Mir M. Ali
Partha Bhattacharyya
Anthony J. Olejniczak

# The Effects of Scholarly Productivity and Institutional Characteristics on the Distribution of Federal Research Grants

*Introduction and Background*

Professional academics rely on federal grants to fund their research. Institutions like the National Institutes of Health (NIH), the National Science Foundation (NSF), and the US Department of Agriculture (USDA) make available substantial financial resources to facilitate scholarly research, which often results in peer-reviewed publications. Research grants play a pivotal role in the development and dissemination of new knowledge; securing competitive research grants also enhances a faculty members' individual reputation, which in turn contributes to a positive perception of the academic institutions employing them. Obtaining research grants depends in part on a feedback cycle, whereby a strong record of scholarly publication and an affiliation with a well-regarded research institution improve a scholar's ability to obtain

The authors thank Dr. Lawrence Martin, Dean of Graduate School, Professor of Anthropology and Anatomical Sciences, Stony Brook University, affording us the opportunity to work with the Faculty Scholarly Productivity (FSP) Index database (Academic Analytics, LLC). We also thank two anonymous referees and the editor of the Journal of Higher Education for their helpful reviews and comments.

The views expressed in this paper are those of the authors and do not necessarily represent the views or policies of the University of Toledo, National Center for Human Evolutionary Studies, the National Institute on Aging, NIH or any other Federal Agencies.

*Mir M. Ali is a professor of economics at the University of Toledo, Partha Bhattacharyya is an economist at the National Institute on Aging, NIH, and Anthony J. Olejniczak is a Juan de la Cierva fellow at the National Center for Human Evolutionary Studies in Burgos, Spain.*

*The Journal of Higher Education,* Vol. 81, No. 2 (March/April 2010)

funding, but having previously obtained funding enhances one's ability to publish and increases the prestige of one's institution (Liebert, 1977). The purpose of our study is to measure the influence of institutional characteristics and faculty[1] scholarly productivity on the dollar amount and total number of federally funded competitive research grants won by researchers at American institutions.

Specifically, this study examines whether research faculty, regardless of the reputation of their institutional affiliation and publication history, are homogeneous in their likelihood to secure competitive research grants. The primary hypothesis may be stated: there exists heterogeneity in the distribution of research grants among scholars from disparate academic institutions. Multiple alternative hypotheses point towards specific types of bias in the distribution of research grants based on the characteristics of the institution from whence the grant proposals emanated, and based on non-grant related scholarly behavior of the faculty. This study examines whether differences exist in how *faculty-specific* factors (e.g., the quantity of journal articles published, the number of citations garnered by those papers, the number of honorific awards won) and *institution-specific* factors (e.g., whether the institution is public or private, whether the institution is affiliated with the American Association of Universities (AAU), the geographic location of the institution, etc.) impact the number and dollar amount of grants awarded to that institution.

Previous studies of grant distribution and faculty productivity focused on the determinants of obtaining grants, and identifying whether certain institutions have a competitive edge over others; such studies were typically limited by a lack of measures to control for faculty productivity and institutional reputation, which are the outcomes of securing research dollars (and thus a non-independent element of the same feedback cycle). Counts of published research articles, for instance, were the only measure of faculty productivity in Liebert's research (1976; 1977). Relying solely on publication quantity lacks a measure of the perceived quality of the faculty member's work (e.g., the number of times that article has been cited by others). Our measure of productivity includes citations to scholarly publications, thus accounting to some extent for the perceived quality of the faculty members' scholarship. In addition to publications and citations, we also examine the number of honorific awards received by faculty members.

Taking advantage of institutional characteristics available in the data set we employed, institutional reputation has been controlled in a statistically more rigorous manner than has previously been done (Eshelman et al., 2000; Liebert 1976; Liebert, 1977; Wood, 1990). One of the primary advantages of our data is the ability to isolate AAU member insti-

tutions, and to distinguish private from public universities. AAU affiliation may account for a wide array of features contributing positively towards an institution's reputation (Eshelman et al., 2000; Fairweather, 2002; Liebert 1976; Liebert, 1977; Teodorescu, 2000; Wood, 1990).

In addition to attempting to control for faculty- and institution-specific factors, our study sample has several advantages. Previous studies have concentrated on specific disciplines (Eschelman et. al 1999; Wagner et. al 1994) or specific institutions (Blaund et. al 2005); in the present study our focus is on all academic disciplines within two broad fields: natural sciences and social sciences, and our sample includes all of the faculty members from institutions in the United States with doctoral programs in subfields of the natural sciences or social sciences. Previous studies only present data on the number of grants that have been awarded to faculty (Liebert, 1976; Liebert, 1977; Wagner et al., 1994; Blaund et al., 2005); in the present analysis we examine both the number and the dollar amount of grants awarded[2]. Even if most researchers have some probability of obtaining a grant, the distribution of dollars may still be selective. The amount of grant money obtained is likely to be proportionately related to faculty productivity (Liebert, 1977), perhaps to a greater degree than the gross number of grants.

