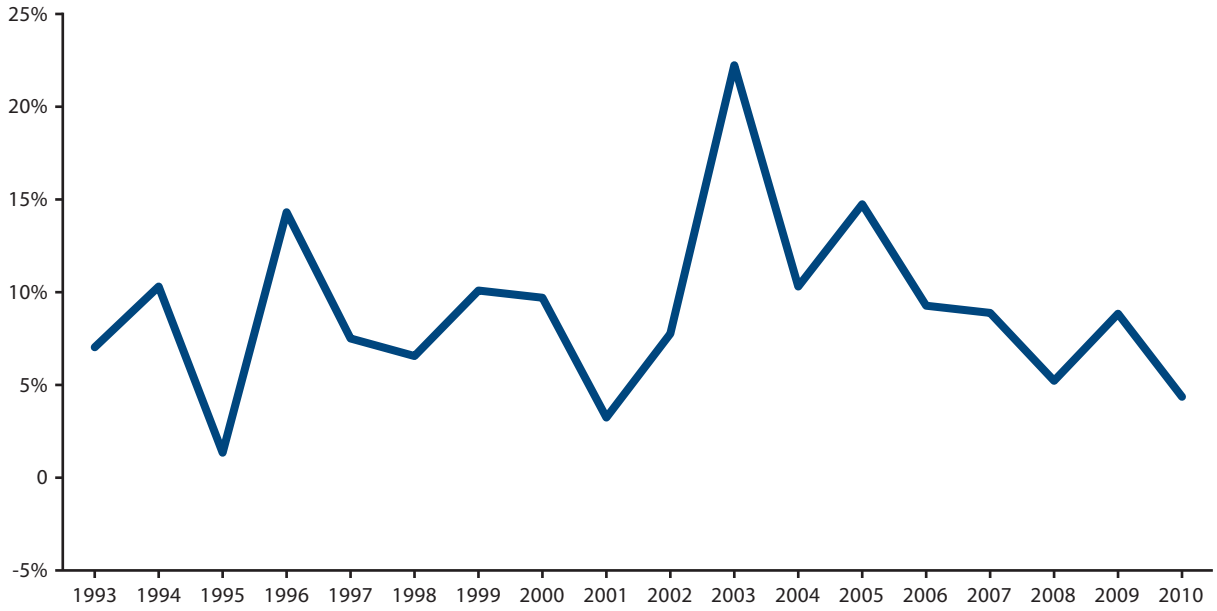
Figure 7. University income from Australian Competitive Grants, 1992-2010, in 2010 Dollars



Source: Higher Education Research Data Collection, various years

Figure 8 shows the annual percentage change in real (Commonwealth) income, 1993 to 2010. The average annual change under the Keating Government (1993-96) was 5.3%. Under the Howard Government (1997-2007) the average annual increase was 7.1% (with a spike over 2003-2007 of 10.1% per annum) compared with merely 3.2% over 2008-2010 under the Rudd Government.

Figure 8. Annual increases in university income from Australian Competitive Grants (constant dollars)



The Labor (Rudd and Gillard) governments have concentrated on funding short-term initiatives focused on infrastructure and capital funding as part of the stimulus package and terminating programs such as Future Fellowships, Super Science Fellowships and National Collaborative Research Infrastructure Scheme (NCRIS) projects.

Under the Rudd Labor Government the rate of annual increase in Australian Competitive grants fell to 3.2% over the period 2008-10, and while this includes a short-term increase due to the funding of Super Science and Future Fellowships, the annual increase will begin to decline rapidly from 2014 as a result of the termination of the Future Fellowships Scheme. The Labor Government has also not provided for the further funding of major national research facilities.

Over the period 2002-12, the average funding for the first year of ARC Discovery grants declined in real terms by 8.9%, peaking in 2006. Over 2002-2006 there was an 8.5% increase while over 2007-2012 there was a decline of about 13%. In the same period success rates for Discovery fell from 25.47% to 21.95% after a peak in 2005 under the Coalition Government of 30.9%.

Funding for the Research Training Scheme (RTS) has not been increased (other than by annual indexation) since its introduction in 2001. Consequently, RTS funding in real terms has declined by about 14% in the period 2001 and 2012. At the same time the Domestic HDR load has increased significantly so that RTS funding per Domestic HDR EFTSU has fallen by over 23% in the same period.

Similarly block funding through the Institutional Grants Scheme/Joint Research Engagement scheme (IGS/JRE) has declined in real terms over the same period. In addition the Labor Government has changed the funding formula to remove Category 1 (national competitive grants) funding from the JRE block fund and in doing so has reduced the Go8 funding share. The change to the JRE formula was partly designed to offset the gains expected to be made by Go8 universities through the application of research quality evaluation results from the Excellence in Research for Australia (ERA) initiative.

The ERA evaluative process itself from 2009 and subsequently has provided incentives, reputational as well as financial, for universities to address areas of weak research performance and build on their research strengths. Action has included buying in star researchers and expanding

doctoral student enrolments, especially international students. This sharper focus on research performance may well have influenced factors taken into account by the world university rankings.

