

Patterns behind the rankings: mining academic league tables to reveal variability and covariation

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ABSTRACT

University League Tables are widely used to compare the standing of individual departments or universities, both nationally and internationally. In response to criticisms, the League Tables have become more sophisticated and use more resources to ensure better measurement, although difficulties still abound. Rather than being limited to uni-dimensional measures of standing, it is argued in this paper that the data from League Tables can also be used to investigate the range of characteristics of universities and the covariation of these characteristics. Presenting factor analyses based on many of the available League Tables shows that quite complex patterns are often yielded although some traditional distinctions such as research versus teaching dimensions sometimes occur.

Introduction

The recent explosion of University League Tables has been aimed partly at better fulfilling the widespread demand for information from potential students and their parents and advisors, although other League Tables are orientated towards establishing the world ranking of research institutions as nations jockey to seek global intellectual prestige or prowess. The main thrust behind the development of League Tables has been the entrepreneurial opportunity for selling (directly or indirectly) information about different universities, with this market quickly developed by media interests: especially those focusing on higher education. However, another thrust for these developments has been national higher education and research policies that have been concerned about whether their country's abilities in industrial innovation are sufficient to drive their economies and also about their universities' abilities to successfully participate in the huge international market for students, and especially for post-graduate students.

However, League Tables are widely thought by commentators to suffer methodological difficulties and also to give rise to deleterious consequences for those organisations and staff disadvantaged by the measurement systems proposed. These methodological difficulties include the unsoundness of many of the frameworks which guide the collection and presentation of data and the quality of the data that are deployed. Often this is because immediately available data is pressed into service, rather than there being a process of carefully identifying what measures are needed and allocating the resources necessary for obtaining these. As always happens when public performance-measurement systems are set up, there then arises a pressure on organisations and individuals within them to maximise their standing, and this may sometimes involve a subsequent skewing of their performances as well as fuelling their public relations efforts.

Nevertheless, the collected information offers some interesting potentials for research into the realities of these universities. Over time these datasets have tended to assemble wider arrays of data and to have increased their validity and reliability, and the pace of change and improvement is fast. As well as using widely available organisational data, some League Tables are underpinned by careful (or less careful) surveys of staff and/or students and sometimes other stakeholders such as employers. The bibliometric or scientometric data which is the main underpinning of most efforts measures (despite many limitations) the very heart of knowledge production which is surely one of the few main “core businesses” of universities. The range of some of the League Tables is impressive, with several including worldwide coverage of a fairly full range of tertiary institutions and also some non-teaching research organisations: others are only national in scope but nevertheless endeavour to be nationally comprehensive. Sample (often actually population) sizes are often quite large. Unfortunately, the time depth is very thin and so it is difficult to trace change. Although data is often presented on web sites wrapped up within preset formulae which restrict alternative measures, more recently the underlying information is also presented. In particular, systems are now set up so that data can be manipulated to develop user-specific summative rankings data and very often the data can be downloaded for free. (Mind you, the downloading systems provided are usually not well-adapted to massive cross-the-board capturing of data and capture of data often takes ingenuity and hard work.) This means that secondary analysis can be used to analyse patterns in the data.

This paper examines data from a range of web sites providing university performance information (and especially those covering sociology or the social sciences more generally) to reveal patterns in the data. The study will focus on patterns amongst the different components of the League Tables without being concerned at all with the ranking results of the summative rankings which are so central to many of the exercises.

Some investigations of universities as organisations are concerned with identifying the correlations between some “output” variable and other characteristics (inputs, although more often merely structural features). In this investigation each data system accessed provides an array of data available, mainly dependent variables although with some independent variables, but all variables are treated as different parts of the same broad field, with the analytical concern being to ascertain the extent to which the various variables hang together. Given the questions being posed and the broad interpretation aimed at, it is appropriate that the data analysis is therefore dominated by factor analyses – which have the statistical purpose of uncovering patterns in data. A standard approach deploying principal components and then varimax rotation is used, with recourse to oblique rotations where patterns are recalcitrant.

