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An evaluation of the REF2021 Output Results

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Auditing the Auditors: An evaluation of the REF2021 Output Results*

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Abstract

We apply the Hole algorithm to evaluate the REF2021 output quality exercise. We find that the implied journal ranking agrees quite closely with the ABS-SCOB journal ranking, and in particular the GPA's agree with a 91% correlation.

KEYWORDS: Journal quality; Ranking; Research funding;

JEL: A1

1 Introduction

The UK has recently concluded the Research Excellence Framework (REF2021) exercise involving 157 universities, 76,132 academic staff and 185,594 research outputs. The nationally constituted panels (organized by 34 different disciplines) reviewed the submissions according to Outputs (60%), Impact Case Studies (25%), and Environment (15%). The evaluation was previously done in 1992, 1996, 2001, 2008 and 2014 although different names were used and different weighting was put on the three categories. This time the emphasis was on submitting as many researchers as possible and output quanta were set at 2.5 times the number of submitted staff, and so there was less opportunity for units to strategize on who to submit and so on. The two consequences of the evaluation are financial and reputational: the government allocates the block research grant according to both the

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quality and the quantity of the units' submissions, and the REF team publish league tables and assorted statistics on the performance of different universities.

We evaluate the REF2021 output evaluation process for Economics (unit of assessment 16, Economics and Econometrics, according to the REF). The output component is by far the largest part of the REF and is also the one that is most amenable to analysis, since there is much work on evaluating research outputs, indeed this is what Journals do. There were a total of 25 universities who submitted UOA16's with a total of 973 staff and 2,232 outputs. The data available from the REF process consists of percentage scores in five categories for each institution. The panels classified outputs into 4*, 3*, 2*, 1*, and Unclassified (although this was tiny in Economics); the formal definition of what these mean is repeated in the Appendix. Overall: 36.1% of outputs in Economics were classified as 4*, 56.2% as 3*, 6.5% as 2*, 0.9% as 1*, and 0.3% as U. This is similar to the average across all disciplines, where: 36% of outputs were classified as 4*, 47% as 3*, 15% as 2*, and 2% as 1*.

The individual paper specific evaluation by the REF panel was deleted, of course, so there is quite limited information, although we do also observe about each paper/book submitted, i.e., which journal, who are the authors etc. Based on this, Hole (2017) proposed a methodology for inferring the average quality of journals or the journal ranking implicitly from this data, and he applied this methodology to the 2014 exercise. We follow his approach updated to the 2021 exercise. We also collected paper specific citation information from `Google` and journal classification from the Association of Business Schools (ABS-SCOB list (we tried several different sources for this)) and carry out some regression analysis to see how closely related the REF outcomes are with this standard journal rating system. Working papers and book chapters are assigned a rank which equals the modal rank of SCOB for output submitted by the respective department minus one.

2 Methodology

We observe p_{iq}, the REF panel determined proportion of $q-$star submissions in department i, where $q = 1, 2, 3, 4$, while $i = 1, \ldots, I$. In our case $I = 25$. In total there are N papers from R journals submitted, where $N = 2232$ and $R = 227$ but only 67 journals have more than five submissions (and these accounted for 84.6% of the total submissions). Like Hole (2107) we restrict attention to journals with five or more submissions (and ignore books and working papers) and we drop the unclassified category. Each department has a different portfolio of journal submissions: institution i has N_{ir} papers published in journal J_r with $r = 1, \ldots, R$, which is observed. We define $\mathbb{N}_{iq}$ as the observed integer number of papers of quality q submitted by institution i, where $p_{iq} = \mathbb{N}_{iq}/N_i$.

Let X_j^*, $j = 1, \ldots, N$ denote the unobserved individual paper quality on the same scale, i.e.,

$X_j^* \in \{1,2,3,4\}$ and let J_r^*, $r = 1,\ldots,R$ denote the unobserved REF asserted quality of the set of journals, i.e., $J_r^* \in \{1,2,3,4\}$. In general we might think that quality is uniquely defined at the paper level but perhaps not at the journal level, since even top journals can have a bad day, and this latter assumption would be contrary to the stated REF review process. For our fitting procedure we follow Hole (2017) and implicitly suppose that journal quality is uniquely defined, although as we will see the results we report implicitly reflect paper specific quality variation. We discuss this interpretation issue further in the Appendix.

For a given candidate vector of journal qualities $J = (J_1,\ldots,J_R)$ with $J \in \mathcal{J} = \{1,2,3,4\}^R$, let $X_k(J)$ denote the implied quality of the k^{th} publication from institution i. Define

$$\widehat{p}_{iq}(J) = \frac{1}{N_i}\sum_{k=1}^{N_i} 1\left(X_k(J) = q\right), \quad q = 1,2,3,4, \tag{1}$$

which is the implied percentage of quality q journals associated with institution i ($1(.)$ is the indicator function). We then calculate the objective function

$$SSD(J) = \sum_{i=1}^{25} N_i \sum_{q=1}^{4} \left(p_{iq} - \widehat{p}_{iq}(J)\right)^2 \tag{2}$$

and search over $J \in \mathcal{J}$ to minimize SSD.[1] Here, we are searching over a very large parameter space with a lot of redundancy: many permutations of J yield the same outcome $\widehat{p}_{iq}(J)$ because R is large relative to the available information, which is determined by the number of institutions I. Specifically, if $R = 70$, then $\mathcal{J}$ has cardinality 10^{42} so this is a massive parameter set to search over. Even if we could find the minimum of the objective function it would not be unique, and given the discontinuous discrete nature of the problem we may only be able to compute the minimizing value up to some numerical tolerance factor ϵ, that is, we may find a value $\widehat{J} \in \mathcal{J}$ such that $SSD(\widehat{J}) = \min_{J\in\mathcal{J}} SSD(J) + \epsilon$. From a computational point of view this is an NP- hard problem. From a statistical point of view the parameter vector J is unidentified and the identified set is unknown.

We next describe the algorithm used to try to locate the minima of SSD. The search is carried out by a stepwise algorithm in which we start with some initial journal classification (specifically the SCOB ranking) and then proceed sequentially through the journals changing the assigned category if this improves the SSD. This is repeated until the improvement in SSD is small. The parameter vector J is not identified here and different sequences of journals leads to different outcomes even

[1] We also considered a minimum distance criterion function, as discussed in the Appendix.

after convergence. A natural search order is to randomize within SCOB categories, that is, to start with the highest ranking journals and proceed to the lowest. Specifically, randomly choose the order within the top five and play that out and then randomly choose the order within the remaining 4* category, play that out, and so on. Another search order is based on the number of submissions ordering, that is, order journals by their submission count, divide into four categories, and then search sequentially from most numerous to least numerous categories where you randomize order within each category. This is kind of like a greedy algorithm since we expect that the highest quality journals are more homogenous in terms of quality whereas the lower quality journals may be more hit or miss. Following Hole we report the average over a thousand alternative sequences along with the range of outcomes. The outcome is a percentage count of each journal r in each quality category q. This may be understood as a way of describing the identified set; in the appendix we discuss a Bayesian approach in which we obtain the posterior distribution of journals' qualities given the observed data (N_{ir}), $(\mathbb{N}_{iq})$.

