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Should Top Universities Be Led By Top Researchers and Are They? A Citations Analysis

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Abstract
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The lifetime citations are counted by hand of the leaders of the world's top 100 universities identified in a global university ranking. These numbers are then normalized by adjusting for the different citation conventions across academic disciplines. Two statistical measures are used -- Pearson's correlation coefficient and Spearman's rho.

This study documents a positive correlation between the lifetime citations of a University's president and the position of that university in the global ranking. Better universities are run by better researchers. The results are not driven by outliers. That the top universities in the world -- who have the widest choice of candidates -- systematically appoint top researchers as their vice chancellors and presidents seems important to understand. This paper also shows that the pattern of presidents life-time citations follows a version of Lotka's power law.

There are two main areas of contribution. First, this paper attempts to use bibliometric data to address a performance- related question of a type not seen before (to the author's knowledge). Second, despite the importance of research to research universities -- as described in many mission-statements -- no studies currently exist that ask whether it matters if the head of a research university is himself or herself a committed researcher. Given the importance of universities in the world, and the difficulty that many have in appointing leaders, this question seems pertinent.

Keywords
citations, leadership, world university rankings, university presidents

Comments

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A citations analysis

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Should top universities be led by top researchers and are they?

A citations analysis

Purpose of this paper

This paper addresses the question: should the world's top universities be led by top researchers, and are they?

Design / methodology / approach

The lifetime citations are counted by hand of the leaders of the world's top 100 universities identified in a global university ranking. These numbers are then normalised by adjusting for the different citation conventions across academic disciplines. Two statistical measures are used -- Pearson's correlation coefficient and Spearman's rho.

Findings

This study documents a positive correlation between the lifetime citations of a university's president and the position of that university in the global ranking. Better universities are run by better researchers. The results are not driven by outliers. That the top universities in the world -- who have the widest choice of candidates -- systematically appoint top researchers as their vice chancellors and presidents seems important to understand. This paper also shows that the pattern of presidents' life-time citations follows a version of Lotka's power law.

What is original / value of paper?

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Introduction

This paper is a study of universities and those who lead them. It appears to be the first of its kind. Although there is a large academic literature on leadership, there has been little statistical thinking about presidents of universities [1].

The paper is interested in the question: should research universities be led by top researchers? It is explored empirically by examining what the world's universities actually do. If the best universities -- who arguably have the widest choice of candidates -- systematically appoint top researchers as their presidents, this could be one form of evidence that, on average, better researchers may make better presidents. Economists would call this a revealed preference argument.

When looking at the individuals who lead the world's top 100 universities it is possible to find both a handful of Nobel Prize winners and a handful of leaders with few or no research citations. It might be thought from this fact that there is no systematic link between research output and university leadership. Yet there is a pattern. This paper uncovers a correlation between the research background of a leader and the position of their university in a world league table.

Why is this question important?

First, around the world, interest in university leadership and governance has grown as universities have become increasingly competitive and global. Major changes have taken place in universities and subsequently in the role and responsibilities of their leaders. (These have been documented in Bargh et al 2000, Bok 2003, Tierney 2004, among others). It seems valuable to understand successful leadership in these times.

Second, given the centrality of research performance in many university mission statements -- expressed through the quality of research produced, the research eminence of staff and the concomitant income they generate -- it is logical to turn to the research background of their presidents. The first question, addressed in this paper through statistical tests using Pearson's correlation coefficient and Spearman's rho, is to ask whether the world's top universities currently appoint top researchers to the position of president. Possible interpretations are discussed after the results are presented.

Finally, the emphasis in this study is on the world's leading research universities. This group has been chosen because it is important to understand the actions of successful organisations. But it is also significant to note that the majority of these universities are based in the United States. Much has been talked of in the press about issues of brain-drain (see for example Time Magazine, March 15, 2005) as faculty from Europe, Asia and beyond move to the US. Given the likely significance of universities to an economy, if many top academics leave their home country this might be a cause for concern.

The role of research universities is currently receiving attention in Europe. The European Parliament has created the Lisbon Agenda outlining goals 'to make the European Union the most competitive and dynamic knowledge-driven economy by 2010" (European Parliament, March 2002). In Germany the Social Democratic Party recently announced a plan to spend 1.9 billion Euros to develop 10 elite universities that 'can compete with the world's best' (April 9 2005, DW-World.de). In 2002 a group of top universities in Europe founded the League of European Research Universities (LERU). On their website it states ‘LERU acknowledges that Europe has lost its pre-eminent position in basic research’ (www.leru.org).

Methodology

This paper focuses on one set of variables or characteristics, namely the lifetime citations of presidents. This score is used here as a measure of how research-active and successful a president has been in his or her academic career. The lifetime citation score of presidents is normalised in this study to adjust for different disciplinary conventions.

The university ranking used in this study has been produced by the Institute of Higher Education at Shanghai Jiao Tong University in their ‘Academic Ranking of World Universities’ (2004). (See Appendix 1 for the full list of 100 universities). As is explained below, this is probably the most reliable league table available.

Citations

Citations are references to authors in other academic papers as acknowledgement of their contribution to a specific research area. Citation information used in this study comes from Web of Science, the on-line database comprising the Science Citation Index, Social Science Citation Index and the Arts and Humanities Citation Index.

Data on the presidents of the world's top 100 universities, identified as shown below, were collected between mid October and early December 2004. Only those presidents in post during this period are included and to the author's knowledge no presidents changed during this 3 month period. Biographical information came from university web sites, though direct requests for CVs were made on occasion. Each president's lifetime citations were counted by hand.

Most important when using citations as any kind of measure is recognition of the huge differences between disciplines. For example, a highly cited social scientist might have a lifetime citation score of around 5,000 whereas a molecular biologist could have a score over 20,000. Bibliometric indicators have been used more consistently across the sciences than in the humanities and social sciences. Such use is most evident in the natural and life sciences, though less so in engineering and the behavioural sciences (van Raan 2003). These disciplines publish more journal articles and have a higher prevalence of co-authorship.

The social sciences are patchier. For example, economics relies heavily on journal articles though, unlike the science publications that tend to publish quickly, in economics it can take up to two years from acceptance for publication of a journal article to appear (Hamermesh 1994). Writing articles for journals is less common in the arts and humanities. These disciplines tend more towards publishing monographs. Cronin et al (1997) found that in the discipline of sociology two distinct groups of highly cited academics co-existed -- those highly cited through journal articles and those through monographs. This should not present a problem here because citations from both books and journals have been counted.

ISI has created a 'Highly Cited' (ISI HiCi) category that identifies approximately the top 250 academic researchers (depending on discipline) across 21 broad subject areas. They are dominated by science subjects, totalling 19. The social sciences are also covered, but there are only two social science subject areas, namely 'Economics and Business' and 'Social Sciences - General'. Currently no 'Highly Cited' category exists for authors in the arts or humanities.

The discrepancies in citation levels across disciplines are demonstrated in the number of new cited references that appear in ISI every week. The sciences generate approximately 350,000 new cited references weekly, the social sciences 50,000 and the humanities 15,000.

Using citation thresholds produced by ISI HiCi a normalised citation score has been produced in this paper for 23 subject areas (see next section and Appendix 2). These include a score for the humanities that has been generated for the purposes of this study. It is necessary to note that the discipline of law is classified in ISI as being in the social sciences not the humanities. It is included here in the 'Social Sciences - General' category.

