Do Congressional Earmarks Increase Research Output at Universities?

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Abstract: For twenty years universities have been able to bypass peer-reviewed research competition for federal funding and seek a direct appropriation of funding from Congress. Proponents of this earmarking claim that this funding helps the university build the infrastructure needed to be able to compete for peer-reviewed funding. Opponents claim this funding is used poorly and is less than productive than peer-reviewed funding. This paper attempts to answer this question by examining whether earmarked funding, when treated as a stock of capital, increases the number of academic articles published and/or the number of citations per article published. Using two panel data sets that span 1980 to 1998, incorporating university and year fixed effects, and using an instrumental variables estimation, this paper shows that while the number of articles published increase, the number of citations per article decrease. Depending on the data set used the annual increase in articles ranges, on average, between 8 and 14 percent. The annual decrease in citations per article ranges between 9 and 57 percent. If we concentrate only on earmarks for agriculture, earmarks that often are for small discrete projects, the results suggest the effect from an increase in earmarked funding is not statistically different from zero for both publications and citations per publication. These results suggest that earmarked funding may increase the quantity of publications but decreases the quality of the publications and the performance of earmarked funding is lower than that from using peer-reviewed funding.

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For the past fifty years, most federal research funding has been allocated to universities using a peer-reviewed competition. Since 1980, Congress has interfered with this process by awarding some funding directly to universities under a process known as earmarking. Earmarks to U.S. institutions reached an all-time high of $1.67 billion in 2001, representing ten percent of total federal research funding distributed to universities (Brainard and Southwick (2001)).

Surprisingly, little is known about the effect of earmarks on research productivity. Proponents claim earmarking allows universities that are not "traditional" recipients of federal research funding to build the infrastructure necessary to compete for peer-reviewed funding. Others believe this type of funding distribution represents pork-barrel allocations that are not used as productively as peer-reviewed funding.[1] This paper examines whether earmarked funding increases research productivity as measured by academic publications at research and doctoral universities.

Earmarks are used in a variety of ways for research and development activities. Many earmarks are designated for institutes, laboratories, and other capital-intensive projects. Earmarks are also awarded for smaller, discrete research projects. It is not unusual for these smaller projects to be related to a larger capital intensive earmarked grant or to receive earmarked funding for multiple years. Given most earmarks are likely to have a long term impact on research activities, this paper treats earmarks as a stock of funding and measures the effect of a change in the funding stock on the number of articles published and the number of citations per article published.

This paper finds that earmarks increase the number publications but decrease the number of citations per publication. On average, an additional $1 million in earmarked funding increases the number of articles published between 21 and 42 articles. This represents an annual increase in the number of articles produced between 8 and 14 percent. The quality of these articles, as measured by the number of citations per article, declines between .25 and 1.3 citations per article. This represents an annual decline between 9 and 57 percent. Thus, if earmarks are used to build the infrastructure for research activities at universities, the results suggest that while earmarked funding increases research activities at universities, the quality of this research decreases.

This paper also examines the relationship between earmarked funding and academic publications in the area of agriculture, given a significant percentage of earmarked funding is for agricultural research. Many of these earmarks are for smaller projects that receive earmarked funding over several years. The results suggest the effect of earmarked funding in agriculture is not statistically different from zero for both the number of publications and for the number of citations per publication. These results provide further support that earmarks used for small, discrete projects, may not be as effective on research productivity as research funding allocated under more traditional methods such as peer-reviewed processes.

Previous research has focused on the political process involved in earmarking. Savage (1991, 1999) explores the politics underlying congressional earmarks to universities. He explores the reasons why universities seek earmarks, the role that lobbyists play, and the power of the members serving on the appropriations committee on the distribution of earmarked funding. De Figueiredo and Silverman (2001) explore the relationship between earmarked funding and lobbying expenditures by universities. They find, on average, positive returns to these lobbying expenditures. No one, however, has examined how earmarked funding has impacted research activities and revenues at universities. This paper, thus, is the first attempt at measuring the relationship between earmarked funding and one type of research activity.

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[1] *See* Teich (2000) for a discussion of these issues.

The paper proceeds as follows. Section I discusses the methods used to define earmarks, and reports summary statistics. Section II discusses the empirical specification, the results, as well as robustness issues and the effect of earmarked funding on research in agriculture. Section III provides a brief conclusion.

I. What are earmarks and how are they measured?

Earmarking is a vehicle by which Congress may circumvent agency discretion. Under the more traditional appropriations process, Congress develops a series of appropriations bills (which must be approved by the President) that allocate the discretionary part of the budget to federal agencies. For any given agency, the appropriations legislation will outline the programs funded by the agency. The agency, however, retains the discretion to allocate the funding it receives using procedures established by the agency.[2] In contrast, an earmark represents a funded amount identified in the appropriations bills or accompanying reports that is allocated to one or more universities. Earmarked funds are transferred to the agency and the agency is expected to allocate these funds as per the language designated in the bill or the reports.[3]

Earmarks are measured several ways. Savage (1999) examines the appropriations legislation and accompanying reports to identify the recipient institutions and the amounts allocated to these institutions. The *Chronicle of Higher Education* identifies earmarks by asking the federal agencies responsible for distributing the earmarked funding. The agencies provide information on the amounts distributed, the recipient university, and the reason for the earmark. Although these two methods appear similar, they differ substantially. The Savage data suffer from the lack of knowledge as to whether the agency indeed distributed the funding as well as the actual amount

[2] *See* Kleinman (1995) and Feller (1999) for an elaborate discussion of the history and distribution of research funding.

distributed by the agency. Although agencies are expected to distribute earmarked funding, in some instances, the agency may require an institution to submit a proposal for the research covered by the earmark and may reject the proposal under certain conditions. Similarly, the agency may "tax" part of the earmarked amount to cover the administrative costs associated with distributing the earmark.[4]

In analyses conducted by the *Chronicle of Higher Education* (2001) and the American Association for the Advancement of Science ("AAAS") (2001), the bulk of earmarks are distributed by the Departments of Agriculture and Commerce, and by NASA. Agencies with large budgets for peer-reviewed funding such as the National Science Foundation ("NSF") and the National Institutes of Health ("NIH") are responsible for very few of the earmarked appropriations. Although the bulk of earmarked funding is directed at activities concerned with research and development activities at the universities, earmarks also cover such things as distance learning projects, university transportation systems, renovations of dormitories, and projects identified as community outreach projects (e.g. job-training programs). Identifying these types of earmarks is more difficult using the Savage data set than using the data set from the *Chronicle of Higher Education ("Chronicle").*

I use both data sets.[5] The Savage data set covers the period 1980 to 1996 and, thus, is useful for identifying earmarked funding from its inception. The *Chronicle* data set covers the period 1990 to 1999 and is useful because of the method used to collect the data and the detail it provides on the reason for the earmark. I use the total earmarks received by the university for each year covered by the data. Because the *Chronicle* data set provides a detailed description of the

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[3] In rare instances, earmarks are used to resurrect research programs that were agency sponsored research projects in prior years but the agency discontinued. In these instances, the agency may award the funding under a peer-reviewed process. Often this occurs in the area of agriculture, where some grants are distributed using a formula.