The remainder of the paper is organized as follows: the next section discusses our econometric model, its specification and justification. This is followed by an explanation of the database construction and a presentation of the descriptive statistics motivating the multivariate analysis. The next section is an explanation of results, and we conclude with a discussion of our findings and potential avenues for future research.

### *Econometric Model*

Our empirical model is devised to analyze how non-grant related measures of faculty productivity and institutional characteristics are associated with the number of grants and the dollar amounts of grants that are obtained by those faculty members. A conventional ordinary least squares (OLS) regression model with the dollar amount of grants as the dependent variable is not appropriate, as there are many faculty members who are not supported by competitive research grants at a given time, violating the OLS linearity assumption (Amemiya, 1984). Moreover, the number of grants obtained by faculty members is a discrete variable, also rendering OLS as inappropriate. Appropriate alternative regression models were thus utilized; both a Tobit model and a Poisson model were estimated, with the dollar amount of grants won and the number of grants won as the dependent variables, respectively.

The Tobit analysis is fruitfully adopted in studies where the dependent variable cannot be less than some minimum amount (e.g., the dollar amount of competitive research grants won by any faculty member cannot be less than zero; Greene, 2000). The Poisson analysis is appropriate in cases where the dependent variable is a non-negative integer value, such as the number of grants obtained in our study (Greene, 2000). The number of grants in our study is, conveniently, characterized by a Poisson distribution; thus a Poisson model was regressed to account for this characteristic of the dependent variable.

The following equations are the two estimates in the analyses:

$$y_i = a_0 + \beta x_i + \gamma z_i + \varepsilon_i$$
$$v_i = a_0 + \beta x_i + \gamma z_i + \varepsilon_i$$

where $y_i$ and $v_i$ refer to the dollar amount of grants and the number of grants, respectively. $x_i$ is the vector of measures for faculty productivity and $z_i$ represents other explanatory variables that are likely to affect our dependent variables, such as the number of honorific awards received, and institutional characteristics. To accurately estimate whether institutional affiliation impacts the distribution of research grants awarded, private/public status and AAU affiliation are controlled in the models. Liebert (1977) found that research faculty has a greater probability of securing competitive grants if their appointments are at universities where a greater proportion of the faculties are already recipients of research grants. This can be interpreted as an indicator of institutional reputation that might be positively correlated with the probability of securing new grants. To account for previous institutional success in securing research grants, we controlled for the percentage of faculty at an institution who are supported by grants (spanning 2003–2004), the percentage of faculty at an institution that has recently published journal articles (spanning 2003–2004), and the percentage of faculty whose work has been cited by others (spanning 2003–2004).

## *Data and Descriptive Statistics*

### *Database Construction*

We employed the Faculty Scholarly Productivity (FSP) 2004 restricted database (Academic Analytics, LLC), which covers 107 academic disciplines at 354 PhD granting institutions in the United States. There are total of 7,300 PhD programs and 168,025 individual faculty members in this database, which are collected and updated annually by soliciting information from universities directly and via brute-force data

collection techniques such as mining the most recent university bulletin and catalogue. Journal publication and citation data for each faculty member in the FSP database were derived from the Scopus™ database (Elsevier, B.V.) including data on approximately 15,000 peer-refereed journals from 4,000 international publishers. Federally funded competitive grant data in the FSP database were collected from the following federal agencies: (a) the National Institutes of Health (NIH), (b) the National Science Foundation (NSF), and (c) the U.S. Department of Agriculture (USDA). These data were downloaded from respective agency websites. Only new standard grant instruments (i.e., not continuations or extensions) were included. Honorific awards in the FSP database were collected from 27 award-granting institutions identified in the 1995 National Research Council (NRC) list of honors and awards.[3] Identifiers for institutional characteristics, such as public or private, AAU or non-AAU member institution, and the region (e.g., South, Midwest) of each university are also coded in the database. Data elements are matched to faculty names using DataFlux™ software (DataFlux Corporation, Cary, NC).[4]

In addition to journal publication, citation, honorific award, and research grant data being matched to individual faculty members in the FSP database, one of the primary advantages of this dataset is its inclusion of an exhaustive catalogue of faculty members from every Ph.D. granting institution from all fields of social and natural sciences,[5] facilitating a thorough exploration of the heterogeneity that may exist between schools and individual programs in terms of the number of grants and the dollar amount of grants.