In this paper, each university president is assigned a normalised citation score, which reflects both the differences across disciplines and their personal citation levels. This score is referred to as the *'P-score' = president's individual lifetime citation score normalised for discipline*. The P-score has been generated by using a scale produced by ISI HiCi. It has been used here as an exchange rate normalising the different citation conventions across disciplines. Each president's lifetime citation score has then been divided by their subject score. The normalised P-score produced through this process makes it possible to do like-for-like comparisons between individuals from different disciplines.

Substantial effort has been made to try to accurately assign citation numbers to people's names. Though some measurement error must be presumed, two studies that adopt different counting methods -- Seng and Willett (1995) who use a very precise method on the one hand, and Oppenheim (1995) who assigned citations more approximately on the other -- both report very similar correlations.

Van Raan (1998, 2003, 2005) has raised areas for concern when using citations as measures of quality. He suggests that citation indices have become easy tools for policy makers and university administrators keen to make quick assessments of individual research output and quality (2005). Wouters (1999) points out that the ISI system was designed to retrieve information not evaluate it.

Self-citing is a potential problem that can take two forms: first, over-citing one's own work in academic papers and, second, self-citation in journals to try to raise the journal impact factor. An example of this is raised by Fassoulaki et al (2000), where authors report a significant correlation between self-citation levels and journal impact scores in the 1995 and 1996 issues of six anaesthesia journals.

Other possible difficulties with citations include inconsistencies in methods of referencing, and inaccuracies in citation statistics (Moed 2002, King 2004). Finally, monopoly concerns have been raised about over-reliance on the Web of Science (Weingart 2003, 2004).

Language biases have been shown to exist within ISI (van Leeuwen et al 2001) though it is now considered to be less of a problem because most journals publish in English (King 2004). King suggests that preferential referencing may take place in the US (i.e. that Americans are more likely to reference Americans), partially a feature of the size of that nation's output. To try to circumvent this, separate analyses of US data are offered below.

Although van Raan (2005) notes the weaknesses of bibliometric measures, he also argues that citations are a good indicator of performance over long periods of time. His preference for evaluating science is to couple peer review with bibliometric analysis.

King (2004) suggests that citations are the most reliable measure of research quality and output. In a feature in the journal 'Nature', King uses the ISI citation index to measure the quantity and quality of science across different nations (2004).

There have been a number of studies comparing the UK's Research Assessment Exercise (RAE) results with bibliometric measures. Oppenheim (1997) uses ISI data to compare 1992 RAE results with citation indicators in three subject areas: anatomy, genetics and archaeology. He finds a strong correlation between the two methods of assessment and notes that in archaeology there is a greater reliance on monographic literature. Norris and Oppenheim (2003) replicate this study with the same results following the 2001 RAE. Smith and Eysenck (2002) discover a similar correlation across all UK psychology departments in the 2001 RAE.

Normalising citations to produce P-scores

To obtain a P-score the individual presidential citations were divided by the ISI Highly Cited disciplinary thresholds (see Appendix 2). The threshold dates correspond to the dates the data were collected within a month. The subject thresholds are being used here as an exchange rate for assessing different citation conventions.

The humanities score was created by the author using the ‘new cited references’ generated by ISI each week. Corresponding with the data collection dates as closely as possible, the sciences approximated at 350,000 new cited references weekly, the social sciences 50,000 and the humanities 15,000. If we divide the social science weekly score of 50,000 by the humanities 15,000 we get a figure of 3.33. The author has then divided the ‘Social Sciences, General’ score of 117 (see Appendix 2) by 3.33 which creates a score of 35.13. The number 35 has been used here as the ‘Humanities, General’ score.

League tables

As higher education has become global, in the recruitment of international students and staff, so have league tables. International tables have existed for a number of years in areas such as business education through the Financial Times. In 2003 the first global league table of universities was produced by the Institute of Education in Shanghai at Jiao Tong University (SJTU). SJTU used a process of inviting comment through their website to make adjustments to their methodology for the 2004 table.

The UK based Times Higher Education Supplement (THES) produced a global ranking in November 2004 (www.thes.co.uk) which has not been used in this study. There are three main problems with the league table. First, 50% weight is assigned to a subjective 'peer-review' process where 1300 academics across 88 countries are invited to name the top institutions in their geographic area and their academic field. This is the largest component in the ranking yet there is no information available on the background of these global academics. That is a concern. For example, how might an individual's choice have been influenced by their own place of education, sabbatical leave or co-authorship, and so on? Second, 10% weight is given for the international nature of an institution's student body and staff. However, there is little explanation about why 'international' is a proxy for high quality. Finally, because the THES is a commercial organisation it is not possible to access the data or check the calculations.

An advantage of the SJTU table is that it is not produced by a newspaper or magazine. Media-generated league tables are ubiquitous and controversial. Tables, such as those in The Times, and US News and World Report in the US, offer information to potential students across a range of criteria. Media-driven league tables may be useful heuristic devices for students but as objective tools of assessment of university quality they are unreliable. Perhaps the main criticism is that they are produced by commercial organisations designed to make money by selling their publications. Therefore a headline is required. To generate a story, the methodology is changed, often annually, which ensures that institutions at the top rotate (Lombardi et al 2002). Lombardi and colleagues suggest instead that, in the US, university positions actually change very little each year if a fixed method of analysis is used (2002).

The Center for Studies in the Humanities and Social Sciences (*www.thecenter.ufl.edu*') was created as a non-profit organisation in 1998 in the United States. Its mission is to develop methods for measuring and improving university performance. For a number of years *TheCenter* has produced an alternative ranking, 'The Top American Research Universities' (Lombardi et al 2003).

This ranking differs from media equivalents because actual numbered positions are not assigned. Instead universities are assessed on nine separate measures. Those that score highly in at least one of the nine measures are put into a 1-25 top research university category [2].

The measures of university quality used in both *TheCenter* and the SJTU world league tables do not exactly correspond. However, it is interesting to compare the number of US universities at the top in both tables. *TheCenter*'s top-25 category has 52 universities included. Of these, 44 also feature in the SJTU global table. Positions 1-27 are exactly correlated in both rankings. In other words, these two rankings of top US universities are very similar.

The 'Academic Ranking of World Universities' (2004) league table uses 6 different criteria to assess universities. The table below comes from the SJTU web site:

Table 1. <u>Methodology used in SJTU ranking 2004</u>

Criteria	Indicator	Code	Weight
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	Alumni	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	Award	20%
	Highly cited researchers in 21 broad subject categories	HiCi	20%
Research Output	Articles published in Nature and Science*	N&S	20%
	Articles in Science Citation Index-expanded and Social Science Citation Index	SCI	20%
Size of Institution	Academic performance with respect to the size of an institution	Size	10%
Total			100%

* For institutions specialized in humanities and social sciences such as London School of Economics, N&S is not considered, and the weight of N&S is relocated to other indicators.

There are, arguably, some weaknesses in the SJTU methodology. First, younger universities stand to lose out; particularly in the first category that assigns weight (10%) to alumni awards. Second, the humanities and the social sciences are weakly represented here -- though SJTU have done some adjustment for this. There are no ISI HiCi's in the arts and humanities and far fewer in the social sciences. The Awards category is also limited. Nobel Prizes are only given for achievement in physics, chemistry, medicine/physiology, economics, literature and peace, and Fields Medals only for mathematics.