The 2010 Excellence in Research for Australia (ERA) outcomes provided the Government with the opportunity for the first time to provide research block grant funding based on demonstrated research excellence. In 2012 the Government incorporated those outcomes into the funding formula for the Excellence Component of Sustainable Research Excellence (SRE) Threshold 2 funding. The funding driven by ERA outcomes in 2012 was $65.7 million of SRE Threshold 2 funding, only about 4% of the total funding provided through research block grants. The weightings used in the formula were 7:3:1:0:0 for ERA rankings of 5:4:3:2:1. Australia's investment through ERA needs to be compared with the English approach through its Research Assessment Exercise (RAE). There the amount allocated for research excellence annually exceeds £1 billion, and the top rated research is weighted by a factor of 9 rather than 7 as in Australia. Nevertheless, the ERA weights sent a strong signal to Australian universities to strive for excellence in research.

As noted above, Go8 universities lead the Australian placements on all the major world rankings. This is largely because the rankings are skewed in favour of academic peer-reviewed research output quality and the Go8 universities perform the lion's share of fundamental research, and especially in health and medical research including clinical research. Table 17 shows that the Go8 accounts for almost two-thirds of all of Australia's higher education research effort, including more than half of applied research and experimental development, and some three quarters of basic research.

Table 17. Australia's Higher Education research effort by activity type, 2010

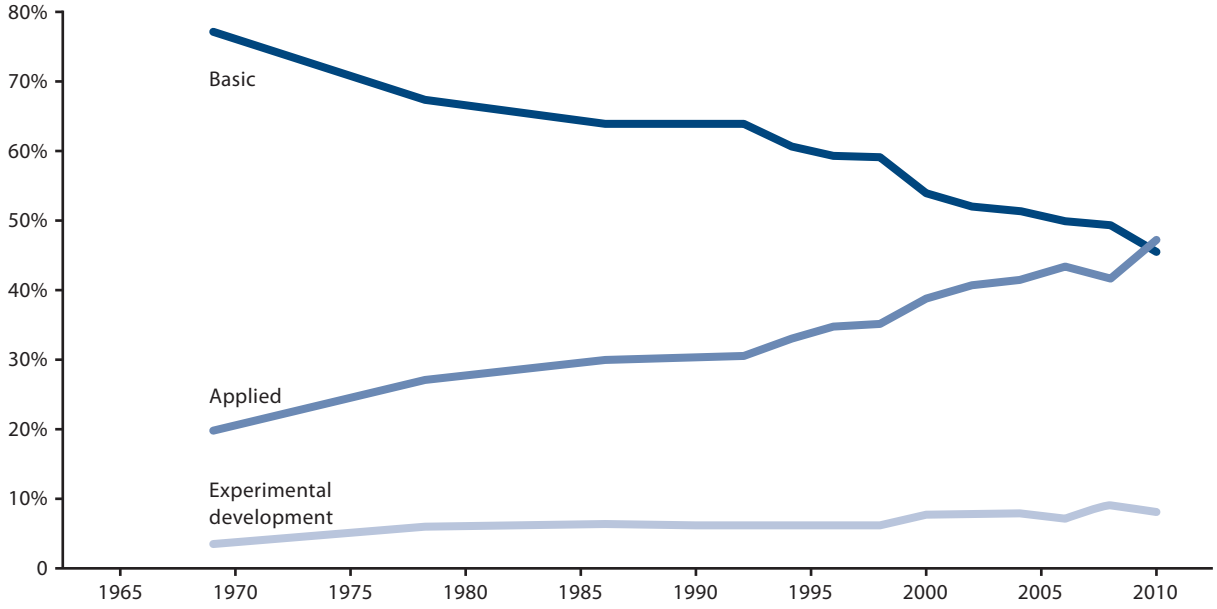
Type of activity	National Higher Education Effort ($m)		Go8 share (%)
Pure basic research	2,052.2	(25%)	82
Strategic basic research	1,653.0	(20%)	60
Applied research	3, 835.8	(47%)	52
Experimental development	662.0	(8%)	60
Total research activity	8,203.0	(100%)	62

Source: Australian Bureau of Statistics, 8111.0. and Go8 universities. Note: the effort amounts include estimates of university staff salaries apportioned to type of research activity.

Thus there is a reasonable alignment between the functions of Go8 universities and the research-related indicators employed by the major world university rankings. Yet, as we have seen, Australia's leading universities, while ranking relatively well at present, are being challenged by the rapid rise of universities in Asia and elsewhere. Concurrently, Australia's investment in research is in drift.

Figure 9 shows a trend decline in the basic research share of the total higher education research effort in Australia over the last 40 years. Whereas in 1969 basic research represented 76.7% of university research in Australia by 2010 it had fallen to 45.2%. Over the same period applied research increased its share from 19.7% to 46.7%, making it the dominant type of activity. To some extent, the change in reported types of research activity reflect changes to labelling, particularly as researchers have been required to relate their research grant proposals to socio-economic objectives or national priorities as a condition of funding.