### *Descriptive Statistics*

The distribution of grants from NIH, NSF, and USDA among non-AAU Public, AAU Public, non-AAU Private, and AAU Private universities is illustrated below. Diagram 1 demonstrates that although AAU private universities account for 7% of the database, they account for a much larger share of federally-funded grants (25%) and grant dollars (30%) compared to their public AAU counterparts, which obtained 32% of the grants and 31% of the grant dollars. On a per grant basis, AAU private universities obtain higher levels of funding than AAU public universities. Non-AAU private universities, which account for 35% of our sample of institutions, accounted for 10% of grants and 12% of grant dollars, whereas non-AAU public universities accounted for 48% of the sample and obtained 33% of the grants and 27% of the grant dollars.

Diagram 2 depicts the distribution of average the grant dollar amount by the number of publications for each type of university. For a faculty member with a total number of journal publications ranging from zero to

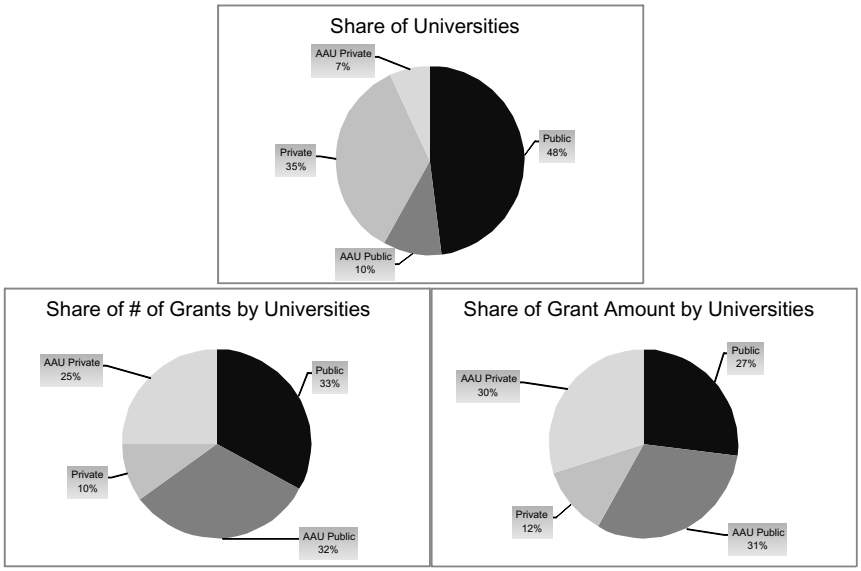
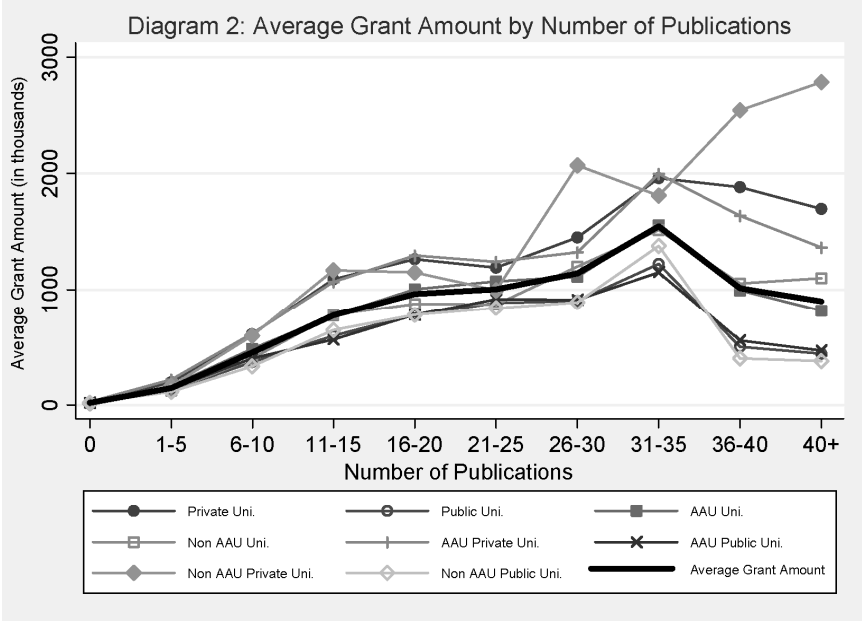



Diagram 1: Share of Universities, Number of Grants, and Grant Amount by Universities



five, grant dollars do not vary widely; as the number of publications increases, the grant dollar amount increases as well. Faculty at private universities (both AAU and non-AAU) obtains more grant dollars than their peers at public institutions. This difference increases as publication count increases, and is above the average grant amount for both AAU private and non-AAU private universities. After the twenty-first publication, non-AAU private universities surpass the grant dollar amount of AAU private universities.

