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Government Impact at Research Universities: Reactions by Alumni, Corporations, Foundations, and Others to Federal Research Expenditures

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Abstract: This paper examines the relationship between federal research funding and private donations at 221 private and public research and doctoral universities between 1973 and 1997. As with previous studies, there is a positive relationship between these two sources of funding for these universities. This paper extends previous research by examining the effect of federal research funding across five different types of private donors: alumni, corporations, foundations, other individuals, and donations given as bequests. The results suggest there is a positive correlation across all types of donors, but that the effect varies across the donors. After controlling for potential endogeneity and omitted variable bias, the effect of increasing federal research expenditures by one dollar ranges between 6 and 61 cents. The strongest effect is seen with respect to alumni, especially alumni from private universities. Although there are statistically significant differences in the reactions by alumni at private and public universities to changes in federal funding, I find no significant differences in the reactions by other types of donors across these types of universities.

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Despite much literature studying the question of how private donors react to changes in government funding, little has been done to explore the reactions by different groups of donors to the same institution. In the area of higher education, Payne (1999a) explores the issue of how donors to different types of private higher educational institutions react to changes in government funding.[1] She finds a positive reaction at research universities and a zero or negative effect at universities classified as liberal arts colleges, community colleges, and schools whose highest degree offered is a master's degree. One hypothesis suggests this difference stems from the fact that universities engage in both research and instruction and that the knowledge about the quality of these two types of products differs. With respect to research, private donors may not be completely or as informed about the quality of the research as they are with respect to the instruction being conducted by the university. Thus, with respect to donations that are directed towards a university's research endeavors, donors may look to the government for information in addition to treating the government funding as a substitute. Another hypothesis that would explain a positive correlation between donations and government funding is that the government funding has a spillover effect on the goods produced using private donations if there are different goods produced with private and public funding. This hypothesis is explored further in this paper.

[1] Connolly (1997) also examines funding to universities. She explores the relationship between internal and external research funding to universities and finds a positive correlation between the two types of funding. In addition, Okunade (1996) and Harrison, Mitchell, and Peterson (1995) look at different graduate alumni donations and the effects of development office expenditures and other school attributes on alumni donations, respectively. Mcpherson and Schapiro (1991), and Ehrenberg, Rees, and Brewer (1993a, 1993b) examine the crowd out effect of government aid for students on institutional support. Octen and Weisbrod (1998) examine the responsiveness of donations to a number economic variables, including price, advertising, and government grants for different types of nonprofit organizations, including higher educational institutions.

Implicit in Payne (1999a) is that the distribution of alumni, corporate, foundation, and other types of donors vary across the different types of institutions. The reasons for donating as well as the level of knowledge about the quality of the goods provided by the institution most likely vary across donor types. As such, the results in that paper may be driven in part by this difference in distribution.

This paper explicitly examines the relationship between private donations by group of donor to changes in government research funding. Utilizing a data set that spans more than twenty-five years of data on private donations and federal government research funding to private and public research and doctoral institutions, I study the impact on changes in government funding on donations by alumni, corporations, foundations, other individuals, and those given as a bequest. After controlling for potential endogeneity and omitted variable bias, I find that federal research funding has a positive impact across all types of private donations. Across all donations, the effect of increasing federal research funding by one dollar is an increase of total donations by 75 cents. The effect on the different types of donors varies, suggesting differences in the reactions by these different types. The average effect of a dollar increase in federal research funding ranges from 6 cents for bequests to 27 cents for alumni donations.

The results that do not control for endogeneity or omitted variable bias suggest the reaction by alumni, corporations, foundations, and other individuals at private universities is greater than the reaction by these types of donors at public universities. After controlling for endogeneity and omitted variable bias, however, the difference in the reaction between private and public universities is not statistically significant for donations except those from alumni. With respect to alumni, the results suggest private donations by alumni at private universities increase by 60 cents for a dollar increase in federal research funding whereas the increase at public universities is slightly negative but imprecisely measured.

I. Framework and Data

The framework for analyzing the relationship between private donations and government grants to research universities is provided in Payne (1999). That paper follows the traditional theories of crowd-out and crowd-in as presented in Andreoni (1990), Rose-Ackerman (1981), Sugden (1982), Sugden and Weisbrod (1998), Cornes and Sandler (1984), Feldstein (1980), Warr (1983), and Steinberg (1987), among others. Under this literature, private and public funding are treated as inputs used to produced a particular charitable good. The difference in the relationship between these two inputs depends on the motivation of and on the level of information about the charitable good being produced by the private donor. If donors are not completely informed about the good or service provided by a nonprofit organization they may look at government funding as a source of information about the good in addition to treating it as a substitute. Under this scenario, there is both a negative (from the substitution between the two inputs) as well as a positive (from the information provided through the change in government funding) impact of a change in government funding on private donations. Under complete information, however, theory suggests a reaction that would range from zero to a negative dollar for dollar substitution between private donations and government funding depending on the motivation underlying the private donation. If the donor gives for purely personal or egoistic reasons, there should be no relationship between the private donations and government funding. If the donor gives for purely altruistic reasons, there should be a dollar for dollar crowd-out effect.

Within this framework, we can allow different groups of donors to have different motivations for giving as well as different levels of information regarding the actions being taken by the universities. Donors to universities include not only alumni but also corporations and foundations. Unlike alumni, these types of donors are likely to be giving because they are

interested in furthering a specific line of research. Most foundations, for example, distribute their funds upon receiving requests for research funding which focuses on just a few areas of research. In comparison to government research funding, donations from foundations and corporations are more likely to mirror the process used to allocate government funding.

Alumni, although interested in research, may also be interested in giving for reasons that include matters such as the quality of the instruction at the university, the success of alumni at the institution, and the quality of the sports and other activities at the university. With respect to alumni and individual donations, the process is likely to vary insofar as the individuals are not likely to undertake the same amount of effort and expense in ascertaining a university's research quality.

