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Highly Cited Leaders and the Performance of Research Universities

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There is a large literature on the productivity of universities. Little is known, however, about how different types of leader affect a university's later performance. By constructing a new longitudinal data set, I provide evidence that the research quality of a university improves after it appoints a president (vice chancellor) who is an accomplished scholar. The findings have policy implications for governments, universities, and a range of research and knowledge-intensive organizations.

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Highly Cited Leaders and the Performance of Research Universities

1. Introduction

Although there is a large literature on the research productivity of universities[1], little is known about how different types of leader affect a university's performance. By creating a new longitudinal data set, I try to fill this gap. I provide evidence that a university's later research performance improves if it appoints a president (vice chancellor) who is an accomplished scholar. More broadly, I argue that in knowledge-intensive organizations, where the majority of employees are expert workers, having a leader who is also an expert may be beneficial to the institution's long-term performance. The paper's results seem of potentially wide interest to policy-makers and to our understanding of R&D processes.

Research universities are part of the knowledge-based sector (Mintzberg, 1979). They are an interesting case both because they are a significant source of innovation in society and because their leaders' technical expertise can be measured reasonably objectively. There have been a number of influential empirical studies of leaders in higher education[2]. Yet there has been little statistical thinking about how university presidents and vice chancellors influence performance. It seems appropriate to ask the question: Should top universities be led by top scholars? A natural alternative idea is that a leader needs primarily high managerial ability allied merely to some acceptable minimum level of technical ability. By contrast, what this paper's later data appear to suggest is a fairly smooth relationship between the level of scholarship and university quality. My central argument is that in settings where expert knowledge is the key factor that characterizes an organization it is likely to be expert knowledge that should be key in the selection of its leader.

Research is central to a university's success. Institutions that produce the best research receive the largest share of public funding and private philanthropy. There

[1] The literature on the determinants of university research performance and innovation includes Johnes and Johnes, 1993, 1995; Von Tunzelmann et. al., 2003; Oppenheim and Stuart, 2004; Rigby and Edler, 2005; Adams and Clemmons, 2006; Crespi and Geuna, 2006; Katz, 2006; Zhang and Ehrenberg, 2006 and Charlton and Andras, 2007; Gonzalez-Brambila and Veloso, 2007.
[2] For example, Cohen and March, 1974; Birnbaum, 1988; Rosovsky, 1991; Middlehurst, 1993; Bargh et al., 2000 and Ehrenberg, 2004.

is also a significant relationship between the quality of research and the extent of industry funding (Gulbrandsen and Smeby, 2005).

It has recently been shown that there is a positive correlation between the scholarly achievement of a university's president and the position of that university in a global ranking. The higher a university is ranked in the 'Academic Ranking of World Universities'[3], the higher the life-time citations of its leader. This pattern has been replicated for deans of business schools (Goodall, 2006 a,b). However, asking if scholar-leaders make a difference to the research performance of a university -- that is, addressing issues of causality -- means it is necessary to go beyond cross-section patterns.

2. Longitudinal Evidence

The quality of a university is established over years. It incorporates factors such as an institution's history, reputation, age and wealth -- thus creating noisy conditions from which to isolate the contributions of individual leaders. It may be possible, however, to get an indication of a leader's effect through a longitudinal method that uses lags, an acceptable performance measure (i.e. not league tables) and control variables. Indeed, it could be argued that researchers have an obligation to continue to try to establish the effectiveness of leaders despite the cloudy conditions, because of the effort invested in recruitment and the resources paid out in employment (leaders are normally the highest paid in organizations, including universities). It is suggested in this paper that:

Hypothesis: There is a positive relationship between the prior scholarly ability of a university president and the future success of that institution.

Information from the UK is used because of the unique method of assessing performance that has been available in that country for a number of years – the Research Assessment Exercise (RAE)[4]. The dataset constructed here covers a panel of 55 UK research universities, and 157 university presidents.

[3] The ranking is produced by the Institute of Higher Education at Shanghai Jiao Tong University, 2004.
[4] The Research Assessment Exercise (RAE) was designed to help inform UK funding bodies' decisions about how to distribute public money for research.

3. Methodology

The hypothesis is tested by using multiple regression analysis with university performance as the dependent variable and the scholarly success of presidents[5] as the key independent variable. Control variables for university income, presidential age and discipline are also used. These are incorporated to check the robustness of the correlations between university performance and a leader's research history. The focus is on longitudinal changes in university performance.