Figure 9. Trends in shares of research by type of activity, Australia, 1969-2010



Source: Australian Bureau of Statistics, 8111.0, various issues.

Nonetheless, the apparent trend decline in the share of basic research raises the question: 'what is the appropriate balance between basic and applied research in national higher education systems'? Australia now has less than 50% of higher education research defined as basic, including 'strategic basic' (or in Frascati Manual terminology 'oriented' research). Apart from the research of Medical Research Institutes, the large share of research in publicly funded research agencies (e.g. CSIRO) and private institutions and firms is application oriented. Australia has a much higher level of reliance on its universities than most other countries for its basic research. Even so, the basic research share of the total research effort of US academic institutions has remained reasonably stable at around three quarters, 76.7% in 1970 and 74.6% in 2009 (NSF, 2012). It is not self-evident that Australia should continue to reduce its basic research effort.

Importantly, the position of Australia's leading universities in the world university rankings, and especially those rankings which set a high bar in respect of research output quality, is primarily a function of capacity to undertake long-term fundamental research which advances knowledge on a global basis.

Governments around the world increasingly view research funding as a purchase of technical information needed to further some specific goal rather than as a consequence of public policy aimed at creating educated researchers or new understandings for the long-term good of the nation (Armstrong, 2003). We are seeing a convergence internationally in a public policy emphasis on the utility of publicly-funded research, its demonstrable 'impact' and commercialisability.

It is one thing to draw on impact exemplars as a basis for communicating to the lay community the benefits of their investment in research. It is quite another thing to limit research investment to research oriented only to a demonstrable benefit. It is limiting to do so, not least because the actual uses of research are not always immediately evident and the applications do not always turn out to serve the purposes for which the research was initially intended. Even worse is to spurn research that has no obvious immediate utility as not being worth funding. A proper sense of balance is necessary. Pressure for short-term instrumentalist outcomes from research can reduce incentives for speculative and path-breaking research. Indulgent long-term research can

miss opportunities for solving pressing social, environmental or economic problems. A narrow disciplinary focus risks forfeiting the great potential for creative ideas and new insights at the intersections between disciplines.

In their reflective essay of 2008, *What are universities for?*, published by the League of European Research Universities, Geoffrey Boulton and Colin Lucas offer a corrective to the narrow and immediate instrumentalism of government policies in many countries. They note a "growing tendency to see universities as sources of highly specific benefits… particularly marketable commodities for their customers, be they students, business or the state." They suggest that research universities are able to make such contributions because they deal with the universality of knowledge:

> "They seek to understand that which we do not understand; they seek to explain complexity; they seek to discover that which is hidden from us. They seek to establish what is common to all of us and what distinguishes us each from another or each group from another. These things are common to the whole of university endeavour whatever the discipline. They are not 'academic' in the pejorative sense of the word, but are of profound, practical utility. They are the foundation upon which the university enterprise rests and upon which its significance for society is built" (Boulton & Lucas, 2008).

Hence they argue that governments should respect the essential core of the research university and not act to erode or circumscribe it. This is not a novel reminder. As Derek Bok observed in 1990, universities "help in but do not determine" outcomes such as effective corporate governance, sound financial regulation, competent government, effective schools, improved health or reduced poverty. He cautioned that "we will debase our academic institutions and the work they do if we think of them merely or even primarily as means rather than ends" (Bok, 1990).

Debates over research orientations have been going on fruitlessly for more than half a century. Divisions have been evident within the academy, with scientists in the natural disciplines tending to regard basic research as intellectually 'pure' and 'deep' while Engineering researchers have tended to regard applied research as 'real' and 'worthwhile'. In practice, many of the former distinctions between basic and applied research have blurred. In the lay community, the traditional justifications for public funding of basic research have come under question, partly through the 'democratisation' and 'commercialisation' of science – the challenge to researcher autonomy and authority and the demand for citizen participation, and the expectation of direct and immediate outcomes of research for product and process innovation.

Vanevaar Bush argued that as basic research has no direct commercial application it will not get funding from industry, but as it produces scientific capital for the nation it deserves public support (Bush, 1945). Conversely, applied research should be funded by industry not government. The Bush advocacy asserted a linear relationship from basic to applied research, suggesting that the quality of the underlying research is a precondition of applicability: technical developments are ultimately based on theoretical advances. The Frascati manual defines basic research in the following terms: "Basic research is experimental and theoretical work undertaken to primarily acquire new knowledge of the underlying foundations of phenomena and observable facts" (OECD, 1994).