The above framework, however, assumes the university only produces one type of research and that the inputs used towards research are substitutes. Private donations and government funding may be used in slightly different ways to produce different goods. For example, government funding may be directed at more basic research that tends to be under provided in the private sector, whereas private funding may be directed more towards applied research. Similarly, private funding may be directed at instruction. Although private and public funding may be directed at different types of goods provided by the university, there still may be spillover effects from changes in government funding.[2] To illustrate this, consider the following model. The university may be thought of producing R, a composite set of goods that pertain to research. R is a function of school quality θ, private donations p, and government grants, g:

$$R = \theta v(g + \alpha p) + \theta s(g) w((1 - \alpha) p) \quad (1)$$

[2] Similarly there may also be spillover effects from private funding on government funding, however, since this paper is concerned specifically with the impact of government funding on private funding, I concentrate only on the spillover effects from government funding.

where v represents a concave function common across all institutions representing the research that is conducted using government funding and all or part of private donations, w represents a concave function common across all institutions representing the research good that is different from that produced by v and uses all or part of private donations, s is a concave function representing the spillover effect of g on the research good on w, and α is the share of private donations that is used to produce the good represented by v. Using this framework, we can allow differences between the types of goods produced with research money from the different sources of funding. The spillover effect, s, may be thought of generally to include such things as extending the results from basic research to applied research projects, a required matching of private and public funding for a big research project, as well as complimentarity aspects between private and public funding. Although the framework concentrates on research goods, instruction can be incorporated into the model since instruction can be considered, at least in part, part of total research output by a university.[3] Within this framework, the signalling effect of government funding for private funding is a subset of the spillover effect; in this context, s(g) may be thought of as a signal of quality that affects private donations.

Equation (1) allows the university to value private donations and government funding differently by placing different values on the functions v and w. Private donors maximize an indirect utility function that represents the value of the research provided less the disutility of the donation:

$$R = \theta v(g + \alpha p) + \theta s(g) w((1-\alpha) p) - p \qquad (2)$$

After solving for the optimal private donation, p*, it is straightforward to show an increase in g results in a change in p*:

[3] For example, research funding is used to support graduate and undergraduate students through tuition waivers and research assistantships. In addition, research findings are used in the classroom in many instances.

$$\frac{dp^*}{dg} = -\frac{\theta v''(g+\alpha p) + \theta s'(g) w'((1-\alpha)p)}{\alpha^2 \theta v''(g+\alpha p) + (1-\alpha)^2 \theta s(g) w''((1-\alpha)p)} \tag{3}$$

The sign of the denominator is negative due to the concavity of v and w, thus, the sign of equation (3) depends on the numerator. The first term in the numerator is negative and the second term is positive since s is increasing in g. Thus, the government funding is a substitute for private donations and has a positive effect on donations through the complementarity between the g and the production of w. The direction of the change in private donations due to a change in government spending depends on whether the effect from the spillover effect from government funding dominates the substitution effect.

Across the different groups of private donors (alumni, bequests, other individuals, corporations, and foundations), the impact of government funding on donations is likely to vary since the types of goods produced with the private funding and the level of information will vary across the different types of funding. Informational asymmetry is likely to be more of a problem with respect to alumni and other individuals insofar as any given individual would have to undertake a great expense to ascertain information about the quality of a university's research program. Assuming the uses of alumni donations go more towards instruction, the spillover effects from government research funding is likely to be less than if the funding is going directly to research. With respect to corporations and foundations, however, I expect the informational asymmetry to be smaller with these types of donors but that the spillover effects to be stronger.

Utilizing the above framework, we can explore the relationship between federal research funding and private donations to research universities:[4]

$$\mathrm{P_{it}} = \alpha_i + \beta_t + \lambda_{prt} + \gamma G_{it} + \varepsilon_{it} \tag{4}$$

[4] By research universities, I utilize the Carnegie (1994) classification of higher educational institutions and those schools classified as a research or doctoral university. These schools, in general, award a minimum level of Ph.D. degrees across several disciplines. There are approximately 236 universities that meet this qualification.

Where P represents private donations and G represents federal research funding by school i at time t. Included in the analysis are school fixed effects (α), a time trend (β), and a regional time trend for public and private schools separately (λ). The school fixed effects controls for differences across the schools that are not time-varying that may affect the relationship between federal research funding and private donations. For example, we may expect a well-known school to receive greater private and public funding than a school that is not as well known. The time trend controls for time-varying changes that affects all schools similarly; these effects include macroeconomic changes, changes in the government policy towards research funding, and changes in federal tax codes which affect private donations. The universities studied have been grouped into nine regions.[5] The regional time trend controls for time-varying changes that may affect the schools located in the same region similarly. Schools located within the same region may be affected similarly to changes in government policy, economic and demographic conditions. Given, however, that private schools may be affected differently from public schools, the regional time trend is interacted with a dummy variable representing whether the university is public or private.

The federal research funding measures and institutional information were gathered from CASPAR, the data base maintained by the National Science Foundation which gathers data collected by several government agencies from universities. Most of the data are collected on a yearly basis since 1969 or later and cover all research and doctoral universities.[6] The federal research funding term measures all funding expended during the academic year obtained from

[5] The following states are covered within each region: Region 1: Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont. Region 2: New Jersey, New York, and Pennsylvania. Region 3: Illinois, Indiana, Michigan, Ohio, and Wisconsin. Region 4: Iowa, Kansas, Minnesota, Missouri, North Dakota, Nebraska, and South Dakota. Region 5: District of Columbia, Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia. Region 6: Alabama, Kentucky, Mississippi, and Tennessee. Region 7: Arkansas, Louisiana, Oklahoma, and Texas. Region 8: Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming. Region 9: Alaska, California, Hawaii, Oregon, and Washington.

[6] Access to the CASPAR data set is at www.nsf.gov.

the U.S. government. This funding includes funds obtained under peer-reviewed processes as well as through other processes such as congressional earmarking.[7] The research funding may represent funding awarded in the year for which the expenditure is made as well as funds awarded in prior years.

Private donations were obtained from the Council for Aid to Education (CAE). CAE conducts annual surveys of universities in which the university is asked to supply information on the donations received during the academic year. The data contain information on total donations received as well as different categories of donations. I examine total donations and donations from alumni, corporations, foundations, as bequests, and from individuals other than alumni and parents of students.[8] Although most schools respond to the surveys, because the CAE is a voluntary survey, the schools do not always respond to the survey every year.