This study uses panel data comprising all UK research universities that competed three times in the Research Assessment Exercise (RAE). Performance is observed in the RAE in 1992, 1996 and 2001. To identify a president's scholarly success, each individual's lifetime citations have been hand-counted and normalized for discipline[6]. An alternative would have been to use the simpler measure of a scholar's H-index -- see for example Oppenheim, 2007 -- but the decision was taken to use instead the more exact lifetime citations count.

3.1 The Sample of Institutions

The 55 institutions selected make up the oldest and most established research universities in the UK (for a list of sample institutions, see Appendix A). They are often referred to as the 'old' universities, those that existed before 1992, a period that marked major expansion in the number of UK higher education institutions. This group have consistently generated the majority of academic research and they continue to receive the bulk of UK research income[7].

As suggested above, age, size, wealth and reputation are all contributing factors to the long-term success of any university. But it is important to mention that success over the last 40 years among UK research universities has not been confined to one particular group. There has been movement up and down in RAE performance and also in various league tables (see, for example, league tables in The Guardian newspaper, The Times and Times Higher Education Supplement). In this study, one

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[5] President is used here to denote the executive leader of a university. The term is used to include vice chancellor, principal, director, among others.
[6] Hence I do not count patent citations in the sense of Oppenheim, 1997.
[7] Figures available from the UK Higher Education Statistics Agency, 2006.

that spans nine years, the data show that improvement in performance is not confined to the largest or the oldest institutions.

3. 2 The Leaders

The sample includes 157 British university presidents. They have led the 55 universities over, approximately, a twenty-year period. It is the presidents in place in 1992 and 1996 that appear most in the statistical analysis. Biographical information has come from 'Who's Who', the Association of Commonwealth Universities, and from individuals' biographies.

The focus in this paper is on presidents' lifetime citations. These are normalized for discipline into a P-score, or scholarly score, and used as a proxy measure of each individual leader's past research productivity. (Descriptive data on the sample of presidents are available in Appendix B).

3.3 Dependent Variable: University Performance

There are several ways to measure the long-term performance of a university. One of the most common, although possibly one of the least scientific, is to use the league tables which have become ubiquitous. The main problem with rankings is their lack of consistency in assessment methodologies. Most league tables are media-generated, produced by commercial organisations designed to make money by selling their publications. To create a story, the methodology is changed, often annually, which ensures that institutions at the top rotate (Lombardi et al., 2002).

The UK has had a system for appraising research universities since 1986, one that takes place every four to five years. Selectivity is on the basis of quality in that institutions that conduct the best research receive a larger proportion of the available grant. Based on peer review, the Research Assessment Exercise provides quality ratings for research across all disciplines. Panels use a standard scale to award a rating for each submission. Scores are assigned to units of assessment (equivalent to academic departments broadly speaking) depending on how much of the work is judged to reach national or international levels of excellence[8].

[8] Information about RAE available from www.hero.ac.uk.

The Research Assessment Exercise (RAE) is the measure of university performance used in this study. It was felt to be appropriate because of the emphasis it places on the output of academic research, which is a core function of research universities, the other being teaching. Although teaching is a central activity of universities, it could be argued that it is research quality that top universities prioritize. This seems clear from the fact that promotion within the faculty is typically through a peer-review process that focuses almost entirely on candidates' research productivity. There is some evidence in the UK that an academic department's teaching quality is linked to its research quality[9].

3.4 Measure of Performance

University performance is measured here across three Research Assessment Exercises and is used to assess how much each university has improved or declined in the number of top scoring departments across these periods. The ratings have changed over the different assessment exercises, but generally they range from 1 to 5-star (signified here as 5*) which is the highest grade. The paper's focus is on improvement in the number of departments that achieved the highest scores in the RAE[10]. These grades are synonymous with research considered, by peer-review, to be of international excellence. Achieving the very top grades is a challenging task because excellence must be reached across almost all faculty in a given unit of assessment[11].

University performance is, then, measured here by comparing the growth, or decline, in the number of departments graded excellent in the Research Assessment Exercise. These figures are generated both for the *level* of the number of units and also as growth in the *changes over time* for each of the sample institutions.

Have the mover universities moved in part because their leaders were better scholars? To understand whether university performance in the Research Assessment

[9] In the UK a separate measure for teaching quality was established by government – Teaching Quality Assessment (TQA). TQA scores have been shown to correlate highly with RAE scores (Shattock, 2003). In other words, those institutions that perform best in the RAE tend to obtain the highest TQA scores also.