A series of dichotomous descriptors has arisen in the course of debate, such as the following:

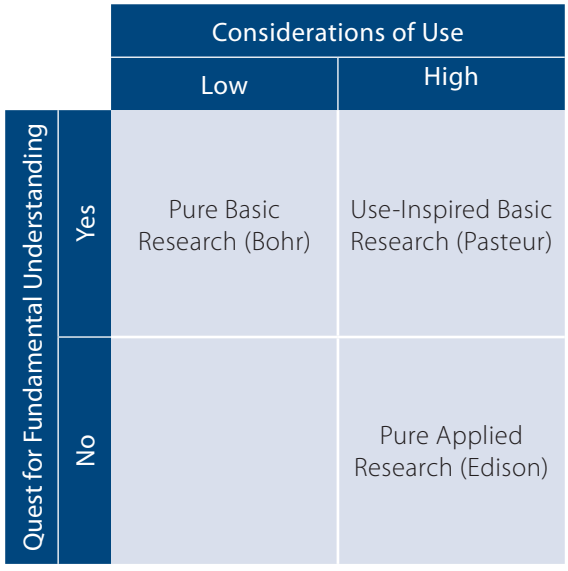
- *Basic research is performed without regard to practical ends whereas applied research is driven by finding solutions to practical problems.* Yet basic research can yield surprising practical benefits (e.g. global positioning systems derived from research into the theory of relativity) and basic problems can arise in the process of exploring solutions to practical challenges, e.g. immersion

of materials in deep water environments. Developments in information and communications technology speed up the processes of discovery to exploitation, e.g. in biotechnology.

- *Basic research is general, applied research is contextual.* Yet many breakthroughs in basic science have solved context-specific problems and insights derived from applied research have broadened theoretical understandings.
- *Basic research asks why? Applied research asks how?* Yet for some, such as astronomers researching deep space, the answers to how we came into being produce the answers to why we are.
- *Basic is path-breaking, applied research is path-following.* Yet, fundamental discoveries can be made in attempts to solve practical problems as basic problems are set and solved in application settings (Gibbons, et al. 1994).
- *Basic research is curiosity-driven or researcher initiated, whereas applied research is problem-driven or user-initiated.* Yet, the initial intent of research does not necessarily constrain its conduct.
- *Basic research is long-term whereas applied research is short-term.* Yet attempts to find cures for cancers and dementia have taken decades.

In an endeavour to accommodate the overlap between basic and applied research, Stokes (1997) proposed a new category of "use-inspired basic research" based on the aim of research spanning a quest for fundamental understanding and considerations of use (see Figure 10).

Figure 10. Pasteur's Quadrant



Stokes, 1997

The Stokes' approach is reflected in Australia's categories of research expenditure, including 'pure basic', 'strategic basic', and 'applied'. Even so, these categories relate to the intent of research rather than its content or processes or results. A plurality of approaches to research is necessary and patient expectations are required with regard to research outcomes. A wide definition of research can accommodate a diversity of research orientations:

> "In the broadest sense of the word, the definition of research includes any gathering of data, information and facts for the advancement of knowledge" (Shuttleworth, 2008).

Conclusion

The current main world university rankings broadly group the leading research universities of nations. Australia's Go8 universities are generally within the top 250 ranked universities, with several institutions in the top 50-100 on some measures. This recognition is commendable, however imperfect the individual rankings may be.

Use is made of rankings by prospective students, governments and universities themselves. There is not always a good alignment between the purposes for which rankings are designed and the ways they are used.

All of the rankings are deficient methodologically, and some are seriously flawed. Considerable work needs to be done to overcome the major deficiencies in ranker methods, especially those reliant on reputational surveys and proxy indicators, to give them greater statistical validity and reliability and better representation of disciplinary fields and cross-disciplinary work.

Because of the complexity of universities their assignment to ranks will always give a false sense of precision. It would be more appropriate for universities to be banded on the basis of their performance in relation to sets of criteria rather than ranked one after another.

Because of the diversity of universities in terms of what and how they teach, research and otherwise engage with their communities, the evaluative criteria need to be appropriate to their varying roles and activities. The criteria that are relevant for research-intensive universities are not as suitable for universities that do not research in all areas they teach.

For universities and other higher education providers whose functions are less research related, the current suite of world rankings are misleading for students and others and dangerous, neither appreciating what different institutions do and what they stand for, nor providing relevant references for their improvement. Indeed, the international exposure of the rankings – and all that goes with that in terms of branding for graduate opportunities, student recruitment, investment, partnering and alumni support – can press some universities to distort their missions and dilute the strengths they have and need to develop for serving their communities.

For those institutions in particular a more diverse and balanced set of comparative indicators needs to be developed with a focus on rating their educational and service strengths, and by field of education as well as on a whole of institution basis. This will require the development of indicators related to teaching and learning, diverse research orientations, and community engagement functions.

The current, mostly commercial rankings are filling a void, given the proliferation of data and marketing hype alongside the failure of universities themselves to adequately inform the communities that sustain them. Unless the university sector takes the initiative to develop appropriate and accessible ways of explaining their contributions, their directions will be increasingly determined by values set by others. One option is for groups of like institutions internationally to develop sets of criteria related to their missions in common, or at least to work with rating and ranking agencies to build typologies for comparative assessment.

Meanwhile, for Australia's leading universities, it is no time for complacency. Their positions are challenged by the rapid rise of universities in Asia and elsewhere. Additionally they face three main public policy threats: under-investment; dilution of investment; and narrow instrumentalism of support.

The first threat is one of under-investment in competitive research grants, research infrastructure,

and talent development – doctoral and postdoctoral students and early career researchers. Australian Government funding for research, research infrastructure and research training has plateaued and started to decline in recent years. There is currently no forward provision for real growth in any of the research funding programs. Without adequate resource inputs Australia's best will not be able to stay with the pace of the world's best.