Table 1 reports the summary statistics for federal research funding and private donations. The number of schools for which there is a positive value recorded in the data set between 1973 and 1997 is reported in column (1). In column (2) I report the number of observations. Columns (3) through (6) report the mean, standard deviation, median, and maximum amounts, respectively. In column (7), I report the average fraction per total donations the subgroups of private donations represent. All dollar amounts are reported in 1993 dollars. On average, annual federal research funding is $39 million where as annual total donations is $27 million. Alumni donations represent an average of 23 percent, corporate donations represent 26 percent, and foundation grants represent 18 percent of total donations. Average donations from bequests are

[7] Earmarked funds are, in general, specifically identified in the budget passed by the U.S. Congress which directs agencies to allocate specific funding to a particular school. Although the level of earmarked funds has increased dramatically over the last ten years, funding that is allocated through a peer reviewed process represents the majority of research funding.

[8] Donations gathered are those received by the university and designated for charitable purposes. Excluded are amounts received under a contract (e.g. contracted research). The category of corporations includes business-sponsored foundations (those organizations that have been created by and funded exclusively by a business).

$3 million and average donations from other individuals are $5 million, representing, on average, 9 and 21 percent of total donations.

Figures 1 and 2 depict funding over time for the sample of universities studied. Figure 1 depicts total federal research funding and total donations for the sample of schools with observations in every year between 1973 and 1997.[9] Throughout the entire period, federal research funding is greater than total donations. Both types of funding, however, have increased over time. The gap between total federal funding and private donations narrowed considerably in the mid-1980s, but then widened again after 1987. Presumably this widening represents, in part, a change in donor behavior after the Tax Reform Act of 1986 increased the price of giving for most donors. In more recent years, the gap appears to be narrowing again.

Figure 2 depicts the average ratio of donation by category type to total donations over time. Alumni donations, other individuals (not depicted in the graph), and bequests have not changed much over time. Corporate donations have increased somewhat, especially after the early 1980s. Foundation grants appear to be falling during the period.

Table 2 reports average federal research funding and private donations across public and private universities. Private universities, on average, receive more than public universities in federal research funding and in all types of donations. The average difference between the types of schools for federal research funding and total donations is $5 million and $19 million, respectively. The distribution of private donations across public and private universities varies with public universities relying most on corporate donations and private universities relying most on alumni donations.

Figure 3 graphs the relationship between private donations and federal research funding. There appears to be a positive relationship between federal research funding and total donations

(panel A), alumni donations (panel B) and corporate donations (panel C). The relationship between federal research funding and foundation grants (panel D), bequests (panel E), and other individuals (panel F) is less clear. Although not depicted separately, the relationship between private donations and federal research funding at private and public universities is similar to that depicted in Figure 3; there appears, however, a slightly clearer positive relationship between federal funding and private donations at public universities than at private universities.

II. Results

A. OLS Estimation

Table 3 reports the results from the OLS estimation of equation (1). These results assume federal research funding is exogenous and that there is no bias in the coefficients from omitted variable bias. Overall, across all categories of donations, the results suggest a positive and significant relationship between federal research funding and private donations. Government funding seems to have a more positive effect on donations for current expenditures, alumni, corporate, and foundation grants. Moreover, there appears to be a distinct difference in the relationship between federal funding and the different types of donations across private and public universities.[10]

The odd columns (1, 3, 5, 7, 9, and 11) report the results when the relationship between private and federal funding is assumed to be the same across private and public universities. Across all donations, increasing federal research funding by one dollar increases private donations by 56 cents. Across the different types of donors, private donations rise with increases

[9] There are 77 universities with observations in every year. If instead of using total donations and federal funding to these schools I use the average donations and federal funding across the entire sample, the relationship is similar to that depicted in Figure 1.

[10] In addition to using the federal research funding at time t in the regression, I also tried various lags in the federal research funding. The results are similar regardless of the lag in the federal government measure. Presumably this is because the federal research funding covers monies expended for research in year t and not the total amount awarded in federal research funding in that year. Thus the expenditures covers monies expended in the given year from grants awarded over a multi-year period.

in federal research funding, ranging between 2 cents for bequests and 17 cents for alumni. Although the largest difference in the change in private donations across alumni, corporations, and foundations is only 7 cents, it is somewhat surprising that the biggest effect is seen with respect to alumni and not corporate or foundation giving. Also surprising is that despite the likelihood that the information provided and/or spillover effects are likely to be different by alumni, corporations, and foundations, the average relationships between the private donations and federal funding are similar across these three types of donors.

The odd columns of Table 3 report the results when the assumption that the relationship between federal funding and donations is the same across private and public universities is relaxed. To relax the assumption I interacted the federal research funding measure with a dummy variable presenting whether the university is private or public. These results are reported in the even columns of Table 4. Except for funding from foundations and bequests, the relationship between federal funding and private donations vary based on whether a school is public or private. In general, there is a much stronger relationship between federal funding and private donations at private universities. Moreover, across the different types of donors, there are bigger differences in the reactions to changes in government funding by the private schools. The strongest relationship remains the alumni, suggesting that on average, an increase in federal funding will increase private donations by 27 cents; corporate donations increase by 15 cents and foundation grants increase by 12 cents. For public universities, an increase in federal funding by one dollar will increase alumni, corporate, and foundation giving an average of 10 cents. Potentially the smaller effect seen at public universities could be attributed to a difference in the efforts expended by the university for private funding. In addition, if state governments react to changes in federal research funding in a similar fashion as private donors, the overall effect of a

change in federal research funding may be similar to that at private universities. The role of state governments with respect to research funding, however, is left for future research.

B. Two Stage Least Squares

The results from Table 3 suggest a strong and positive relationship between private donations and federal research funding. They also suggest the relationships vary across the different types of private donations and between private and public universities. These results, however, assume there is no bias in the results from omitted variable or endogeneity bias. Omitted variable bias arises if there are measures that affect private donations that are not included in the estimation that are correlated with the federal research funding measure, thereby biasing the coefficient. For example, if the time and regional time trends do not control effectively for changes that would affect the activities of the universities (e.g. modifying the nature of the research being conducted by the university or the level of research and/or programs offered by the university), there could be omitted variable bias. If the reactions by private donors and the federal government to such changes are in the same direction, this would suggest a positive bias, which could explain, at least in part, the positive coefficient on the federal research funding measure.

Endogeneity bias arises if federal research funding is not an exogenous measure. Although the theoretical framework assumes the government moves first and private donors react second, if the government does not always move first, there is a potential problem with endogeneity. Thus, if federal research funding and private funding are jointly determined (e.g. a researcher seeks funding from both the federal government and a foundation) or if government agencies look at private funding before awarding federal funding in some instances, raising an

issue of causality, the results could be biased.[11] Following the framework that treats private and public funding as two inputs that are used in a university's production function, the inputs should be simultaneously determined.