Data on the 100 university presidents

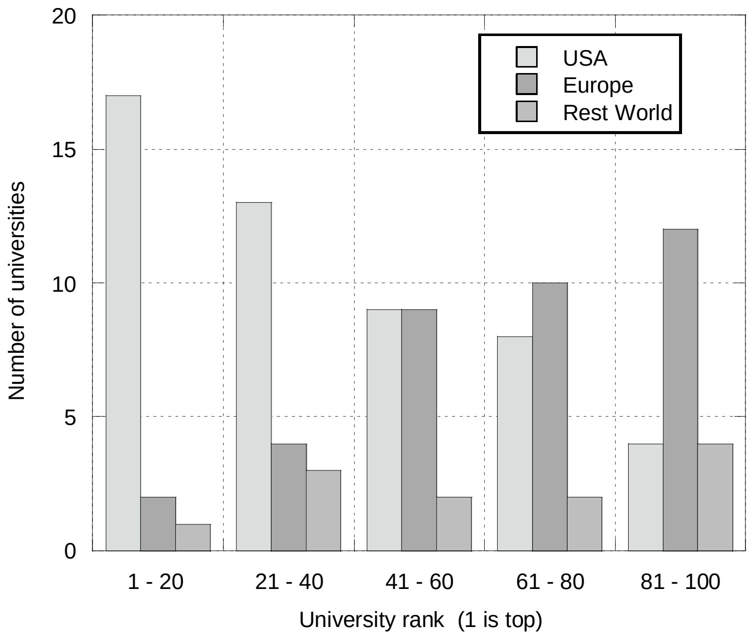
It is important to note that the world league table ranks institutions by assigning points (as per criteria above). This can result in two or more institutions being given the same position (see the full list in Appendix 1).

The universities in the top-100 table are dominated by the United States, where 51 of the institutions are located. As can be seen in Figure 1, US institutions are unevenly spread across the world's top 100, dominating the top 20 with 17 universities, and with 30 in the top 40. Of the 100 total, only 4 in the bottom 20 are US-based. If we treat American states as individual nations, California, with a population of 36 million, has the highest number of leading universities. Ten Californian institutions are within the top 55; 6 of these are in the top 20, and 7 of the 10 are public or state universities.

Thirty-seven institutions out of 100 are located in European countries. Of these, 11 are in the United Kingdom, 7 in Germany, 4 in both France and Sweden, 3 in Switzerland, 2 in the Netherlands, and 1 each in Austria, Denmark, Finland, Norway, Italy and Russia. Finally, among the top 100 there are 12 universities in the rest of the world -- 5 in Japan, 4 in Canada, 2 in Australia, and 1 in Israel.

The nation location of an institution is not always reflected in the nationality of its president. For example, the top 10 universities are found in two countries -- US (8) and UK (2), whereas the leaders come from four -- Canada, New Zealand, UK, and the US.
There are 15 female presidents in the sample. Six are in the top 20 universities and 10 are within the top 50. North America dominates with 9 US female presidents and 2 in Canada. The remaining four are in Denmark, France, Sweden and the UK.

Figure 1. The cross-country distribution of the world's top 100 universities



Every president in the group of 100 universities has a PhD. The majority have been academics though two presidents spent most of their careers in non-research positions in industry or government, and a small group went almost directly into academic administration.

The age of a president potentially affects his or her lifetime citation levels. The older they are, the greater the opportunity to accrue citations. It is therefore necessary to check whether presidents with the highest levels of lifetime citations are in fact older than those with fewer citations. Some European universities still publish date of birth information, though they are in the minority. Birth dates can be loosely calculated by using individuals' age at graduation from first degree. Using this method it is possible to compare the ages of presidents at the top and bottom of the top-100 global league table.

If it is shown that the top presidents are markedly older than those in the bottom 20, then adjustment of citation scores would be necessary.

The ages of only 80% of presidents in the top 20 universities and 80% of presidents in the bottom 20 could be obtained. The mean age of presidents in the top 20 universities is 58 years. In the bottom 20 category the mean age of president is 60. Because of the closeness in age between these two groups, and in particular the slightly older average age of the lowest quintile, citation scores have not been adjusted.

Figure 2. The disciplines of the presidents of the world's top universites

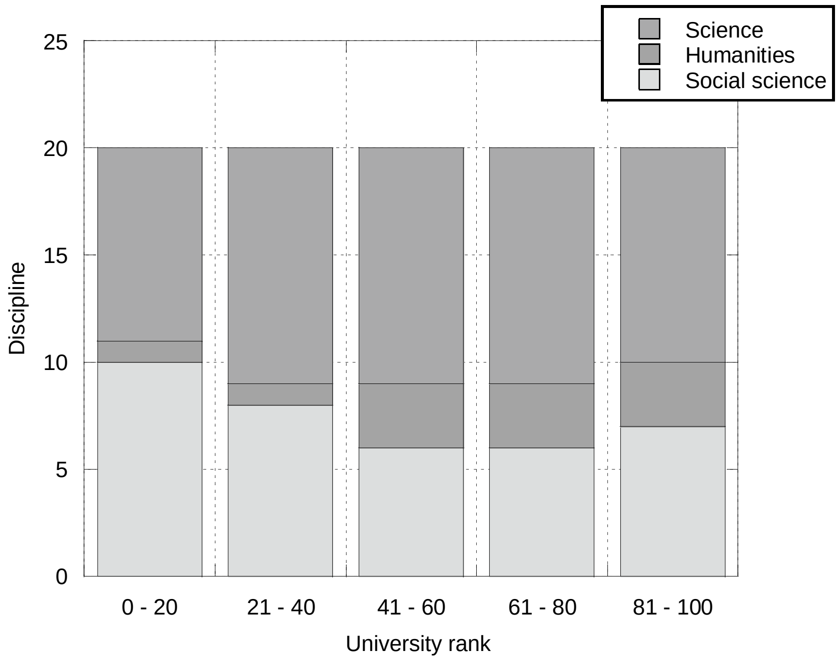


Figure 2 displays the disciplinary background of the presidents. What is noticeable is the evenness of disciplinary spread across each quintile. Of the 100 presidents, 52 have a scientific background. The scientists are dominated by the life sciences at 50%, but there are also 11 engineers, 6 physicists, 5 chemists and 4 computer scientists.

Thirty-seven of the 100 presidents are social scientists. The largest disciplinary group among the social scientists is that of lawyers, who number 15. Within a second group of 16 there is an even spread of educationalists, political scientists, sociologists and those from public and social policy. Finally, there are 6 economists.

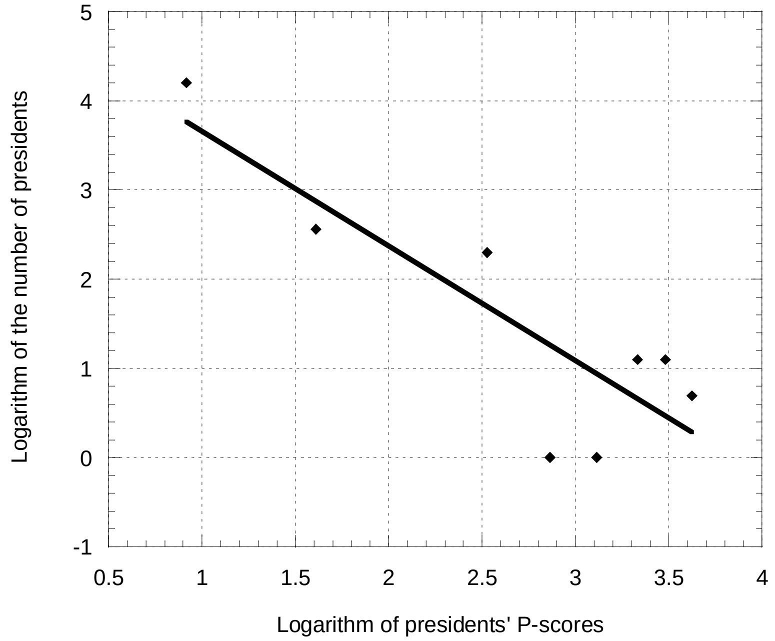
Eleven presidents are from the arts and humanities. This group is noticeably smaller. Taylor (1986) documents the disciplinary distribution amongst vice chancellors and principals in the UK in 1986. He also cites earlier work by Collison and Millen (1969) who showed that in the UK between 1935 and 1967 the proportion of presidents from the arts declined from 68% to 48% while scientists rose from 19% to 41%. Taylor then reports his own findings, that by 1981 67% of vice chancellors and principals were scientists, 13% from the social sciences and less than 20% were from the arts. Cohen and March (1974) showed a similar pattern -- in the number of presidents from the arts - for the US between 1924 and 1969.

