Political influence behind the veil of peer review: an analysis of public biomedical research funding in the U.S.*

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ABSTRACT

The U.S. public biomedical research system is renowned for its "peer-review" process that awards federal funds to meritorious research performers. Although Congressional appropriators do not earmark federal funds for biomedical research performers, I argue that they support allocations for those research fields that are most likely to benefit performers in their constituencies. Such disguised transfers mitigate the reputational penalties to appropriators of interfering with a merit-driven system. I use data on all peer reviewed grants by the National Institutes of Health during the years 1984 – 2003, and find that performers in the states of certain House appropriations committee members receive 5.9 – 10.3 percent more research funds as compared to unrepresented institutions. The returns to representation are concentrated in state universities and small businesses. Members support funding for the projects of represented research performers in fields in which they are relatively weak, and counteract the distributive effect of the peer review process.

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1 Introduction

How do politicians concentrate federal benefits in their constituencies when reputational concerns constrain them from making direct transfers to their constituents? An immense amount of research has focused on the transfer of such benefits as rivers and harbors projects, defense contracts, and academic earmarks by Congressmen to their constituencies (see Alvarez & Saving's [1997] review).[1] However, the absence of a counterfactual allocation mechanism for federal benefits makes it difficult to assess the distributive effect of political influence in these studies. A second strand of literature observes that politicians make "indirect" transfers to interest groups when the reputational penalty for making indirect transfers is less than that for making direct transfers (Tullock 1983, Coate & Morris 1995). Again, there is very little empirical analysis of indirect transfers or on the relationship between the form of transfers and the concentration of constituency benefits.

This study addresses the deficiencies posed above by analyzing federal funding for biomedical research in the U.S., which amounted to $28.4 billion for fiscal 2007.[2] The National Institutes of Health (NIH), the agency responsible for biomedical research, supports half of all federal nondefense R&D and over 60% of federal R&D in U.S. universities. The NIH allocates funds among research performers by a mechanism based on "peer review" of the scientific merit of performers' research proposals and is considered an exemplar research agency because of its avoidance of politically mandated performer-specific earmarks (AAAS 2008).

Congressional appropriations bills and committee meeting reports reveal that although committee members do not earmark allocations to biomedical research performers, they frequently support specific biomedical research fields and projects. I argue that members seeking to favor their constituents transfer federal resources to those biomedical fields that are most likely to reach research performers in their

[1] The premise of this research stream on distributive politics is that politicians seek to enhance their reelection prospects by transferring federal benefits to their constituencies. Congressional institutions such as committees are structured to facilitate these transfers (Mayhew 1974, Ferejohn 1974, Fiorina 1977 Weingast & Marshall 1988).

[2] NIH accounts for 20% of all federal R&D which in 2007 was estimated to be 1% of GDP (AAAS 2008).

constituencies. Such indirect transfers to members' constituencies, couched in the form of patronage for particular research topics, are more palatable to the scientific community and the public than direct transfers to performers that bypass the peer review procedure for distributing research funds.

I test whether research performers in the states of appropriations committee members receive a higher level of peer-reviewed biomedical research funds by using data on all grants awarded by the NIH to 8,310 external research performers between the years 1984 and 2003 – a period during which federal support for the agency grew from $4.6 billion to $26.3 billion. I exploit the panel structure of the data to control for the possibility that research performers (or states) that receive larger amounts of federal biomedical research funds are more 1ikely to be represented in appropriations committees.

I find each additional member on the House subcommittee that deals with NIH appropriations (the Labor, Health and Human Services, Education, and Related Agencies or the "LHHE" subcommittee of the House Appropriations Committee) is associated with a 5.9% increase in NIH research funding for represented institutions. State universities, which receive the largest share of federal biomedical research funds (41.5% of all NIH extramural awards in FY2003), and small businesses are especially benefitted by House-LHHE representation, receiving increases of 8.8% and 10.3% per House-LHHE member respectively. Representation on the House and Senate appropriations committees is associated with transfers of 2.9 to 6.7% of total NIH extramural research grants for the period of this study. $0.9 billion of the $20 billion worth of peer-reviewed extramural awards made by the NIH in the year 2003 can be attributed to the constituency interests of HAC LHHE representatives.