[4] For exploring the politics of earmarks, the Savage data set is superior because it identifies the appropriations subcommittee responsible for proposing the earmark.

[5] AAAS also collects data on earmarking that focuses solely on funding directed at research and development. This collection, however, started with the 2001 earmarks.

reason for the earmark, I created two measures of earmarks that reflect only those amounts used for research and development activities. The first captures funding that could be associated with research and/or development projects undertaken by the university, including funding for institutes, facilities, equipment, and specific research projects. The second measure captures funding used for institutes, facilities, laboratories, or buildings, and, thus, is a subset of the first. It captures funding for things that are more closely related to the research infrastructure of the universities.

Another difference between the Savage and *Chronicle* measures concerns the use of "shared" earmarks. In some instances, an earmark may be shared among several universities and other types of institutions. The Savage data set allocates a portion of the shared earmark to each participating university. The *Chronicle* data set provides the total amount of the shared earmark but does not indicate what percentage of the total each institution received. I do not include the shared earmarks as reported in the *Chronicle* data set in the analysis.[6] The reason for this is that in many instances the shared earmarks are allocated to a consortium or other grouping of universities that suggests the funding may be allocated using a competitive process. As such, these earmarks are different from those that are allocated to a specific university.[7]

Of the 120 research universities analyzed in this paper,[8] 101 received earmarks using the Savage data set and 96 received earmarks using the *Chronicle* data set.[9] In contrast, of the 97

[6] If the shared earmarks are included in the analysis, the signs of the coefficients in all of the specifications do not change. The magnitudes of the coefficients change slightly.

[7] The structure of the shared earmarks makes it difficult to ascertain for all earmarks the number of institutions sharing the earmark and the percentage of the earmark received by each institution.

[8] I exclude from the analysis Harvard University and Johns Hopkins University because the publications and federal research funding measures are extremely large relative to the other universities and, thus represent outliers.

[9] Those universities that did not receive earmarked funding using the *Chronicle* data set for research, development, or infrastructure purposes are: Brigham Young University, Brown University, California Institute of Technology, Duke University, Emory University, Kent State University, Rice University, Rockefeller University, SUNY at Stony Brook, St. Louis University, Temple University, Tulane University, University of California at Irvine, University of California at San Francisco, University of California at Santa Barbara, University of California at Santa Cruz, University of Houston, University of Illinois at Chicago, University of Notre Dame, University of Southern California, University of

doctoral universities studied, 58 received earmarks using the Savage data set and 54 received earmarks using the *Chronicle* data set. Of the research universities, many received several years of earmarked funding; over 63 percent of the Savage universities received more than 5 years of earmarks and over 68 percent of the *Chronicle* universities received more than 4 years of earmarks.[10] Of the doctoral universities, most received fewer than 6 years of funding in the Savage data set and fewer than 4 years of funding in the *Chronicle* data set. Only a handful of doctoral universities received many years of earmarked funding.

The majority of institutions that consistently receive earmarked funding are public universities. Of the private universities that received earmarked funding, 50 percent only received one or two years of funding. Of the public universities that received earmarked funding, 50 percent received 7 or fewer years of funding in the Savage data set and 6 or fewer years of funding in the *Chronicle* data set.[11]

Table 1 reports summary statistics for the earmarks for research and doctoral universities. All dollars are reported in constant dollars using the NSF fiscal year deflator with 1996 as the base year. The average earmark in the Savage data set is $4.8 million, ranging from $2000 to $66.5 million. The average earmark using the *Chronicle* data set is less, $3.7 million, ranging from $21,000 to $83.9 million. The average earmark for the "infrastructure" designated earmarks is only slightly lower than the research oriented earmarks suggesting that the bulk of earmarked funding

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Wisconsin at Milwaukee, Vanderbilt University, Virginia Commonwealth University, and Washington Universities. Some of these institutions may have received earmarked funding under a shared earmark.

[10] The University of Georgia, for example, received several years of funding for a biocontainment research facility and a laboratory on environmentally sound agriculture production, and research on urban pests, peanut breeding, and Vidalia onions, among other projects. Pennsylvania State University received several years of funding for research on such things as coal based jet fuel and milk safety, a satellite communications project, and a coal utilization center, among other things. Among those universities that only received one year of earmarked funding for research related projects, Yale University received funding for a project on lyme's disease, the University of Chicago received funding for research on storm analysis, and the Case Western Reserve University received funding for a biomedical research facility.

distributed to research and doctoral universities is used for more capital intensive purposes. Distinguishing between the research and the doctoral institutions, the average earmark is slightly higher for the research universities. Given most doctoral universities are smaller than research universities, the impact from an earmark to a doctoral university may be greater.

Figures 1 and 2 depict the average earmarked funding to research and doctoral universities using the Savage and the *Chronicle* data, respectively. The Savage data suggest that, over time, earmarked funding has been steadier for the research universities than for the doctoral universities. During the early 1980s, the average earmark is relatively flat. The growth in earmarks started in the late 1980s with a slight decline in the early 1990s. The *Chronicle* data, figure 2, show the decline in earmarks continued for the research universities until about 1997. Doctoral universities, however, started to experience an increase in earmarked funding starting in 1996.

The summary statistics for total federal research funding are reported in panels B and C of Table 1.[12] Panel B distinguishes the universities based on whether a university received at least one year of earmarked funding. For both research and doctoral universities, average federal funding is higher for those universities that received earmarked funding than for those that did not receive earmarked funding. Panel C compares federal funding in the years in which an institution received earmarked funding with federal funding in the years in which the institution did not receive earmarked funding. There is little difference between the periods of receiving earmarked funding and not receiving earmarked funding for the research universities. For the doctoral universities, there is a big difference. In the years for which earmarked funding was received, average federal funding is \$11.5 million. In the other years, average federal research funding is only \$4.7 million.

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[11] A list of the universities studied is provided in Appendix 1.

[12] Unfortunately the method used to collect data on federal research funding and earmarked funding differs, making it difficult to conduct an extensive analysis of the relationship between federal research funding and earmarked funding.

Figure 3 illustrates this difference in the potential impact of earmarks on research and doctoral universities over time. Figure 3 plots the average federal research funding for research and doctoral universities based on whether the institutions received earmarked funding in the year under study. For most of the years, average federal research funding for the research and doctoral universities that received earmarked funding and the research universities that did not receive earmarks are very similar. Average research funding for the doctoral institutions in the years the institutions did not received earmarked funding is much lower.