2.1 GPA modelling

The vector of quality counts can be analyzed directly as in Battistin and Ovidi (2022). There are a number of scalar performance measures that people focus on such as the % of 4* count; this seems appropriate for comparing elite universities but is not helpful in comparing universities that don't have any 4*! We work with a Grade Point Average, which is widely used in say the US educational system to measure students average performance.

We define the GPA for each institution as

$$GPA_i = \sum_{q=1}^{4} p_{iq} q, \quad i = 1, \ldots, I. \tag{3}$$

In the Appendix we discuss an alternative matching procedure based on GPA. We fit the linear regression with the $i = 1, \ldots, 25$ institutions

$$GPA_i = \alpha + \beta \times Acite_i + \gamma \times Aage_i + \delta \times Scobgpa_i + \sigma \times Submission_i + \varepsilon_i, \tag{4}$$

where $Acite_i$ is the average citation of the institution's papers, $Aage_i$ is the average age (in months) of the institution's papers, $Scobgpa_i$ is the GPA of the institution's papers implied by the SCOB journal classification, and $Submission_i$ is the total number of submission by the institution. These variables are all expected to have a positive effect on an institution's GPA. In particular, we might expect that the size of the institution (as measured here by $Submission_i$) has a positive effect on the

research quality of the institution ceteris paribus. We also tried logs for all variables since they are all non-negative. One null hypothesis of interest is that $\beta = \gamma = \sigma = 0$. We may also want to include the impact and environment scores for each institution $impact_i$ and $environment_i$ as there may be a positive relation between them and the output quality. However, it is clear that they are not exogenous to GPA and so we use an instrumental variable strategy where impact and environment scores from the previous REF2014 are instruments.

3 Results

There were 28 units submitted to REF2014, and only 25 submitted to REF2021, partly this is due to more submission of economists through the related UOA17 (Business and Management). There were two Universities (Bath and Northampton) that submitted in 2021 but not in 2014.

Table 1 reports our main results, which are the percentage of 1000 runs that a journal is classified as 4*,3*,2*, or 1*. As discussed we get different classifications across runs and this can be interpreted as a description of the identified set. The top four implied journals agrees with ABS-SCOB and the wider professions' evaluations. The *Review of Economic Studies* is a little off the pace and behind say the *Journal of Financial Economics*. As commented in Hole (2017) the new AEA journals score highly. Economic History journals such as *Explorations in Economic History* do quite well in comparison with statistics journals such as the *Journal of the American Statistical Association*. We show some robustness checks in Tables 2 and 3 that roughly confirm our results.

In Table 4 we show the top ten journal counts by institutions, which show the considerable segmentation of the 25 institutions - Northampton University's top journal count ($\max_r N_{ir} = 2$) was at the *International Journal of Sustainable Development & World Ecology*, whereas for LSE this was the *American Economic Review* (with $\max_r N_{ir} = 33$). Cambridge tops in *Journal of Econometrics* and *Economic Theory* ($\max_r N_{ir} = 8$) and has a much lower number of AER's (6) than LSE or UCL. Cambridge also has far fewer submissions in the EJ, which is the most common journal across the whole of UOA16.

In Table 5 we ordered institutions by the number of submissions. There is a large variation across institutions, with University of Oxford having the highest number count at 209, and University of Northampton lowest at 21.

In Table 6 we report the results of the GPA regressions. Essentially, institution GPA is largely and almost exclusively determined by the SCOB implied GPA. The joint coefficient test in Table 7 shows the average level of citation, the average age of the papers and the number of submissions in the institution provide no additional predictive power. The pairwise correlation between the SCOB

implied GPA and the REF implied GPA is 91%. However, the lower tail is less well fitted by the SCOB GPA, which makes sense since the quality of the journals in which lower ranked institutions tend to publish is much harder to determine. The intercept in the regression is positive (although it is not significant at the 5% level) indicating that even if the SCOB implied GPA was zero, the institution would receive a GPA of 1.79 from the REF panel.

Model IV_1 in Table 8 shows the results when using impact scores and environment scores from 2014 as instruments. Results from Economics and Econometrics panel from 2014 REF exercise is lacking for the University of Bath and the University of Northampton, so the number of observations drop from 25 to 23. The weak instruments test shows the 2014 environment score is a weak instrument, so model IV_2 is estimated with only 2014 impact scores as instrument for the 2021 impact scores, as shown by model IV_2. The Environment2021 and Impact2021 variables in the IV regressions are not significant (and Environment has a negative coefficient, although impact has a positive effect). Furthermore, the adjusted fit of these regressions is inferior to the models without these endogenous variables.

In Table 9 we compare the SCOB GPA-implied ranking with the REF GPA-implied ranking. There is a high association. In Figure 1 we show the univariate regression line with scatter plot. Oxford and Cambridge both seem to sit in similar positions exactly on the regression line, whereas UCL and LSE are slightly above the regression line. There are some larger outliers on both positive and negative dimensions. For example, the University of Surrey would be ranked 3rd according to SCOB GPA but only achieved rank 12 according to the REF panel. On the other hand City University ranked 22nd according to the panel but only 16th according to the SCOB implied ranking.

4 Conclusions

The Stern report (2016, p6.4) (not the climate one) estimated that REF2014 cost £246 million to conduct; presumably this is not including the time of the academics involved. For example, OUP guidelines for referees suggest a minimum of two hours work per paper per round per referee per journal. The REF process ignores this huge investment of time by academic referees and ask universities and panels to do this work over again for 185,594 outputs! In disciplines such as Economics where the journal hierarchy is widely perceived to be informative (imperfectly so of course) this seems to be potentially overkill. At a time when the Government is looking for efficiency savings perhaps this is a good place to start! The very high correlation (91%) between the SCOB-implied ranking and the REF implied ranking suggests that: (1) either the REF panel spends an extreme amount of time reviewing outputs and comes to the same conclusions as the Journals or the REF panel just

implicitly follows the journal hierarchy without much reinterpretation; (2) either way automated evaluation based on journal labels can deliver almost identical results with minimal cost, Hole (2017) and Battistin and Ovidi (2022).

5 Appendix

5.1 Some REF definitions

REF2021 definition of research quality:

- **Four star**: Quality that is world-leading in terms of originality, significance and rigour.
- **Three star**: Quality that is internationally excellent in terms of originality, significance and rigour but which falls short of the highest standards of excellence.
- **Two star**: Quality that is recognized internationally in terms of originality, significance and rigour
- **One star**: Quality that is recognized nationally in terms of originality, significance and rigour.
- **Unclassified**: Quality that falls below the standard of nationally recognized work. Or work which does not meet the published definition of research for the purposes of this assessment.