There are major questions about universities (and related organisations) which data harvested from League Tables might illuminate. Since the more detailed datasets provide information about the different areas of operation in universities, investigation into how these different areas of operation interrelate might be posed. One issue is the extent to which universities co-produce highly rated research, teaching and service functions, and it is this question which this paper focuses on. Other issues are raised here but their investigation postponed for other occasions. One such further issue is the consistency of university performances over the array of fields they cover (e.g. is a high ranking sociology department likely to be accompanied by a high ranking physics department?). Another is the effect on universities of their national, regional or urban context or their particular socio-demographic profile. Finally, do different types of university (e.g. general universities compared to technology universities) have different effects?

In line with the broadly inductive approach being deployed, only a broad theoretical framework can be pressed into service. Universities and their components (such as departments), as with all organisations, must attempt to set goals appropriate to their place in their environment and mobilise appropriate resources for achieving these. Resources are limited and so choices must be made about their goal-mix to emphasise which may result in any of a variety of configurations. Some

units will be able to achieve high standing across several aspects, and other forced to accept low standing across several aspects, whereas other units may be more mixed – having higher rankings on some aspects and lower rankings on others.

In utilising the data there are some further methodological issues that need to be considered. One issue is that often the data is standardised and sometimes transformed. Careful attention is needed as to whether the data is standardised or not for size of university (itself a complex issue). After all, a major effect of some universities entirely flows from their size, and absolute measures can often differ from the results arising from relativised measures: clearly there has to be a preference for the latter or the use of both.

Different League Tables provide information at different levels of disaggregation. Usually individual universities (sometimes separate campuses) are the units, but in some cases the data is provided at faculty, discipline or department level and so patterns can be examined at different scales. It is not always clear whether patterns found at one level also hold at other levels. Finally, a limitation of some League Tables is that they concentrate on the few more elite institutions and do not cover the full range of organisations and the effect of such limitations of scope will be noted.

Relevant literatures

There is a broadly relevant literature examining the characteristics of universities, their personnel, students and contexts – and the relationships holding amongst these. Some studies sketch the remarkable changes wrought in the contours of university systems from the effects of the neoliberal changes of the last few decades, and the particular instruments such as measurement systems. Such changes include much commercialisation and marketisation, more competition, higher pressure to publish, less tenure security and a higher level of differentiation within the university system. The datasets deployed in this study may be able to illuminate the end point up to the present of such changes but, lacking adequate time-series, cannot trace the changes.

Stung by the looming effects of such changes on their own activities, and the urgent national policy consequences, academics have published a raft of essays on, and studies into, League Tables in recent years. These include studies by Buela-Casal et al. (2007), Dill and Maarja (2005), Merisotis and Sadlak (2005), Taylor and Braddock (2007), TheCenter (2004), Tijssen (2003), User and Massimo (2006; 2007) and Van Dyke (2005). Interesting essays on consequences include those from: Weingart (2005); Eccles (2002), Marginson (2007) and Marginson and van der Wende (2007).

There is also a more focused literature centred on the League Tables and the errors of their ways. For example, Clarke (2002) critiques the *US News and World Report* rankings; Florian (2007) reports that he found the results of the Shanghai ranking of world universities to be irreproducible; while Laudel (2005) queries whether external research funding is a valid indicator for research performance.

Finally, although not directly related to League Tables, a wide range of studies of individual careers and characteristics of academics have been carried out. Some focus on factors linked to publication outputs or to teaching characteristics and others on the (trade-off?) relationships amongst the roles within the academic role-set or between that role-set and family or personal lives. In line with the larger picture of university change, higher degrees of pressure and stress are often reported. One particular focus for debate has involved the unpacking of the teaching/research nexus. In a particularly controversial meta-analysis Hattie was able to demonstrate that the correlation between teaching and research prowess barely hovers above a null result in very many studies, and that it may be better to see this relationship as totally random (Marsh & Hattie, 2002). An earlier study also reported such a null relationship (Fox, 1992). This potential finding is one of several that can be tested against the wider range of data made available through League Tables. Unfortunately, this is the only clear-cut relationship which has been uncovered in the literature, and how other aspects of university operations interrelate remains rather murky.