To control for these biases, I utilize a two stage least squares estimation in Tables 4 and 5. Provided the federal research funding is estimated in the first stage using measures that explain federal research funding but do not directly explain private donations, the potential bias from endogeneity and omitted variables will be removed. As explained in more detail in Payne (1999b) and Payne and Siow (1999), one set of measures that may be used to instrument federal research funding are those that affect the shadow price of federal research or the ease with which federal research funding may be obtained. Given federal research funding is allocated by government agencies and those agencies depend on Congress for their budgets, having representation on the two congressional appropriations committees (one in each chamber) may affect the ease with which funding is allocated to a particular university.[12] To proxy this, I use two measures that indicate whether a school has members on the appropriations committees from which he received an undergraduate degree. Each measure is the number of general members on the appropriations committee that received an undergraduate degree from the university for the Senate and House committees.[13]

[11] Connolly (1997) examines the issue of causality between internal and external research funding at universities and finds a positive correlation between the two types of funding. External research funding is defined as all monies received from public and private sources; internal research funding is defined as monies allocated within the university for research purposes.

[12] On the assumption that there is a strategic interaction between agencies and Congress, even utilizing a peer-review process in awarding federal research funding, an agency still has an incentive to reward schools that have an affiliation with the members of Congress primarily responsible for determining the agency's budget. See Payne (1999b) for a fuller explanation of the theoretical underpinnings of the relationship between Congress and agencies.

[13] Other measures that could be used include two dummy variables for each chamber that indicate whether there is a member on the appropriations committee that is the majority leader or the ranking minority member on the committee. The coefficients in the 2SLS regression are similar to those reported if these measures are included In addition, measures that reflect whether a university is located in an appropriations committee member's congressional district (state if the member is a Senator) could also be used. In general, however, these measures, although strong predictors for federal research funding, do not satisfy the over-identification test used to determine whether the instruments belong in the first or second stage regressions.

Other measures that may reflect the ease with which a school may be awarded federal research funding concerns the level of research funding awarded to other universities. This type of measure represents two types of effects. First, if other schools are receiving research funding, given the government has a fixed budget from which to allocate research funding, the amount of funds which may be allocated to a given school is smaller. The second effect reflects changes in government policy or a shift by the schools with respect to the types of requests and uses of research funding that may not be absorbed in the time and regional time trends which lead to a shift in policy that may benefit or detriment all schools. Thus, with such a measure, the effect of federal research funding to other schools may be positive or negative depending on which effect dominates the other. For this measure, I use the average federal research funding expended by schools of the same type of ownership (private or public) and the same Carnegie (1994) classification (Research I or II, or Doctoral I or II) located outside of the region in which the school is located.

For both types of instruments, I lag the measures by 2 years. Given congressional budgeting is done in one year and the agency allocations may not be expended by the university until a future year, the lag controls for this difference in timing.[14] Tables 4 and 5 report the results that use 2SLS to estimate the relationship between federal research funding and private donations. Table 4 reports the estimates using the assumption that the relationship between these two measures does not vary based on whether the university is private or public. Table 5 reports the estimates that relax this assumption.

Column (1) of Table 4 reports the coefficients on the instruments in the first stage regression. Overall, the F-statistic on these instruments is significant at less than a one percent

[14] Varying the lag or using different combinations of the instruments do not change the results reported in Tables 5 and 6. With respect to the lag, this is due in part to the fact that a member of Congress serves an average of 7 years on the appropriations committee; given the estimation incorporates school fixed effects, the congressional measures

level. Individually, the coefficient on the federal research expenditures for schools outside of the regions is positive, suggesting that if average federal research expenditures outside of the region increase by one dollar, research expenditures will increase by 86 cents. This positive coefficient suggests universities of the same ownership type and Carnegie classification benefit jointly from changes in government policy in research funding and/or these universities engage in similar behavior in seeking federal research funding. The coefficients on the Senate and Appropriations committee measures are also positive and significant. They suggest that by serving on the appropriations committee, a member with an alma mater affiliation joining the committee can increase federal research funding an average of $2.7 million in the Senate and $2.3 million in the House.[15]

The remaining columns of Table 4 report the coefficients on the federal research funding measure in the second stage regression for each category of private donations. Table 4 also reports the statistics and p-values for the over-identification and Hausman (1978) tests. The over-identification test measures the extent to which the instruments used in the first stage regression have any predictive value in the second stage regression.[16] The Hausman test measures the extent to which the coefficient from the second stage regression is different from the OLS regression.[17]

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are capturing movements on and off the committees as well as movement between general membership and leadership positions on the committees.

[15] As explored in Payne (1999b), the data suggest schools that have a member with more than 11 years on the appropriations committees who attended the school benefits the school more than a member with less than 11 years of service on the committee.

[16] The test is performed by regressing the residuals from the second stage regression on the instruments and other exogenous measures. The test statistic is the number of observations used in the regression multiplied by the r-square and is a chi-square distribution with degrees of freedom equal to the number of instruments less one. If the statistic is significant, the instruments may belong in the second stage regression and, therefore, are not acceptable set of instruments.

[17] The test is performed by regressing the measure of private donations on the real and predicted federal funding measure and the exogenous measures. The statistic is the f-statistic on the predicted federal funding measure; a significant f-statistic suggests the 2SLS estimation is more consistent than the OLS estimation.

With the exception of alumni donations and bequests, the over-identification test is satisfied; the p-values are greater than .20. For the specification that uses alumni donations as the dependent variable, the p-value on the chi-square statistic for the over-identification test is .004; the p-value of the specification that uses bequests as the dependent variable is .08. The significance of the chi-square statistic in these two instances suggests the instruments have some predictive value in the second stage regression. Presumably, the instruments in addition to measuring a change in the shadow price of federal research funding proxy some omitted variable that is correlated with both federal research funding and alumni donations.

The F-statistic for the Hausman test is significant at less than a five percent level for all of the specifications except the specification that uses corporate donations as the dependent variable. The significance of the F-statistic suggests the coefficients from the second stage regression are more consistent than those from the OLS regression.