[10] These are 5A*, 5B* and 5A. In RAE 1992 the three top scores were 5A, 5B and 5C.

[11] I chose to use the highest grades (i.e. 5A*, 5B* and 5A) because in RAE 1996 a third of all submissions received a grade somewhere in the fives, and by 2001 the number of fives awarded rose even higher to 55% of the total submissions. Therefore, with so many submissions scoring a five grade in 1996 and 2001, it was felt necessary to lift the threshold of performance to the top three RAE grades awarded.

Exercise can be explained partially by the leader-characteristic of scholarship, the study examines whether there is a correlation between a president's lifetime citations and the later movement, up or down, in the number of excellent departments in his or her institution. It also controls for institutional revenue, age and the scholarly discipline of presidents.

3.5 Independent Variable: Presidents' Lifetime Citations

Citations are references to authors in other academic papers as acknowledgement of their contribution to a specific research area. They are used in this paper to signify the scholarly ability of each president. Bibliometric information is generally viewed as a reliable indicator of research performance over time (van Raan, 2003) and it compares fairly with peer review (Nederhof and van Raan, 1993)[12].

Most academics who go into administrative jobs reduce their research output. This depends, somewhat, on their discipline. The data generated for the purposes of this study make it clear that university presidents accumulate the overwhelming majority (approximately 95%) of their citations before they become institutional leaders.

For this paper the lifetime citations of British university presidents are normalized for discipline[13]. 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 total of around 1000 whereas a molecular biologist could have a score over 10,000. Bibliometric indicators have been used more consistently across the sciences than in the humanities and social sciences (van Raan, 1998). These disciplines publish more journal articles and have a higher prevalence of co-authorship.

3.6 Why Use Citations Instead of Journal Articles?

There is a growing body of work that uses citations to assess intellectual output and productivity (see, King, 2004 and Bayers, 2005). Moreover, citation

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[12] For an overview of the strengths and weaknesses of using bibliometric data, see van Raan, 1998 and Goodall, 2006a.

[13] Citations data collected October 2005 from ISI Web of Knowledge. Citations to books and articles are recorded.

counts are a good predictor of professorial salaries (Hamermesh et. al., 1982) and Nobel Prizes (Garfield and Welljams-Dorof, 1992).

An alternative approach is to count an author's published articles and weight by journal impact-factors. However, this presents three problems. First, monographs would be excluded from the data. Second, the quality of a journal is a noisy measure of the future impact of individual articles (Oswald, 2007). For example, many highly cited articles are not published in 'Grade A' journals and vice versa. Finally, assigning weight to journal quality through, for example, ISI Impact Factors might not be reliable -- even if they were available -- for papers published 10-20 years ago. Furthermore, impact factors still rely on citations to rank journals.

3.7 Normalizing Citations to P-scores

In this paper, each university president is assigned a normalized 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 normalized for discipline*. The P-score has been generated by developing a scale that is then used as an exchange rate, normalizing the different citation conventions across disciplines. A description of the normalization process is presented in Appendix C.

The presidents in this study span a number of years, and therefore those who are older have, in principle, had longer to accrue citations. Hence, for example, if the presidents with low numbers of citations can be shown to be significantly younger than those with high life-time scores, age could be influential. However, inspection of the age profile of all leaders in my dataset finds that there are no age differences between those with the highest and lowest citation scores[14].

3.8 Control Variables: Organizational Revenue, Age and Discipline of President

Three control variables have been included in the regression analysis: organizational income, the president's age, and the academic discipline of each president. Allowing for lags, university revenue has been included for years 1992/3

[14] Age is also not a factor in the cross-sectional studies -- see Goodall a&b.

and 1996/7[15] (figures supplied by the Higher Education Statistics Agency in the UK). The income figures include government funded grants, tuition fees and education grants and contracts, research grants and contracts, endowment and investment income, miscellaneous income and income from services rendered.

The age variable has been included by calculating the age of an incumbent president in 1992 and 1996. The academic discipline of a president is defined by creating two fields, the 'sciences' that are coded 0, and the 'social sciences and humanities' coded 1.

4. Results

Table 1 gives means and standard deviations for presidents' citation scores and the university performance variable -- the number of departments that scored an excellent grade in Research Assessment Exercises 1992, 1996 and 2001.