In sum, scholarly attention to League Tables has tended to either celebrate the successes they point to or to emphasise their difficulties. This paper attempts to move into a productive space in which the data assembled can be used to link up with and extend the more general scholarly literatures on universities as organisations.

Data in readily-available League Tables

The first substantive task is to endeavour to uncover those League Table projects which yield information on universities and to indicate something of the range of their data. To obtain a broad overview two portals were examined: those provided by *Wikipedia* (http://en.wikipedia.org/wiki/College_and_university_rankings) and by the University of Illinois (<http://www.library.uiuc.edu/edx/rankgen.htm>). A wide range of different measurement options is available in terms of scope and range of measures used: see Table 1. Some are limited to either research or student based material, which did not suit the present concern. Tables are available from US, Canadian, UK, German, Swiss, Chinese and Australian sources. The sources are fairly evenly split between those providing international and national coverages. Where a source provides information about units within universities this is noted. Van Dyke (2005) has provided a useful classification of the type of information often included:

- quality of academic staff;
- quality of incoming students;
- quality of teaching programme;
- resources;
- stakeholder's opinions; and
- other.

Whereas the emphasis for the internationally-orientated League Tables is almost entirely on research-orientated material, nationally-orientated systems are more likely to include data on teaching and other concerns that are more relevant to students. Reflecting the advance of internet technology, more recent additions have begun to include webometric data on internet connection densities.

Having provided an overview of the available League Tables, the next step is to examine in more detail the criteria they use in establishing these rankings and the data deployed to meet these objectives. The relevant measures used will be indicated in working through the results from those indicator systems which have been accessed for this study.

The substantive portion of this paper provides two types of analyses: of useable datasets with university-wide data, and then those focused on particular subject matters – in this paper sociology, or more widely social sciences. It seems reasonable to assume that more detailed levels usually provide more valid and reliable information. The remainder of this paper works through the relationships found in various of the datasets. Firstly, the world-level datasets will be examined, followed by national-level ones, and then the various more specialised dataset results are reviewed. All those websites where data could be downloaded were used in this study. Where faculty-specific or department-specific information can be downloaded, only social sciences or sociology are taken as case study areas.

Table 1. Major available League Tables (in alphabetical order)

Agency	Name of ranking	Coverage	Approx. size	Criteria used	Scale of information provided: Subject-specificity
Asiaweek	Best universities 2000	Asia	c80	Mixed	—
4icu	International Colleges and Universities Rankings	World	Not clear	Website popularity/usage	—
CEST (Switzerland)	Scientometric Profiles	World	Very large	Publications	Subject-specific
DAAD (German Academic Exchange Service)	German University Ranking	Germany	c250	Multiple	Subject-specific
Grade My University	Grade My University	World	—	Student reviews	—
Graduate-school.phds.org	Customised Graduate Program Rankings	US	00s	Mixed	Subject-specific
Guardian	Guide to Universities	UK	c120	Mixed	—
MacLeans	Universities Ranking	Canada	c40	Mixed	—
Melbourne Institute	Index of standing of Australian Universities	Australia	c35	Mixed	Some broad subject-specific
Newsweek	Top 100 Global Universities	World	100	Limited	—
Shang Jaio Tong University	Academic Ranking of World Universities	World	c300	Research performance	—
Times Higher Education Supplement (THES)	World University Rankings	World	200/500	Mixed	Broad subjects
The Times	Good University Guide	UK	c120	Mixed	Subject-specific
The Center for Measuring University Performance	Top American Research Universities	US	200	Mixed	—
University Metrics	Global University Rankings	World	300	Web-metrics	—
US News and World Report	College Rankings	US	—	Mixed	—
Webometrics	Ranking of World Universities	World	4000 plus	Volume/visibility/impact of websites	—