The second threat is that of dilution of investment – a tendency to spread available resources across all universities, typically on a formulaic basis, and to avoid the concentration necessary for achieving the capacity to do internationally-recognised breakthrough research.

The third threat is that of narrow instrumentalism – a bias against basic research, and a preference for applied research with a demonstrable impact and immediate commercial pay off.

A combination of under-investment, social levelling and narrow instrumentalism in policy for higher education and university research is inimical to sustaining excellence for those universities whose mission is liberal and professional education of high quality in the context of internationally-referenced basic research and nationally-applicable applied research. If these three threats were to be realised in Australian public policy – and they are imminent – we will not be celebrating for much longer the position of our leading universities in the world league.

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Appendix 1. The construction of rankings

There are major differences in the methods used by the five main rankings. These differences can be seen in the definitions of what constitutes quality, in the criteria and indicators used to measure quality, in the measurement processes and in the presentation format.

ARWU

The ARWU is focused on research metric-based indicators:

- Alumni of an institution winning Nobel Prizes and Fields Medals (10%)
- Staff of an institution winning Nobel Prizes and Fields Medals (20%)
- Highly cited researchers in 21 broad subject categories (20%),
- Papers indexed in Science Citation Index-expanded and Social Science Citation Index (20%)
- Papers published in *Nature and Science* (20%)
- Per capita academic performance of an institution (10%)

The total number of the alumni of an institution winning Nobel Prizes and Fields Medals. Alumni are defined as those who obtain bachelor, Master's or doctoral degrees from the institution. Different weights are set according to the periods of obtaining degrees. The weight is 100% for alumni obtaining degrees in 2001-2010, 90% for alumni obtaining degrees in 1991-2000, 80% for alumni obtaining degrees in 1981-1990, and so on, and finally 10% for alumni obtaining degrees in 1911-1920. If a person obtains more than one degrees from an institution, the institution is considered once only.

The total number of the staff of an institution winning Nobel Prizes in Physics, Chemistry, Medicine and Economics and Fields Medal in Mathematics. Staff are defined as those who work at an institution at the time of winning the prize. Different weights are set according to the periods of winning the prizes. The weight is 100% for winners after 2011, 90% for winners in 2001-2010, 80% for winners in 1991-2000, 70% for winners in 1981-1990, and so on, and finally 10% for winners in 1921-1930. If a winner is affiliated with more than one institution, each institution is assigned the reciprocal of the number of institutions. For Nobel prizes, if a prize is shared by more than one person, weights are set for winners according to their proportion of the prize.

The number of Highly Cited Researchers in 21 subject categories includes those individuals that are the most cited within each category as reported by Thomson Reuters. Being acknowledged by Thomson Reuters as a Highly Cited Researcher means that an individual was among the 250 most-cited researchers in a defined discipline within a specific time-period based on analysis of papers covered in Web of Science from 1981-2008. If a Highly Cited Researcher has two or more affiliations, they were asked to estimate their weights (or number of weeks) for each affiliation. More than 2/3 of those multi-affiliated Highly Cited Researchers provided such estimations and their affiliations receive the weights accordingly. For those who did not answer, their first affiliation is given a weight of 84% (average weight of the first affiliations for those who replied) and the rest affiliations share the remaining 16% equally.

The total number of papers indexed in Science Citation Index-Expanded and Social Science Citation Index in 2011 accounted for 20%. Only publications of 'Article' and 'Proceedings Paper' types are considered. When calculating the total number of papers of an institution, a special weight of two was introduced for papers indexed in the Social Science Citation Index.

The number of papers published in Nature and Science between 2007 and 2011 accounted for 20%. To distinguish the order of author affiliation, a weight of 100% was assigned for corresponding author affiliation, 50% for first author affiliation (second author affiliation if the first author affiliation was the same as corresponding author affiliation), 25% for the next author affiliation, and 10% for other author affiliations. Only publications of 'Article' and 'Proceedings Paper' types were considered.

In addition the bibliometric indicators were included as part of the per capita indictor in which weighted scores of five indicators were divided by the number of full-time equivalent academic staff. The per capita indicator amounts to 10% of the ranking score.

Both the Highly-cited and publications in Nature and Science Indicators are strongly lagged indictors with the former based on citation data from 1981-2008 and the latter based on publications between 2007 and 2011.

The methodology has the purported advantage that the data is metric based and does not rely on data provided by the universities themselves or on surveys. The focus is clearly on research and not on teaching and learning.

Times Higher Education –Thomson Reuters

The THE Thomson Reuters 2012-2013 ranking was derived (as in 2011-12) from 13 separate indicators grouped under five categories: Teaching (reputational survey 15%, a range of student/staff ratios and income per academic 15%), research (reputational survey 15% and a range of income and publication measures 15%), citations (30%), international outlook (ratios of international to domestic staff and international students to domestic students, research measure 7.5%), industry income (research income from industry scaled against the number of academic staff, 2.5%).