5.2 Objective Functions

Here, we discuss alternative objective functions for the journal assignment question. In multinomial problems it is more common to work with the minimum distance or minimum chi-squared objective function

$$MD(J) = \sum_{i=1}^{25} \left(p_i - \widehat{p}_i(J)\right)^{\intercal} V_i^{-1} \left(p_i - \widehat{p}_i(J)\right),$$

where

$$V_i = N_i^{-1} \left(\text{diag}(p_i) - p_i p_i^{\intercal}\right), \quad p_i = \begin{pmatrix} p_{i1} \\ p_{i2} \\ p_{i3} \end{pmatrix}, \ \widehat{p}_i(x) = \begin{pmatrix} \widehat{p}_{i1}(J) \\ \widehat{p}_{i2}(J) \\ \widehat{p}_{i3}(J) \end{pmatrix}.$$

The main difference is the presence of the inverse covariance matrix weighting that takes account of correlation within categories. In fact, we must drop one of the categories since otherwise the 4

by 4 matrix is singular. The justification for this objective function is that the observed data for each institution is a vector of frequencies associated with a multinomial distribution. Note that by standard matrix algebra

$$V_i^{-1} = N_i \left(\text{diag}(p_i) + \frac{1}{1 - i^\intercal p_i} i i^\intercal \right).$$

We have $1 - i^\intercal p_i = p_{i4}$ and maybe this causes a problem if some institutions have submitted zero proportion in that category. In practice we must drop different categories for different institutions depending on where their hole is. This objective function is actually quite similar to the weighted least squares objective function.

We also considered matching by GPA instead of the vector of quality counts. We have (with the unobserved n_{irq} the number of quality q papers published in journal r submitted by institution i)

$$GPA_i = \frac{1}{N_i} \sum_{q=1}^{4} q \sum_{r=1}^{R} n_{irq} = \frac{1}{N_i} \sum_{r=1}^{R} N_{ir} \sum_{q=1}^{4} \frac{n_{irq}}{N_{ir}} q = \frac{1}{N_i} \sum_{r=1}^{R} N_{ir} \sum_{q=1}^{4} p_{irq} q = \frac{1}{N_i} \sum_{r=1}^{R} N_{ir} GPA_{ir},$$

and if we impose that $GPA_{ir} = GPA_r$, we can write the implied GPA of the institution in terms of the GPA of the journal. Instead of matching on the 4 category counts we could match on GPA, that is, we find the GPA of the journals $SSD(GPA) = \sum_{i=1}^{25} N_i (GPA_i - \widehat{GPA}_i(GPA))^2$, where GPA_i is the REF returned GPA and $\widehat{GPA}_i$ is the GPA associated with a given quality assignment for J. In this case the natural parameter space is $GPA \in \mathcal{G} = [1, 4]^R$ and derivative based algorithms can be used although the identification issue remains. This involves a reduction in information, since we are aggregating the raw data further. But it does not make much difference to the implied ranking of journals.

5.3 Interpretation and Bayesian Model

The fitting procedure we work with finds a vector J of journal qualities, and implicitly assumes that this is uniquely defined, although the outputs we obtain are vectors of percentages, since the found values of J vary depending on the starting value and the order of updating. We may interpret this as a description of the identified set. An alternative way of interpreting this is to suppose that quality is uniquely at the paper level in which case it is natural to obtain a vector of quality counts, and we show how this can be done from a Bayesian point of view.

Suppose that the $R \times 1$ vector J of parameters has associated prior probabilities

$$\Pr(J_r = q) = \pi_{rq}, \quad \pi_{rq} \geq 0, \ \sum_{q=1}^{4} \pi_{rq} = 1, \quad r = 1, \ldots, R.$$

That is, a given paper X_j that is published in journal J_r has probability π_{rq} of being assigned quality q. Then, we calculate the likelihood based on the observed average institutional quality counts $\mathbb{N}_{1q}, \ldots, \mathbb{N}_{Iq}$ $(q = 1, 2, 3, 4)$ with $I = 25$, where $\mathbb{N}_{iq} = N_i \times p_{iq}$ is the integer number of papers of quality q submitted by institution i. For each institution i, the integer-valued $R \times 4$ matrix $\underline{n}_i = \{(n_{ir1}, n_{ir2}, n_{ir3}, n_{ir4}),\ r = 1, \ldots, R\}$ that describes the journal specific quality counts is unobserved and is to be searched over subject to the constraints implied by the row and column sums being known. The likelihood is (assuming independence across everything)

$$L\left(\mathbb{N}_{1,1}, \ldots, \mathbb{N}_{I,4}, N_{1,1}, \ldots, N_{I,R} | \pi\right) = \prod_{i=1}^{I} \sum_{\underline{n}_i \in \mathcal{N}_i} \prod_{r=1}^{R} \pi_{r1}^{n_{ir1}} \pi_{r2}^{n_{ir2}} \pi_{r3}^{n_{ir3}} \pi_{r4}^{n_{ir4}}.$$

The set $\mathcal{N}_i$ is defined below (based on the counts $\{N_{ir}, \mathbb{N}_{iq}\}$) :

$$\mathcal{N}_i = \left\{ \underline{n}_i : n_{irq} \in \{0, 1, \ldots, \min\{N_{ir}, \mathbb{N}_{iq}\}\}, \sum_{q=1}^{4} n_{irq} = N_{ir}, \sum_{r=1}^{R} n_{irq} = \mathbb{N}_{iq} \right\}.$$

The logic is that for a given institution with quality count $\mathbb{N}_{iq}$ we can achieve this by $n_1 + \ldots + n_R = \mathbb{N}_{iq}$, where n_r is the unobserved integer count of journal r that is of that quality (we drop subscripts for clarity). Clearly, $n_r \geq 0$ and n_r is less than or equal to the total number of papers from those journals that were submitted by the institution. We have to compute the probability of all possible integer vectors that are compatible with these restrictions. In practice this calculation is impossible since $\mathcal{N}_i$ may contain a vast number of elements that need to be evaluated. The Bayesian approach would be to compute the posterior distribution

$$\Pr\left(J_1 = q_1, \ldots, J_R = q_R | \mathbb{N}_{11}, \ldots, \mathbb{N}_{I4}, N_{1,1}, \ldots, N_{I,R}\right) \propto L\left(\mathbb{N}_{1,1}, \ldots, \mathbb{N}_{I,4}, N_{1,1}, \ldots, N_{I,R} | \pi\right) \times \text{prior}(\pi),$$

and its marginals $\Pr\left(J_r = q | \mathbb{N}_{11}, \ldots, \mathbb{N}_{I4}\right),\ q = 1, 2, 3, 4$. This looks similar to the output that we obtain from the Hole algorithm.

Likelihood Computation. The difficult part is the computation of the likelihood. In practice one approach is to choose first an integer n_{i11} randomly from $\{0, 1, \ldots, \min\{N_{i1}, \mathbb{N}_{i1}\}\}$ and then choose n_{i12} randomly from $\{0, 1, \ldots, \min\{N_{i1} - n_{i11}, \mathbb{N}_{i2}\}\}$, and then choose n_{i13} randomly from $\{0, 1, \ldots, \min\{N_{i1} - n_{i11} - n_{i12}, \mathbb{N}_{i3}\}\}$, and then let $n_{i4} = N_{i1} - n_{i11} - n_{i12} - n_{i13}$. Then choose an integer n_{i21} randomly from $\{0, 1, \ldots, \min\{N_{i2}, \mathbb{N}_{i1} - n_{i11}\}\}$ and then choose n_{i22} randomly from $\{0, 1, \ldots, \min\{N_{i2} - n_{i21}, \mathbb{N}_{i2} - n_{i12}\}\}$, etc. Given an $R \times 4$ matrix $\underline{n}_i = (n_{irq}) \in \mathcal{N}_i$ one can evaluate the likelihood contribution for institution i. Actually, one should start at some random location r, q and draw randomly integer values consistent with the constraints, and then go to another random

location and draw randomly integer values consistent with the constraints etc. This comes out similar to the Hole algorithm.