Diagram 3 shows the distribution of the average number of grants and publications for each type of university. Public universities (both AAU and non-AAU) secure fewer grants than private universities. Table 1 provides descriptive statistics of variables by number of publication. As the number of publications increases, grant dollars and the number of grants also increase.

*Empirical Findings*

Tables 2 and 3 show how faculty productivity and institutional characteristics impact the number of grant dollars won and the gross number of grants won based on the Tobit and Poisson models.[6] The dependent vari-

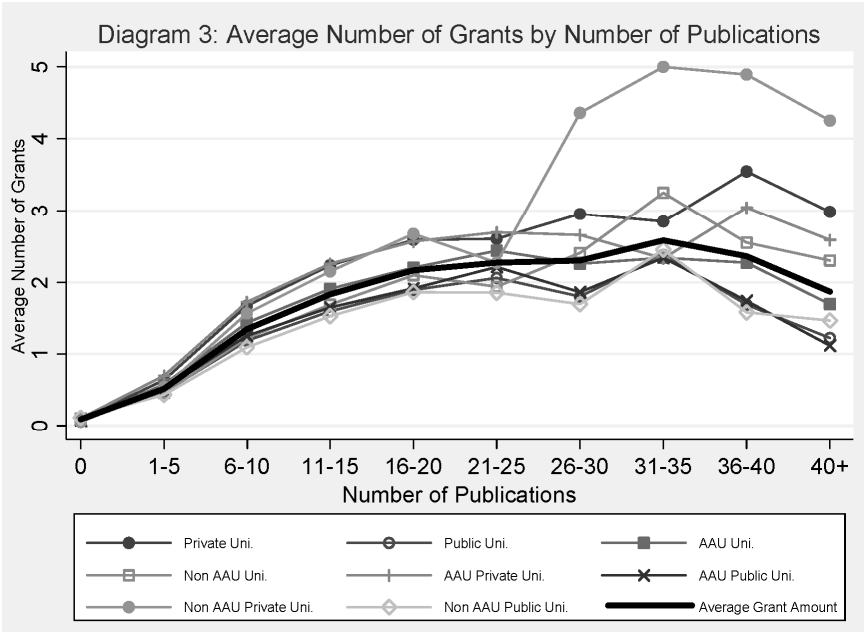


TABLE 1
Means of Selected Variables by Number of Articles Published in Journals

| Number of Publications | Number of Grants | Total Grants Amount | Percent of Faculty That Has Grants | Total Citations | Freq. |
|---|---|---|---|---|---|
| 0 | 0.09 | 18685.95 | 0.04 | 0 | 92,995 |
| 1–5 | 0.52 | 144964.00 | 0.26 | 3.76 | 56,092 |
| 6–10 | 1.35 | 449295.90 | 0.49 | 18.80 | 12,097 |
| 11–15 | 1.83 | 775930.40 | 0.57 | 38.25 | 3,850 |
| 16–20 | 2.16 | 962042.50 | 0.57 | 56.47 | 1,536 |
| 21–25 | 2.27 | 1003085.00 | 0.57 | 74.36 | 698 |
| 26–30 | 2.30 | 1138952.00 | 0.58 | 102.51 | 350 |
| 31–35 | 2.58 | 1543414.00 | 0.64 | 119.78 | 179 |
| 36–40 | 2.36 | 1013409.00 | 0.60 | 104.77 | 88 |
| 40+ | 1.86 | 897858.60 | 0.51 | 160.36 | 140 |

able is alternated across models to capture the effect of the explanatory variables (faculty productivity and institutional characteristics) on the overall competitive grant securing process. Faculty productivity and institutional characteristics may have different effects on the likelihood of securing grants and the actual dollar amount that is awarded. Although it is likely that the dollar amount of grants and the number of grants will be concentrated among more productive faculty members, it is not clear how the magnitude of this effect varies between faculty productivity and institutional characteristics. It may be that the influence of an individual faculty member's productivity and the characteristics of his home institution are not homogeneous when considered in light of the number of grants and the dollar amounts awarded.[7] Thus, separate analysis based on the two different dependent variables is expected to provide greater insight regarding how the distribution of grants (in terms of both the number and the amount) varies across different institutions.