Across all measures of private donations, except for the corporate donations, the 2SLS coefficient on federal research funding is greater than the OLS coefficient and is statistically different from zero. For total donations, the results suggest that by increasing federal research funding by one dollar, total donations will increase by 75 cents. A greater coefficient in the 2SLS estimation suggests the bias from endogeneity and/or an omitted variable is downward. If the bias stems only from omitted variables, this suggests there are unmeasured shocks that are negatively correlated with government funding and positively correlated with private donations or vice versa. An example of such a correlation might involve a university that decides to engage in more complicated research. Potentially, the government (because of its use of a peer-review process in awarding research funding) understands the relevance of more complicated research than private donors. In the OLS specification, by not controlling for this type of change by the university, under the above scenario the change would negatively affect private donations

and positively affect federal research funding, and thus the coefficient on the federal research funding measure would be negatively biased. Another explanation of a negative bias involves shifting from basic to applied research. Presumably, private donors and the government may prefer opposite types of research. If a university changes its focus from basic to applied research and this is not captured in the other measures, this could cause a downward bias in the OLS coefficient.

In addition to more positive coefficients in the 2SLS estimation, there are more striking differences across the types of donors. Alumni remain the more reactive group to changes in federal funding insofar as the coefficient on the federal funding measure in the specification using alumni donations as the dependent variable is greater than the coefficients for the other types of donations. Foundations, however, are more reactive to changes in federal research funding than corporations. These differences across the different types of donors suggest a difference in the types of reactions and, therefore, the reasons for reacting to changes in federal research funding.

Table 5 reports the coefficients in the specifications that allow the relationship between federal funding and private donations to vary across the private and public universities. The first two columns report the coefficients and F-test on the instruments in the first stage regressions for the public and private universities, respectively. In the first stage, the reactions to the political measures vary based on the ownership of the university. The coefficients are more positive and stronger for the public universities than for the private universities. The reactions to average research funding by schools located outside of the region in which the university is located, are similar across both types of universities.

In the second stage, with the exception of alumni donations, the coefficients on the federal research funding measure are no longer significantly different between private and public

universities. This suggests the differences that were seen in the OLS regression (Table 3), reflect differences in the difference in reactions by the federal government and private donors to omitted variable across the universities based on ownership. By using a 2SLS set up, the first stage regression effectively controls for differences in the level of research funding received by private and public universities due to factors that affect the shadow price of research funding.

With respect to alumni donations, the positive impact of federal research funding is only seen in the private universities. The coefficient on the federal funding measure for public schools is slightly negative but not statistically different from zero. This suggests a difference in the role played by alumni with respect to giving at private and public universities. Anecdotally it is believed that public universities have not placed as great an emphasis on alumni donations as private universities. This is also seen in the means for alumni donations reported in Table 2. The difference in reaction to federal research funding could, therefore, reflect a difference in the emphasis placed on alumni donations by a university and/or a difference in the uses of alumni donations by the university. If, for example, alumni donations are used more for non-research related activities (e.g. sports and extra-curricular activities) at public universities, we should expect there to be less of a relationship between alumni donations and federal research funding.

C. Robustness of Results

In measuring the effect of federal research funding on private donations using a 2SLS method of analysis, several sets of instruments were utilized. These instruments included variations of the political measures and the regional measure of outside funding; these variations included using different lags for the instruments as well as variations in the construction of the measures.[18] For the most part, the coefficients on the federal research funding measure were similar to those reported in Tables 4 and 5. Although, the f-statistic for the instruments in the

first stage regression were always significant at less than a 5 percent level, in some instances the over-identification test was not always satisfied. There are two sets of instruments used that are illustrative of the other instruments.

The first set used the level of research funding outside of the region in which the school is located by type of ownership but not by Carnegie (1994) classification along with the political measures as instruments. In the set of regressions using the assumption that the reaction by public and private universities to changes in federal funding is the same, the over-identification test was not satisfied in most of the specifications. The coefficients on the federal funding measures were all slightly lower than those reported in Table 4. For example, the coefficient for the specification using total donations as the dependent variable, the coefficient was .58. In the set of regressions that allow the reaction to federal research funding to vary across public and private universities, the over-identification test is satisfied in most specifications. The differences in the reactions are statistically significantly different from each other for the corporate donations and bequests. Most notably, the reaction by corporate donors is negative (-1.36) at private universities and imprecisely measured at public universities. These results when compared to the results in Tables 4 and 5 suggest two things. First, that the part of the instrument that captures federal research funding outside of a region in which a school is located that is allocated to schools of the same type of ownership but different Carnegie (1994) classification not only predicts the federal funding but also helps to explain private donations to the school. The results suggest the reaction to this type of measure by private donors is opposite to that of the federal government. In addition, the results suggest that corporate behavior towards unmeasured shocks varies based on whether the university is public or private.

[18] For example, in Payne (1999b) the results suggest the alma mater effect is strongest for the senior members on the committee; thus instead of using the measure of the number of general members on the committee, I used the measure of the number of senior members on the committee with an alma mater affiliation.

The second set of instruments used that produced slightly different results is the same set used in Tables 4 and 5. Included, however, in both the first stage and second stage regressions, was a measure of the average research funding to schools located within the same region as the school studied with the same type of Carnegie (1994) classification (lagged by 2 years). The inclusion of this additional regressor diminished the f-statistic for the instruments in the first stage regression slightly; the coefficient in the first stage regression was positive and statistically significant. In the second stage regression, the coefficient on this regressor was negative and significant for total and alumni donations and foundation grants; the coefficient was positive and significant for the corporate donations. The coefficient on the federal research funding measure, however, is more positive than those reported in the Table 4 for all specifications than the specification using corporate donations as the dependent variable.[19] These results illustrate the points raised above that there may be omitted variables in which private donors and the government react differently, as well as that corporate donors behave differently from other types of donors.

III. Conclusion

There are many studies that examine private donations and/or government funding to research universities and other nonprofit organizations. Few studies, however, examine the differences in the relationship between government funding and private donations across different types of donors. This paper examines this issue for private and public research universities in the United States. In particular, I examine the differences between federal research expenditures and donations by alumni, corporations, foundations, and other individuals, as well as bequests. The framework used to analyze these relationships allows for a positive correlation between the private donations and government funding due to informational

[19] The coefficient on the federal funding measure is as follows for the following specifications: Total Donations: .88;

asymmetries about the quality of the research and/or potential spillover effects between different uses of research funding.