Results

The THES ratings (Table 2) emphasise scholarly performance and international recruitment (of both staff and students) with a considerable emphasis on reputation gleaned from a large survey. (The scantiness of the methodological details for this survey have been criticised and it has been considered that it is skewed towards “English-speaking academics” within a “British” context.) Moreover, the rankings are not particularly stable, with a 2003/2004 correlation of approximately $r = 0.85$. Interestingly, the factor analysis produces three factors: which might be termed research prestige, international staff/students and faculty ratio. This is strong disconfirmation of the idea that the international dimension reinforces or flows from research prestige. Internal features such as efficiency (faculty/student ratio) are also not linked with research prestige. On the other hand, recruiters of graduands apparently stress the research prestige factor. The analysis seems to also suggest that the overall score calculated by the THES ignores the variation supplied by three of its component variables.

Table 2. THES rotated component matrix - world universities

Variable	Component		
	1	2	3
Overall score	.937	.169	.242
Peer review score	.858	.055	.110
Recruiter review	.760	.230	.059
Citations faculty	.667	-.311	-.296
International faculty %	-.030	.878	.103
International students %	.215	.848	-.052
Faculty/student ratio	.129	.020	.958

* In all tables, numbers in bold type indicate coefficients which are significantly loaded on the component.

Results from the Shanghai Jiao Tong University’s ARWU are similar to the THES with an even stronger emphasis on research esteem. Since all the variables are highly related to each other only one factor is produced (and so is not reported here). When the top performing universities are compared to each other in relation to performance in the sciences, engineering, life sciences, medicine and the social sciences again only a single factor emerges, although the correlations are moderate rather than large.

The Melbourne Institute’s analyses of Australian universities (Table 3) are able to draw on a very large range of data, including separate measures for laboratory and non-laboratory areas of scholarship. Two highly overlapping factors emerge. The first factor clearly covers research-orientated measures, not only in terms of publications but also citations, research grants and income and subjective ratings. The second factor loads both on research performance in general and on more prestigious research-related measures. But the factor analysis of the Australian data does not produce clear results, which may be because of the very wide variety of measures it includes. It is possible, too, that there are too few institutions for separate factors to be revealed. Clearly, further investigation is required.

Table 3. Melbourne Institute - Australian universities rotated component matrix

Variable	Component	
	1	2
Other research income	.933	.289
DEST publications	.877	.427
ESI publications (laboratory)	.870	.467
National competitive grants	.864	.444
Graduate programs	.846	.251
ESI citations (laboratory)	.811	.562
International impact of staff	.797	.592
Views of CEOs and deans	.763	.628
Undergraduate intake	.721	.258
ESI publications (non laboratory)	.685	.660
Research performance per head	.663	.589
Undergrad programs	.635	.479
Highly cited	.201	.956
Resosurces	.367	.850
Academy membership	.517	.821
ESI citations (non laboratory)	.663	.671

The Times database (see Table 4) draws on a wide range of data, but a factor analysis of the variables relating to some 100 sociology programmes in the UK yielded only two factors. The first focuses on a range of measures of quality of inputs and outputs (entry standards of students and honours obtained plus completions, research quality, spending on academic services and also the staff/student ratio). In contrast, student satisfaction with teaching and expenditure on student facilities load on a second factor. *The Guardian* also supplies subject-specific League Tables for the UK, but the range of information is very student-focused and analysis was not particularly interesting.