Overall indicator	Individual indicators	Percentage weightings
Industry Income – innovation	Research income from industry (per academic staff)	2.5%
International outlook (staff, students, research)	Ratio of international to domestic staff	2.5%
	Ratio of international to domestic students	2.5
	Proportion of internationally co-authored research papers	2.5%
Teaching – the learning environment	Reputational survey (teaching)	15%
	PhDs awards per academic	6%
	Undergrad. admitted per academic	4.5%
	Income per academic	2.25%
	PhDs/undergraduate degrees awarded	2.25%
Research – volume, income and reputation	Reputational survey (research)	18%
	Research income (scaled)	6%
	Papers per research and academic staff	6%
Citations – research influence	Citation impact (normalised average citation per paper)	30%

The reputational component of the rankings is derived from an Academic Reputation Survey of 'representative' academic staff around the world conducted by Thomson Reuters.

Data for citation impact (measured as a normalised average citation per paper) comes from Thomson Reuters' database over a five year period.

The THE Thomson Reuters ranking method was changed in 2010. Earlier rankings used the ranking system produced by QS (see below). The ranking method changed again from 2011 to 2012 with the inclusion of the research indicator in international outlook, a reduction in the weighting for citations and other minor changes.

QS World University Rankings

QS uses a ranking based on Academic peer review (40%), recruiter review (10%), Faculty student ratio (20%), Citations per faculty (20%) and International orientation (10%).

The Academic Peer Review is a survey which asks active academics across the world about the top universities in fields they know about. The recruiter review samples recruiters who hire graduates on a global or significant national scale.

QS previously used citations data from Thomson Reuters for its 2004 to 2007 rankings but now uses data from Scopus (Elsevier). The total number of citations for a five-year period is divided by the number of academic staff in a university to yield the score for this measure, which accounts for 20 per cent of a university's possible score in the Rankings.

For major world universities, the Scopus and Thomson Reuters databases capture more or less the same publications and citations. For less mainstream institutions, Scopus has more non-English language and smaller-circulation journals in its database. But as the papers there are less heavily cited, this can also mean fewer citations per paper for the universities that publish in them.

International orientation is derived from measures intended to capture their internationalism: five percent from their percentage of international students, and another five percent from their percentage of international staff.

The QS ranking, although including both teaching and research measures, is heavily based on reputational surveys and as such has been criticised for the validity of its ranking system.

QS Stars

QS Stars is described as a system that evaluates universities worldwide using a rating method. Universities are awarded a rating of one to five stars against eight criteria; Research Quality, Teaching Quality, Graduate Employability, Infrastructure, Internationalisation, Innovation & Knowledge Transfer, Third Mission and Specialist Subject Criteria. Each criterion has its own indicators, weightings.

A typical Four Stars university described as "highly international, demonstrating excellence in both research and teaching. The institution provides an excellent environment for students and faculty." A typical Five Stars university is described as "generally world class in a broad range of areas, enjoys a high reputation and has cutting edge facilities and internationally renowned research and teaching faculty. A typical five-star plus institution is "not just world-class, but an elite destination to which the very best students and faculty worldwide will aspire. Its brand name will transform the résumé of anyone connected with it. Five Stars + can apply equally to the world's foremost comprehensive and specialist institutions."

Three Australian universities are recorded as having 5stars+ ratings: Monash University, The University of New South Wales, and The University of Queensland. Seven are recorded as having 5stars: Deakin; Newcastle; UniSA; UTS, QUT, RMIT, and Wollongong. Two are recorded with 4stars: Swinburne and Tasmania.

QS Stars ratings may be obtained by a university paying for a special QS audit at a cost for the audit and a three-year licence of US$30,400 (Jibbins, 2012). Some universities – Cambridge and Harvard among them – have not had to pay for the accreditation process for their five-star rating as their award is based on publicly available information. The main market for QS stars are institutions not ranked highly on the basis of publicly available metrics.

Head of the QS Intelligence Unit Ben Sowter, is reported as saying:

> "In global terms, viewing the quality of world universities through a frame of reference defined by the likes of Cambridge and Harvard has limitations. With universities all over the world charging substantial fees to international students, an objective means of differentiating between the quality of the services they provide is indispensable. QS Stars allow students to make more informed choices, while also helping universities to recruit more effectively by providing independent verification of the areas in which they excel" (Jibbins, 2012).

That is nothing short of a marketing spiel along the lines that 'if you can't cut it in the objective measurement stakes then buy our ratings and you will more than recoup the costs through growth in student fee revenues'. It is an attractive business model @$35,000 for potentially 17,000 institutions = $595 million per year. While some universities are opting to gain a QS star rating for marketing purposes many are (yet?) not, including those that would be likely to be rated highly and those not so highly rated. It will be interesting to see whether a divide will emerge between those who pay to be rated and those that do not.