Does political representation favor R&D performers in those fields of research in which they are relatively "strong," or fields in which performers receive relatively lower funds? I find that research performers in the lowest two quartiles of grant recipients in any biomedical field average a 3.6% - 6.4% increase for research in those fields from House LHHE representation. Research fields in which represented performers are strong however, do not receive larger allocations than otherwise comparable, but unrepresented performers. By contrast, peer review that is not moderated by political representation concentrates funding in the top-quartile research fields of performers. These findings highlight a tension

between the distributive effects of merit-driven allocations and politically motivated transfers – a topic of debate in U.S. science policy at least since Vannevar Bush's 1945 proposal for a politically insulated public R&D system.

The remainder of the paper is organized as follows. Section-2 describes the congressional and bureaucratic institutions that affect the transfer of public funds to biomedical research performers. Section-3 specifies the empirical model and discusses my data. Section-4 reports estimates of committee member influence, robustness checks, and ancillary results. Section-5 examines the effects of committee representation on funding for the stronger and weaker fields of research performers. Section-6 concludes by discussing the implications of political oversight of the American public biomedical R&D enterprise.

2 An overview of the Congressional appropriations process for biomedical research

Politicians in Congressional committees responsible for the allocation of federal resources trade off the electoral benefits of concentrating resources in their constituencies against the reputational consequences of favoritism. Reputational penalties can be imposed by the Congress, which has the power to vote against committee actions, or by other groups that are harmed by committee members' allocation decisions. Politicians may hence prefer "disguised" methods of transfers to avoid detection by the public of the real motivation for transfers. Tullock (1983) calls such methods "indirect transfer mechanisms" and cites as an example a politician who supports the construction of a road routed so as to increase the value of certain pieces of real estate, rather than directly transferring cash to the real estate owner and locating the road optimally (Coate & Morris 1995). [3]

[3] In a political economy model, Coate & Morris (1995) show how uncertainty among voters about the effect of different transfer policies and the type of politicians can result in indirect transfers that are inefficient. The authors cite public projects such as the construction of dams and rivers or earmarks as examples of indirect transfers (see p 1227). Yet, in reality there is little uncertainty about the intended beneficiaries of typical "pork barrel" projects, or their benefits to the rest of the society. The case considered here more accurately illustrates indirect transfers because the public is not well-informed of the effects of allocating money for research in different biomedical research fields.

Do congressional appropriators of biomedical research funds rely on indirect transfer mechanisms to benefit research performers in their constituencies by supporting certain research topics and projects? I address this question in two distinct parts that deal respectively with the form and effect of political transfers. The first part examines the appropriations process and the grant allocation system at the NIH, and characterizes the form of transfers to research performers. I find that unlike bills associated with other agencies, appropriations bills related to the NIH rarely if ever include performer-specific earmarks. Subcommittee meeting reports related to NIH appropriations nevertheless include extensive language supporting specific research topics and projects, which operates as an indirect transfer mechanism. The second part statistically tests whether the peer-reviewed grants made by the NIH are concentrated in committee members' constituencies.

2.1 The National Institutes of Health and biomedical research in the U.S.

The National Institutes of Health is a part of the U.S. Department of Health and Human Services and provides 85% of total federal support for R&D in the biological, medical, and psychological sciences (based on FY2004 federal obligations, NSF 2008). More than 80% of the agency's funding is awarded annually through competitive grants to researchers at over 3,000 universities, medical schools, and other research institutions (the rest of the funds support "intramural" research and miscellaneous activities at the NIH). NIH funding has led to numerous fundamental discoveries, including the first vaccine to prevent cervical cancer, the first implantable permanent artificial heart approved by the FDA, the first trial of gene therapy in humans, identification of the first drug to show efficacy against HIV, and sequencing of the human genome (The NIH Almanac 2007).

The NIH is organized into 27 independent research institutes and centers listed in Table 1. Institutes specialize by disease (*e.g.* National Cancer Institute), organ (National Eye Institute), field of science and medicine (*e.g.* National Institute of General Medical Sciences), or by stages of human development (*e.g.* National Institute on Aging) (McGeary & Smith [2002] provide an excellent description of the NIH's organizational structure).