Maybe it helps to consider a simple example. Suppose that there are two dice with 6 outcomes each with probability π_i but we only observe the sum of the two dice. Suppose that $X_1 + Y_1 = 6$, then this can be made by $1+5, 5+1, 2+4, 4+2$, and $3+3$ so the likelihood for this single roll is

$$L(X_1 + Y_1 = 6|\pi) = 2\pi_1\pi_5 + 2\pi_2\pi_4 + \pi_3^2.$$

In this case we see that the MLE is not uniquely defined because too many parameters relative to observations. Suppose that the parameter space is

$$\Theta = \left\{ \pi : \pi_i \in \left\{ 0, \frac{1}{6}, \frac{2}{6} \right\}, \sum_{i=1}^{6} \pi_i = 1 \right\}.$$

Lets suppose that we have a starting value $\pi = (1/6, \ldots, 1/6)$ and then compute $L(X_1+Y_1 = 6|\pi) = 5/36$. If we increase π_1 to $2/6$ and decrease π_3 to zero we obtain $L(X_1 + Y_1 = 6|\pi) = 6/36$ an improvement, but the same is achieved by other upgrades. The maximum is achieved at the case where $\pi_3 = 2/6$ and either $\pi_2 = 2/6$ and $\pi_4 = 2/6$ (and $\pi_1 = \pi_5 = \pi_6 = 0$) or $\pi_1 = 2/6$ and $\pi_5 = 2/6$ (and $\pi_2 = \pi_3 = \pi_6 = 0$) in which case $L(X_1 + Y_1 = 6|\pi) = 12/36$. Which solution is reached will depend on the order in which the elements are updated. The Hole algorithm would give $\pi_3 = 2/6$ and $\pi_j = 1/6$ for $j = 1, 2, 4, 5$. A Bayesian approach here is specify $p(x) = \Pr(\pi_1 = x_1, \ldots, \pi_6 = x_6)$ for each element $x \in \Theta$ and then the posterior distribution for π is given by

$$f(\pi|X + Y = 6) = \frac{(2\pi_1\pi_5 + 2\pi_2\pi_3 + \pi_3^2)\, p(\pi_1, \ldots, \pi_6)}{\sum_{\pi\in\Theta} (2\pi_1\pi_5 + 2\pi_2\pi_3 + \pi_3^2)\, p(\pi_1, \ldots, \pi_6)},$$

which is a joint distribution defined on Θ. The marginals $f(\pi_i|X+Y = 6)$ are obtained by averaging out the other variables.

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Table 1: Results from 1000 runs with journals grouped by initial assigned ranking scores

Journal	4*	3*	2*	1*	submissions
Quarterly Journal of Economics	0.988	0.012	0.000	0.000	34
American Economic Review	0.981	0.019	0.000	0.000	125
Econometrica	0.968	0.032	0.000	0.000	72
Journal of Political Economy	0.885	0.115	0.000	0.000	66
American Economic Journal: Macroeconomics	0.841	0.151	0.008	0.000	24
Quantitative Economics	0.830	0.163	0.007	0.000	31
Journal of Financial Economics	0.784	0.147	0.069	0.000	6
American Economic Journal: Microeconomics	0.747	0.249	0.004	0.000	27
American Economic Journal: Applied Economics	0.619	0.378	0.003	0.000	33
American Economic Journal: Economic Policy	0.609	0.271	0.120	0.000	23
Review of Economic Studies	0.606	0.394	0.000	0.000	90
Journal of the European Economic Association	0.568	0.432	0.000	0.000	83
Economic Journal	0.536	0.464	0.000	0.000	133
Explorations in Economic History	0.523	0.477	0.000	0.000	6
Journal of Econometrics	0.517	0.483	0.000	0.000	103
Journal of Monetary Economics	0.501	0.490	0.009	0.000	44
Journal of Economic History	0.500	0.239	0.261	0.000	11
Theoretical Economics	0.494	0.486	0.020	0.000	40
Journal of Finance	0.488	0.512	0.000	0.000	6
Econometric Theory	0.466	0.412	0.122	0.000	8
Review of Financial Studies	0.454	0.546	0.000	0.000	17
International Journal of Industrial Organization	0.357	0.613	0.030	0.000	8

Continued on next page

Journal	4*	3*	2*	1*	submissions
Journal of the American Statistical Association	0.356	0.644	0.000	0.000	11
European economic review	0.355	0.640	0.005	0.000	6
Journal of Labor Economics	0.328	0.671	0.001	0.000	17
Economica	0.301	0.691	0.008	0.000	13
Journal of Economic Theory	0.274	0.726	0.000	0.000	116
Review of Economics and Statistics	0.249	0.751	0.000	0.000	59
Journal of Public Economics	0.230	0.770	0.000	0.000	60
RAND Journal of Economics	0.117	0.104	0.779	0.000	15
Annals of Statistics	0.095	0.365	0.540	0.000	7
Journal of Environmental Economics and Management	0.083	0.914	0.003	0.000	11
Journal of Human Resources	0.079	0.856	0.065	0.000	9
International Economic Review	0.063	0.937	0.000	0.000	37
Journal of Mathematical Economics	0.055	0.938	0.007	0.000	8
Oxford Bulletin of Economics and Statistics	0.051	0.949	0.000	0.000	5
American Economic Review: Insights	0.049	0.942	0.009	0.000	5
Review of Economic Dynamics	0.048	0.952	0.000	0.000	15
Journal of Applied Econometrics	0.041	0.805	0.154	0.000	21
Economic Theory	0.031	0.966	0.003	0.000	16
Journal of Industrial Economics	0.028	0.972	0.000	0.000	8
Labour Economics	0.025	0.975	0.000	0.000	6
Journal of Financial and Quantitative Analysis	0.016	0.947	0.037	0.000	5
Journal of International Economics	0.012	0.988	0.000	0.000	49
Journal of Urban Economics	0.011	0.989	0.000	0.000	7
Journal of Development Economics	0.010	0.982	0.008	0.000	40
Journal of Economic Dynamics and Control	0.007	0.965	0.028	0.000	22
Journal of Time Series Analysis	0.006	0.994	0.000	0.000	7
Journal of Business and Economic Statistics	0.003	0.997	0.000	0.000	25
Journal of Economic Behavior and Organization	0.000	1.000	0.000	0.000	35