Using the preferred specification, the results suggest a positive correlation between private donations and federal research funding across all types of donors. The effect of increasing federal research funding by one dollar ranges from 6 cents for bequests to 27 cents for alumni donations. The reaction by corporations and foundations differs from alumni donors between nine and fifteen cents. Using other results as reported in the paper, the results also suggest the motivation and behavior of corporations to changes in federal research funding and other things at the university level is different from that of alumni and foundations.

Overall, the results suggest there are differences in the behavior and reactions by the five types of donors studied in this paper. The evidence suggests that there are spillover effects from government research funding on these different donor groups. The spillover effects, although not conclusive, stem most likely from the complementarity in the types of goods produced by a research university that use different amounts from the various types of donations and federal funding. In addition, given the strong correlation between research funding and alumni donations, the evidence suggests that some donors may use government funding as a signal of quality regarding the research and other goods produced by the university.

Alumni Donations: .36; Corporate Donations: .09; Foundation Grants: .23; Bequests (.06, not statistically significant); Other Individual Donations: .15.

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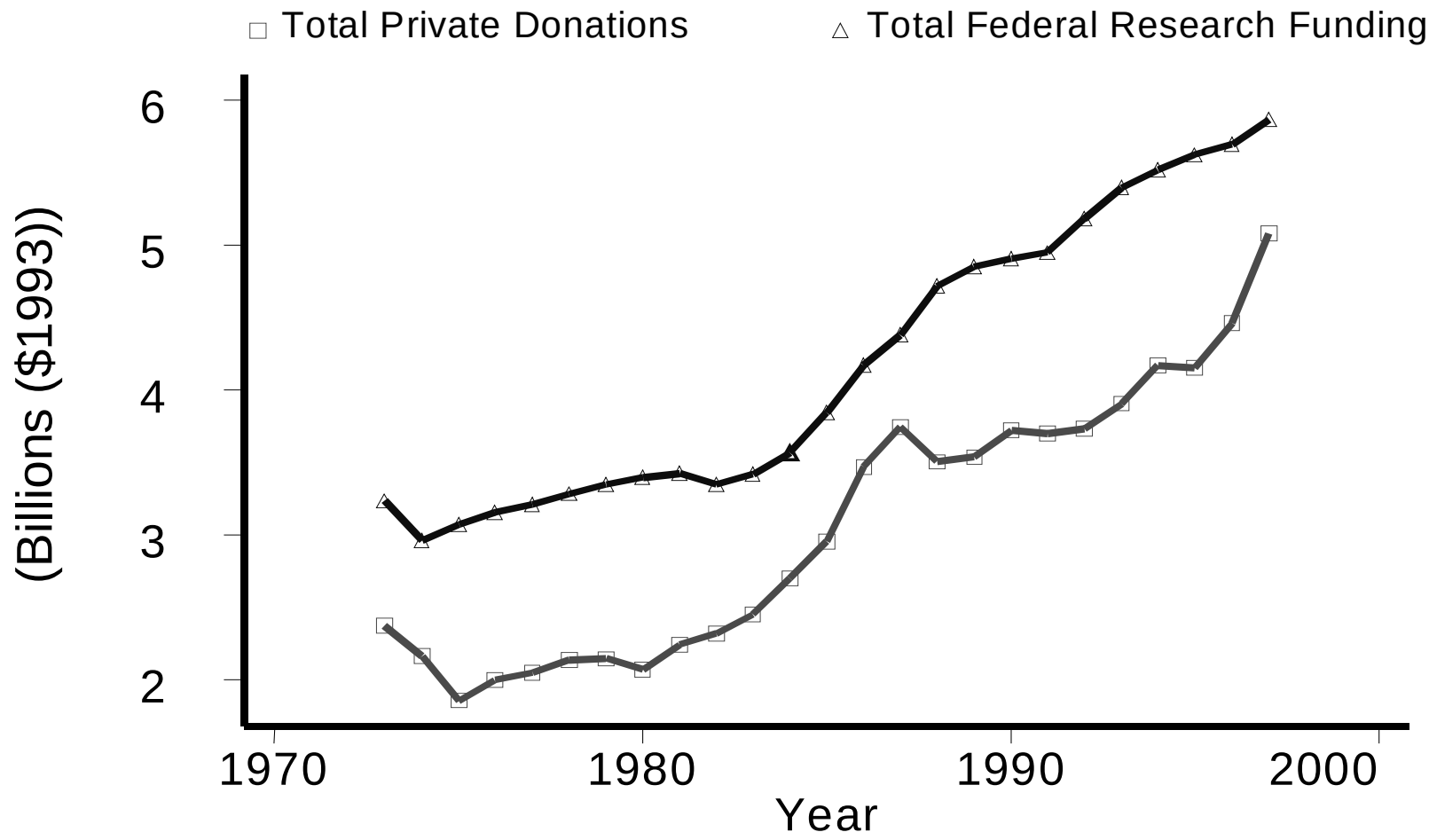