Table 1 here

The Institutes at the NIH utilize a "dual peer review" process to evaluate research proposals. In the first stage of this process, grant applications are evaluated by panels of non-federal scientists in relevant scientific disciplines and research areas. These experts score applications based on their significance, technical merit, innovativeness, and investigators' qualifications. Each application is then assigned a single "priority score," the average of all experts' scores. Applications with scores below a predetermined cutoff do not advance to the second stage and are not recommended for funding. Acceptable applications are assigned to the NIH institute or center best suited to fund the research where they are reviewed in a second round by a "National Advisory Council" composed of scientists and public representatives. Each Institute/Center's Advisory Council recommends applications for funding by considering priority scores and the proposed project's relevance to the Institute's mission. The Director of the Institute/Center makes the final funding decision based on the relevant Advisory Council's recommendation (NIH 2008).

2.2 The Congressional appropriations process and the NIH

Although Institutes within the NIH allocate grants to research performers, the allocation of federal funds among Institutes is the result of a complex process of negotiations among the NIH director, Office of Management and Budget (OMB), Department of Health and Human Services (DHHS), and the Congress. Budget requests are assembled by the individual Institutes in negotiations with the NIH Director and staff. The Director of the NIH then negotiates with the Department of Health and Human Services and the Office of Management and Budget within the Executive Office of the President to craft a budget request for the NIH that is consistent with White House priorities. The resulting "President's budget request" is submitted to the Congress.

The bulk of annual congressional decision making on presidential budget requests for federal agencies takes place in the appropriations committees of the House and Senate, especially within the relevant subcommittee of each chamber's appropriations committee. In the House Appropriations Committee (HAC), the NIH budget request is handled by the Labor, Health and Human Services, and Education and Related Agencies Subcommittee (LHHE). A similarly named subcommittee of the Senate

Appropriations Committee (SAC) evaluates the NIH budget request in that chamber. Appropriations subcommittee members from both the House and the Senate separately discuss the President's budget request and seek inputs and clarifications from the NIH staff in "hearings" before drafting appropriations bills and reports. Subcommittee recommendations are voted on by the full appropriations committee and reported to the floor of each chamber. Differences between the House and Senate appropriations bills, if any, are resolved through negotiations in a "conference committee," producing a final appropriations bill that is voted on by Congress.[4]

The bills reported out to the floor of the House and Senate by each chamber's appropriations committee indicate the total appropriations figures for each of the NIH institutes and centers. Subcommittee meeting reports that accompany appropriations bills contain important additional detail and guidance on the disbursement of appropriations by the institutes and centers. According to David Minge, a former U.S. House Representative, language supporting earmarks and "pork barrel spending" in these reports often escape congressional or public scrutiny. Although the commentary in subcommittee meeting reports lacks the force of the law, federal agencies are attentive to the "guidance" provided in these reports since subcommittee members enjoy long tenures and have considerable power to punish deviant agencies in subsequent appropriations (Minge 2002 p116).

2.3 Indirect political transfers in NIH appropriations

The appropriations subcommittee meeting reports for the "Departments of Labor, Health and Human services, and Education and Related Agencies" covering the 20 fiscal years between 1984 and 2003 provide fascinating insights into the breadth and depth of subcommittee members' influence on the priorities, actions, and organization of the NIH. Senate and House LHHE subcommittee reports contain detailed directions to the Institutes on the following four types of transfers that directly affect the level of federal support for the different fields of biomedical research.

[4] The final appropriations authorized by the Congress for the NIH have exceeded the President's requests by about 8% on average during the period of this study. Appropriations exceeding budget requests are unique to biomedical research, since the Congress, especially the HAC, commonly cuts budget requests.

1 Institute-level transfers. At the broadest level, LHHE members alter the distribution of appropriations among NIH institutes and centers to reflect their biomedical research priorities. The inter-Institute distribution approved by the HAC and SAC LHHE subcommittees was different from the allocations requested by the NIH Director in all but four of the 20 appropriations bills that they produced between 1984 and 2003 (fiscal years 1996, 1997, 1998, and 1999 are the exceptions). For example, for FY1994, the House appropriated $269 million more than the amount requested by the President for the NIH (total appropriations of $10.94 billion). For that year, while all other institutes and centers received at least the amounts they sought, the National Center for Human Genome Research received less than its requested amount. Subcommittee reports may also recommend the creation of new institutes or centers that increase the level of funding for research areas supported by these new entities.