Continued on next page

Journal	4*	3*	2*	1*	submissions
Games and Economic Behavior	0.000	1.000	0.000	0.000	74
European Economic Review	0.000	1.000	0.000	0.000	52
Experimental Economics	0.000	1.000	0.000	0.000	6
Journal of Health Economics	0.000	1.000	0.000	0.000	19
Management Science	0.000	0.998	0.002	0.000	19
Journal of Money, Credit and Banking	0.000	0.984	0.016	0.000	13
Scandinavian Journal of Economics	0.000	0.889	0.111	0.000	9
European Journal of Operational Research	0.000	0.859	0.141	0.000	5
International Review Of Financial Analysis	0.000	0.556	0.444	0.000	10
Oxford Economic Papers	0.000	0.508	0.492	0.000	16
Journal of International Financial Markets, Institutions And Money	0.000	0.500	0.498	0.002	7
Public Choice	0.000	0.462	0.536	0.002	5
European Journal of Finance	0.000	0.376	0.624	0.000	8
International Journal Of Finance And Economics	0.000	0.305	0.695	0.000	6
Journal Of Banking And Finance	0.000	0.293	0.707	0.000	5
Journal of Financial Stability	0.000	0.207	0.784	0.009	5
Journal of Empirical Finance	0.000	0.087	0.913	0.000	5

Table 2: Results from 1000 runs with journals grouped by number of submissions

Journal	4*	3*	2*	1*	submissions
American Economic Journal: Applied Economics	0.987	0.013	0.000	0.000	33
Quantitative Economics	0.987	0.007	0.006	0.000	31
Quarterly Journal of Economics	0.983	0.017	0.000	0.000	34
American Economic Journal: Macroeconomics	0.975	0.021	0.004	0.000	24
Journal of Financial Economics	0.909	0.047	0.044	0.000	6
American Economic Review	0.897	0.103	0.000	0.000	125
Econometrica	0.892	0.108	0.000	0.000	72
Theoretical Economics	0.829	0.166	0.005	0.000	40
Review of Financial Studies	0.805	0.195	0.000	0.000	17
American Economic Journal: Economic Policy	0.803	0.123	0.074	0.000	23
Journal of Political Economy	0.796	0.204	0.000	0.000	66
Journal of Finance	0.791	0.209	0.000	0.000	6
American Economic Journal: Microeconomics	0.726	0.270	0.004	0.000	27
Journal of the American Statistical Association	0.709	0.291	0.000	0.000	11
Journal of Labor Economics	0.701	0.298	0.001	0.000	17
Review of Economic Studies	0.671	0.329	0.000	0.000	90
Econometric Theory	0.668	0.167	0.165	0.000	8
Journal of Economic History	0.637	0.137	0.226	0.000	11
Journal of Monetary Economics	0.627	0.368	0.005	0.000	44
Explorations in Economic History	0.566	0.434	0.000	0.000	6
International Journal of Industrial Organization	0.453	0.484	0.063	0.000	8
Journal of the European Economic Association	0.439	0.561	0.000	0.000	83
European economic review	0.381	0.612	0.007	0.000	6

Continued on next page

Journal	4*	3*	2*	1*	submissions
Economic Journal	0.336	0.664	0.000	0.000	133
Journal of Econometrics	0.335	0.665	0.000	0.000	103
Review of Economics and Statistics	0.274	0.726	0.000	0.000	59
Journal of Economic Theory	0.269	0.731	0.000	0.000	116
RAND Journal of Economics	0.257	0.015	0.728	0.000	15
Economica	0.211	0.787	0.002	0.000	13
Journal of Human Resources	0.199	0.748	0.053	0.000	9
American Economic Review: Insights	0.183	0.813	0.004	0.000	5
Journal of Environmental Economics and Management	0.153	0.836	0.011	0.000	11
Annals of Statistics	0.137	0.170	0.693	0.000	7
Journal of Financial and Quantitative Analysis	0.128	0.843	0.029	0.000	5
Economic Theory	0.090	0.908	0.002	0.000	16
International Economic Review	0.068	0.932	0.000	0.000	37
Journal of Mathematical Economics	0.057	0.934	0.009	0.000	8
Journal of Business and Economic Statistics	0.056	0.944	0.000	0.000	25
Review of Economic Dynamics	0.039	0.961	0.000	0.000	15
Journal of Time Series Analysis	0.027	0.973	0.000	0.000	7
Journal of Public Economics	0.022	0.978	0.000	0.000	60
Labour Economics	0.018	0.982	0.000	0.000	6
Journal of Urban Economics	0.015	0.983	0.002	0.000	7
Journal of Economic Dynamics and Control	0.011	0.966	0.023	0.000	22
Journal of Development Economics	0.010	0.989	0.001	0.000	40
Journal of Applied Econometrics	0.008	0.940	0.052	0.000	21
Journal of International Economics	0.007	0.993	0.000	0.000	49
Journal of Industrial Economics	0.007	0.993	0.000	0.000	8
Oxford Bulletin of Economics and Statistics	0.002	0.998	0.000	0.000	5
Journal of Economic Behavior and Organization	0.000	1.000	0.000	0.000	35
Games and Economic Behavior	0.000	1.000	0.000	0.000	74
European Economic Review	0.000	1.000	0.000	0.000	52

Continued on next page

Journal	4*	3*	2*	1*	submissions
Experimental Economics	0.000	1.000	0.000	0.000	6
Journal of Health Economics	0.000	1.000	0.000	0.000	19
Scandinavian Journal of Economics	0.000	0.972	0.028	0.000	9
Management Science	0.000	0.948	0.052	0.000	19
Journal of Money, Credit and Banking	0.000	0.898	0.102	0.000	13
European Journal of Operational Research	0.000	0.859	0.141	0.000	5
International Journal Of Finance And Economics	0.000	0.805	0.195	0.000	6
Journal of Financial Stability	0.000	0.589	0.393	0.018	5
Public Choice	0.000	0.508	0.482	0.010	5
Journal of International Financial Markets, Institutions And Money	0.000	0.431	0.565	0.004	7
Journal Of Banking And Finance	0.000	0.427	0.573	0.000	5
Oxford Economic Papers	0.000	0.373	0.627	0.000	16
Journal of Empirical Finance	0.000	0.298	0.702	0.000	5
International Review Of Financial Analysis	0.000	0.105	0.895	0.000	10
European Journal of Finance	0.000	0.056	0.944	0.000	8