### *Tobit Estimates*

The Tobit estimates in Table 2 shows that the number of publications and citations play a positive role in influencing the dollar amount of grants won. The percentage of faculty at an institution having already won competitive research grants, having journal publications, and whose publications have garnered citations, are also positively correlated with the dollar amount awarded, indicating that institutional past performance (i.e., our proxy for institutional reputation) has a significant effect on the dollar amount obtained. This is reinforced by the negative coefficient of the variable indicating whether the institution is pub-

TABLE 2

Tobit Regression of Total Grant Amount (100,000)

| Variable | Public Institution | | AAU | | Public AAU | | Private AAU | |
|---|---|---|---|---|---|---|---|---|
| | Coefficient | (Std. Err) | Coefficient | (Std. Err) | Coefficient | (Std. Err) | Coefficient | (Std. Err) |
| Total number of journal publications | 2.513*** | (0.029) | 2.486*** | (0.029) | 2.506*** | (0.029) | 2.504*** | (0.029) |
| Total number of journal publications square | –0.048*** | (0.001) | –0.047*** | (0.001) | –0.048*** | (0.001) | –0.047*** | (0.001) |
| Total journal citations | 0.047*** | (0.003) | 0.048*** | (0.003) | 0.049*** | (0.003) | 0.047*** | (0.003) |
| Total number of awards | 0.301 | (0.497) | 0.052 | (0.499) | 0.352 | (0.499) | 0.113 | (0.499) |
| Percentage of faculty with grant | 14.573*** | (0.538) | 15.793*** | (0.545) | 15.251*** | (0.545) | 14.563*** | (0.538) |
| Percentage of faculty with publication | 8.292*** | (2.104) | 14.113*** | (2.164) | 10.127*** | (2.130) | 10.430*** | (2.118) |
| Percentage of faculty with citations | 5.320*** | (2.047) | –1.929 | (2.120) | 4.012* | (2.066) | 1.591 | (2.082) |
| Biological & biomedical sciences | 14.522*** | (0.222) | 14.878*** | (0.224) | 14.548*** | (0.222) | 14.698*** | (0.223) |
| Physical & mathematical sciences | 7.776*** | (0.249) | 7.909*** | (0.249) | 7.819*** | (0.249) | 7.823*** | (0.249) |
| Engineering | 5.439*** | (0.272) | 5.548*** | (0.272) | 5.447*** | (0.272) | 5.517*** | (0.272) |
| Social & behavioral science | 5.858*** | (0.287) | 5.942*** | (0.288) | 5.904*** | (0.288) | 5.881*** | (0.287) |
| Public institution | –0.628*** | (0.107) | — | — | — | — | — | — |
| AAU | — | — | 2.590*** | (0.161) | — | — | — | — |
| Public AAU affiliated institution | — | — | — | — | 1.351*** | (0.164) | — | — |
| Private AAU affiliated institution | — | — | — | — | — | — | 2.255*** | (0.210) |
| Constant | –41.962*** | (0.511) | -44.474*** | (0.536) | –43.146*** | (0.522) | –42.869*** | (0.512) |
| Sigma | 19.019 | (0.085) | 19.018 | (0.085) | 19.029 | (0.085) | 19.015 | (0.085) |
| Pseudo $R^2$ | 0.095 | — | 0.095 | — | 0.095 | — | 0.095 | — |
| Log likelihood | –155400 | — | –155287 | — | –155384 | — | –155360 | — |
| Prob. $\chi^2$ | 0.000 | — | 0.000 | — | 0.000 | — | 0.000 | — |
| Number of observation | 168025 | — | 168025 | — | 168025 | — | 168025 | — |

Significance Level: *: 10%  ** : 5%  *** : 1%

Following variables were run in the model but not included in the results: Faculty Size <500; Faculty size between 500 and 1000; Midwest, South, West.