2 Transfers among research fields. Subcommittee support for particular fields of biomedical research often is related to concern over particular diseases. In every subcommittee report, research field-level specifications range in number from two for the smaller institutes and centers like the NIAAA to thirty for such large institutes as the NHLBI, NIDDK and NCI. Unlike reallocations of requested funds among Institutes that are described in appropriations bills, transfers within Institutes among research fields are rarely associated with specific dollar amounts and more often are indicated in the meeting reports that accompany appropriations bills through language "urging," "recommending," and "strongly supporting" increases or decreases for specific research areas. Members recommend new research fields for funding (Example 1) as well as support increased funding for specific research fields (Example 2).

Example 1: "Hemolytic Uremic Syndrome (HUS)..is caused by a bacterium that may be present in undercooked meat products which can result in sudden and severe digestive and kidney complications. The Committee encourages NIDDK to support research on HUS in order to develop effective treatments for the disorder." House LHHE meeting report related to appropriations for NIDDK, FY1996

Example 2: "The Committee once again heard very moving testimony about Dystrophic Epidermolysis Bullosa from parents of children who are afflicted with this disease, as well as from some of its victims….The committee directs that a portion of the increased resources provided in this bill be used to encourage expanded research on Epidermolysis Bullosa and related diseases. The Committee requests a report, prior to hearings on the 1985 budget, as to how this directive has been carried out." House LHHE meeting report related to appropriations for NIADDK, FY1984 (p 47).

3 Transfers among research projects. Project-level transfers support particular lines of research (Example 3) and/or research projects (Example 4) within a given disease field. Project-level advocacy tends to be highly targeted and accounts for a large proportion of the suggestions made by members to Institutes and Centers in committee reports.

Example 3: "The Committee notes favorably that NIAAA has publicized its intention to support research on the health effects of moderate wine and alcohol consumption at a significant funding level. The Committee urges NIAAA and other Institutes to support and assist research efforts in these areas, especially the impact of alcohol on cardiovascular health and longevity and on the dietary role of antioxidants and moderate alcohol consumption." House LHHE meeting report related to appropriations for NIAAA, FY1996.

Example 4: "The Committee is encouraged by continued progress in developing oral chelators for the treatment of Cooleys anemia and strongly urges that this work be continued." House LHHE meeting report related to appropriations for NHLBI, FY1992.

4 Research performer-specific transfers. The most specific of transfers indicate both the purpose and the recipient of research funding. These transfers are commonly known as "earmarks" and can be considered to be direct political transfers to research performers, in contrast to the more indirect transfers effected through the three mechanisms described above. The House-LHHE subcommittee reports contained no instances of performer-specific earmarks during this period; Senate LHHE subcommittee reports contained the following two instances.

Example 5: "The Committee notes that retroviral infections in large domestic animals are excellent models for retroviral-induced diseases such as leukemia lymphosarcoma and AIDS in humans. The Committee believes that a retrovirus research center would well advance science and notes the expertise of Iowa State University in this field. The Committee directs that up to $1,000,000 be made available for such a center." Senate LHHE meeting report related to appropriations for NCI, FY1992

Example 6: "The Committee has received information concerning the Appalachian region's need for a state-of-the-art cancer center in West Virginia. It has been estimated that about one-third of the West Virginians dying from cancer might have been saved by early diagnosis and treatment. This lack of organized statewide approaches to cancer prevention, detection, and accessibility to specialized care underscores the need for an academically-based cancer program for the State of West-Virginia. The committee directs that $4.5 Million be used to facilitate the development of a cancer center at West Virginia University." Senate LHHE meeting report related to appropriations for NCI, FY1985 (p 55).

How do the four types of transfers described above relate to the constituency interests of LHHE members? The chair of the subcommittee responsible for the report incorporating Example 5 was Senator Tom Harkin from Iowa. Among the authors of the report that included Example 6 was Senator Robert C.

Byrd of West Virginia – then the second most senior member of the Senate LHHE subcommittee. The West Virginia University now hosts a cancer center in its "Health Sciences Center" named after Robert C. Byrd. The University of California at San Francisco and Weill Medical College of Cornell University at New York were beneficiaries of NIH grants in 1996 and 1992 for research on the "beneficial effects of moderate wine consumption" and "oral chelators for the treatment of Cooleys anemia" respectively.[5] These grants may be associated with the project-level transfers illustrated in Example 3 and Example 4 and coincide with the appointment of the then relatively junior Representatives Nancy Pelosi of California and Robert J. Mrazek of New York to the HAC-LHHE.