In a study by Dolton and Ma (2001) on CEO Pay, the disciplinary backgrounds of UK vice chancellors are reported. Drawn from a wide cross-section of British universities (including Oxbridge, civic universities, former colleges of advanced technology, among others), they note that VCs in position in 1999 included 3% lawyers, 13% engineers, scientists made up 25%, social sciences including business 36% and finally VCs from the arts and humanities made up 13%. 10% were reported as being non-academics.

Of the 100 presidents in the current paper's sample, 12 are ISI Highly Cited (HiCi) academics. These individuals are more common in the top universities. Of the 12 presidents in HiCi, 6 are in the top 20 group of universities, 3 in the next 20, 2 in the next and 1 in the fourth quartile. Finally, there are 3 Nobel Prize winners among the presidents (all in medicine) -- two in the top 20 and one in the 20-40 category.

The distribution of citations across the 100 presidents fits Lotka's Law, an application that is often used in bibliometric research. Lotka (1926) describes the frequency of publication by authors in a given field. As can be observed in Figure 3 using presidents' P-scores, a version of this law applies here. Lotka's power law predicts that of all the authors in a specific field, approximately 60 percent will publish just one article, 15 percent will have two publications, 7 percent of authors will publish three pieces, and so on (Potter 1988). According to Lotka's Law of scientific productivity, only 6 percent of the authors in a field will produce more than 10 articles (the number making *n* contributions is about $1/n^2$ of those making one). This law is most accurate when applied over long periods of time and to large bodies of work -- for example individuals' lifetime citations.

Figure 3. <u>The distribution of presidents' lifetime citations follows Lotka's power law</u>



The results

As outlined above, the 100 presidents' lifetime citations are represented by a normalised P-score.

The individual citation scores of the 100 presidents, before adjustment, range from 0 to 28,718. The mean citation score is 2731 and the median is 371. After adjusting for discipline, the highest P-score is 37 points and the lowest is 0. The mean P-score is 6.03 and the median is 2.27. When the group of 100 is split into two, the top leaders of the 50 universities have a mean P-score of 8.76 and a median of 4.57, and those in the bottom half of universities have a mean P-score of 3.30 and a median of 0.93. Of the total group of 100 presidents, 4 have a citation score of zero.

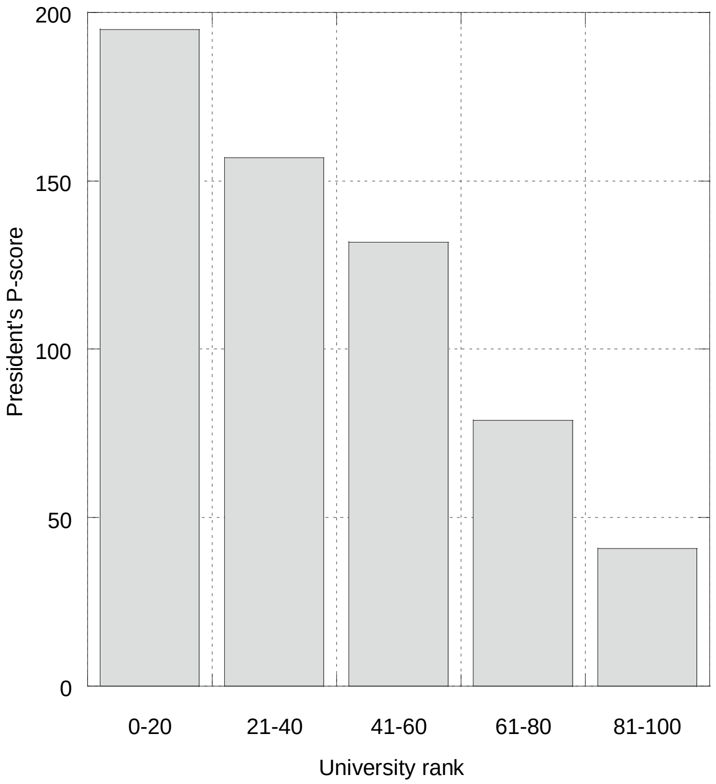
The results are presented here in scatter plots and cross tabulations - that are grouped into quintiles (the '1-20' group always refers to the top of the SJTU table and 1 equals Harvard).

The most highly ranked universities have leaders who are more highly cited. Figure 4 shows this. It gives a cross-sectional breakdown of P-score by university rank in quintiles. This shows a monotonic decline in citation levels as the universities go down in world rank.

The next step is to try to establish statistical significance. The paper does this in two ways.

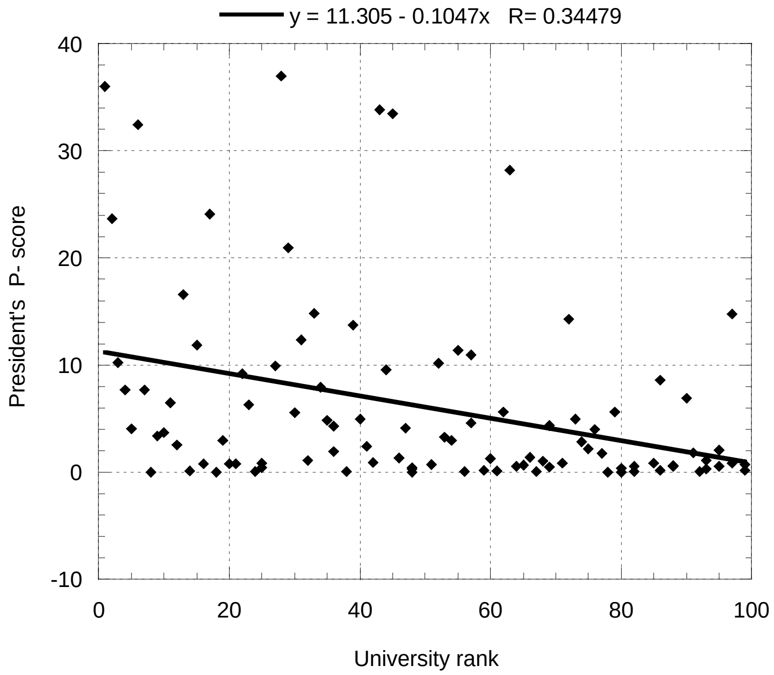
A natural first approach is to test whether the rank ordering of one variable is correlated with the rank order of the second variable. Spearman's rank correlation coefficient is an appropriate measure. The highest P-score is ranked 1 and the lowest P-score is ranked100. The actual rank of presidents' P-scores is then tested for a correlation against university rank.