With respect to the Savage and *Chronicle* data, average earmarked funding is slightly higher for the Savage data than for the *Chronicle* data. This is most likely attributed to three things. First, the measures from the *Chronicle* data do not include funding received under shared earmarks. Second, the *Chronicle* data exclude funding for items that do not appear to be related to research activities. Third, the methods used to collect the data, as explained above, were different. To explore this third reason, I compared the Savage data for 1990 to 1996 with the *Chronicle* data for the same period, after including all earmarked funding and apportioning the shared earmarked funding based on a simple average across the universities. The correlation between these two measures for this period is quite low. Although I have examined the data in many ways, there is no obvious reason why the earmarked funding as measured by Savage and as measured by the *Chronicle* should differ as such. It appears, however, that the principle reason for the difference in the earmarked funding stems from the method used to collect the data.

II. How do earmarks affect research productivity?

A. Empirical Specification

To measure the effect of earmarks on research productivity, there are several types of measures that could be used to identify research output. I focus on publications in academic journals insofar as they proxy research output in more traditional outlets. Data on articles published and citations to articles published are available each year from 1981 to 1998 from the Institute of Scientific Information. I use data at the institutional level for papers published during that year covering approximately 5700 academic journals covering more than 50 disciplines. The citations per article published are the total number of citations to articles published in a particular year, accumulated to 1999, divided by the number of articles published in that year. Thus, the number of citations per article in earlier years will be higher, on average, than the number of citations per article near the end of the sample period; the year fixed effects should control for this difference. Panel D of Table 1 reports the average number of articles published and citations per article for the universities studied, overall and for the two periods studied.

In assessing how to model the effect of earmarks on publications, it is important to consider the intended effect on research. Given most earmarks are used for infrastructure related purposes, we should expect a long term effect insofar as the funding potentially will improve research at the university by enabling the university to hire better researchers, have better facilities, etc. I summed the earmarked funding from the first year of each data set from the beginning of the period, representing a stock of accumulated funding. The average stock of funding for the Savage data set is $21 million. The average stock of funding is $13 million for the *Chronicle* research oriented data set and $11 million for the *Chronicle* building/infrastructure data set.

To measure the effect of publications on the stock of earmarked funding, I use the following empirical specification:

$$P_{ist} = \alpha_i + \lambda_t + \beta \sum_{0}^{t-1} E_{is} + S_{st}\gamma + \varepsilon_{ist} \qquad (1)$$

where P is the measure of research productivity for university i in year t and E is the measure of earmarked funding for university i, summed from the beginning of the data set to year t-1. I lag the earmarked funding measure by one year to reflect the fact that the publication year for many articles is not the same as the year in which they are written.[13] Also included in the specification are year and university fixed effects and state level measures. The year effects are intended to capture macro effects that affect all universities similarly. The university fixed effects capture non-time varying aspects of the university that could impact the publications and funding of the university. For example, a university with a strong reputation in research is likely to publish more than a university with a weak reputation in research. The state level measures capture time varying changes in the socio-economic and political environment under which the university operates.

E is potentially correlated with the error term of the regression as the error term would include other inputs involved in the production of research. Payne and Siow (2001) illustrate that if the shadow prices of the other inputs to research are different from that of earmarked funding, the OLS estimate of β is biased. Merely including measures of these other inputs in the regression equation will not remove this bias if the shadow prices of these inputs are correlated.

Another problem concerns the fact that not all universities receive earmarked funding. In part this is due to the fact that not all universities seek an earmark, thus raising a potential selection issue. Fortunately, the data set on publication measures cover the majority of universities classified as a research or doctoral institution, so our sample is <u>not</u> restricted to only those that receive earmarks. This fact and the use of a fixed-effects instrumental variables estimation minimizes the potential selection bias.[14]

[13] The results do not vary dramatically for longer lags on earmarked funding.
[14] I could include a selection correction term by creating the inverse Mills ratio from the probit of whether a university receives an earmark based on whether the university has a member that has some affiliation with the university serving

The preferred specification, therefore, is an instrumental variables regression. The instruments used to predict earmarked funding are the average of federal research funding divided by the number of articles published for universities, with the same research or doctoral designation, located outside of the region in which the university under study is located for several disciplines. The four measures, lagged by 3 years, reflect the following disciplines: social sciences, engineering, life sciences, and agriculture. These measures help to proxy the distribution of research funding to other universities and the productiveness of this funding by other universities, thus providing a measure of the interest of the university under study in seeking earmarked funding.

As illustrated in Payne and Siow (2001), the coefficient from the instrumental variables specification estimates the change in research outcome when a university buys an additional unit of the measured federal funding due to change in shadow price of earmarked funding. Thus, it captures the total change in output produced by an institution when it obtains an additional unit of input due to a change in the shadow price of the earmarked funding.

B. Results

Tables 2 and 3 report the effects of a change in the stock of earmarked funding on the number of articles published and citations per article under the OLS and IV estimations. Table 2 reports the results using the number of publications as the dependent variable. Table 3 reports the reports the results using the number of citations per publication as the dependent variable. The results from the OLS specification are reported in the top panel and the results from the IV specification are reported in the bottom panel. In addition to reporting the coefficient on earmarked funding from the second stage regression, I report the p-value of the f-test of the instruments from the first stage regression, the p-value from the over-identification test and the p-

on the appropriations committee (by representing the district in which the university is located or by having an alma value from the Hausman (1978) test. The first test is used to measure the power of the instruments in predicting the level of earmarked funding. The second test is used to measure whether the instruments belong in the second stage regression; a low p-value suggests they belong in the first and not the second stage regression. The third test is used to measure whether the coefficient in the second stage regression is statistically different from the coefficient in the first stage regression.

Across all columns, the three tests discussed above are satisfied. The effect of earmarked funding on the number of publications is positive and statistically significant at a p-value less than .05. Using the Savage dataset, column (1), the results suggest that an additional $1 million in earmarked funding provides an additional 21 publications. Given the average earmark in the Savage data set is $4.6 million, this suggests that, on average, a university will produce an additional 97 articles per year, or an increase of 11 percent.

Using the *Chronicle* dataset, column (2), the results suggest that an additional $1 million in research funding provides an additional 22 publications. Given average earmarked funding is $3.5 million, this suggests, on average, a university will produce 77 more articles per year, an increase of 7 percent. Using the *Chronicle* dataset that contains the earmarked funding levels for the more infrastructure related funding, column (3), the results suggest there is an increase of 41 articles per million in earmarked funding. This suggests that, on average, an additional 148 articles are produced, an annual increase of 14 percent.

In contrast, increasing the stock of earmarked funding decreases the number of citations per article. Using the Savage data set, column (1) of Table 4, with an additional $1 million in earmarked funding, citations per article decline by 0.25, approximately 9 percent annually. Using the *Chronicle* dataset, column (2), citations per article decline by 0.74, approximately 31 percent.

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mater affiliation with the university).

Using the earmarked funding measure for the more infrastructure related funding, column (3), the results suggest citations per article decline by 1.3, approximately 57 percent.

By treating earmarked funding as a stock that can be used to help strengthen a university's research endeavors, the results provide consistent results, regardless of the data set used. Earmarked funding increases the number of articles published but decreases the quality of those articles, as measured by the number of citations per article.