While the existence of the Robert C. Byrd Health Sciences Center can be credibly attributed to Senator Byrd's representation on the LHHE, a causal link between grant recipients and subcommittee members is less compelling in the transfers among Institutes, research fields and projects. This is because the first three types of transfers, unlike performer-specific transfers, do not directly award funds to performers and are moderated by the NIH's peer review process. It is plausible that beneficiaries of these indirect transfers and representation in subcommittees are not causally related, but linked through factors such as the research specializations of performers and the relative importance of research topics that affect both subcommittee actions and NIH awards. The following section hence exploits a database of all NIH peer-reviewed grants to test whether research performers represented by members of the LHHE subcommittees receive increased funding, after controlling for various unobservable characteristics of these research performers. The near absence of performer-specific earmarks and abundance of field-specific transfers suggest that any observed concentration of NIH funds in the constituencies of members must be a consequence of the indirect transfers achieved by the language of subcommittee reports.

3 Empirical specification and data

3.1 Empirical specification

[5] Grant number 5R01AA011205-02 for project titled: "Antiatherogenic Effects of Moderate Alcohol Use"; Grant Number: 5R01HL043027-04 for project titled: "New Promise for Oral Iron Chelation."

To test the influence of appropriations committee members on the level of peer-reviewed funds for biomedical R&D received by performers, I estimate a linear regression of the form:

$$\log(GRANT)_{ijt} = \alpha + \beta REP_{jt} + \delta T_t + C_i + u_{ijt} \quad (1)$$

where '*i*' indexes the research institution or performer receiving NIH grants, '*j*' the state of the research performer's location, and '*t*' the time period of the grant. The dependent variable is a logged measure of NIH research grant dollars. *REP* is the number of committee members in the state of the research performer. I separately estimate the influence of LHHE subcommittee members and other members of appropriations committees since the latter may trade constituency benefits with LHHE members (Weingast & Marshall 1988).

Unobserved factors that affect allocations to performers, such as the growth during this period of overall federal funding for biomedical R&D, may be correlated with performers' representation in appropriations committees (Figure 1 and Table 2 respectively show that both NIH grants and the number of members on the LHHE subcommittees have grown during the period of this study). To eliminate the possibility of spuriously inferring a relationship between performer receipts of NIH grants and representation simply because the two variables display similar time trends, I include *T* to capture trends in NIH grants common across all grant recipients.

Research performer effects C_i control for the unobserved characteristics of performers – such as their research quality, size of research enterprise, or research specialization – that may be correlated with both their receipts of research grants and representation in committee positions. Since performers do not change their location, C_i also captures the time-constant unobservable attributes of the districts and states of performers' location.

3.2 The data

(i) Biomedical research funds

The Consolidated Grant Applicant File (CGAF) database contains a record of every research proposal for which a grant was made by the "dual peer review" process at the NIH. After eliminating

awards that supported "intramural" activities (*i.e.* research performed at federal labs and the NIH) and research in non-U.S. locales, I identified 8,310 unique institutional recipients (based on the institutional affiliation of the primary investigator) of NIH grants between the years 1984 through 2003.[6] For each of these 20 years, I gathered the annual dollar amount of awards received by these 8,310 research performers. These awards represent about 70%[7] of all federally supported biomedical R&D and 95%[8] of the NIH's total extramural grants for the period. Figure 1 incorporates these data in a graph of the total dollar value of the awards made by the NIH for the years 1984-2003.

Figure 1 here

NIH grant recipients are classified as public universities, small firms (for-profit entities with fewer than 500 employees), private universities, corporations (for-profit entities with more than 500 employees), and others (including non profits, hospitals, and community colleges). Public universities are the largest recipients of NIH funds – in 2003, public universities received 41.5% of all NIH extramural support awarded to U.S. performers, followed by private universities (34.6%) and other nonprofit institutions (20.5%). Figure 2 displays trends in NIH funding for each of the five major categories of R&D performers during 1984-2003.