Figure 4. **A cross-tabulation of presidents' lifetime citation P-scores by world university rank (in quintiles)**



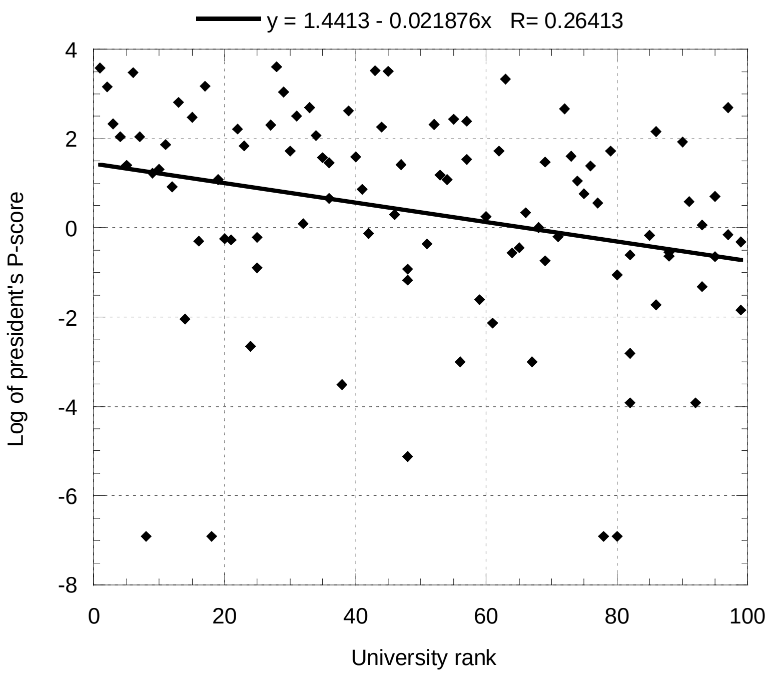
Using these data, Spearman's rho is calculated at 0.378. With 100 observations the associated 5% critical value for a two-tailed test is 0.195, and at 1% it is 0.254, which establishes that the correlation is statistically significant at conventional confidence levels.

Figure 5. Presidents' P-scores by rank among the world's top 100 universities



A second approach can be seen in Figure 5, which gives the distribution of the 100 individual P-scores by world university rank. Using Pearson's coefficient (r), the degree of linear relationship between the 'rank of university' and 'president's P-score' can be examined. For the data in Figure 5, Pearson's r is 0.345. The 1% critical value on a two-tailed test is 0.254, which means again, that the relationship is statistically significant [3]. There continues to be a statistically significant relationship if the natural logarithm of P-score is used; this can be seen in Figure 5a.

Figure 5a. Logarithm of presidents' P-scores by university rank



This correlation, between cites and university quality, can also be seen amongst the sub-sample of female presidents, though at 15 the group is small (Figure 6). It is also statistically significant at the 1% level. The disciplinary breakdown of the 15 female presidents is 7 scientists, 7 social scientists and 1 from the humanities. One president is Highly Cited.

US universities make up 51 out of the 100. The mean P-score for this US group is 8.07 with a median score of 4.86, which is higher than the world group mean of 6.03 and median of 2.27. There are 25 scientists, 21 social scientists and 5 in the humanities. Of the 12 Highly Cited presidents in total, 9 are based in US universities, though two of these are non-Americans -- 1 is from Canada and 1 from the UK, who is also a Nobel Prize winner.

Figure 6. Female presidents' P-scores by university rank

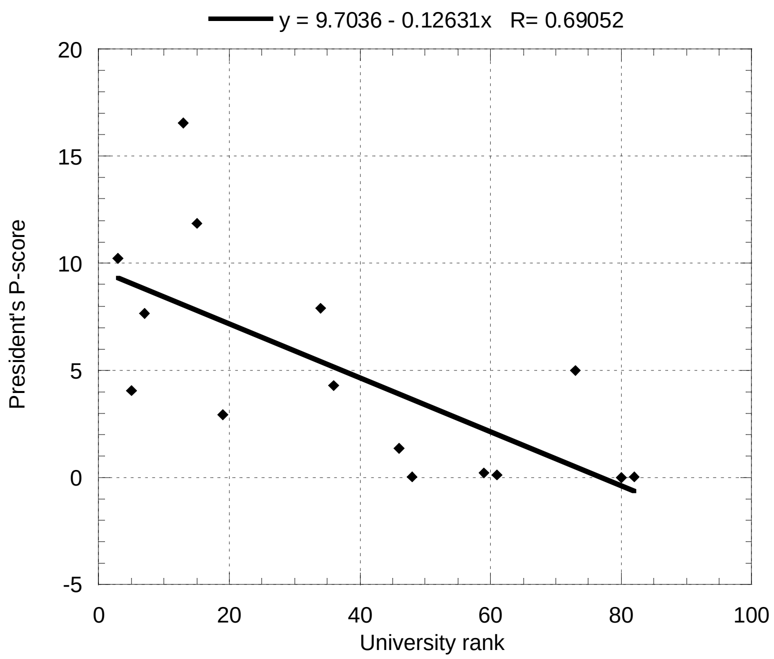
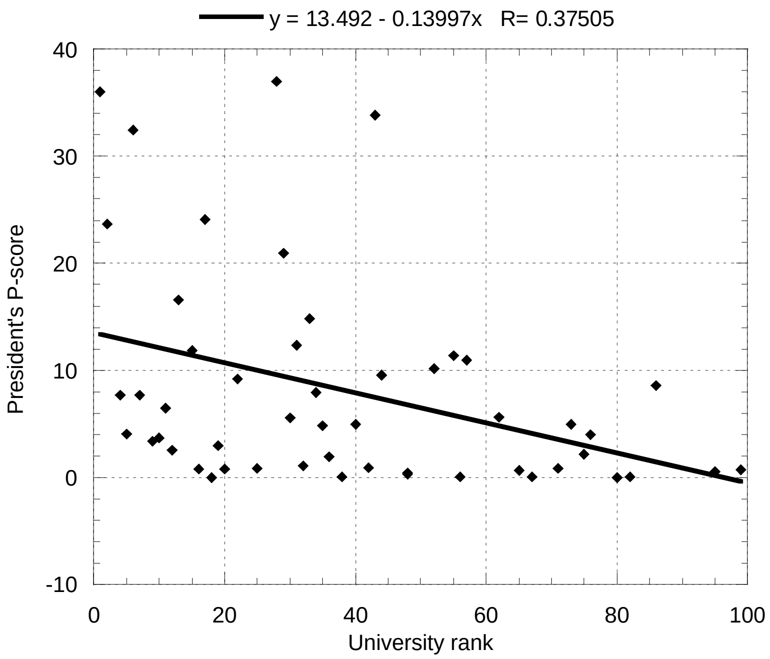


Figure 7 presents a scatter plot for the sample of US presidents. Again there is a correlation between citation levels and (world) university position. The correlation is significant at the 1% level.

It is useful to note that university rank explains only 12% of the variance in leaders' citations. In other words, there are many other explanatory factors that are not being measured here. However, these correlations are significant enough to warrant further investigation and discussion.

Figure 7. US presidents' P-scores by university rank



Is the citation-rank correlation true for universities outside the US?