C. Robustness of Results

There are three potential issues concerning the results reported above. First, whether the accumulation of the earmark over the entire sample period is the proper way to measure the stock of funding. Especially for the Savage data, expecting an earmark received in 1980 to continue to have an effect in 1996 may be far-fetched. I, therefore, tried three other measures: accumulating the stock over a four year period, a six year period, and treating the stock accumulated for the previous four years at 100 percent of funding and discounting the earmarks received in the remaining prior years. The results are similar for all three of these measures as to those reported in Tables 2 and 3.

The second issue concerns the use of a levels specification. A log specification may be better. Given the number of zero earmarks in the data set, however, estimating a log specification is problematic. An alternative to the log specification is one that uses square roots of the measures. While the magnitudes differ, the sign of the coefficient on the earmark measure is the same as that reported in Tables 2 and 3.

The third issue concerns the treatment of earmarks as a stock, given some of the earmarks are used for more discrete research projects.[15] If we treat the earmarks as a flow of funding with a

[15] Using the *Chronicle* data set, most of the institutions that received earmarked funding for discrete research projects also received funding for projects related more towards infrastructure needs. There are only 28 universities that only received funding for the more discrete research projects. Of these institutions, 17 universities received only one or two

one time effect on research productivity, we could use a specification that regresses the output measure on a lagged value of one year of earmarked funding. For the many universities that receive multiple years of earmarked funding, the purpose of the funding from one year is often related to the purpose of the funding for subsequent years, presenting a problem. Thus, the effect of the funding on publications may be very noisy. Ignoring this concern, the results using the Savage data set are similar to those reported above. The results using the *Chronicle* data set are reversed; there is a negative effect on the number of publications but a positive effect on the number of citations per publication. The source of these differences in results appears to be a function of the method used to collect the earmarking data and the method used to measure the effect of earmarks on research output.[16]

D. Effect of Earmarking in Agriculture

The final analysis explores the relationship between earmarked funding and publications in the field of agriculture. Given a large percentage of the smaller earmarks are directed at projects involving agriculture, it is appropriate to isolate these types of earmarking funding. In addition, given many of the earmarked projects are aimed at smaller projects (that receive repeated years of funding), it allows us to explore how the smaller levels of earmarked funding affects publications in this discipline.

years of earmarked funding for research projects. For the schools that received several years of funding only for discrete research projects, the earmarks tended to cover the same type of project across time.

[16] If a flow specification is used, capturing the short term effect of earmarked funding on publications is difficult if the lag on the earmarked funding is not correct, suggesting there may be some nonlinearities associated with the earmarked funding. As such, I explored several different specifications. First, I used a two or three year moving average of the earmarked funding and publications. Second, I tried different lag structures on the earmarked funding. Third, I tried including as a second regressor either the minimum or the maximum of the two or three previous years of earmarked funding. Using a moving average or a different lag on the earmarked funding did not change the results using a one year lag of the earmarked funding. For most of the specifications, including a second regressor that was created by taking the minimum or maximum of the previous years of earmarking did not change the results on the first regressor. Moreover, the coefficient on the second regressor was usually imprecisely measured.

Table 4 reports the summary statistics for the level of earmarked funding in agriculture. The level of earmarked funding using the Savage data is $4.6 million whereas the level of earmarked funding using the *Chronicle* data set is $1.4 million per university. These differences suggest that earmarked funding for agriculture was much higher in the 1980s than in the 1990s. Figure 4 depicts the average level of federal research funding to institutions based on their Carnegie (1994) classifications and whether they received earmarked funding in the year under study. Figure 4 suggests a difference from that seen in Figure 3. For both research and doctoral universities, the figure suggests that both types of universities benefit greatly from earmarked funding compared to those years when no earmarked funding is received.

Columns (4) and (5) of Tables 2 and 3 report the OLS and IV regression results for the specification that regresses the publication measures in agriculture on the stock of earmarked funding in agriculture. Across the IV specifications, the coefficients are imprecisely measured suggesting the effect of an additional dollar of earmarked funding on the publications measures is not statistically different from zero. With respect to the agriculture data, many of the earmarks represent smaller amounts of earmarked funding. As such, these results suggest that earmarks that represent potential research projects that might be considered under peer-reviewed competitions but instead are awarded funding under an earmarked grant, have little impact on the research productivity of the university.[17]

III. Conclusion

"Direct" funding of research activities by Congress through the appropriations process has increased at research and doctoral universities over the last decade. Until now, although other researchers have explored the political process involved in awarding earmarks (*see* Savage (1999)) and the returns to lobbying as measured by earmarks (*see* de Figueiredo and Silverman (2001)), little research has been done to study the impact of earmarks on research productivity. This paper studies this question. Utilizing a panel data set that contains two methods used to collect information on earmarked funding this paper studies the stock effect of earmarked funding on research publications. The results suggest an increase in the stock of earmarked funding increases the number of articles published but decreases the number of citations per article published.

Although peer-reviewed competition has been criticized as a method of awarding research grants by government agencies, this paper suggests if we instead rely more on politics to distribute funding, research quality declines. Part of this decline may be attributed to the fact that earmarked funding may be more concerned with applied than basic research and, therefore, promote activities that do not result in academic publications. Whether this is a good use of federal funding is a question that should be explored in future research.

Another topic left for future work is that concerning the motivations of universities in seeking earmarked funding and the effect of earmarked funding on other types of university activities. Many types of academic institutions receive earmarked funding, including research universities that receive a high portion of peer-reviewed competitive grants. Thus, in addition to understanding how earmarked funding affects research productivity as measured using more traditional measures of research activities, we also need to explore how earmarked funding affects other types of activities within a university.

[17] It is important to note, however, that many research grants distributed by the Department of Agriculture a formula is used to distribute the funding across the universities instead of a peer-reviewed competition.

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Figure 1:
Earmarks to Universities, Savage Data