TABLE 3

Poisson Regression of Number of Grants

| Variable | Public Institution | | AAU | | Public AAU | | Private AAU | |
|---|---|---|---|---|---|---|---|---|
| | Coefficient | (Std. Err) | Coefficient | (Std. Err) | Coefficient | (Std. Err) | Coefficient | (Std. Err) |
| Total number of journal publications | 0.214*** | (0.001) | 0.207*** | (0.002) | 0.213*** | (0.001) | 0.210*** | (0.002) |
| Total number of journal publications square | –0.005*** | (0.000) | –0.005*** | (0.000) | –0.005*** | (0.000) | –0.005*** | (0.000) |
| Total journal citations | –0.000 | (0.000) | –0.000 | (0.000) | 0.000 | (0.000) | –0.000 | (0.000) |
| Total number of awards | –0.027 | (0.025) | –0.064** | (0.025) | –0.022 | (0.025) | –0.059** | (0.025) |
| Percentage of faculty with grant | 2.038*** | (0.019) | 2.289*** | (0.020) | 2.118*** | (0.019) | 2.087*** | (0.019) |
| Percentage of faculty with publication | 0.139 | (0.116) | 0.637*** | (0.122) | 0.285** | (0.118) | 0.315*** | (0.118) |
| Percentage of faculty with citations | –0.226** | (0.108) | –0.663*** | (0.113) | –0.278** | (0.109) | –0.486*** | (0.110) |
| Biological & biomedical sciences | 1.404*** | (0.013) | 1.429*** | (0.013) | 1.401*** | (0.013) | 1.421*** | (0.013) |
| Physical & mathematical sciences | 0.582*** | (0.016) | 0.597*** | (0.016) | 0.584*** | (0.016) | 0.588*** | (0.016) |
| Engineering | 0.425*** | (0.017) | 0.437*** | (0.017) | 0.423*** | (0.017) | 0.437*** | (0.017) |
| Social & behavioral science | 0.540*** | (0.019) | 0.552*** | (0.019) | 0.544*** | (0.019) | 0.544*** | (0.019) |
| Public institution | –0.052*** | (0.005) | — | — | — | — | — | — |
| AAU | — | — | 0.354*** | (0.009) | — | — | — | — |
| Public AAU affiliated institution | — | — | — | — | 0.151*** | (0.009) | — | — |
| Private AAU affiliated institution | — | — | — | — | — | — | 0.297* | (0.010) |
| Constant | –2.732*** | (0.027) | –3.123*** | (0.029) | –2.859*** | (0.027) | –2.875*** | 0.027) |
| Pseudo $R^2$ | 0.284 | — | 0.289 | — | 0.284 | — | 0.286 | — |
| Log likelihood | –121434 | — | –120632 | — | –121356 | — | –121026 | — |
| Prob. $\chi^2$ | 0.000 | — | 0.000 | — | 0.000 | — | 0.000 | — |
| Number of observation | 168025 | — | 168025 | — | 168025 | — | 168025 | — |
| Significance Level: *: 10 ** : 5 *** :1 | | | | | | | | |

Following variables were run in the model but not included in the results: Faculty Size <500; Faculty size between 500 and 1000; Midwest, South, West.

lic or private; private institutions have access to a wider scale of resources and also enjoy a generally higher reputation (National Research Council, 1995), contributing positively to the number of grants their faculty members obtain. Thus, faculty members at public institutions are likely to obtain fewer grant dollars compared to their private institution counterparts.

Honorific awards are not a significant determinant of the dollar amount of grants. This is in accordance with an observed tendency for honorific awards to be obtained at the end of the research cycle, whereas grants are awarded based on the likelihood of productive outcomes.

The dollar amount of grants obtained also varies by field of specialization. Faculty in the biological and biomedical sciences and faculty in physical and mathematical sciences are more likely to secure grants carrying a higher dollar value compared to faculty in engineering and the social sciences. This dispersion persists across private and public institutions. Moreover, AAU membership plays a significant role in influencing the dollar amount of grants. This is expected because AAU members are invited based in part on the strength of their scholarship. Faculty at both public and private institutions are likely to benefit from AAU member status. Nonetheless, faculty at public AAU institutions secure fewer grant dollars compared to faculty at private AAU institutions (the coefficient is 1.35 for public AAU whereas the coefficient for private AAU is 2.25).

As the number of publications increases, the dollar amount of grants awarded increases, but at a decreasing rate (this is captured by the total publication square variable). That is to say, having some journal publications enhances one's ability to secure competitive research grant dollars, but the having more publications does not lead to securing larger grants.

### *Poisson Estimates*

Poisson estimates verify the positive relationship between faculty productivity and the number of grants obtained. As the number of publications and citations increases, the number of grants obtained also increases. More productive faculty members enjoy a higher probability of securing grants. Institutional affiliation has nearly the same effect on the number of grants as it does on the dollar amount of grants, with a few exceptions. Being associated with a public institution decreases the probability of securing grants, whereas being at an AAU member institution contributes positively to the probability of securing grants. Faculty at public and private institutions incur differential incremental increases in their propensity to secure competitive research grants by

becoming an AAU member institution. The Tobit model also showed that the benefits of AAU membership accrued to public universities are less than for private universities.

The percentage of faculty at an institution who has published a journal article recently has a positive effect on the dollar amount of grant money awarded, as seen in the Tobit model. However, it does not contribute positively to the number of grants won (indicated by its statistical non-significance in the Poisson model). This indicates that institutional reputation plays a greater role in influencing the dollar amount of grants than the number of grants. This is supported by our result that the percentage of faculty with publication becomes significant after controlling for AAU affiliation. Honorific awards do not contribute positively to the number of grants obtained. Similar to our results from the Tobit model, it may be concluded that grants are based on the likelihood of productive outcomes, whereas awards represent the end of a research cycle.