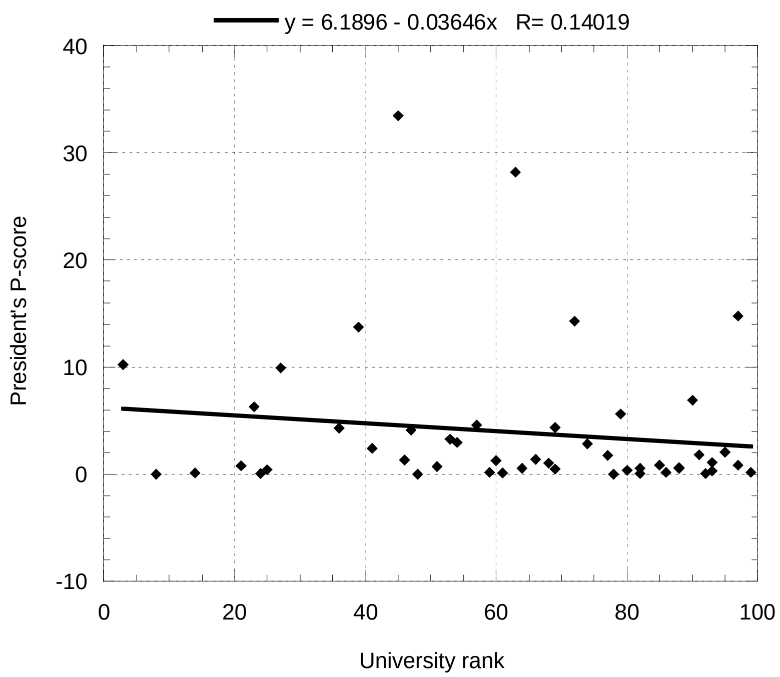
So far we have identified a strong positive relationship between the citation levels of university presidents and the position of their institution within a ranking of 100 universities. This association exists amongst the 100 presidents in total, the female group, and the 51 US presidents.

The mean citation P-score for presidents in the 49 countries in the rest of the world is 3.91 with a median score of 1.07. This is below the 100-group mean P-score of 6 and it is half the US mean P-score of 8. Therefore US presidents are twice as cited as those in the rest of the world.

In the rest of the world the presidents include 27 scientists, 16 social scientists and 6 in the humanities. There are 3 Highly Cited researchers in the group. Two are from the Netherlands and one in Germany.

Figure 8 shows there is no statistically significant correlation between citation levels and position of president across the 49 countries in the rest of the world.

Figure 8. Presidents from the rest of the world P-scores by university rank



As can be seen in the data, one of the differences between the top American universities and non-American universities is that the former choose leaders who are more highly cited.

Outliers

It is important to ensure that the results from this study have not been unduly influenced by a small number of presidents with extremely high P-scores. To do this, two tests are available. First, we can return to Spearman's rho, which puts an equal weight on each observation instead of assigning continuous values. As has been pointed out above, a statistically significant rank correlation has been established, with a significance level better than 1%.

The second check on outliers is simply to delete the data used from the highest P-scores for the Pearson's test. To do this the top 5% of P-scores, all located within ranges 30 and 40, were withdrawn and the correlation re-tested, with a result of 0.297. With 95 observations the 5% critical value for a two-tailed test is 0.200 and at 1% it is 0.260, so the correlation remains.

Possible interpretations

Data on world university rankings have only recently become available. That universities with strongly research-intensive missions appoint as their presidents men and women with strong citation records does not appear to have been previously documented. The data in this paper do not enable judgements to be made about the weight assigned by selection committees to the research records of presidential candidates as distinct, for example, from other criteria such as managerial expertise or entrepreneurship. But the data do suggest that research universities look for candidates who fit institutional missions.

Internationally active researchers lead the world's top universities. On average, the higher the university is in the global ranking, the more highly cited is that institution's president. There are, of course, exceptions. Two universities from the Netherlands -- in positions 39 and 63 -- both have presidents who are Highly Cited. (It is interesting to note that these are the only two universities in the top 100 from that country). And there are top universities led by presidents with few or no citations. However, these cases are in a minority.

These findings show that in at least one area the top universities are making different choices from those lower in the global ranking. What can we learn from this difference? Why do those institutions at the top appoint former researchers to the role of president?

There are a number of possible reasons for the correlation. They include:

Hypothesis 1: Better researchers make better leaders of research universities

It has been recognised in the literature that presidents need to learn particular skills to enable them to lead a university (Cohen and March 1974, Rosovsky 1991, Middlehurst 1993, Bargh et al 2000, among others). In the UK an organisation for training academic leaders has recently been established with government funding.

Whilst the education and career background of academic leaders has attracted some interest (Cohen and March 1974, Taylor 1986, Bargh at al 2000, Dolton and Ma 2001) little specific attention has been given to the research background of presidents. Yet many university websites make a great deal of the eminence of the president.

It seems clear that better researchers will tend to have greater prestige within the hierarchy of the academy, and presidents who are highly cited may, therefore, enjoy credibility and negotiating strength that extends beyond their own discipline. Jeremy Knowles, the former Dean of Harvard's Faculty of Arts and Sciences (from 1991–2002), said that he believed his own research record helped his position as dean because it gave him greater status and therefore negotiating power when dealing with eminent faculty (interview with author April 12, 2005). This suggests that being a cited researcher is of symbolic importance.

This message was repeated in an interview with Amy Gutmann, President of the University of Pennsylvania, who said that 'being a researcher sends a signal to the faculty that you, the president, share their scholarly values and general understanding of the culture of the academy' (interview April 28, 2005).

Being a successful research academic may also help in attracting faculty, particularly 'stars', to a university, which has become a preoccupation the world over. Having a president who is a distinguished researcher may enhance the appeal of an institution.

Alternatively it may be that two separate components are involved when leading a research university, namely managerial expertise and inherent knowledge. The former pertains to having knowledge of generic functions such as finance and budgeting, human resource management, corporate governance, among others. Most presidents running top universities will have had experience in managerial positions -- running large laboratories, as head of department or pro-vice chancellor. Experienced managers can also be brought in to perform specialised administrative roles. Thus a former UK university vice chancellor has suggested (in personal correspondence) that what matters is scholarship not just management -- that we should take management for granted.

The term ‘inherent knowledge’ is used here to suggest a specific knowledge of, or insight into, academe that is borne out of expertise gained through academic research. It suggests that good researchers may bring something else to the role of leader -- a perspective and understanding directly linked to their past as a successful scholar.

It is possible that inherent knowledge also helps leaders inform strategy-making. For example, it may be easier to interpret research trends and future intellectual directions. But how easy is it for a highly cited chemist to assess a faculty member from information science or discern the future direction of modern languages? One possibility is that faculty at the top of their fields can make a fair assessment about the quality of work produced by those in other fields by using the same mechanisms used generally in academia: namely citation indices and peer review.

Hypothesis 2: Top universities appoint good researchers for reasons relating to external factors such as PR and fundraising

It has been said that US presidents in top universities spend a great deal of time fundraising and subsequently that they are less involved with running the institution. This is not the place to compare US presidential leadership with European rectors or British vice chancellors. Briefly, however, the American system is unitary with the president at the head of the hierarchy. Though the president reports to a powerful board of trustees, he or she is ultimately in charge, with a role similar to that of a chief executive officer. Senior academic administrators in the US (deans, provosts, chairs of departments) are normally appointed not voted into position by faculty. In short, the US presidential system is recognised as giving greater authority and powers to university leaders when compared to other systems of higher education from Europe to Japan (Rosovsky 1991, Bargh et al 2000). This is particularly true of US private universities. US publics on the other hand are more exposed to state government intervention.

Amy Gutmann, President of University of Pennsylvania, was clear in an interview that she is centrally involved in making senior appointments and in deciding the overall strategic direction of the university. Long term strategy is designed through a collaborative process involving the president, and the deans and provosts that she appoints and whose work she oversees (April 28 2005).

