

Are funded articles more highly cited than unfunded articles? A preliminary investigation.

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Introduction

It may seem natural to assume that funded research in a subject is, on average, more highly cited than unfunded research in the same subject. Explanations for this assumption could include: (a) funders use peer-review to select more promising researchers and research proposals and (b) funded research has access to more resources than unfunded research.

This research examines the extent to which the assumption of higher citation is supported by citation evidence, by comparing, for articles in fifteen Science Citation Index subjects, the citation level of funded US research with that of unfunded US research. The significance of this investigation is that it gives some indication of how effectively funding bodies fund high quality US science. This is particularly important in the current financially stringent times, when government funding of research is likely to decline.

Background

An investigation of the Curriculum Vitae found a significant association between receiving NSF funding and increased number of publications (Gaughan & Bozeman, 2002). An investigation of grant and fellowship applications to two renowned funding agencies found that in both life sciences and social sciences the awardees, on average, were more highly cited than the rejected applicants. (Bornmann, Leydesdorff & van den Besselaar, 2010). Studies of LIS obtained

mixed results. An investigation of 716 articles published in four LIS journals in 1989–1993 (Cronin & Shaw, 1999), did not find a statistically significant correlation between average citation and whether an article was funded. However, an investigation of 266 articles published in 1998 in seven LIS journals found that funded articles were, on average, more highly cited than unfunded articles (Zhao, 2010).

Although the above studies indicate interest in comparing funded with unfunded research, few studies have compared the citation levels of funded with unfunded research. However, Lewison (1998) in an investigation of Gastroenterology found that funded articles were, on average, more highly cited than unfunded articles. For fifteen subjects this current research addresses: To what extent is funded research in a subject more highly cited than unfunded research in the same subject?

This question is addressed by comparing, for articles published in 2008, the average citation of (a) NSF funded articles, (b) funded articles that are not NSF funded ('non-NSF funded') and (c) unfunded articles. 2008 was chosen, as this is the earliest year for which Web of Science (WoS) publishes citation data; and the NSF was selected as it funds a large number of articles in diverse branches of science.

Data and Methods

The fifteen subjects investigated are the WoS science subjects for which at least 400 articles published in 2008

acknowledge the NSF and have at least one USA author. In order to avoid the findings being distorted by national differences in citation levels, this study confines itself to articles that were refined by Countries/Territories to 'USA'. For each subject, the funded articles were identified by selecting 'Funding Agency' in the 'Analyse facility' and the NSF separated by restricting the funder to NSF, National Science Foundation and the many alternative ways of referring to the NSF.

Findings

Table 1 presents for the 15 subjects with the highest number of NSF funded US affiliated articles published in 2008 the ratios of (a) the average citation of NSF funded articles to that of unfunded articles and (b) the average citation of non-NSF articles to that of unfunded articles.

In the table, on average across the subjects, the mean citation of NSF funded articles was 11% higher than that for unfunded articles, with a very low dispersion of .14 and the mean citation of funded articles not NSF was 21% lower than that for unfunded articles, with a very low dispersion of .10. For fourteen of the fifteen subjects the NSF funded articles had a higher citation level than the unfunded articles and for all subjects the citation level of the unfunded articles was higher than that of the funded articles that were not NSF funded. On average, NSF funded research was 41% more highly cited than non-NSF funded research. For all subjects, apart from the three marked with asterisks, the NSF funded more articles than any other funder.

Table 1: Average citation between 2008 and 2010, for articles published in 2008.

| SCI subject category | NSF / Not funded | Non-NSF / Not funded |
|---------------------------------------|------------------|----------------------|
| Mathematics | 1.58 | .84 |
| Engineering, Electrical & Electronic | 1.27 | .85 |
| Geosciences, Multidisciplinary | 1.15 | .78 |
| Physics, Applied | 1.10 | .78 |
| Physics, Atomic, Molecular & Chemical | 1.10 | .74 |
| Ecology | 1.10 | .64 |
| Materials Science, Multidisciplinary | 1.08 | .84 |
| Physics, Condensed Matter | 1.08 | .82 |
| Physics, Multidisciplinary | 1.07 | .91 |
| Chemistry, Physical | 1.06 | .77 |
| Chemistry, Multidisciplinary | 1.05 | .84 |
| Astronomy & Astrophysics ** | 1.04 | .76 |
| Biochemistry & Molecular Biology * | 1.04 | .80 |
| Nanoscience & Nanotechnology | 1.04 | .81 |
| Multidisciplinary Sciences * | .85 | .60 |
| Mean | 1.11 | .79 |
| Dispersion (SD/Mean) | .14 | .10 |

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Discussion and Conclusions

One limitation is that WoS data on funded articles for 2008 may be skewed: The number of articles published in 2008 with the word 'NSF' as the funder was less than half the number for articles published in 2009. Although some NSF funded WoS articles were published as early as January 2008, it is possible that the funded articles are skewed towards the second half of 2008. If this is the case then the number of citations for funded articles would be lower, as they would have had less time to accrue citation. Although this study included the most widely used alternative formats to 'NSF', it could not identify less frequently used alternative formats or misspellings. This limitation seems

unlikely to have had a substantial effect on the findings, as it would not have resulted in the omission of a large number of NSF funded articles.

Another limitation is that it uses a two year citation window (2008 to 2010) and the findings may differ if a longer window were used. It is not possible to use a longer citation window at present, as WoS records funding acknowledgements for few articles published prior to 2008.

Despite these limitations, the findings provide an early indication that the NSF has been much more effective than the norm for funders at funding high quality research. One explanation is that NSF may tend to fund larger teams and more highly co-authored research is, in general, more highly cited. Another explanation is that higher impact journals may be more likely to accept NSF funded articles.

The finding that the citation level of non-NSF funded articles is less than unfunded articles raises concerns about the effectiveness with which less established funders, than the NSF, identify high quality research. This result contrasts with Lewison (1998), described above; we investigated US funding whereas Lewison investigated UK funding.

An interesting question is whether industry-funded articles are cited less highly. We plan to investigate whether, on average, NSF funded research has more authors than unfunded research. For 12 of the 15 subjects, the NSF funded the most articles; we also plan to investigate whether average citation correlates with the number of funded articles.

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References

Bornmann L., Leydesdorff L. and van den Besselaar P. (2010). A meta-evaluation of

scientific research proposals: Different ways of comparing rejected to awarded applications. *Journal of Informetrics* 4(3), 211-220.

Cronin, B. and Shaw, D. (1999). Citation, funding acknowledgment and author nationality relationships in four information science journals. *Journal of Documentation* 55(4), 402-408.

Gaughan M. and Bozeman B. (2002). Using curriculum vitae to compare some impacts of NSF research grants with research Center funding. *Research Evaluation* 11(1), 17-26.

Lewison G. (1998). Gastroenterology research in the United Kingdom: funding sources and impact. *GUT*, 43(2) 288-293.

Zhao D.Z. (2010). Characteristics and impact of grant-funded research: a case study of the library and information science field. *Scientometrics* 84(2), 293-306.