*Conclusion and Discussion*

Multivariate analyses were undertaken to estimate the effect of faculty productivity and the characteristics of their respective institutions on the distribution of federally funded grants. Taking advantage of a dataset that includes all faculty from PhD granting institutions across an extensive spectrum of disciplines, the study explored how the number of grants are effected (and also how the distribution of grant dollar amounts is effected), depending on person-specific and institution-specific measures of scholarly productivity and institutional reputation. Unlike previous studies, a wide array of institutional characteristics and faculty productivity measures were controlled.

Results indicate that, in addition to individual faculty member productivity, grant distribution is a function of institutional characteristics. Faculty members at private institutions are more likely to secure larger grant dollar amounts than faculty at public institutions. Although faculty at public institutions that are AAU members are in an advantageous position compared to non-AAU members in terms of securing grants, it is still the faculty at private institutions that gain more grant dollars by being members of the AAU. However, in terms of the number of grants awarded, faculties at AAU private institutions and AAU public institutions are homogeneous in their propensities to secure competitive federally funded grants. Institutional characteristics play a more significant role in effecting the dollar amount of grants than the number of grants.

The dataset we examined is cross-sectional, covering a limited window of time; because the dataset is based upon scholarship attached

to individual researchers, however, annual updates of the data will allow longitudinal trends in grant distributions to be captured. These trends, coupled with knowledge of the patterns of movement of individual faculty members between institutions from year-to-year inherent in the FSP database will allow important questions to be addressed regarding whether AAU and private institutions hire the most promising and productive scholars away from other universities, or perhaps scholars are more productive because they are affiliated with an AAU or private institution (which provide reputations and as-of-yet unmeasured resources enhancing the scholarly potential of their research faculty).

With the exception of induction into the AAU, most actionable applications of our research necessarily await longitudinal data. Some findings of immediate consequence do arise from the results, however. Paramount among these is that the benefit of having published journal articles (in terms of one's ability to secure grants) tapers as the number of journal articles increases. Although having *some* journal publications is a significant predictor of grant-getting success, faculty members may be better off to dedicate resources to securing more research funding rather than writing more papers, in the long term. This finding appears to stand in contrast to the "publish or perish" morale pervasive in modern academia (recently editorialized by Lawrence, 2007), but is in reality a call to moderation in publication quantity. By utilizing resources to seek and acquire funding rather than publishing more than is necessary to convey research results, a scholar's reputation and productivity (and that of their home institution) are likely to be bolstered more than if the primary focus is publishing as much as possible.

The promise of individual-level productivity data being produced annually opens several avenues to future research. Exploratory factor analysis examining whether individual faculty member characteristics, or aggregate institutional characteristics, play a greater role in the propensity to secure grants will shed light on the impact of individual "star scholars" on departments, with obvious implications for hiring and tenure strategies. Tracking new scholars as they enter academia (and enter the FSP database) allows the feedback cycle between securing grants and writing papers to be explored with respect to the characteristics of the institution where the new scholars are hired. Our results are also relevant to granting agencies; while it is clear that reasoning underlie grant-giving decisions, longitudinal data will elucidate whether grant-giving practices are actually equitable given the history of productivity of the scholars and institutions receiving the grants.