Appointment committees may select high-profile academics as presidents for external reasons. The alumni may be encouraged to give more generously. Gaining greater media exposure for the institution may also be a motive. Alternatively, if the governing body of a university wants to push an institution in a different direction, towards research, it may consider appointing a good researcher to signal a change in the internal culture.

Hypothesis 3: The correlation is explained through unobservable heterogeneity

This would mean that research talent is merely a proxy for leadership ability. The positive relationship between presidents' P-scores and university rank may actually be picking up a correlation between other variables. For instance, presidents who are good at research may just be good at everything. This is the alternative to a cause-and-effect relationship.

All correlations are potentially susceptible to this kind of criticism. It seems implausible, however, that candidates' research records do not play a part in their selection for headship of institutions with prominent research missions.

Concluding comments

This study, which seems to be the first of its kind, finds a correlation between the citations of presidents and the positions of their universities in a world league table. Better universities are run by better researchers.

The statistical relationship is strong for the group of 100 universities as a whole, and for the sub-samples of female presidents and US presidents. On average, one extra point on a president's adjusted citation score, where scores run from zero for the least-cited president to a score of up to 40 for Highly Cited and Nobel-prize winning presidents, is associated with ten extra places in the world's top-100 ranking of universities. No statistically significant correlation is found, however, for the sub-sample of universities from the rest of the world.

Simple quantitative research of this kind may offer insights into university leadership - insights that are particularly relevant to universities that want to compete for a position amongst the world's top research institutions. The best universities, which can choose from the widest pool, are systematically selecting top researchers to lead them. What do such researchers bring to the role of leader? This paper posits that there are two central components involved in leading research universities: managerial expertise and inherent knowledge. It is suggested here that better researchers may have greater inherent knowledge about academe that in turn informs their role as leader. A president's research background may also have symbolic value in that it sends out a signal about the values of that institution. And finally, being a reputed researcher may raise a leader's status within the academic community and enhance his or her powers of negotiation.

However, the paper notes that other interpretations of the data are possible. One is that universities choose top researchers for reasons of prestige and to assist in fundraising. This is probably true as a factor for selection, though it is unlikely to be the sole function of a president in a top institution. Another is that research ability is simply a proxy for some other kind of talent that is useful to leaders.

Causality cannot be established through these correlations. The performance of a university has not been shown here to be linked to the actions of a president or vice chancellor, whether highly cited or not. However, this type of study starts the process of understanding whether there may be benefits from appointing a researcher as president. A further study is underway exploring causality.

Notes

1. President is used here to denote the executive leader of a university. The term is used to include principal, vice chancellor, rector, director among others.
2. The measures include: total research, federal research, endowment assets, annual giving, national academy members, faculty awards, doctorates granted, postdoctoral appointees and SAT scores. Some degree of ranking does exist because they are ordered depending on the number of points they score across the nine categories. So the top three universities score 9 out of 9, the next six universities score 8 out of 9, and so on.
3. It should be noted that there is evidence that the residuals are skewed.

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APPENDIX 1.

Top 500 World Universities (1-100) 2004*

World Rank	Institution	Country	Total Score	Score on Alumni	Score on Award	Score on HiCi	Score on N&S	Score on SCI	Score on Size
1	Harvard Univ	USA	100.0	98.6	100.0	100.0	100.0	100.0	60.6
2	Stanford Univ	USA	77.2	41.2	72.2	96.1	75.2	72.3	68.1
3	Univ Cambridge	UK	76.2	100.0	93.4	56.6	58.5	70.2	73.2
4	Univ California - Berkeley	USA	74.2	70.0	76.0	74.1	75.6	72.7	45.1
5	Massachusetts Inst Tech (MIT)	USA	72.4	74.1	78.9	73.6	69.1	64.6	47.5
6	California Inst Tech	USA	69.0	59.3	66.5	64.8	66.7	53.2	100.0
7	Princeton Univ	USA	63.6	61.0	76.8	65.4	52.1	46.8	67.3
8	Univ Oxford	UK	61.4	64.4	59.1	53.1	55.3	65.2	59.0
9	Columbia Univ	USA	61.2	77.8	58.8	57.3	51.6	68.3	37.0
10	Univ Chicago	USA	60.5	72.2	81.9	55.3	46.6	54.1	32.7
11	Yale Univ	USA	58.6	52.2	44.5	63.6	58.1	63.6	50.4
12	Cornell Univ	USA	55.5	46.6	52.4	60.5	47.2	66.2	33.6
13	Univ California - San Diego	USA	53.8	17.8	34.7	63.6	59.4	67.2	47.9
14	Tokyo Univ	Japan	51.9	36.1	14.4	44.5	55.0	91.9	49.8
15	Univ Pennsylvania	USA	51.8	35.6	35.1	61.2	44.6	72.6	34.0
16	Univ California - Los Angeles	USA	51.6	27.4	32.8	60.5	48.1	79.9	24.8
17	Univ California - San Francisco	USA	50.8	0.0	37.6	59.3	59.5	62.9	48.8
18	Univ Wisconsin - Madison	USA	50.0	43.1	36.3	55.3	48.0	69.2	19.0
19	Univ Michigan - Ann Arbor	USA	49.3	39.8	19.3	64.8	45.7	76.7	20.1
20	Univ Washington - Seattle	USA	49.1	22.7	30.2	57.3	49.6	78.8	16.2
21	Kyoto Univ	Japan	48.3	39.8	34.1	40.0	37.2	77.1	46.4
22	Johns Hopkins Univ	USA	47.5	48.7	28.3	43.7	52.6	71.7	14.2
23	Imperial Coll London	UK	46.4	20.9	38.1	46.2	39.4	65.8	44.5
24	Univ Toronto	Canada	44.6	28.1	19.7	39.1	41.2	78.4	42.8
25	Univ Coll London	UK	44.3	30.8	32.9	41.0	41.0	61.1	42.6
25	Univ Illinois - Urbana Champaign	USA	43.3	41.7	37.4	46.2	36.0	58.2	17.8
27	Swiss Fed Inst Tech - Zurich	Switzerland	43.2	40.3	37.0	39.1	43.2	47.1	41.5