Leiden Ranking

The Leiden Ranking 2011/2012 is based on publications in Thomson Reuters' Web of Science database in the period 2005-2009. Only publications (articles, letters, and reviews) in the sciences and the social sciences are included. Publications in the arts and humanities are excluded because in these domains the bibliometric indicators do not have sufficient accuracy. As a result the Leiden ranking is a measure of research in the physical and social sciences and with no metrics relating to teaching and learning

The Leiden Ranking includes the following bibliometric indicators:

- *Mean citation score (MCS)*. The average number of citations of the publications of a university.
- *Mean normalized citation score (MNCS*). The average number of citations of the publications of a university, normalized for field differences, publication year, and document type. An MNCS value of two for instance means that the publications of a university have been cited twice above world average.
- *Proportion top 10% publications ($PP_{top\ 10\%}$)*. The proportion of the publications of a university that, compared with other similar publications, belong to the top 10% most frequently cited. Publications are considered similar if they were published in the same field and the same publication year and if they have the same document type.

Citations are counted until the end of 2010 in the above indicators. Author self citations are excluded.

In addition a range of bibliometric indicators measuring research collaboration are included:

- *Proportion collaborative publications (PP_{collab})*. The proportion of the publications of a university that have been co-authored with one or more other organizations.
- *Proportion international collaborative publications ($PP_{intcollab}$)*. The proportion of the publications of a university that have been co-authored by two or more countries.
- *Mean geographical collaboration distance (MGCD)*. The average geographical collaboration distance of the publications of a university, where the geographical collaboration distance of a publication equals the largest geographical distance between two addresses mentioned in the publication's address list.

- *Proportion long distance collaborative publications ($PP_{>1000\,km}$)*. The proportion of the publications of a university that have a geographical collaboration distance of more than 1000 km.

The Leiden Ranking can be adjusted to take into account different ways of counting joint publications and adjusting for non-English language publications.

Webometrics

The Ranking Web or Webometrics has been produced since 2004 and is revised every six months by the Cybermetrics Lab of the Spanish National Research Council (CSIC). It is derived from information about the performance of universities from all over the world based on their web presence and impact. Since 2008 the portal has also included webometrics rankings for research centres, hospitals, repositories and business schools. The ranking aims to promote academic web presence and support Open Access initiatives for increasing the transfer of scientific and cultural knowledge generated by the universities to the wider society.

Webometrics uses link analysis rather than citation analysis or reputational surveys for quality evaluation. Webometrics log-normalise the variables before combining according to a ratio 1:1 between activity/presence and visibility/impact groups of indicators. The July 2012 composite indicator comprises:

- *Presence (20%)*. The total number of webpages hosted in the main webdomain (including all the subdomains and directories) of the university as indexed by the largest commercial search engine (Google).
- *Impact (50%)*. Content quality is evaluated through a "virtual referendum", counting all the external inlinks that the University webdomain receives from third parties. The link visibility data is collected from Majestic SEO and ahrefs. Both use their own crawlers, generating different databases. The indicator is the product of number of backlinks and the number of domains originating those backlinks. The maximum of the normalised results is the impact indicator.
- *Openness (15%)*. This indicator takes into account the number of rich files (pdf, doc, docx, ppt) published between 2007 and 2011 in dedicated websites according to the academic search engine Google Scholar.
- *Excellence (15%)*. This indicator counts scientific output within the 10% most cited papers in their respective scientific fields.

HEEACT rankings

HEEACT uses the following criteria:

- Research productivity (weighed 20%) – The number of published articles of the last 11 years (10%) and the number of articles of the current year (10%).
- Research impact (weighed 30%) – Number of citations of the last 11 years (10%), the number of citations of the last two years (10%), and the *average* number of citations of the last 11 years (10%).
- Research excellence (weighed 40%) – The h-index of the last two years (20%), the number of highly-cited papers (15%), and the number of articles of the current year in high-impact journals (15%).

Quantitative data is drawn from Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). The data is normalized by faculty number to account for different institution sizes. The indicators used in this methodology highly emphasize research quality (80% of the performance

score) and short-term research performance (55% of the score).

The HEEACT rankings were terminated in 2011. The Taiwanese education authority has announced that the Government will no longer support rankings by Higher Education Evaluation and Accreditation Council of Taiwan.

SIR World Report

The SIR World Report 2012 includes 3290 research institutions from 106 countries. The indicators include:

- *Output*. Total number of documents published in scholarly journals indexed in Scopus.
- *International Collaboration*. Institution's output ratio produced in collaboration with foreign institutions. The values are computed by analysing an institution's output whose affiliations include more than one country address.
- *Normalised Impact*. The values (in %) show the relationship between an institution's average scientific impact and the world average set to a score of 1, i.e. a NI score of 0.8 means the institution is cited 20% below world average and 1.3 means the institution is cited 30% above average.
- *High Quality Publications*. Ratio of publications that an institution publishes in the most influential scholarly journals of the world; those ranked in the first quartile (25%) in their categories as ordered by SCImago Journal Rank SJR indicator.
- *Specialisation Index*. The Specialisation Index indicates the extent of thematic concentration / dispersion of an institution's scientific output. Values range between 0 to 1, indicating generalist vs.specialised institutions respectively. This indicator is computed according to the Gini Index for the national economy.
- *Excellence Rate*. The Excellence Rate indicates the amount (in %) of an institution's scientific output that is included into the set of the 10% of the most cited papers in their respective scientific fields.
- *Scientific Leadership*. Leadership indicates the number of papers in which the corresponding author belongs to the institution.