Table 4. *The Times* rotated component matrix – UK sociology departments

Variable	Component	
	1	2
Entry standards: the average A-level score of new students under the age of 21	.942	.068
Rank: the original Good University Guide ranking	-.939	-.231
Good honours: the percentage of graduates achieving a first or upper second class degree	.879	.204
Research assessment: a measure of average quality of the research undertaken in the university	.883	.280
Graduate prospects: a measure of employability of the graduates of a university	.796	-.064
Student-staff ratio: a measure of the average staffing level in the university	-.783	-.068
Completion: a measure of the completion rate of those studying at the university	.764	.405
Academic services spend: the expenditure per student on library and computing facilities	.680	.055
Student satisfaction: a measure of the average teaching quality of the university	-.105	.935
Facility spend: the expenditure per student on student facilities	.379	.416

For the US *graduate-school.phds.org* provides a very comprehensive listing of variables for a range of subjects: here again sociology is used with just over one hundred doctoral programs being included. The factor analysis is not entirely successful, with many variables loading highly on several factors. Nevertheless the first two factors, at least, are eminently interpretable. The patterns found are interesting. There are four factors: 'scientific quality' which loads on citations, perception of educational and scholarly effectiveness, number of faculty, size of programme (in terms of staff and students), grants per faculty, high proportion of research fellowships or research assistantships, undergraduate selectivity, job placement rate and staff publication-rate and negatively on costs (also boarding costs), percent women, and the availability of teaching fellowships. This factor seems to contrast more research-orientated and more teaching-orientated universities.

Table 5. US sociology graduate-schools — rotated component matrix

Variables	Component			
	1	2	3	4
Citations	.981	-.149	.109	-.058
Low cost per year	.962	.205	-.177	.024
Educational effectiveness	.948	.293	-.109	.061
Number of faculty	.942	.205	-.262	-.052
High number of degrees per year	.940	.301	.116	-.114
Grants per faculty	.916	-.308	.246	.076
Faculty quality	.828	.531	-.130	.124
Research assistantships	.762	-.609	.197	-.099
Women	-.745	.162	.453	-.462
Support	.735	-.018	-.131	-.664
Acceptance rate	.714	-.564	-.347	.225
Teaching assistantships	-.678	.158	-.522	-.494
Low room/board expenses	-.668	.477	.402	.405
Postdoctoral placement	-.123	.992	1	-.042
Fellowships	.106	.988	.106	.048
Time to degree	-.093	.892	.364	-.251
Job placement rate	.507	.858	.079	.014
Under-represented minorities	.108	-.816	-.318	-.470
Publications per faculty	.538	-.811	-.14	.228
Debt	-.390	-.800	.370	-.266
Maths	-.223	.713	.609	-.266
Foreign students	-.151	.300	-.941	.33
Low ratio graduate students/ faculty	.281	.176	.915	-.227
Low in-state tuition	-.279	.284	.870	.292
Hi verbal	-.300	.571	.740	.191
Low out-state tuition	.185	.635	.732	.162
Part-time students	.027	.098	.075	.992
Education placement	.098	-.642	-.327	.687

Table 6. DAAD - sociology departments in Germany rotated component matrix

(variables preceded with "S": are derived from a student survey)

Variable	Component					
	1	2	3	4	5	6
S: Courses offered	.866	.314	.048	.126	-.104	-.215
S: Contact between students	.831	.264	.003	.030	-.058	.024
S: Practise support	.825	.444	.002	.068	.056	-.184
S: Employment related prgrams	.818	.275	.022	.270	-.196	-.066
S: Methods training	.815	-.073	-.195	-.146	.251	-.275
S: Contact students-teachers	.808	.052	.321	.201	.219	-.243
S: Workstations	.793	.394	-.056	-.021	-.220	.087
S: Teacher evaluation	.788	.068	-.073	-.294	.041	.279
S: Counselling	.780	.266	.200	.073	.295	-.305
S: Study organisation	.775	.357	-.014	.054	.132	-.354
S: Learning	.763	.149	-.188	-.123	.255	.032
S: Media equipment	.675	.567	.106	-.114	-.052	.262
S: Rooms	.323	.777	.089	-.028	.061	.005
S: Workstations	.331	.760	-.023	-.126	.380	-.127
S: Library	.257	.732	-.011	-.190	-.095	-.152
S: IT infrastructure	.218	.689	-.292	-.097	.472	.154
S: Overall study situation	-.082	-.155	.874	.158	.178	.017
Research reputation	-.168	-.216	.830	.114	.193	.099
Many doctorates	.044	.211	.825	-.201	-.201	-.024
Small university location	.439	.369	.616	-.087	.113	-.017
Many publications	-.119	-.126	.031	-.754	.216	.179
S: High education sport	-.392	.177	-.252	-.719	.053	-.059
Much 3rd party financing	-.006	-.038	-.163	.710	-.311	-.046
Low rent	.104	.242	.306	-.065	.752	.192
"Professors tip"	-.243	-.062	.074	.192	.193	.840