Figure 1: Total Private & Federal Funding 1973-1997

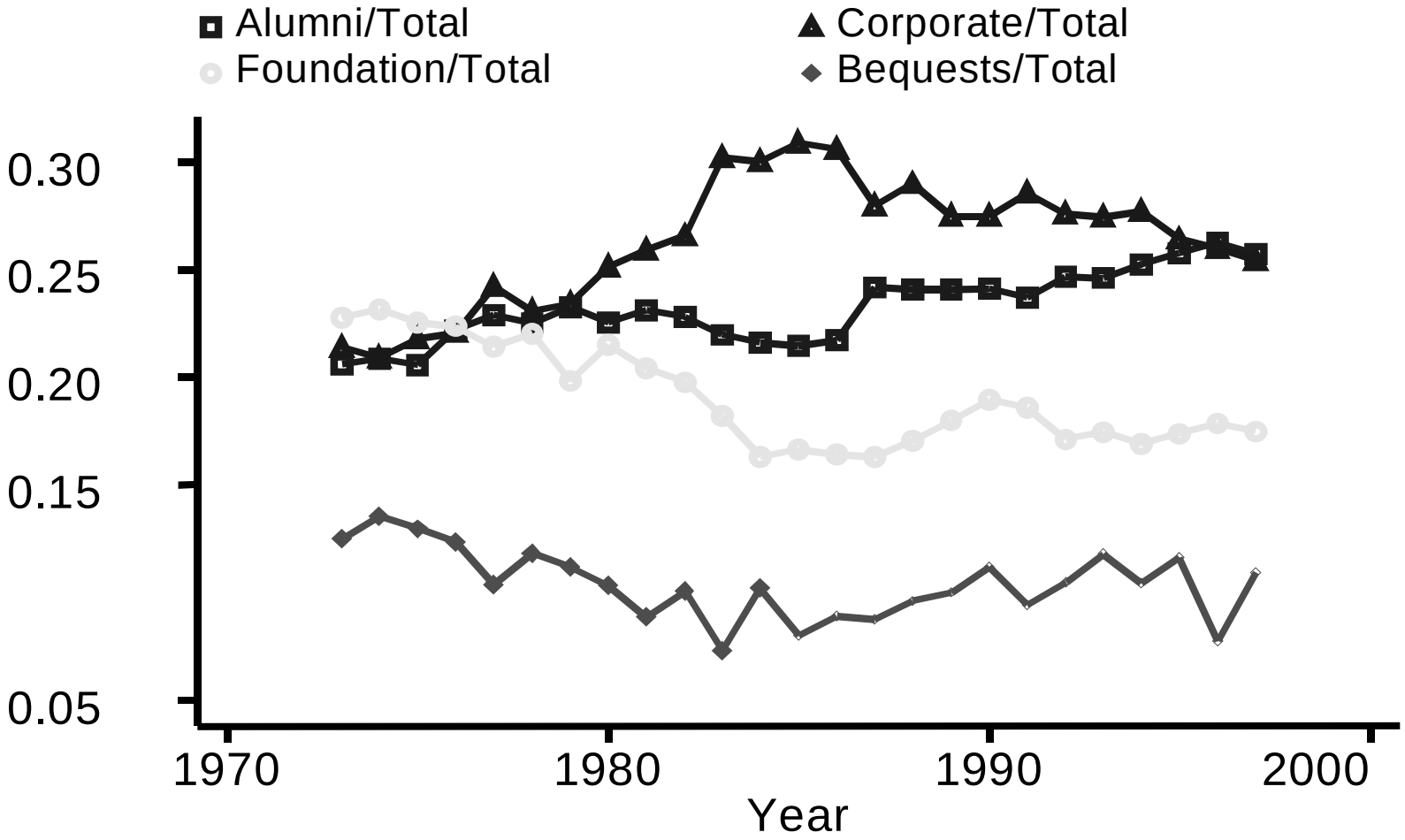

Figure 2: Average Donation Rates, 1973-1997

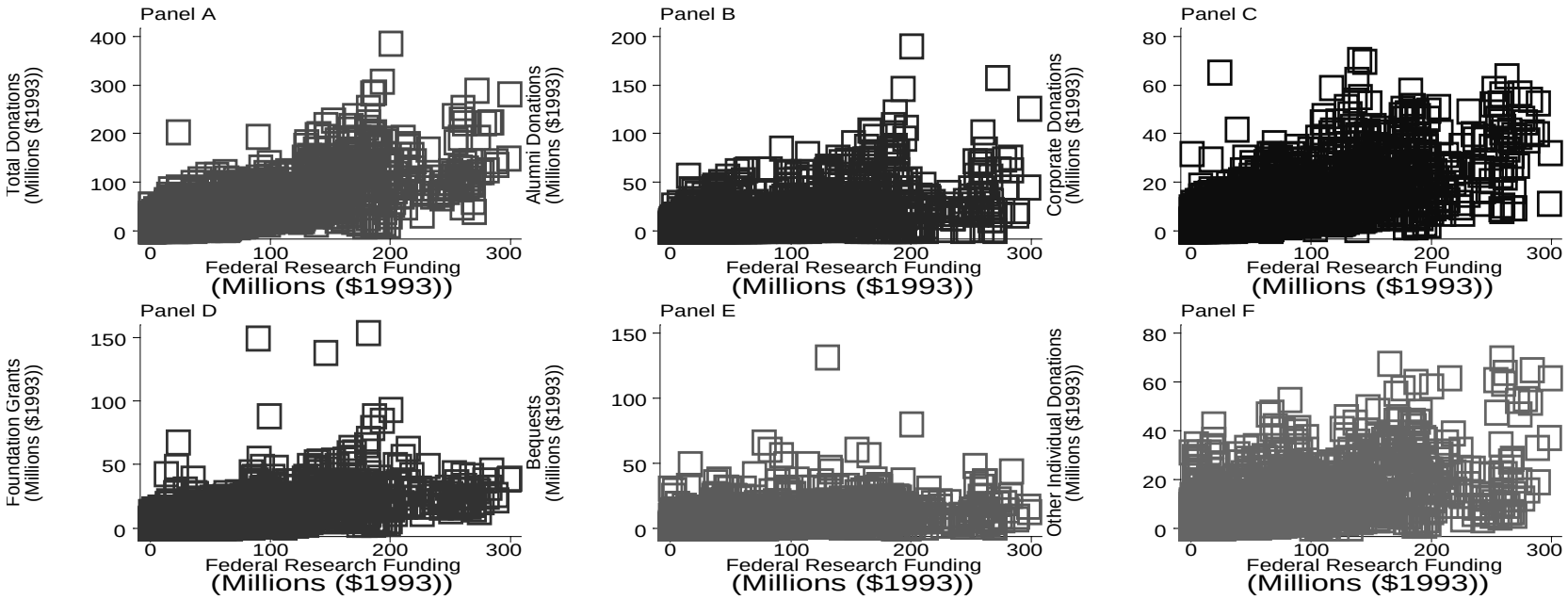

Figure 3:
Private Donations & Federal Funding

Table 1: Average Federal Research Funding and Private Donations

	# of Schools (1)	# of Observations (2)	Mean (3)	S.D. (4)	Median (5)	Maximum (6)	Per Total Donations (7)
Federal Research Funding	221	4373	39.24	52.76	16.88	299.15	
Total Donations	221	4373	27.07	35.86	13.81	384.98	
Alumni Donations	220	4331	7.00	12.82	2.51	189.67	0.23
Corporate Donations	220	4365	6.32	8.62	3.07	70.15	0.26
Foundation Grants	221	4300	5.86	9.74	2.06	153.08	0.18
Bequests	218	3697	3.42	6.47	1.11	131.32	0.09
Other Individual Donations	221	4334	5.35	7.99	2.25	69.60	0.21