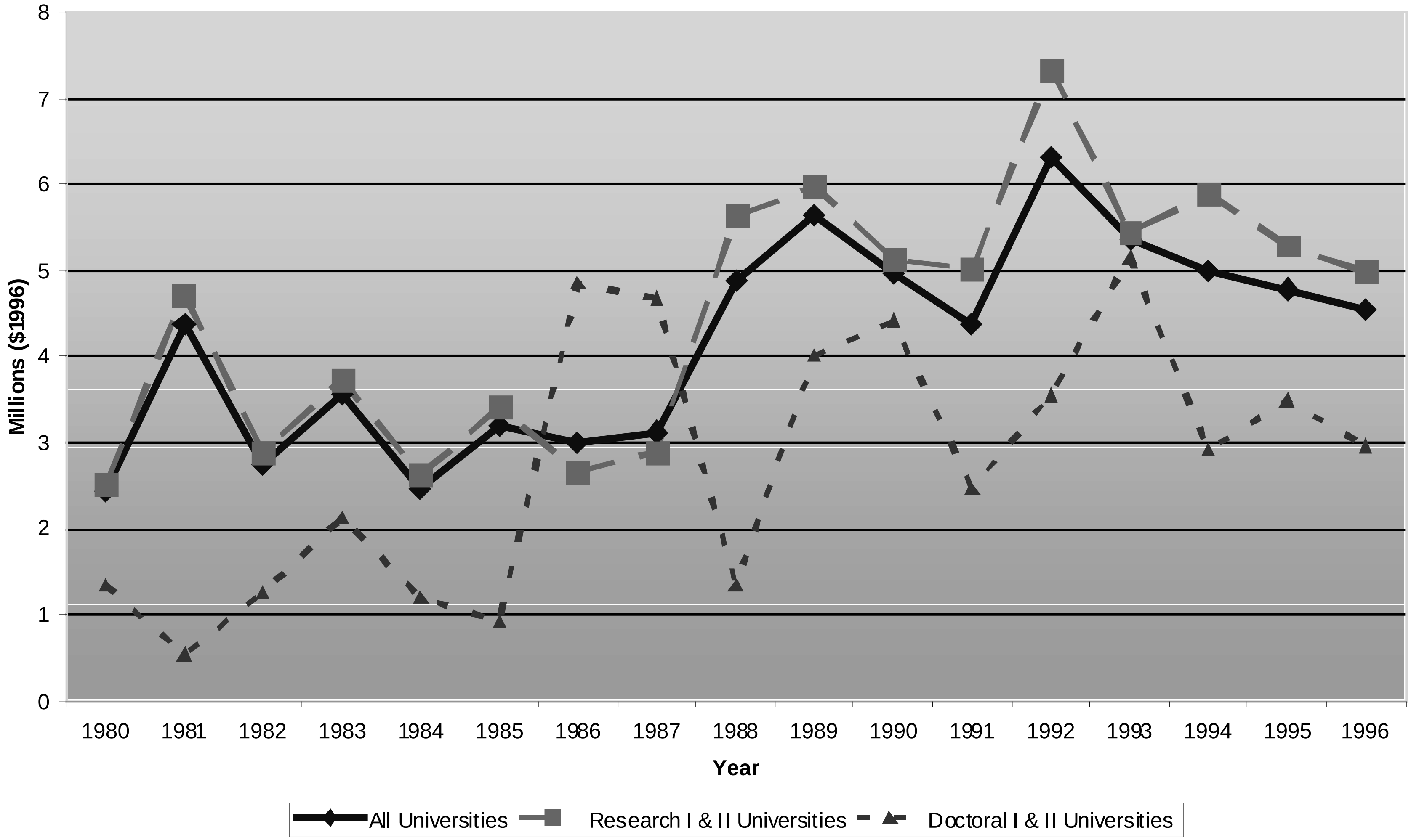

Figure 2:
Earmarked Funding towards Research and Development, Chronicle Data

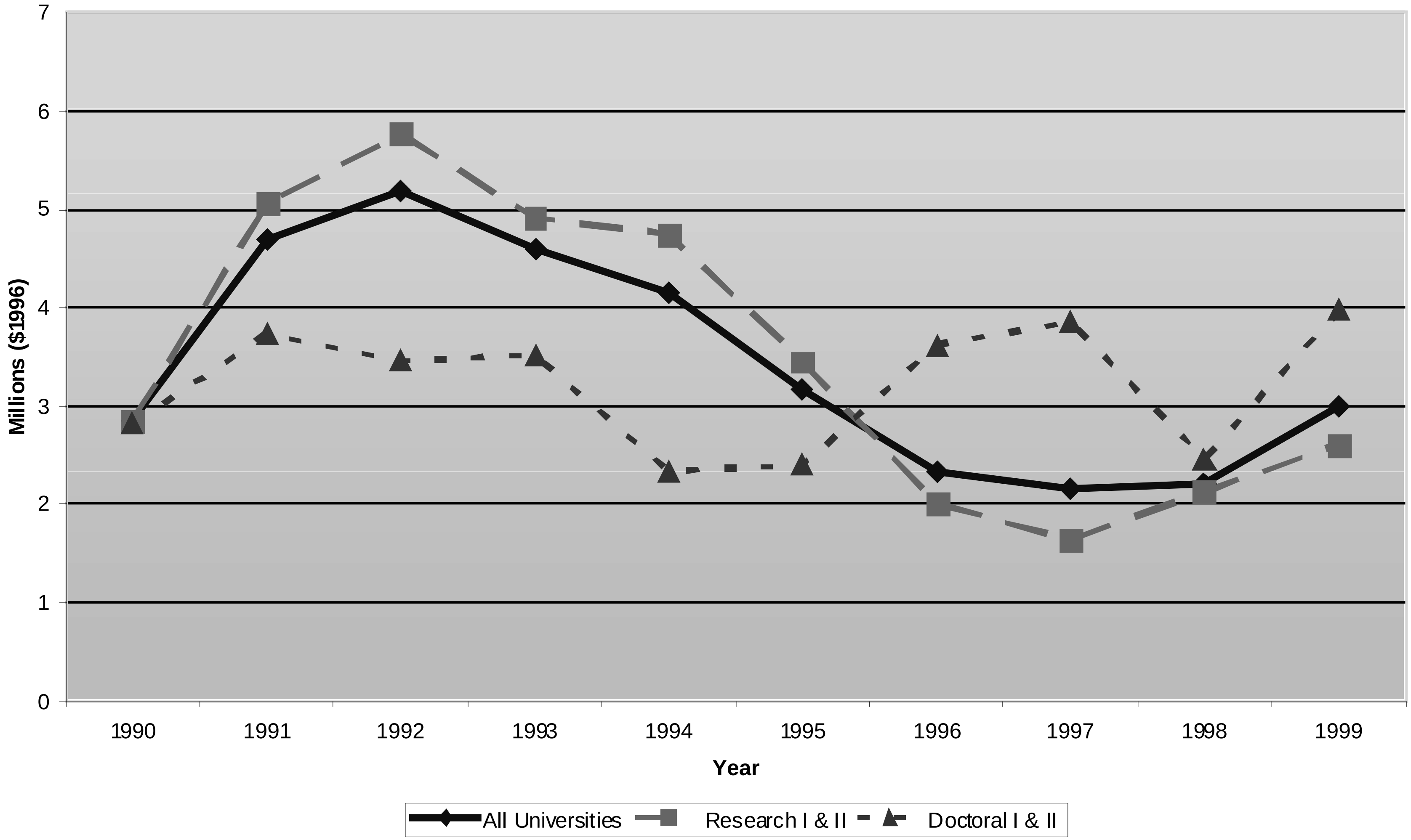

Figure 3:
Comparison of Federal Research Funding