Figure 2 here

(ii) Congressional Appropriations Committee membership

I collected HAC and SAC membership data from Congressional directories. The HAC assigns its members to 12 subcommittees, each of which is in charge of drafting appropriations bills for specific federal agencies and programs. The SAC also has 12 subcommittees, and each member of the SAC typically sits on six to seven subcommittees, unlike her average House counterpart who sits on a maximum of three subcommittees. As noted earlier, LHHE is the subcommittee responsible for NIH's

[6] This starting point was dictated by the availability of subcommittee membership data. Congressional directories prior to 1983 report appropriations committee members, but omit their subcommittee assignments (except for subcommittee chair and minority ranking member).
[7] The numerator excludes intramural, foreign and performers for which institution identity, address or grant amount could not be determined.
[8] The numerator excludes performers for which institution identity, address or grant amount could not be determined.

appropriations. Table 2 reports the number of appropriations committee members, LHHE subcommittee numbers, and the corresponding number of unique states represented for the period of this study (98th through 107th Congress or 1983 through 2002). The median HAC had 57 members, 13 of whom were assigned to the LHHE subcommittee and the median SAC had 29 members, 15 of whom sat on the corresponding LHHE.

Table 2 here

Tables 3A and 3B report patterns of membership for the represented states in the House and Senate LHHE subcommittees. Representation is affected by members' entries and exits from the subcommittee, and a significant number of states are not represented (30 of the 51 states were never represented in the House LHHE and 23 states never had Senators on that chamber's LHHE during this period), generating between- and within- variation in the dependent variable. I collected information on the subcommittee positions of each chamber's LHHE subcommittee members (chairmanship, ranking minority membership and rank) and party status (majority or minority).[9]

Tables 3A & 3B here

Next, I identify the states (and Congressional districts) in which research performers are located from their addresses (inferred from their ZIP codes) by using the U.S. Census' "Congressional District Geographic Relationship Table." Finally, I match the appropriations committee data for each two-year Congress to the corresponding funding allocations of that Congress's two NIH appropriations bills. The House and Senate Appropriations Committee composition data for the 107th Congress (years 2001 and 2002) for example, are matched to the NIH grants made during the years 2002 and 2003 (the '*t*' in (1) thus indexes successive congressional years rather than calendar years). Arranged in this manner, each row of the data contains the funds received by a research performer '*i*' during the congressional year '*t*', and the corresponding representation information for the performer's state for the Congress. The mean institution-year pair in my data receives $ 6,850,247 in NIH grants (SD = $ 3.5e+07).

[9] For these data, I thank Charles Stewart III

4 Results

4.1 Committee member influence

Table 4 presents pooled least squares estimates of the effect of LHHE and other HAC and SAC members on the peer-reviewed biomedical R&D funds received by research performers. Since the dependent variable contains logged values of strictly positive dollar amounts, the coefficients represent effects conditioned on the receipt of R&D funds by performers. All statistical tests are based on White's heteroskedasticity corrected standard errors.

Table 4 here

The first and second columns respectively report estimates of returns to committee membership without and with controls for the characteristics of research performers. Because estimates of β in specifications with performer fixed effects are significantly positive, and those from specifications without fixed effects are statistically indistinct from zero, the unobservable attributes of grant recipients (such as their quality or quantity in represented states) appear to be negatively correlated with representation.

Column 2 suggests that each HAC-LHHE subcommittee member is associated with a 5.3% increase in biomedical research funds for the represented institution ($p<0.004$). Representation on the SAC-LHHE subcommittee membership yields no significant increase in R&D funds for performers, but non-LHHE representation in the SAC results in an average increase in funding for represented institutions of 5.3% ($p < 0.021$). To investigate this surprising finding, I estimated the impact of excluding individual Senators on the SAC non-LHHE coefficient. This analysis revealed that (nearly) all of the effect of SAC non-LHHE members reported in Column 2 (of Table 4) can be attributed to New York Senator Alfonso D'Amato, a member of various non-LHHE subcommittees of the SAC through 1994 during the period of this study.[10] Column 3 (of Table 4) separates the effect of D'Amato (by using a dummy variable to indicate the Senator's state and tenure) and shows that the effect of other non-LHHE SAC members is not

[10] Senator D'Amato earned the nickname "Senator Pothole" for his delivery of constituency services (The New York Times 1992).

statistically different from zero. This "final" specification estimates the returns to performers per HAC-LHHE member as 5.9% ($p < 0.001$).[11, 12] A 5.9% increase in funding for the mean R&D performer translates into an average increase of $370,000 per congressional year. These findings of the disproportionate influence of House LHHE members is consistent with the characterization by Congressional scholars of HAC members as more specialized (and influential) in the activities of their subcommittees than SAC members. The smaller size of the Senate may also enable individual Senators like D'Amato to exercise influence over matters outside the jurisdiction of their SAC subcommittees (cf. Fenno 1966, Savage 1999).