Note: all dollars are reported in 1993 values and in millions

Table 2: Average Private Donations and Federal Funding By Type of Ownership

	Public Universities					Private Universities				
	# of Schools (1)	# of Observations (2)	Mean (3)	S.D. (4)	Per Total Donations (5)	# of Schools (6)	# of Observations (7)	Mean (8)	S.D. (9)	Per Total Donations (10)
Federal Research Funding	143	2612	37.24	48.38		78	1761	42.22	58.53	
Total Donations	143	2612	19.40	24.39		78	1761	38.45	45.77	
Alumni Donations	142	2590	4.08	6.30	0.21	78	1741	11.33	17.84	0.26
Corporate Donations	142	2604	5.80	7.93	0.30	78	1761	7.09	9.51	0.20
Foundation Grants	143	2539	3.66	5.88	0.17	78	1761	9.02	12.84	0.22
Bequests	140	2061	1.99	3.73	0.09	78	1636	5.22	8.43	0.11
Other Individual Donations	143	2579	3.67	5.27	0.20	78	1755	7.83	10.32	0.22

Note: $1993 reported in millions

Table 3: Effect of Federal Funding on Private Donations, OLS

Dependent Variable:	Total		Alumni		Corporate		Foundation		Bequests		Other Individuals	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Federal Research Funding	**0.555**		**0.174**		**0.123**		**0.100**		**0.022**		**0.100**	
	(0.023)		(0.012)		(0.009)		(0.011)		(0.009)		(0.007)	
*Public Schools		**0.436**		**0.104**		**0.102**		**0.086**		**0.031**		**0.078**
		(0.022)		(0.010)		(0.011)		(0.008)		(0.008)		(0.007)
*Private Schools		**0.718**		**0.269**		**0.152**		**0.120**		0.011		**0.130**
		(0.046)		(0.025)		(0.016)		(0.020)		(0.017)		(0.014)
Test Public=Private		30.060		37.680		6.400		2.470		1.150		10.330
(p-value)		(0.000)		(0.000)		(0.012)		(0.116)		(0.283)		(0.001)
# of Observations	4373	4373	4331	4331	4365	4365	4300	4300	3697	3697	4334	4334
R-Square	0.906	0.908	0.838	0.845	0.768	0.769	0.745	0.745	0.555	0.556	0.769	0.771

** school fixed effects as well as a time trend included in all regressions
a region interacted with a public/private dummy and time trend effect also included in all regressions
coefficients in bold indicate a p-value of less than .05; coefficients in italics indicate a p-value of less than .10

Table 4: Effect of Federal Funding on Private Donations, 2SLS

Dependent Variable :	First Stage	Total	Alumni	Corporate	Foundation	Bequests	Other Individuals
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Federal Research Funding		**0.753**	**0.270**	**0.122**	**0.181**	**0.057**	**0.130**
		(0.038)	(0.021)	(0.011)	(0.018)	(0.015)	(0.012)
Instruments (2 year lag)							
Ave Fed Research Funding	**0.856**						
in Other Regions*	(0.026)						
Senate Appropriations	**2.656**						
General Member	(1.028)						
House Appropriations	**2.324**						
General Member	(0.776)						
F-Test on Instrument	386.320						
(p-value)	(0.000)						
Over-Identification Test		0.091	11.147	0.231	3.208	0.359	0.721
(p-value) (2 d.f.)		(0.955)	(0.004)	(0.891)	(0.201)	(0.084)	(0.697)
Hausman Test		52.570	41.040	0.010	51.820	8.610	8.800
		(0.000)	(0.000)	(0.934)	(0.000)	(0.003)	(0.003)
Number of Observations	4136	4136	4101	4129	4067	3524	4101
R-Square	0.967	0.903	0.832	0.773	0.741	0.542	0.772

** school fixed effects as well as a time trend included in all regressions; a region interacted with a public/private dummy and time trend effect also included in all regressions

* Average Federal Research Funding is computed for universities in the sample that are located outside of the region and have the same type of ownership (public/private) and same Carnegie classification

coefficients in bold indicate a p-value of less than .05; coefficients in italics indicate a p-value of less than .10

Table 5: Effect of Federal Funding on Private Donations, 2SLS, Private/Public Universities

Dependent Variable:	First Stage Public*Gov (1)	First Stage Private*Gov (2)	Total (3)	Alumni (4)	Corporate (5)	Foundation (6)	Bequests (7)	Other Individuals (8)
Federal Research Funding								
*Public Schools			**0.811**	-0.069	0.121	**0.320**	0.037	*0.154*
			(0.311)	(0.175)	(0.118)	(0.106)	(0.148)	(0.090)
*Private Schools			**0.694**	**0.606**	0.124	0.044	0.073	0.107
			(0.328)	(0.183)	(0.120)	(0.110)	(0.125)	(0.093)
Test Public=Private			0.030	3.610	0.000	1.690	0.020	0.070
(p-value)			(0.853)	(0.058)	(0.992)	(0.194)	(0.894)	(0.795)
Instruments (2 year lag)								
Fed Research Funding	**0.420**	**0.436**						
in Other Regions	(0.021)	(0.021)						
Senate Appropriations	1.523	*1.133*						
General Member	(0.963)	(0.628)						
House Appropriations	**2.880**	-0.556						
General Member	(0.660)	(0.566)						
F-Test on Instrument	141.500	150.790						
(p-value)	(0.000)	(0.000)						
Over-Identification Test			0.010	0.042	0.231	0.714	0.331	0.583
(p-value) (5 d.f.)			(0.995)	(0.979)	(0.891)	(0.700)	(0.886)	(0.747)
Hausman Test			22.410	17.000	0.060	28.860	5.120	3.580
(p-value)			(0.000)	(0.000)	(0.943)	(0.000)	(0.006)	(0.028)
Number of Observations	4136	4136	4136	4101	4129	4067	3524	4101
R-Square	0.960	0.974	0.901	0.791	0.773	0.699	0.540	0.768

** school fixed effects as well as a time trend included in all regressions; a region interacted with a public/private dummy and time trend effect also included in all regressions

* Average Federal Research Funding is computed for universities in the sample that are located outside of the region and have the same type of ownership (public/private) and same Carnegie classification

coefficients in bold indicate a p-value of less than .05; coefficients in italics indicate a p-value of less than .10