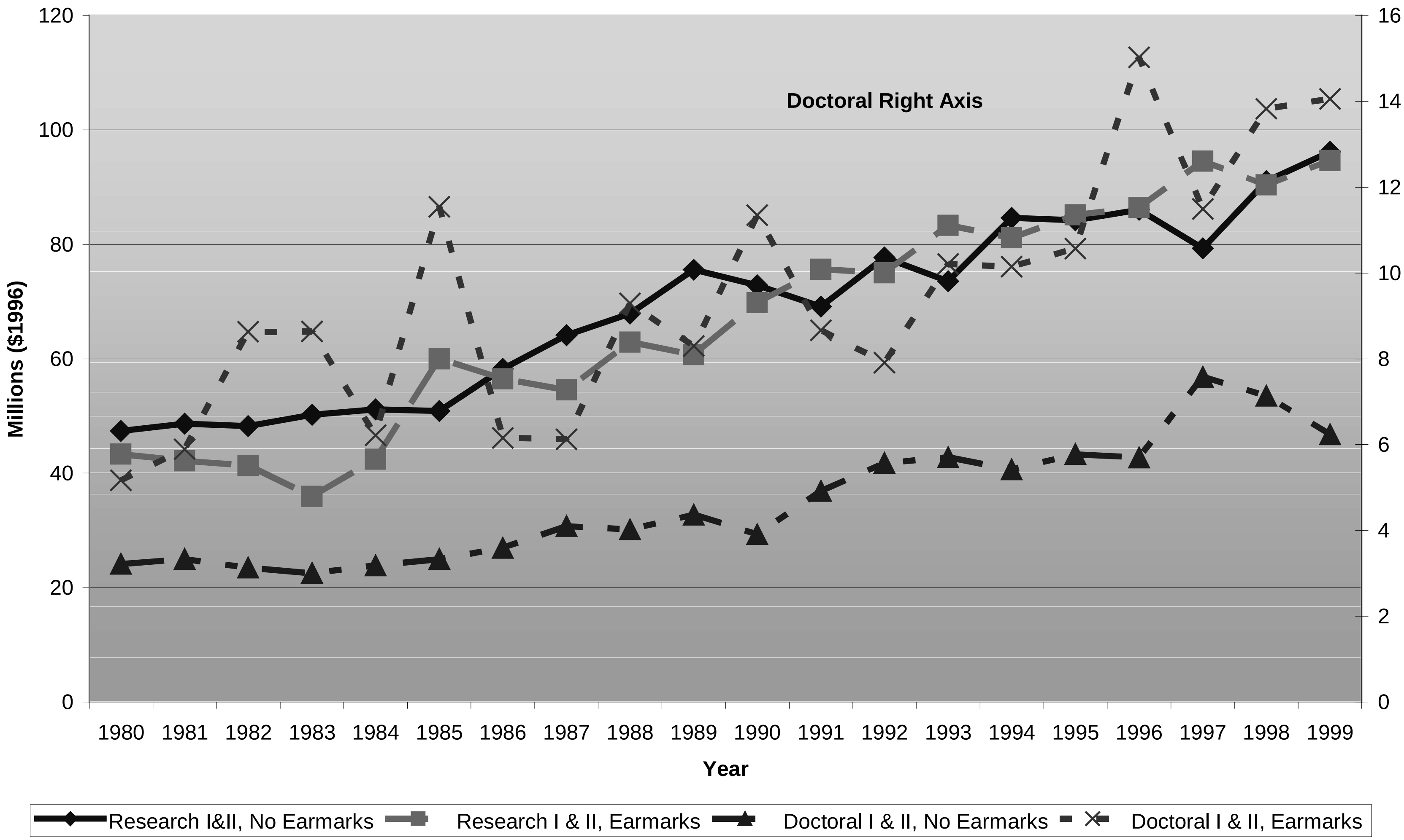

Figure 4:
Federal Research Funding for Agriculture

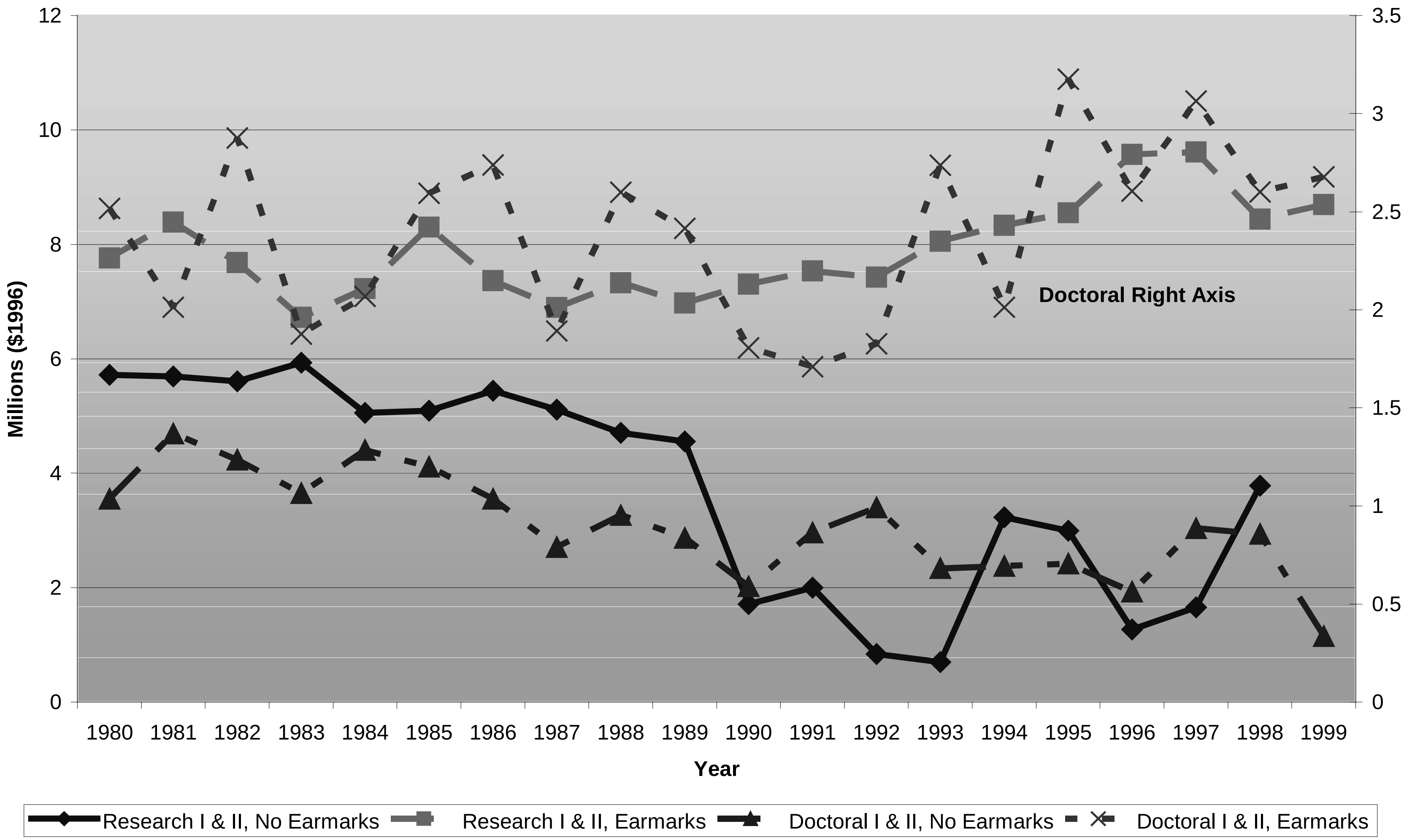

Table 1: Summary Statistics for Earmarking, Federal Research Funding, and Publications Measures