APPENDIX 1

Negative Binomial Regression of Number of Grants

| Variable | Public Institution Coefficient | (Std. Err) | AAU Coefficient | (Std. Err) | Public AAU Coefficient | (Std. Err) | Private AAU Coefficient | (Std. Err) |
|---|---|---|---|---|---|---|---|---|
| Total number of journal publications | 0.239*** | (0.002) | 0.235*** | (0.002) | 0.237*** | (0.002) | 0.237*** | (0.002) |
| Total number of journal publications square | –0.004*** | (0.000) | –0.004*** | (0.000) | –0.004*** | (0.000) | –0.004*** | (0.000) |
| Total journal citations | 0.000 | (0.000) | 0.000 | (0.000) | 0.001* | (0.000) | 0.000 | (0.000) |
| Total number of awards | –0.003 | (0.043) | –0.033 | (0.043) | -0.001 | (0.043) | –0.023 | (0.043) |
| Percentage of faculty with grant | 2.790*** | (0.037) | 2.940*** | (0.038) | 2.876*** | (0.038) | 2.777*** | (0.037) |
| Percentage of faculty with publication | 0.495*** | (0.177) | 1.204*** | (0.181) | 0.702*** | (0.179) | 0.764*** | (0.177) |
| Percentage of faculty with citations | –0.423** | (0.172) | –1.326*** | (0.177) | –0.574*** | (0.174) | –0.899*** | (0.174) |
| Biological & biomedical sciences | 1.442*** | (0.018) | 1.482*** | (0.018) | 1.444*** | (0.017) | 1.464*** | (0.018) |
| Physical & mathematical sciences | 0.703*** | (0.021) | 0.718*** | (0.021) | 0.706*** | (0.021) | 0.710*** | (0.021) |
| Engineering | 0.504*** | (0.023) | 0.516*** | (0.023) | 0.503*** | (0.023) | 0.513*** | (0.023) |
| Social & behavioral science | 0.621*** | (0.024) | 0.628*** | (0.024) | 0.622*** | (0.024) | 0.625*** | (0.024) |
| Public institution | –0.051*** | (0.008) | — | — | — | — | — | — |
| AAU | — | — | 0.314*** | (0.013) | — | — | — | — |
| Public AAU affiliated institution | — | — | — | — | 0.165*** | (0.013) | — | — |
| Private AAU affiliated institution | — | — | — | — | — | — | 0.254*** | (0.017) |
| Constant | –3.185*** | (0.040) | –3.477*** | (0.042) | –3.312*** | (0.041) | –3.275*** | (0.040) |
| Pseudo $R^2$ | 0.149 | — | 0.151 | — | 0.150 | — | 0.150 | — |
| Log likelihood | –107773.34 | — | –107507.69 | — | –107715.98 | — | –107678.55 | — |
| Prob. $\chi^2$ | 0.000 | — | 0.000 | — | 0.000 | — | 0.000 | — |
| Number of observation | 168025 | — | 168025 | — | 168025 | — | 168025 | — |
| Significance Level: *: 10 ** : 5 *** :1 | | | | | | | | |

Following variables were run in the model but not included in the results: Faculty Size <500; Faculty size between 500 and 1000; Midwest, South, West.

## *Notes*

[1]The term *faculty* is used throughout this study to refer to an individual faculty member, rather than the entire body of scholars at an institution. The unit of analysis in regression models presented below is the individual faculty member.

[2]Our use of the term *grant dollar amount* throughout this study refers to the average dollars per grant, not the total sum of grant dollars.

[3]A list of award granting institutions are available upon request.

[4]An explicit treatment of the methodology employed in collecting and matching records within the Faculty Scholarly Productivity dataset may be obtained from Academic Analytics, LLC's website http://www.academicanalytics.com.

[5]This sample includes all tenure-track faculty from PhD programs.

[6]We also employed a Negative Binomial model to estimate the impact of institutional and individual level characteristics on the number of grants obtained. The Poisson model has a greater goodness of fit as indicated by the adjusted $R^2$, and the estimates similar to the Negative Binomial model. Negative Binomial model results are provided in Appendix 1.

[7]Aside from the institutional characteristics reported, we also controlled for geographic locations and the institutions' overall faculty size. Both of these variables do not influence our model specification.

## *References*

Amemiya, T. (1981). Tobit Models: A Survey. *Journal of Econometrics*, *24*, 3–61.

Bland, C. J., Center, B. A., Finstad, D. A., Risbey, K. R. & Staples, J. G. (2005). Theoretical, Practical, Predictive Model of Faculty and Department Research Productivity. *Academic Medicine, 80*(3), 225–237.

Eshelman, D. J., Sullivan, K. L., Parker, L., and Levin, D. C. (2000). The Relationship of Clinical and Academic Productivity in a University Hospital Radiology Department. *American Journal of Radiology, 174*, 27–31.

Fairweather, James S. (2002). The Mythologies of Faculty Productivity. *The Journal of Higher Education, 71*, 27–48.

Greene, W. H. (2000). *Econometric Analysis* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Lawrence, P. A., (2007). The Mismeasurement of Science. *Current Biology, 17*(15), R583–R585.

Liebert, R. J. (1976). Productivity, Favor and Grants Among Scholars. *The American Journal of Sociology, 82*(3), 664–673.

Liebert, R. J. (1977). Research-Grant Getting and Productivity Among Scholars: Recent National Patterns of Competition and Favors. *The Journal of Higher Education, 48*, 164–192.

National Research Council (1995). *Research-Doctorate Programs in the United States: Continuity and Change*. Washington, DC: National Academy of Sciences

Teodorescu, D. (2000). Correlates of Faculty Publication Productivity. *Higher Education, 39*, 201–222.

Wood, F. (1990). Factors Influencing Research Performance of University Academic Staff Higher Education. *Higher Education, 19*(1), 81–100