28	Washington Univ - St. Louis	USA	43.1	25.1	26.6	41.9	46.8	56.2	44.9
29	Rockefeller Univ	USA	40.2	22.7	59.8	31.5	43.6	27.1	38.6
30	Northwestern Univ	USA	39.5	21.8	19.3	47.9	35.8	57.2	37.0
31	Duke Univ	USA	38.9	20.9	0.0	48.6	46.8	62.7	36.2
32	New York Univ	USA	38.7	33.9	25.0	43.7	39.3	50.9	19.1
33	Univ Minnesota - Twin Cities	USA	38.3	36.1	0.0	53.9	35.9	69.6	12.8
34	Univ Colorado - Boulder	USA	37.8	16.6	29.8	43.7	38.3	47.5	27.4
35	Univ California - Santa Barbara	USA	37.0	0.0	28.5	45.4	41.4	44.0	36.2
36	Univ British Columbia	Canada	36.3	20.9	19.3	36.0	31.6	59.5	34.9
36	Univ Texas Southwestern Med Center	USA	36.3	16.6	33.9	33.8	40.5	40.0	34.9
38	Vanderbilt Univ	USA	35.1	12.6	30.2	37.1	23.8	50.2	41.7
39	Univ Utrecht	Netherlands	34.9	30.8	21.4	31.5	29.9	58.1	22.1
40	Univ Texas - Austin	USA	34.8	21.8	17.1	50.2	28.8	53.7	12.8
41	Univ Paris 06	France	33.9	35.7	23.9	23.1	24.7	56.7	32.6
42	Univ California - Davis	USA	33.6	0.0	0.0	48.6	37.2	64.7	20.7
43	Pennsylvania State Univ - Univ Park	USA	33.5	14.1	0.0	50.2	37.7	58.7	14.2
44	Rutgers State Univ - New Brunswick	USA	33.4	15.4	20.4	38.1	36.1	48.2	19.5
45	Tech Univ Munich	Germany	33.3	43.1	24.1	27.6	20.4	50.0	32.0
46	Karolinska Inst Stockholm	Sweden	33.0	30.8	27.8	32.7	21.6	49.8	21.5
47	Univ Edinburgh	UK	32.9	22.7	17.1	27.6	36.7	49.1	31.6
48	Univ Paris 11	France	32.5	33.3	34.2	21.4	21.3	46.8	31.2
48	Univ Pittsburgh - Pittsburgh	USA	32.5	18.9	0.0	42.8	26.5	67.0	20.0
48	Univ Southern California	USA	32.5	0.0	27.3	41.9	23.0	53.5	20.5
51	Univ Munich	Germany	32.4	37.2	21.1	12.4	32.0	56.0	31.1
52	Univ Rochester	USA	32.0	33.3	9.1	30.3	27.2	44.9	50.1
53	Australian Natl Univ	Australia	31.9	17.8	12.9	41.0	31.4	43.6	30.7
54	Osaka Univ	Japan	31.5	12.6	0.0	26.2	31.2	72.1	30.2
55	Univ California - Irvine	USA	31.4	0.0	25.0	33.8	29.6	47.2	29.9
56	Univ North Carolina - Chapel Hill	USA	31.2	12.6	0.0	38.1	34.5	60.5	20.3
57	Univ Maryland - Coll Park	USA	31.1	25.9	0.0	40.0	33.2	54.0	17.4
57	Univ Zurich	Switzerland	31.1	12.6	27.3	21.4	30.3	48.9	29.9

59	Univ Copenhagen	Denmark	31.0	30.8	24.7	23.1	22.6	48.1	29.8
60	Univ Bristol	UK	30.6	10.9	18.2	32.7	26.6	49.1	29.4
61	McGill Univ	Canada	30.4	28.8	0.0	31.5	26.3	59.0	29.2
62	Carnegie Mellon Univ	USA	30.3	18.9	30.2	32.7	17.4	38.8	34.0
63	Univ Leiden	Netherlands	29.8	25.1	15.8	30.3	22.0	47.3	30.3
64	Univ Heidelberg	Germany	29.7	10.9	27.7	23.1	22.1	49.7	28.5
65	Case Western Reserve Univ	USA	29.6	37.2	11.8	23.1	22.2	46.1	40.6
66	Moscow State Univ	Russia	29.5	51.5	34.9	0.0	8.1	58.5	28.3
67	Univ Florida	USA	29.3	15.4	0.0	33.8	24.3	66.4	16.3
68	Univ Oslo	Norway	29.2	25.9	34.1	19.5	17.2	42.1	28.0
69	Tohoku Univ	Japan	28.8	18.9	0.0	19.5	26.1	69.3	27.7
69	Univ Sheffield	UK	28.8	23.5	14.4	23.1	28.8	46.2	27.7
71	Purdue Univ - West Lafayette	USA	28.7	18.9	17.1	31.5	22.1	50.5	13.8
72	Univ Helsinki	Finland	28.6	18.9	18.2	15.1	23.7	56.9	27.5
73	Ohio State Univ - Columbus	USA	28.5	17.8	0.0	41.0	20.6	61.3	9.6
74	Uppsala Univ	Sweden	28.4	25.9	32.9	0.0	30.4	52.5	14.5
75	Rice Univ	USA	28.3	21.8	22.3	26.2	23.7	30.2	44.6
76	Univ Arizona	USA	28.1	0.0	0.0	31.5	37.7	56.5	18.1
77	King's Coll London	UK	28.0	16.6	23.5	23.1	19.8	46.2	26.9
78	Univ Manchester	UK	27.9	25.9	19.3	21.4	18.2	48.6	26.8
79	Univ Goettingen	Germany	27.4	38.8	20.4	17.5	18.2	42.8	26.3
80	Michigan State Univ	USA	27.0	12.6	0.0	39.1	28.4	50.5	10.5
80	Univ Nottingham	UK	27.0	15.4	20.4	23.1	20.1	45.1	25.9
82	Brown Univ	USA	26.8	0.0	13.9	30.3	27.9	41.4	30.4
82	Univ Melbourne	Australia	26.8	15.4	14.4	21.4	19.2	53.0	25.8
82	Univ Strasbourg 1	France	26.8	29.5	22.9	21.4	21.3	35.2	25.7
85	Ecole Normale Super Paris	France	26.5	47.9	25.0	17.5	18.2	29.6	25.4
86	Boston Univ	USA	26.3	15.4	0.0	32.7	29.6	51.5	9.6
86	Univ Vienna	Austria	26.3	25.1	15.8	8.7	22.0	54.5	25.3
88	McMaster Univ	Canada	26.0	16.6	19.3	23.1	16.2	45.2	25.0
88	Univ Freiburg	Germany	26.0	25.1	21.4	19.5	18.0	40.9	25.0

90	Hebrew Univ Jerusalem	Israel	25.9	15.4	0.0	26.2	29.5	48.3	24.9
91	Univ Basel	Switzerland	25.8	25.9	17.5	21.4	24.2	35.5	24.8
92	Lund Univ	Sweden	25.6	29.5	0.0	26.2	22.0	54.0	11.2
93	Univ Birmingham	UK	25.5	25.1	11.2	24.7	14.0	47.6	24.5
93	Univ Roma - La Sapienza	Italy	25.5	16.6	15.8	12.4	24.3	57.4	7.9
95	Humboldt Univ Berlin	Germany	25.4	29.5	21.9	8.7	14.8	49.7	24.4
95	Univ Utah	USA	25.4	0.0	0.0	32.7	30.7	48.4	20.1
97	Nagoya Univ	Japan	25.2	0.0	14.4	15.1	23.7	55.3	24.2
97	Stockholm Univ	Sweden	25.2	29.5	30.2	17.5	14.9	35.7	15.3
99	Tufts Univ	USA	25.1	18.9	17.1	19.5	19.1	40.6	29.2
99	Univ Bonn	Germany	25.1	19.9	20.4	17.5	16.7	43.9	24.1

***** The methodology for the 2005 Global Ranking produced by SJTU has been slightly modified (see http://ed.sjtu.edu.cn/ranking.htm).

APPENDIX 2.

Citation thresholds for scientists across different disciplines
(January 1994 - June 2004)

Subject area	Scientist
Agricultural Sciences	154
Biology & Biochemistry	780
Chemistry	648
Clinical Medicine	1095
Computer Science	84
Economics & Business	169
Engineering	182
Environment/Ecology	248
Geosciences	433
Humanities, General*	35
Immunology	763
Materials Science	219
Mathematics	130
Microbiology	534
Molecular Biology & Genetics	1234
Multidisciplinary	123
Neuroscience & Behaviour	908
Pharmacology & Toxicology	312
Physics	1832
Plant & Animal Science	292
Psychiatry/Psychology	393
Social Sciences, General	117
Space Science	1301

Updated Sept 1 2004, Thomson ISI Highly cited, available from http://in-cites.com/thresholds-citation.html

* Humanities score created by Amanda H. Goodall

Note to Table: The above citation thresholds represent the top 1% researchers (approximately 250) in each disciplinary field.