	# of Obs	Mean	S.D.	Minimum	Maximum
Panel A: Earmarked Funding					
Savage Data Set	1,007	4.635	7.779	0.002	66.474
Research I & II	794	4.966	7.899	0.028	65.718
Doctoral I & II	213	3.401	7.198	0.002	66.474
Chronicle Data Set: Research Oriented	731	3.523	5.873	0.021	83.889
Research I & II	547	3.631	6.277	0.021	83.889
Doctoral I & II	184	3.201	4.462	0.027	40.153
Chronicle Data Set: Buildings/Infrastructure	433	3.603	6.181	0.031	83.368
Research I & II	316	3.762	6.792	0.031	83.368
Doctoral I & II	117	3.175	4.097	0.095	28.612
Panel B: Federal Research Funding					
Universities with at least 1 yr of earmarks					
Research I & II	2189	77.346	82.998	2.578	741.655
Doctoral I & II	1281	6.893	8.272	0.038	57.504
Universities with no earmarks					
Research I & II	240	42.312	44.263	1.543	203.533
Doctoral I & II	535	2.977	5.277	0.001	59.093
Panel C: Comparison of Federal Research Funding					
Years with Earmark					
Research I & II	1022	77.453	78.667	5.183	741.655
Doctoral I & II	282	11.505	10.159	0.038	55.845
Years with No Earmark					
Research I & II	1407	71.292	82.05	1.543	728.223
Doctoral I & II	1534	4.68	6.668	0.001	59.093
Panel D: Publications Measures					
# of Articles Published					
1981-1998	4012	885.0867	992.0203	1	4994
1991-1998	1913	1031.343	1119.632	1	4994
# of Citations per Article					
1981-1998	4012	13.04115	9.332039	0	87.63636
1991-1998	1913	8.355395	6.933226	0	53.6647

Table 2: OLS and IV Regressions: # of Articles Published

Dependent Variable: # of Articles Published	Savage (1)	Chronicle Research (2)	Chronicle Infrastructure (3)	Agriculture Savage (4)	Agriculture Chronicle (5)
OLS Specification					
Earmarked Funding	**1.646**	**3.46**	**3.18**	**-0.08**	-0.06
(summed from 1st year)	(0.242)	(0.41)	(0.42)	(0.03)	(0.15)
R-Square	0.971	0.994	0.994	0.946	0.976
# of Observations	3552	1683	1683	2523	1230
IV Specification					
Earmarked Funding	**21.332**	**22.32**	**41.45**	0.08	-0.43
(summed from 1st year of data)	(1.849)	(3.30)	(8.70)	(0.10)	(0.67)
p-value of F-test from 1st stage instruments	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
p-value from over-identification test	(0.481)	(0.620)	(0.958)	(0.596)	(0.270)
p-value from Hausman test	(0.000)	(0.000)	(0.000)	(0.254)	(0.150)
# of Observations	2933	1683	1683	2106	1230

Notes: **Other Measures included in regressions**: university fixed effects, year fixed effects, the following state level measures: unemployment rate, state population, percent of population under 18, dummy variable equal to one if state governor is affiliated with Democratic party, measure of competition between Democratic and Republican parties in state upper and lower legislatures.

Robust standard errors reported in parenthesis unless otherwise stated.

Coefficients in bold significant at < .05.

The over-identification test is used to test the exogeneity of the instruments in the IV estimation. The Hausman test is use to test the significance of the difference between the coefficient in the OLS and the coefficient in the IV specifications.

Table 3: OLS & IV Regressions: # of Citations Per Article

Dependent Variable: Citations Per Article	Savage (1)	Chronicle Research (2)	Chronicle Infrastructure (3)	Agriculture Savage (4)	Agriculture Chronicle (5)
OLS Specification					
Earmarked Funding	**0.007**	**-0.029**	**-0.039**	**0.015**	0.069
(summed from 1st year)	(0.003)	(0.007)	(0.008)	(0.004)	(0.044)
R-Square	0.864	0.881	0.881	0.311	0.471
# of Observations	3552	1683	1683	2436	1161
IV Specification					
Earmarked Funding	**-0.252**	**-0.74**	**-1.32**	-0.14	-0.69
(summed from 1st year)	(0.027)	(0.11)	(0.28)	(0.12)	(0.78)
p-value from F-test in 1st stage instruments	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
p-value from over-identification test	(0.092)	(0.094)	(0.214)	(0.568)	(0.202)
p-value from Hausman test	(0.000)	(0.000)	(0.000)	(0.135)	(0.079)
# of Observations	2933	1683	1683	2034	1161

Notes: **Other Measures included in regressions**: university fixed effects, year fixed effects, the following state level measures: unemployment rate, state population, percent of population under 18, dummy variable equal to one if state governor is affiliated with Democratic party, measure of competition between Democratic and Republican parties in state upper and lower legislatures.

Robust standard errors reported in parenthesis unless otherwise stated.

Coefficients in bold significant at < .05.

The over-identification test is used to test the exogeneity of the instruments in the IV estimation. The Hausman test is use to test the significance of the difference between the coefficient in the OLS and the coefficient in the IV specifications.

Table 4: Summary Statistics for Agricultural Funding

	# of Obs	Mean	S.D.	Minimum	Maximum
Panel A: Earmarked Funding					
Savage Data Set	655	4.611	7.540	0.026	66.327
Research I & II	560	4.681	7.318	0.028	60.894
Doctoral I & II	95	4.200	8.768	0.026	66.327
Chronicle Data Set	425	1.444	1.792	0.021	12.801
Research I & II	360	1.440	1.814	0.021	12.801
Doctoral I & II	65	1.468	1.676	0.153	6.217
Panel B: Federal Research Funding					
Universities with at least 1 yr of earmarks					
Research I & II	1019	7.099	5.842	0.001	59.858
Doctoral I & II	308	1.539	1.445	0.001	6.670
Universities with no earmarks					
Research I & II	50	0.259	0.251	0.003	0.750
Doctoral I & II	21	0.018	0.031	0.001	0.118
Panel C: Comparison of Federal Research Funding					
Years with Earmark					
Research I & II	719	7.865	5.985	0.001	59.858
Doctoral I & II	120	2.219	1.524	0.017	6.670
Years with No Earmark					
Research I & II	350	4.548	4.982	0.001	25.914
Doctoral I & II	209	0.995	1.192	0.001	5.157