4.1 Cross-Sectional Analysis with Lags

Initial results can be found in the simple cross-sectional bar diagram in Figure 1. The focus here is on the presidents of those universities that made the greatest gains, and the smallest gains, in the number of submissions graded excellent between RAE 1992 and 2001. The presidents' citations -- on the Y axis -- represent the means in P-score between 1992 and 1996. By design, this allows for a lag.

As can be seen, the universities that advanced the most during this period -- increasing their number of excellent-rated departments -- were disproportionately led by presidents with higher lifetime citations. The mean citation P-score of leaders running the UK's top five mover-universities at the start is 13.6 and the mean P-score of those heading the top ten mover-universities is 9.6. However, of the universities that accumulated the least number of improved scores across the nine year period -- indeed some actually reduced their number -- the citation P-score of leaders for both the lowest 5 and 10 universities is 3.1. Therefore, presidents leading the top twenty per-cent of mover-institutions are three times more highly cited, and those leading the

[15] The income variable was only available for 47 of the 55 universities. This is because no data were available to the author for the 8 University of London colleges in 1992 when the revenue figures for individual colleges were aggregated into one 'University of London' sum.

top ten per-cent of mover-institutions have over four times the lifetime citations of those who led the universities that performed least well.

Tables 2 - 7 report regression equations. These attempt to establish more carefully whether a statistically significant relationship exists between organizational performance, the dependent variable, and president's P-score, among other independent variables. In the following tables the effect of the independent variables is measured by the coefficients, and the level of significance is given by the t-statistic. Results are presented for three time periods. The first is 1992 to 1996, followed by 1996 to 2001, and finally the full 9 years, 1992 to 2001. Given the likely importance of lags, the results, incorporating two research exercises that span just under a decade, would seem to be the most robust.

Table 2 gives simple results for the *level*, or number, of excellent departments, or top-fives, gained in 1996 in the RAE, and reports the effects of the independent variables in 1992.

As can be seen, the P-score of a president in 1992 is statistically significantly related to the number of top-five departments in 1996. The coefficient is 0.30 (t-statistic = 2.29) which is significantly different from zero at the 5% level. Table 2 also shows that organizational income is statistically significant at the 1% level. The coefficient is 0.10 (t-statistic = 6.27). But age and discipline of president are not here statistically significant[16].

Table 3 gives results for the number of top-five departments in the 2001 RAE and reports the effects of the independent variables in 1996, again allowing for a lag of five years. In 2001 the P-score coefficient is 0.53 (t-statistic = 3.04) which is statistically significant at the 1% level. Again, the finance variable correlates with organizational performance. The coefficient is 0.09 (t-statistic = 7.28). However, there is no statistically significant relationship with either age of leader or their academic discipline. The size of the coefficient on P-score is somewhat mediated by adding the extra variables (comparing column 1 to column 4 in Table 3).

Table 4 again presents cross-sectional evidence but now with a longer lag. Results are given for the number of top-five departments in the 2001 RAE and the effects of the independent variables in 1992. This time I allow for a lag of nine years.

[16] When I enter P-score into the equations after the other independent variables, therefore reversing the process shown in these tables, the results stay the same. This holds for all regression equations presented in this paper.

Here a leader's P-score, the key independent variable, has been averaged between years 1990-94. By averaging P-score over four years I hope to reduce some measurement error insofar as the results are less likely to be driven by one year of observation. Table 4 reports that P-score is statistically significant -- at the 1% level -- after all independent variables have been included. Again the finance variable correlates with university performance.

In terms of the size of the effect of P-score, the equation in Table 4 illustrates that one extra point in a president's P-score (averaged 1990-1994) raises the number of top-five or excellent departments in 2001 by 0.4. In other words, a hypothetical 10 point move in a president's P-score is estimated to generate four excellent departments in 2001; or three extra departments when other variables are included. These are, of course, associations rather than clear cause and effect.

Although lags are used, the results so far are fundamentally cross-sectional. Now we turn to longitudinal analysis where the dependent variable is the change, up or down, in performance.

4.2 Longitudinal Analysis

Table 5 gives regression equations in which the dependent variable is the *change* in the number of top-five, or excellent, departments, in the Research Assessment Exercise between 1992 and 1996. As can be seen in all columns in Table 5, the association between P-score in 1992 and the later performance in 1996 is statistically significant at the 1% level. The coefficient is approximately 0.13 (t-statistic = 3.43). University income does not now, in columns 2-4 of Table 5, have a significant effect on the changes over time in the number of top-five departments. It is likely that money is more significant in equations correlating P-score with the number of top 5 departments, because income is a proxy for size of an institution. A large university will tend to have more departments. When focusing on the change however, income or size appears less important.