Table 3: Results from 1000 runs with journals ordered randomly

Journal	4*	3*	2*	1*	submissions
Quarterly Journal of Economics	0.957	0.043	0.000	0.000	34
American Economic Review	0.931	0.069	0.000	0.000	125
Econometrica	0.928	0.072	0.000	0.000	72
American Economic Journal: Macroeconomics	0.881	0.104	0.015	0.000	24
Quantitative Economics	0.844	0.145	0.011	0.000	31
Journal of Political Economy	0.843	0.157	0.000	0.000	66
Journal of Financial Economics	0.769	0.162	0.069	0.000	6
American Economic Journal: Applied Economics	0.754	0.244	0.002	0.000	33
Review of Economic Studies	0.734	0.266	0.000	0.000	90
Journal of Monetary Economics	0.651	0.320	0.029	0.000	44
Theoretical Economics	0.598	0.363	0.039	0.000	40
Journal of the European Economic Association	0.573	0.427	0.000	0.000	83
Econometric Theory	0.513	0.314	0.173	0.000	8
Economic Journal	0.491	0.509	0.000	0.000	133
Review of Financial Studies	0.468	0.532	0.000	0.000	17
Journal of Finance	0.453	0.547	0.000	0.000	6
American Economic Journal: Economic Policy	0.450	0.385	0.165	0.000	23
Journal of Econometrics	0.445	0.555	0.000	0.000	103
American Economic Journal: Microeconomics	0.445	0.539	0.016	0.000	27
Journal of the American Statistical Association	0.422	0.578	0.000	0.000	11
Review of Economics and Statistics	0.411	0.587	0.002	0.000	59
Journal of Economic Theory	0.380	0.620	0.000	0.000	116
Explorations in Economic History	0.369	0.631	0.000	0.000	6
European economic review	0.365	0.627	0.008	0.000	6

Continued on next page

Journal	4*	3*	2*	1*	submissions
International Journal of Industrial Organization	0.361	0.593	0.046	0.000	8
Journal of Economic History	0.325	0.405	0.270	0.000	11
Economica	0.286	0.695	0.019	0.000	13
Journal of Labor Economics	0.244	0.756	0.000	0.000	17
RAND Journal of Economics	0.205	0.111	0.684	0.000	15
Annals of Statistics	0.128	0.260	0.612	0.000	7
American Economic Review: Insights	0.100	0.883	0.017	0.000	5
Journal of Human Resources	0.093	0.805	0.102	0.000	9
Journal of Environmental Economics and Management	0.075	0.922	0.003	0.000	11
International Economic Review	0.073	0.927	0.000	0.000	37
Economic Theory	0.052	0.944	0.004	0.000	16
Journal of Public Economics	0.047	0.953	0.000	0.000	60
Labour Economics	0.034	0.966	0.000	0.000	6
Oxford Bulletin of Economics and Statistics	0.032	0.968	0.000	0.000	5
Journal of Financial and Quantitative Analysis	0.026	0.935	0.039	0.000	5
Journal of Mathematical Economics	0.025	0.962	0.013	0.000	8
Journal of Applied Econometrics	0.025	0.904	0.071	0.000	21
Journal of Business and Economic Statistics	0.019	0.981	0.000	0.000	25
Journal of Industrial Economics	0.016	0.984	0.000	0.000	8
Review of Economic Dynamics	0.013	0.987	0.000	0.000	15
Journal of Development Economics	0.011	0.982	0.007	0.000	40
Journal of International Economics	0.009	0.991	0.000	0.000	49
Journal of Economic Dynamics and Control	0.009	0.959	0.032	0.000	22
Journal of Urban Economics	0.004	0.995	0.001	0.000	7
Journal of Health Economics	0.002	0.998	0.000	0.000	19
Journal of Time Series Analysis	0.001	0.999	0.000	0.000	7
Journal of Economic Behavior and Organization	0.000	1.000	0.000	0.000	35
Games and Economic Behavior	0.000	1.000	0.000	0.000	74

Continued on next page

Journal	4*	3*	2*	1*	submissions
European Economic Review	0.000	1.000	0.000	0.000	52
Experimental Economics	0.000	1.000	0.000	0.000	6
Management Science	0.000	0.982	0.018	0.000	19
Journal of Money, Credit and Banking	0.000	0.950	0.050	0.000	13
Scandinavian Journal of Economics	0.000	0.935	0.065	0.000	9
European Journal of Operational Research	0.000	0.753	0.246	0.001	5
Oxford Economic Papers	0.000	0.647	0.353	0.000	16
Journal of International Financial Markets, Institutions And Money	0.000	0.594	0.401	0.005	7
Public Choice	0.000	0.472	0.526	0.002	5
International Review Of Financial Analysis	0.000	0.466	0.534	0.000	10
Journal Of Banking And Finance	0.000	0.444	0.556	0.000	5
European Journal of Finance	0.000	0.318	0.682	0.000	8
Journal of Financial Stability	0.000	0.263	0.727	0.010	5
International Journal Of Finance And Economics	0.000	0.255	0.745	0.000	6
Journal of Empirical Finance	0.000	0.098	0.902	0.000	5

Table 4: journals by institution submissions

	Counts
Birkbeck College	
Australasian Journal of Combinatorics	2
Econometric Reviews	2
European Journal of Combinatorics	2
Journal of Business and Economic Statistics	2
Journal of Economic Theory	2
Oxford Bulletin of Economics and Statistics	2
Proceedings of the London Mathematical Society	2
Review of Economic Dynamics	2
Advances in Applied Mathematics	1
American Economic Journal: Macroeconomics	1
Brunel University London	
International Review Of Financial Analysis	9
European Journal of Finance	6
International Journal Of Finance And Economics	6
Journal of Empirical Finance	4
Journal of Financial Stability	4
Journal of International Financial Markets, Institutions And Money	4
European Economic Review	3
European Journal of Operational Research	3
Journal of Money, Credit and Banking	3
Oxford Economic Papers	3
City, University of London	
Journal of Economic Theory	5
Games and Economic Behavior	4
Journal of Econometrics	4
Journal of Economic Behavior and Organization	4
Journal of International Economics	4
Economic Journal	3

Continued on next page

	Counts
Journal of Business and Economic Statistics	3
Journal of Development Economics	3
Journal of Industrial Economics	3
Journal of Urban Economics	3
Queen Mary University of London	
Economic Journal	14
American Economic Review	8
Journal of Econometrics	8
Journal of Monetary Economics	8
Econometrica	6
Review of Economic Studies	6
Journal of the European Economic Association	5
Review of Financial Studies	5
American Economic Journal: Applied Economics	4
Journal of Economic Theory	4
Royal Holloway and Bedford New College	
Journal of Economic Theory	9
Economic Journal	8
Games and Economic Behavior	5
International Economic Review	5
Journal of Econometrics	4
Review of Economic Studies	4
American Economic Review	3
Journal of Development Economics	2
Journal of Economic Behavior and Organization	2
Journal of the European Economic Association	2
The London School of Economics and Political Science	
American Economic Review	33
Quarterly Journal of Economics	14
Journal of Political Economy	12
Review of Economic Studies	12

Continued on next page

	Counts
Econometrica	10
Journal of the European Economic Association	5
Quantitative Economics	5
American Economic Journal: Microeconomics	4
Review of Economics and Statistics	4
American Economic Journal: Applied Economics	3
The University of Bath	
Games and Economic Behavior	14
Journal of Public Economics	9
European Economic Review	8
Journal of Economic Behavior and Organization	8
Economic Journal	6
Economic Theory	4
Journal of Economic Theory	3
American Economic Review	2
Ecological Economics	2
Experimental Economics	2
The University of East Anglia	
Games and Economic Behavior	12
European Economic Review	11
Journal of Economic Theory	5
American Economic Journal: Microeconomics	3
Econometrica	3
Economic Theory	3
International Journal of Industrial Organization	3
Economic Journal	2
International Economic Review	2
Journal of Economic Growth	2
The University of Essex	
Economic Journal	16
Journal of Economic Theory	12