Appendix Table 1: Universities Analyzed

University	# of Years of Earmarks In Savage Data	In Chronicle Data	University	# of Years of Earmarks In Savage Data	In Chronicle Data
Adelphi University	0	0	Texas Woman's University	0	0
Andrews University	0	0	Tufts University	14	6
Arizona State University	8	1	Tulane University	9	0
Auburn University	8	7	United States International University	0	0
Ball State University	1	1	University of Akron	1	0
Baylor University	3	0	University of Alabama	7	5
Boston College	5	2	University of Alabama in Huntsville	3	1
Boston University	0	1	University of Arizona	5	7
Bowling Green State University	0	0	University of Arkansas	15	9
Brandeis University	3	2	University of California-Berkeley	0	7
Brigham Young University	0	0	University of California-Davis	8	8
Brown University	2	0	University of California-Irvine	1	0
California Institute of Technology	0	0	University of California-Los Angeles	2	1
Carnegie Mellon University	5	3	University of California-Riverside	13	0
Case Western Reserve University	2	1	University of California-San Diego	2	1
Clark University	1	0	University of California-San Francisco	1	0
Clarkson University	0	0	University of California-Santa Barbara	1	0
Clemson University	16	9	University of California-Santa Cruz	0	0
Cleveland State University	0	0	University of Central Florida	3	1
College of William and Mary	1	0	University of Chicago	2	1
Colorado School of Mines	3	3	University of Cincinnati	0	0
Colorado State University	7	4	University of Colorado at Denver	0	0
Columbia University	7	4	University of Colorado at Boulder	2	4
Cornell University	10	9	University of Connecticut	9	6
Dartmouth College	2	1	University of Delaware	4	3
De Paul University	1	1	University of Denver	0	0
Drexel University	2	1	University of Detroit Mercy	4	3
Duke University	1	0	University of Florida	8	8
Duquesne University	0	0	University of Georgia	9	9
Emory University	1	0	University of Houston	3	0
Florida Atlantic University	0	1	University of Idaho	15	8
Florida Institute of Technology	0	0	University of Illinois at Chicago	0	0
Florida International University	4	2	University of Illinois at Urbana-Champaign	11	9
Florida State University	6	3	University of Iowa	7	3
Fordham University	1	1	University of Kansas	5	3
George Mason University	4	3	University of Kentucky	10	5
Georgia Institute of Technology	4	5	University of Louisville	0	0
Georgia State University	0	0	University of Maine	8	9
Hofstra University	0	0	University of Maryland Baltimore County	1	1

Idaho State University	0	0	University of Maryland at College Park	8	9
Illinois Institute of Technology	5	6	University of Massachusetts at Amherst	11	9
Illinois State University	2	3	University of Memphis	0	0
Indiana State University	6	6	University of Miami	9	8
Indiana University of PA	1	1	University of Michigan	6	2
Indiana University	8	5	University of Minnesota	12	8
Indiana University-Purdue at Indianapolis	0	0	University of Mississippi	10	8
Iowa State University	16	9	University of Missouri, Columbia	16	9
Kansas State University	11	9	University of Missouri, Kansas City	0	0
Kent State University	0	0	University of Missouri, Rolla	2	1
Lehigh University	4	4	University of Missouri, St Louis	1	1
Loma Linda University	6	6	University of Montana	2	3
Louisiana State University	14	9	University of Nebraska at Lincoln	15	9
Louisiana Tech University	1	0	University of Nevada-Reno	10	6
Loyola University of Chicago	0	0	University of New Hampshire	6	5
Marquette University	1	0	University of New Mexico	6	0
Massachusetts Institute of Technology	7	1	University of New Orleans	6	6
Miami University	0	0	University of North Carolina at Chapel Hill	4	2
Michigan State University	16	9	University of North Carolina at Greensboro	0	0
Michigan Technological University	3	2	University of North Dakota	10	9
Middle Tennessee State University	3	3	University of North TX	0	0
Mississippi State University	16	9	University of Northern Colorado	0	0
Montana State University - Bozeman	15	9	University of Notre Dame	7	0
New Jersey Institute Technology	3	4	University of Oklahoma	8	6
New Mexico State University	15	9	University of Oregon	8	2
New York University	2	1	University of Pennsylvania	6	7
North Carolina State University at Raleigh	6	4	University of Pittsburgh	5	5
North Dakota State University	16	9	University of Rhode Island	7	6
Northeastern University	3	2	University of Rochester	7	1
Northern Arizona University	4	3	University of San Diego	0	3
Northern Illinois University	0	0	University of San Francisco	1	0
Northwestern University	8	5	University of South Carolina	8	6
Nova Southeastern University	0	1	University of South Dakota	1	0
Ohio State University	9	9	University of South Florida	4	5
Ohio University	2	1	University of Southern California	1	0
Oklahoma State University	15	9	University of Southern Mississippi	11	4
Old Dominion University	1	0	University of Southwestern Louisiana	2	3
Oregon State University	16	9	University of Tennessee at Knoxville	5	4
Pennsylvania State University	15	9	University of Texas at Arlington	0	0
Pepperdine University	0	0	University of Texas at Austin	6	5
Portland State University	2	1	University of Texas at Dallas	1	0
Princeton University	0	1	University of Toledo	5	4

Purdue University	11	2	University of Tulsa	1	1
Rensselaer Polytechnic Institute	5	4	University of Utah	8	2
Rice University	0	0	University of Vermont	12	9
Rockefeller University	0	0	University of Virginia	2	1
Rutgers --Newark Campus	0	0	University of Washington - Seattle	10	8
Rutgers – New Brunswick	16	9	University of Wisconsin-Madison	16	9
SUNY at Albany	0	1	University of Wisconsin-Milwaukee	0	0
SUNY at Buffalo	4	2	University of Wyoming	6	5
SUNY at Stony Brook	0	0	University of the Pacific	0	0
San Diego State University	5	3	Utah State University	13	7
Seton Hall University	1	1	Vanderbilt University	0	0
Southern Illinois University-Carbondale	8	6	Virginia Commonwealth University	1	0
Southern Methodist University	0	0	Virginia Polytechnic Institute	11	6
St John's University	0	0	Wake Forest University	7	5
St Louis University	0	0	Washington State University	16	8
Stanford University	2	0	Washington University	2	0
Stevens Institute of Technology	1	2	Wayne State University	2	0
Syracuse University	2	0	West Virginia University	13	9
Temple University	1	0	Western Michigan University	1	1
Tennessee State University	6	6	Wichita State University	4	3
Texas A&M University	16	9	Worcester Polytechnic Institute	1	0
Texas A&M University-Commerce	0	0	Wright State University	1	0
Texas Christian University	0	0	Yale University	0	1
Texas Southern University	2	0	Yeshiva University	0	0
Texas Tech University	11	3			