Columns 3 and 4 show that, again, there is no well-determined effect from the age of a president or the academic discipline to which they belong.

Table 6 shows a slightly different pattern. In 2001 the number of top-fives is statistically unaffected by presidents' P-scores five years earlier in 1996. Although the coefficients on P-score across the four columns are not significantly different from zero, they remain positive. Again, there is no significant effect from income or from the age or discipline of a leader.

A statistically significant relationship between performance and leaders' lifetime citations is reinstated again in Table 7 when a longer time perspective is adopted. As suggested earlier, this may be a more realistic reflection of the length of time needed to improve RAE performance. Presidents' P-scores have again been averaged between years 1990-94 as with the previous nine year equation.

As can be seen, P-scores are correlated with growth in the number of excellent departments obtained nine years later in the 2001 RAE. The coefficient in the first column of Table 7 is 0.24 (t-statistic 3.27) and statistical significance is established at the 1% level. Noticeably, the coefficient is double that of the 1992-1996 result reported in Table 5. Finance, age and discipline are not correlated with university performance. In columns 2-4 of Table 7, their inclusion in the regression equation leaves the coefficient on P-score approximately unaffected.

The results presented in Tables 2 through 7 appear to show that a president's lifetime citations, or past success as a scholar, are significantly correlated with the future number of top grades that a university attains in the RAE. Conversely, university revenue does not affect growth performance. Using a measure that follows the growth in departments rated excellent may be a particularly appropriate gauge of RAE performance, because excellence must be reached across all faculty in a given unit of assessment.

The results presented in this paper illustrate the apparent relevance of presidents' P-scores when explaining universities' performance in the UK Research Assessment Exercise. In other words, there is evidence consistent with a statistical, and perhaps causal, relationship between the past level of scholarship attained by a president and the future performance of their university.

4.3 Checking for Reverse Causality

As mentioned above, these kinds of regression equations may 'favour' institutions that have further to move. A test for this is to include a variable controlling for an institution's original position[17]. This check was done by entering

[17] Thanks to Ronald Ehrenberg for this suggestion.

the number of top-five grades that an institution had in 1992 into a regression equation where the dependent variable is the change in top departments from 1992 to 2001. When this is done, the results reveal that there is no difference in the statistical significance of presidents' P-scores, or in the other independent variables of income, age and discipline (table not reported). Therefore, institutions that improve the most are not doing so merely because they had the furthest scope to change.

Checks for reverse causality are done by introducing a series of lags between a leader being in place, and the future performance of his or her institution. Another test, in the style of Granger causality[18], can be applied that answers the question: are today's leaders not merely a reflection of yesterday's performance. So, for example, a distinguished scholar joins a university after, and possibly as a result of, past good performance. This causal chain is different from my hypothesis that scholar leaders actually improve performance.

To safeguard against this, the leaders' P-scores in 2001 are regressed on universities' RAE performance in 1992. In an equation of this type where the independent variable is the number of top-five, or excellent, departments the coefficient is 0.035 ($t = 0.80$). Thus there is no statistically significant relationship. This test goes some way to disproving the argument that the cross-sectional correlations, showing that top universities appoint top scholars, are merely a result of assortative matching -- put simply, that top universities select distinguished researchers as a matter of course, or because they can.

4.4 Measuring Change on Change

A full fixed-effects test to examine the impact of leaders on the performance of universities would be to regress the change in performance on the change in leader. In my study I show, in a number of ways, that those universities that were consistently led by better scholars went on to perform better in attaining the highest scores in the UK Research Assessment Exercise (RAE). The paper cannot persuasively show that a change in leadership produces a change in performance, because to present such evidence would require an extension beyond the nine years lag included in the data. Early bibliometric data on university leaders are not currently available in ISI Web of

[18] Granger and Newbold, 1974.

Knowledge, the source used in this study. Eventually this problem should be solvable when further data become available.

5. Conclusion

By constructing a new panel data set, the paper shows -- in figures such as Figure 1 and tables such as Table 7 -- that the characteristics of a leader in position today are correlated with the future performance of the organization. This appears to be the first longitudinal evidence that the appointment of a university president who has been a successful researcher can improve the later research performance of their university. It suggests that where the workforce are predominantly experts and professionals, it is specialists, not generalists, who should lead.