Indicators of Australia's Group of Eight Universities

GROUP OF EIGHT

Indicator	The Australian National University	Monash University	The University of Adelaide	The University of Melbourne	The University of New South Wales	The University of Sydney	The University of Queensland	The University of Western Australia	Average for rest of Australia's universities	Closest non-Go8 university	
Net assets (2009) ($million)	1,702	1,629	953	3,507	1,400	3,221	2,792	1,379	631	1,584	Griffith University
Annual revenue (2009) ($million)	835	1,410	615	1,482	1,171	1,392	1,260	732	373	752	Queensland University of Technology
Total research income (2009) ($million)	128	221	146	337	301	279	303	160	27	81	Queensland University of Technology
Total research income per academic staff FTE with a research function (2009) ($thousand)	68	69	92	108	120	93	96	104	39	129	Charles Darwin University
										89	Murdoch University
Nationally competitive research Income (2009) ($million)	77	110	73	166	128	157	129	73	10	32	University of Newcastle
Industry-funded research income (2009) ($million)	24	52	26	79	86	73	82	45	6	20	University of Newcastle
Number of submitted fields with ERA rating of 4 or 5 (2010)	51	51	33	82	56	59	77	29	6	20	Macquarie University
[% of all submitted fields at the university]	78%	57%	44%	80%	64%	58%	76%	35%	14%	36%	Macquarie University
Number of fields (out of 381 narrow disciplines) in which graduate research students are enrolled (2009)	56	112	123	110	86	156	143	103	51	218	Griffith University
										79	Curtin University of Technology
Fields with graduate research student enrolments as a proportion of all fields taught by the university (2009)	44%	48%	63%	45%	41%	71%	65%	50%	29%	81%	Griffith University
										56%	La Trobe University
Total students (2009)	17,579	59,925	22,174	45,448	46,370	50,432	40,583	21,907	24,027	49,233	RMIT University
Undergraduate students (2009)	9,761	42,720	15,535	27,714	28,135	31,161	29,205	16,411	16,873	37,502	RMIT University
[% of all students at the university]	56%	71%	70%	61%	61%	62%	72%	75%	69%		

Indicator	The Australian National University	Monash University	The University of Adelaide	The University of Melbourne	The University of New South Wales	The University of Sydney	The University of Queensland	The University of Western Australia	Average for rest of Australia's universities	Closest non-Go8 university	
PhD students (2009)	2,272	3,025	1,653	3,792	2,837	3,447	3,165	1,837	692	1,671	Macquarie University
[% of all students at the university]	13%	5%	7%	8%	6%	7%	8%	8%	3%	5%	University of Tasmania
Medical students (2009)	346	1,902	872	1,580	1,468	1,159	1,789	1,198	447	725	James Cook University
International students (2009)	4,270	21,114	6,229	12,005	11,487	11,969	8,826	5,137	6,714	24,710	RMIT University
[% of all students at the university]	24%	35%	28%	26%	25%	24%	22%	23%	26%		
Proportion of domestic undergraduate offers with school leaving attainment in top 10% (2010)	61%	53%	47%	75%	55%	63%	53%	62%	29%	41%	University of Technology, Sydney
Attrition rate for first year domestic bachelor degree students (2008)	11.1%	10.9%	15.1%	8.9%	11.3%	10.5%	15.2%	12.8%	21.8%	11.2%	University of Wollongong
Apparent gross student EFTSL to academic staff FTE ratio (2009)	8.7	15.9	12.3	12.6	15.1	14.4	11.2	13.3	29.1	17.8	Flinders University of South Australia
Academic staff (actual FTE including casuals) with Research only appointments (2009)	1,269	1,482	810	1,547	965	1,266	1,807	690	147	433	Griffith University
[% of all academic staff in university]	63%	39%	45%	43%	31%	36%	50%	42%	14%	34%	Charles Darwin University
Academic staff (actual FTE including casuals) with research and teaching appointments (2009)	623	1,712	774	1,567	1,556	1,740	1,348	850	531	964	Queensland University of Technology
[% of all academic staff in university]	31%	46%	43%	44%	51%	50%	37%	52%	61%	97%	University of Canberra
Number of academic staff with doctorate qualifications (2010)	1,334	2,344	981	2,185	2,939	1,954	2,188	1,168	439	1,110	Queensland University of Technology
[% of all academic staff in university]	83%	67%	70%	66%	60%	64%	77%	72%	52%	76%	University of Wollongong

Sources

Higher Education Statistics. Finance 2009; Students 2009; Staff 2009, 2010; Department of Employment, Education and Workplace Relations
2009 Higher Education Research Data Collection; Department of Innovation, Industry, Science and Research.
Excellence in Research for Australia 2010 Outcomes, Australian Research Council
Undergraduate Applications, Offers and Acceptances, 2010; Department of Employment, Education and Workplace Relations

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