Continued on next page

	Counts
Review of Economics and Statistics	9
Journal of the European Economic Association	7
Review of Economic Studies	7
American Economic Review	6
Journal of Econometrics	6
American Economic Journal: Applied Economics	5
Journal of Public Economics	4
American Economic Journal: Microeconomics	3
The University of Kent	
Economic Journal	4
European Economic Review	3
International Economic Review	3
Journal of Applied Econometrics	3
Journal of Development Economics	3
Journal of Economic Behavior and Organization	3
Journal of Economic Dynamics and Control	3
American Economic Journal: Economic Policy	2
American Economic Journal: Macroeconomics	2
Economic History Review	2
The University of Manchester	
Journal of Economic Theory	7
Journal of Environmental Economics and Management	6
Journal of Econometrics	5
Journal of Economic Dynamics and Control	5
Economic Theory	4
Review of Economics and Statistics	4
Economic Journal	3
Games and Economic Behavior	3
Journal of Development Economics	3
Journal of Economic Behavior and Organization	3
The University of Surrey	

Continued on next page

	Counts
Journal of the European Economic Association	8
Journal of Econometrics	6
Review of Economic Studies	6
Economic Journal	5
Journal of Economic Theory	5
Journal of International Economics	3
Journal of Public Economics	3
Games and Economic Behavior	2
Journal of Business and Economic Statistics	2
Journal of Money, Credit and Banking	2
The University of Warwick	
American Economic Review	16
Review of Economic Studies	12
Journal of Political Economy	10
Economic Journal	9
Journal of the European Economic Association	9
Econometrica	7
Review of Economics and Statistics	6
American Economic Journal: Applied Economics	5
Journal of Public Economics	4
Theoretical Economics	4
University College London	
American Economic Review	18
Econometrica	15
Review of Economic Studies	11
Journal of Political Economy	9
Journal of Econometrics	8
Quarterly Journal of Economics	8
Journal of the European Economic Association	5
Journal of Monetary Economics	4
American Economic Journal: Economic Policy	3

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	Counts
Quantitative Economics	3
University of Bristol	
Economic Journal	10
Journal of Economic Theory	10
Journal of Econometrics	6
Journal of Public Economics	6
International Economic Review	5
Review of Economic Studies	4
American Economic Journal: Applied Economics	3
American Economic Review	3
Journal of Political Economy	3
Journal of the European Economic Association	3
University of Cambridge	
Journal of Econometrics	8
Journal of Economic Theory	8
American Economic Review	6
Econometrica	6
Journal of the European Economic Association	6
Theoretical Economics	5
Journal of Public Economics	4
Quantitative Economics	4
Review of Economic Studies	4
Annals of Statistics	3
University of Edinburgh	
Journal of Political Economy	7
Economic Journal	6
Review of Economic Studies	6
Journal of Economic Theory	5
American Economic Review	3
Econometrica	3
Games and Economic Behavior	3

Continued on next page

	Counts
Journal of the European Economic Association	3
Labour Economics	3
American Economic Journal: Microeconomics	2
University of Exeter	
Journal of International Economics	6
European Economic Review	5
Games and Economic Behavior	5
American Economic Review	4
Journal of Econometrics	4
Management Science	4
Review of Economics and Statistics	4
Journal of Environmental Economics and Management	3
Journal of Public Economics	3
Nature	3
University of Northampton, The	
International Journal of Sustainable Development & World Ecology	2
Review of African Political Economy	2
Built Environment	1
Development Policy Review	1
Economic Modelling	1
Global Public Health	1
International Journal of Economics and Finance	1
International Journal of Entrepreneurship and Small Business	1
International Journal of Healthcare Management	1
Journal of Asset Management	1
University of Nottingham, The	
Journal of International Economics	12
Journal of Econometrics	9
Economic Journal	8
Journal of the European Economic Association	8
Journal of Economic Theory	7

Continued on next page

	Counts
American Economic Review	6
Review of Economic Studies	4
Theoretical Economics	4
Journal of Public Economics	3
Review of Economics and Statistics	3
University of Oxford	
Economic Journal	13
American Economic Review	12
Journal of Econometrics	11
Journal of the European Economic Association	11
Econometrica	9
Games and Economic Behavior	9
Journal of Development Economics	9
Journal of Public Economics	9
Journal of Economic Theory	8
Journal of Monetary Economics	8
University of Southampton	
Games and Economic Behavior	7
Journal of Economic Theory	6
European Economic Review	4
Economic Journal	3
International Economic Review	3
Journal of Health Economics	3
Journal of International Economics	3
Journal of Labor Economics	3
Journal of Monetary Economics	3
Journal of Econometrics	2
University of St Andrews	
Economic Journal	5
Journal of Economic Theory	5
Econometrica	2

Continued on next page

	Counts
European Economic Review	2
Journal of Monetary Economics	2
Theoretical Economics	2
American Economic Review	1
American Economic Review: Insights	1
Brazilian Review of Econometrics	1
Economic Inquiry	1
University of Sussex	
Journal of Development Economics	7
Economic Journal	6
Economica	4
Journal of Economic Theory	4
Journal of Economic History	3
Journal of Human Resources	3
Journal of International Economics	3
Review of Economic Studies	3
American Economic Journal: Applied Economics	2
American Journal of Agricultural Economics	2
University of York	
Journal of Econometrics	14
European economic review	6
Journal of Economic Theory	5
Journal of Health Economics	5
Games and Economic Behaviour	4
Journal of Applied Econometrics	4
Journal of Economic Dynamics and Control	4
Journal of Political Economy	4
Economic Journal	3
Journal of Business and Economic Statistics	3

Table 5: journal submissions by institutions

	Institution name	counts
1	University of Oxford	209
2	The London School of Economics and Political Science	137
3	The University of Warwick	128
4	University of Cambridge	120
5	The University of Essex	113
6	Queen Mary University of London	110
7	University College London	108
8	The University of Bath	101
9	University of York	95
10	Brunel University London	93
11	The University of Manchester	90
12	University of Bristol	89
13	The University of Nottingham	87
14	University of Exeter	81
15	University of Edinburgh	78
16	The University of East Anglia	71
17	University of Southampton	68
18	The University of Kent	67
19	Birkbeck College	65
20	City, University of London	62
21	The University of Surrey	62
22	Royal Holloway and Bedford New College	61
23	University of St Andrews	59
24	University of Sussex	57
25	The University of Northampton	21

Table 6: OLS regression for calculated GPA

	Coef
(Intercept)	1.79
	(1.05)
Avg citation	0.00
	(0.00)
Avg years	−0.21
	(0.16)
Scobgpa	0.66***
	(0.12)
Number of submission	0.00
	(0.00)
R^2	0.85
Adj. R^2	0.81
Num. obs.	25

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 7: Joint coefficient test for GPA regression