The paper's hypothesis is tested using multiple regression analysis, with university performance in the UK's Research Assessment Exercise (RAE) as the dependent variable, and presidents' scholarly achievement as the key independent variable. The focus is on changes in university performance over a nine-year period. Control variables for university income, presidential age and discipline are used. Although the data-set is inevitably a fairly small one -- it covers a panel of 55 universities and 157 university presidents -- the inquiry seems to be the first of its kind.

This work adds to a growing empirical literature suggesting that leaders matter (Jones and Olken, 2005, study nations and Bertrand and Schoar, 2003, study managers). The paper's findings seem to have policy implications for universities, R&D units, and other research and knowledge-intensive organizations. It appears that there is a direct pay-off from having leaders who are technical experts in their field.

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TABLE 1
Descriptive Statistics: Data over Three Research Assessment Exercises

Means (and standard deviations)

Variables	1992	1996	2001
President's lifetime citations normalized into a P-score	5.15 (7.47)	4.62 (5.94)	7.13* (21.56)
Number of excellent departments in the university	5.82 (6.82)	6.13 (7.43)	9.6 (8.13)
# Universities	n = 55	n = 55	n = 55

*One president has exceptionally high citations (Anthony Giddens). When I exclude this observation, the P-score mean is 4.38, standard deviation is 6.92. The highly cited president does not influence the paper's results. The key correlations are not affected by this outlier because the calculations in the paper allow for lags. Hence, only presidents' P-scores in 1992 and 1996 are used. The mean P-score of presidents in 1992 is 5.15 and the mean P-score of presidents in 1996 is 4.62.

FIGURE 1
Universities that Improved the Most in the RAE Between 1992-2001 Were Led by Presidents With Higher Lifetime Citations 1992-1996
(n=55 universities)

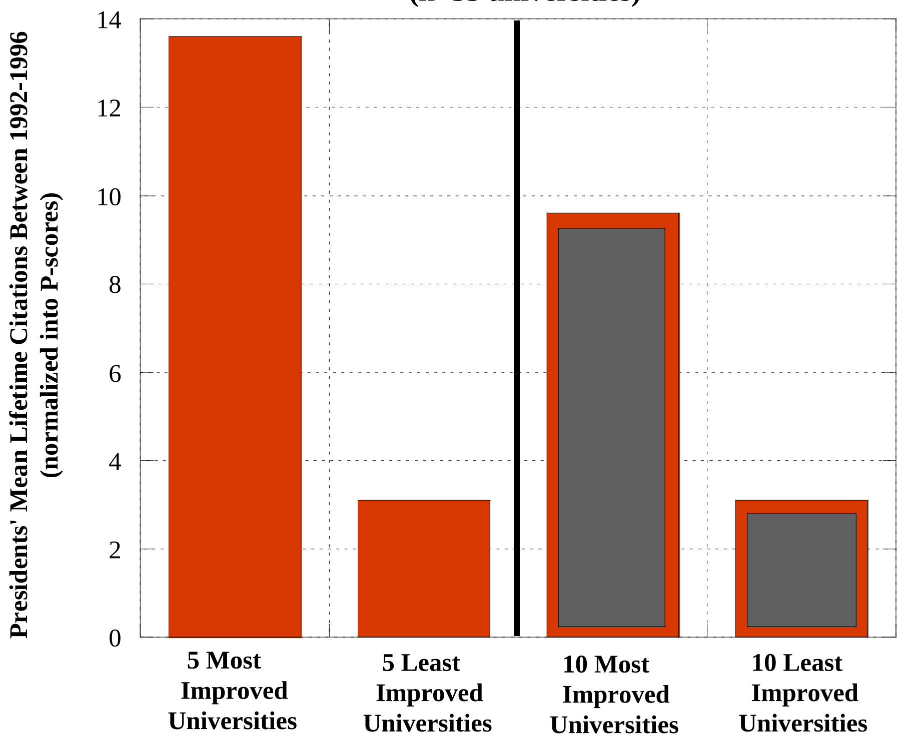

TABLE 2
Regression Equations where the Dependent Variable is the Number of Top Departments in the UK Research Assessment Exercise in 1996

Independent Variables	1	2	3	4
P-score of president in 1992	0.30*	0.21*	0.20*	0.20*
	(2.29)	(2.05)	(1.98)	(1.96)
University income in 1992/93		0.10**	0.11**	0.11**
		(6.27)	(6.56)	(6.28)
Age of president in 1992			0.25	0.26
			(1.58)	(1.53)
Discipline of president in 1992[1]				0.30
				(0.16)
R^2	0.09	0.54	0.57	0.57
Constant	4.58	-4.55	-19.05	-19.57
	(3.87**)	(-2.71**)	(-2.05*)	(-1.97*)
n=55				