The second factor seems to measure teaching or, more generally, student friendliness. At the centre are high placement rates, short times to completion, high maths and verbal scores of incoming students despite low selectivity, together with low room/board expenses. Universities scoring highly on this factor have moderate scores on measures of research quality. The third factor seems to pick up on "student mills" with low tuition fees and poor ratios of students to faculty. The fourth factor picks out the odd pairing of high educational placements with high proportion of part-time students.

The German DAAD ratings (Table 6) are the most comprehensive and well-developed measures, mainly based on a large survey of students. (Those variables marked with a capital S in Table 6 are derived from this survey.) The first factor comprises a broad student-centred cluster of variables which includes teaching as well as teaching support, and interestingly includes more

vocational aspects. The second factor focuses on facilities which are available for supporting learning (especially IT and library). The third factor is more research orientated, although the mix of variables includes research reputation with many doctorates amongst the staff but also overall study situation and small university location. It is surprising that overall study situation is uncorrelated with the more detailed measures of study situation and suggests that there is a halo effect in the survey about the overall feel of the university. The remaining three factors seem to relate (respectively) to university size, cost of living and how professors (surveyed separately for the data system) rate the quality of departments. It is extremely interesting that the views of professors are uncorrelated with any others of the wide array of measures included. Given the central role of university staff in universities and their apparent intimate knowledge of their knowledge of the standing of their own and other universities the misfit between their subjective views and the array of more objective measures presented suggests there are complexities which simple summative ranking would miss. On the other hand, my secondary analysis only covers sociologists, and it is possible that there is some disciplinary blindness which might not be apparent if other disciplines were to be looked at.

Conclusions

The array of data, from a range of sources, has found that there is both considerable complexity in the relationships amongst the components offered by different League Tables and also broad commonalities in patterns. Several of the factor analyses were not able to satisfactorily produce clear simple factors as plainly the complexities within the data defeated ready interpretation. On the other hand, some patterns shine through. Research and teaching dimensions are often separate. However, they overlap on some points, such as aspects of student life, which are research related. Other variables often are unrelated to either major dimension, with subjective evaluations sometimes not closely fitting the pattern of more objective data. While the study offers partial confirmation of the teaching/research non-nexus hypothesis, it also opens up the complexities which this view tends to overlook. In particular, my secondary analyses undermine projects which pretend that the ready development of summative indices then allows universities to be ranked.

Further work is necessary to untangle some of these complexities. In particular, it may well be that scale effects must be sorted out using a multi-level analysis approach. There are major difficulties in comparing national systems or universities located across different countries, as the data available at this level is mainly research related and does not include other dimensions. Is it possible to characterise universities with global measures that cover all disciplines in them, or is it necessary to see how particular disciplines fare within different universities? In this study sociology departments were examined as a case study. But future work needs to provide closer examination of differences between the full range of subject areas. In order to develop a constructive approach to understanding the variation amongst universities the data contained in League Tables must be seen less as measures of ranking and more as repositories of information for uncovering variation. They must be seen less as products and more as sources. The results of secondary analyses built on their data can then, hopefully, be fed back to help in the development of more appropriate rankings which better reflect the variation amongst universities.

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