	Res.Df	Df	F	Pr(>F)
1	20			
2	23	-3	0.91	0.4515

Table 8: Regression results from 4 model specifications

	OLS_1	OLS_2	IV_1	IV_2
(Intercept)	1.793	2.486**	3.685**	3.321**
	(1.049)	(0.842)	(1.010)	(0.879)
Avg_cite	0.001	0.002*	0.002**	0.002**
	(0.001)	(0.0008)	(0.0007)	(0.0008)
Avg_age	−0.206	−0.231+	−0.346*	−0.310*
	(0.162)	(0.125)	(0.129)	(0.116)
Scobgpa	0.662***	0.326*	0.249+	0.207
	(0.116)	(0.122)	(0.134)	(0.126)
Number of Submission	0.0005	0.0002		−0.0004
	(0.001)	(0.001)		(0.0009)
Environment2021		−0.119	−0.166	−0.108
		(0.082)	(0.132)	(0.086)
Impact2021		0.304***	0.226	0.279
		(0.070)	(0.143)	(0.169)
Num.Obs.	25	25	23	23
R2	0.846	0.924	0.817	0.828
R2 Adj.	0.815	0.899	0.763	0.763
AIC	−8.2	−22.0	−25.7	−25.1
BIC	−0.9	−12.2	−17.8	−16.0
Log.Lik.	10.097	18.976		
F	27.432	36.593		
RMSE	0.16	0.11	0.10	0.10

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Rank comparison between GPA implied by REF and by Scob

	ins_name	Rank_GPA	Rank_SCOB
1	University College London	1	1
2	The London School of Economics and Political Science	2	5
3	The University of Warwick	3	6
4	Queen Mary University of London	4	4
5	University of Bristol	5	8
6	The University of Nottingham	6	2
7	The University of Essex	7	7
8	Royal Holloway and Bedford New College	8	9
9	University of Edinburgh	9	13
10	University of Oxford	10	11
11	University of Cambridge	11	10
12	The University of Surrey	12	3
13	University of Sussex	13	17
14	University of York	14	15
15	The University of Manchester	15	20
16	The University of East Anglia	16	19
17	University of Exeter	17	12
18	University of St Andrews	18	18
19	University of Southampton	19	14
20	Birkbeck College	20	24
21	The University of Kent	21	21
22	City, University of London	22	16
23	The University of Bath	23	22
24	Brunel University London	24	23
25	The University of Northampton	25	25

Table 10: Rank comparison between % of 4* submissions by REF and by Scob

	ins_name	REF 4* %	Scob 4* %
1	University College London	1	1
2	The London School of Economics and Political Science	2	3
3	The University of Warwick	3	6
4	Queen Mary University of London	4	5
5	The University of Nottingham	5	2
6	University of Bristol	6	8
7	The University of Essex	7	7
8	University of Cambridge	8	10
9	University of Oxford	9	11
10	University of Edinburgh	10	12
11	Royal Holloway and Bedford New College	11	9
12	The University of Surrey	12	4
13	University of Sussex	13	18
14	University of York	14	15
15	The University of Manchester	15	19
16	University of St Andrews	16	17
17	Birkbeck College	17	23
18	The University of East Anglia	18	21
19	University of Exeter	19	13
20	The University of Kent	20	20
21	University of Southampton	21	14
22	City, University of London	22	16
23	The University of Bath	23	22
24	Brunel University London	24	24
25	The University of Northampton	25	25

Figure 1: Regression of GPA on Scobgpa

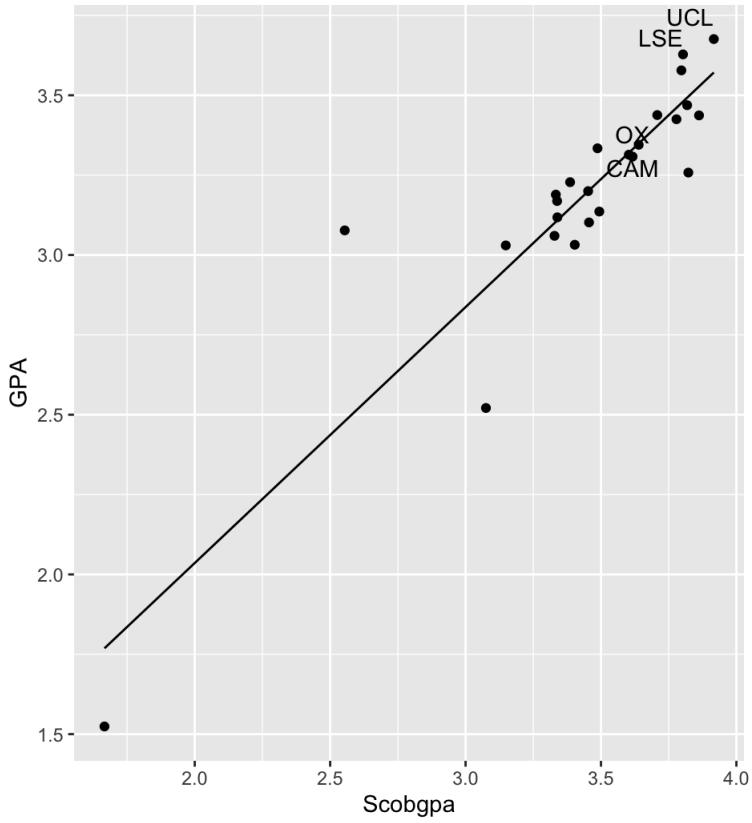

Figure 2: ScobGPA ranking by institutions

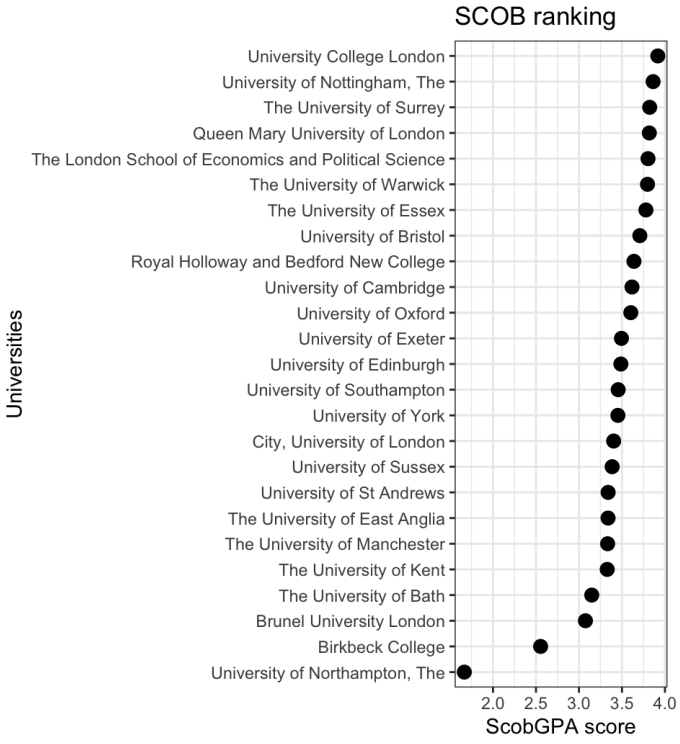

Figure 3: GPA ranking by institutions