Coefficients are shown with t-statistics in parentheses; **p<0.01 *p<0.05
0 = Sciences, 1 = Social Sciences and Humanities

TABLE 3
Regression Equations where the Dependent Variable is the Number of Top Departments in the UK Research Assessment Exercise in 2001

Independent Variables	1	2	3	4
P-score of president in 1996	0.53**	0.33**	0.33**	0.33**
	(3.04)	(2.58)	(2.54)	(2.49)
University income in 1996/97		0.09**	0.09**	0.09**
		(7.28)	(7.06)	(6.87)
Age of president in 1996			0.04	0.04
			(0.21)	(0.21)
Discipline of president in 1996[1]				0.11
				(0.07)
R^2	0.15	0.63	0.62	0.62
Constant	7.17	-3.08	-5.38	-5.61
	(5.53**)	(-1.84)	(-0.49)	(0.48)
n=55				

Coefficients are shown with t-statistics in parentheses; **p<0.01 *p<0.05
0 = Sciences, 1 = Social Sciences and Humanities

TABLE 4
Regression Equations where the Dependent Variable is the Number of Top Departments in the UK Research Assessment Exercise in 2001

Independent Variables	1	2	3	4
P-score of president average 1990-94	0.42**	0.30**	0.29**	0.29**
	(2.70)	(2.61)	(2.57)	(2.54)
University income in 1992/93		0.12**	0.11**	0.11**
		(6.96)	(6.95)	(6.69)
Age of president in 1992			0.20	0.19
			(1.20)	(1.11)
Discipline of president in 1992[1]				-0.14
				(-0.07)
R^2	0.12	0.59	0.60	0.61
Constant	7.48	-2.83	-14.47	-14.21
	(5.76**)	(-1.62)	(-1.48)	(-1.35)
n=55				

Coefficients are shown with t-statistics in parentheses; **p<0.01 *p<0.05
0 = Sciences, 1 = Social Sciences and Humanities

TABLE 5
Regression Equations where the Dependent Variable is the Change in the Number of Top Departments in the UK Research Assessment Exercises 1992-1996

Independent Variables	1	2	3	4
P-score of president in 1992	0.13**	0.13**	0.12**	0.12**
	(3.43)	(3.07)	(2.93)	(2.90)
University income in 1992/93		0.00	0.00	0.00
		(0.55)	(0.64)	(0.65)
Age of president in 1992			0.02	0.02
			(0.36)	(0.29)
Discipline of president in 1992[1]				-0.11
				(-0.15)
R^2	0.18	0.20	0.20	0.20
Constant	-0.37	-0.61	-2.01	-1.81
	(-1.09)	(-0.90)	(-0.52)	(-0.43)
n=55				

Coefficients are shown with t-statistics in parentheses; **p<0.01 *p<0.05
0 = Sciences, 1 = Social Sciences and Humanities

TABLE 6

Regression Equations where the Dependent Variable is the Change in the Number of Top Departments in the UK Research Assessment Exercises 1996-2001

Independent Variables	1	2	3	4
P-score of president in 1996	0.08	0.06	0.05	0.04
	(1.03)	(0.64)	(0.53)	(0.40)
University income in 1996/97		0.00	0.00	0.00
		(0.97)	(0.86)	(0.59)
Age of president in 1996			-0.00	0.06
			(-0.02)	(0.43)
Discipline of president in 1996[1]				1.97
				(1.64)
R^2	0.02	0.04	0.03	0.09
Constant	3.08	2.18	2.53	-1.44
	(5.07**)	(1.80)	(0.32)	(0.18)
n=55				

Coefficients are shown with t-statistics in parentheses; **p<0.01 *p<0.05
0 = Sciences, 1 = Social Sciences and Humanities

TABLE 7

Regression Equations where the Dependent Variable is the Change in the Number of Top Departments in the UK Research Assessment Exercises 1992-2001

Independent Variables	1	2	3	4
P-score of president average 1990-94	0. 24**	0.22**	0.22**	0.22**
	(3.27)	(2.75)	(2.76)	(2.72)
University income in 1992/93		0.01	0.01	0.01
		(1.49)	(1.30)	(1.36)
Age of president in 1992			-0.01	-0.03
			(-0.14)	(-0.28)
Discipline of president in 1992[1]				-0.62
				(-0.46)
R^2	0.16	0.21	0.21	0.21
Constant	2.56	1.17	2.19	3.29
	(4.14)	(0.96)	(0.31)	(0.44)
n=55				

Coefficients are shown with t-statistics in parentheses; **p<0.01 *p<0.05
0 = Sciences, 1 = Social Sciences and Humanities

APPENDIX A.

Universities in the Sample*

1. Birkbeck College, London	29. University of Exeter
2. Brunel University	30. University of Glasgow
3. City University	31. University of Hull
4. Goldsmiths' College, London	32. University of Keele
5. Herriot-Watt University	33. University of Kent at Canterbury
6. Imperial College, London	34. University of Lancaster
7. King's College, London	35. University of Leeds
8. London School of Economics	36. University of Leicester
9. Open University	37. University of Liverpool
10. QMW College, London	38. Loughborough University
11. Queens College Belfast	39. University of Manchester
12. Royal Holloway, London	40. University of Newcastle
13. UMIST	41. University of Nottingham
14. University College London	42. University of Oxford
15. University of Wales, Bangor	43. University of Reading
16. University of Wales, Swansea	44. University of Salford
17. Wales, Aberystwyth	45. University of Sheffield
18. University of Aberdeen	46. University of Southampton
19. University of Bath	47. St Andrews University
20. University of Birmingham	48. University of Stirling
21. University of Bradford	49. University of Strathclyde
22. University of Bristol	50. University of Surrey
23. University of Cambridge	51. University of Sussex
24. University of Dundee	52. University of Ulster
25. University of Durham	53. University of Wales, Cardiff
26. University Of East Anglia	54. University of Warwick
27. University of Edinburgh	55. University of York
28. University of Essex	

* Aston University was excluded from the sample because of their small number of submissions into the RAE over the 9 year period, making comparison and performance measurement difficult. In 1992, 10 departments were submitted, in 1996, 8 departments and in 2001, 5 were submitted.

APPENDIX B.

Description of the Data (Means) Across Three Time Periods

University Presidents	**1980's**	**1990's**	**2000-2005**
Number of male presidents	54	54	50
Number of female presidents	1	1	5
Age of accession to president	52 years	52 years	53 years
President's lifetime citations normalized into a P-score	4.59	7.80*	5.12
Length of president's tenure	10	8	N/A
Presidents who were scientists	41	28	24
Presidents who were social scientists	7	15	17
Presidents who were humanities	5	10	10
Presidents who were non-academics	2	2	4
# Universities	n = 55	n = 55	n = 55

*One president has exceptionally high citations (Anthony Giddens). When we exclude this observation the P-score mean is 5.06. Omitting this president from the analysis leaves the paper's conclusions unaffected.

APPENDIX C.

Citation Normalization Process

The discrepancies in citation levels across disciplines are demonstrated in the number of new cited references that appear in ISI every week (see over). The sciences generate approximately 350,000 new cited references weekly, the social sciences 50,000, and the humanities 15,000[19]. Although the presidents have different disciplinary backgrounds, that require normalization, they are from a single country, which presumably improves validity when using citations data as a comparative measure. Language biases have been shown to exist within ISI (van Leeuwen et al., 2001) but this should not be a problem with a UK cohort.

The P-score produced through a normalization process makes it possible to do like-for-like comparisons between individuals from different disciplines (Goodall, 2006a). To obtain a P-score, the individual presidential citations were hand-counted, totalled, and then divided by the ISI Highly Cited disciplinary thresholds shown above. The thresholds 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 humanities score was created by the author using the previously mentioned 'new cited references' generated by ISI each week. If we divide the social science weekly score of 50,000 by the humanities score of 15,000 we get a figure of 3.33. The author then divided the 'Social Sciences, General' score of 117 by 3.33 which creates a score of 35.13. The number 35 has been used here as the 'Humanities, General' score. Using citation thresholds produced by ISI HiCi, a normalized citation score has been produced in this paper for 23 subject areas.

An effort has been made to try to assign accurately 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 -- report similar correlations.

[19] Figures date from October 2004.

Citation Thresholds for Scientists in Different Disciplines

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

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

* Humanities score created by Amanda H. Goodall (in Goodall, 2006a).

Note to Table: The above citation thresholds represent approximately the top 300 authors in each disciplinary field between 1994 - 2004.