Table 5 here

The aggregate premium enjoyed by research performers represented on the HAC-LHHE, along with that enjoyed by performers in New York during Senator D'Amato's period in office, can be calculated from (1) by: $\sum_{ij} GRANT_{ij} \times \hat{\beta}_j \times REP_{ij}$ where $\hat{\beta}_j$ are the estimated coefficients of representation. Table 5 uses the estimates reported in the last column of Table 4 (significant at $p<0.001$) to calculate the amount of additional funds received by institutions due to committee membership. The allocation of $1.7 billion of the $37 billion awarded by the NIH in 2002 and 2003 appears to reflect the influence of appropriations committee members. Since House LHHE members account for more than

[11] The specifications in Table 4 impose the effect of a second representative from a state to be the same as that of the first. I tested whether a second HAC-LHHE representative from a state has the same effect as the first by estimating model (1) with dummy variables for one and two representatives. This yielded a coefficient estimate of 0.109 on the variable indicating two HAC-LHHE representatives (which is nearly twice the estimate of 0.059 per HAC LHHE member reported in Table 4) and an estimate of 0.001 on single HAC-LHHE representation. However, these coefficients were estimated with large standard errors (0.036 and 0.031 respectively compared to 0.018 on the coefficient of HAC LHHE of Table 4) and the (95%) confidence interval for the single HAC-LHHE dummy did not exclude the estimate obtained on the HAC-LHHE count variable. The following estimations hence retain HAC-LHHE as a count variable.

[12] States represented in the chair of the HAC-LHHE receive 9.1% more in NIH grants, but this effect is estimated with a S.E. of 0.07 and does not statistically reject the null effect. Minority party members of the HAC-LHHE appear to be associated with higher returns (7.6%) than majority members (3.4%) but I was unable to reject the equality of the majority and minority coefficients by a Wald test ($Pr>F = 0.20$). Performers in states representing party leaders do not appear to receive increases beyond the effects attributed to appropriations committee members.

70% of the overall significant effects of representation, the rest of this analysis focuses on their influence while controlling for the effects of all other committee positions.

4.2 Robustness checks and alternative explanations

If the relative demand of research performers for NIH grants changed during years 1983-2002, and if performers successfully lobby to be assigned subcommittee positions in response to their changing demands, then time-constant performer intercepts may not adequately control for the endogeneity of LHHE entry and NIH grants. To investigate this possibility, I examined the effect of entry and exit by members from the House LHHE subcommittee in a panel of research performers that were represented on the subcommittee at least once during 1983-2002. This yielded a dataset of 5,930 research performers in 20 states. Results are reported in Table 6.

Table 6 here

Table 6 shows that performers that were represented at least once during years 1983-2002, experienced a 6% increase in NIH funds during the years of representation. This estimate represents a significant (at $p<0.01$) increase from "before-representation" performer-years, the excluded reference group. In years following the exit of their representative from HAC-LHHE, these performers received no more or less funding than in the years prior to their representation. Because subcommittee member exits are exogenous events (in my panel, six of the nine exits were due to death or retirement from public life of the member) and unlikely to be correlated with the changing specializations of research performers, these results on increased funding for performers only during the years in which they are represented, strengthen a causal interpretation of committee member influence on NIH funding for represented institutions.

Second, although the most salient definition of "constituency" for House members' efforts to channel resources to their supporters is the congressional district, the regression equations define representation of House members at the state level. I redefined the relevant "locality" for purposes of analyzing NIH grants as the congressional district in an alternative specification and found that the effects of House subcommittee membership are estimated as 6.2% ($p<0.001$) at the state level and 2.7%

(statistically not different from zero) at the congressional district level. One explanation for this result is that fewer than 4% of NIH grant recipients overall are located in the districts of subcommittee representatives and 83% of the represented recipients are in the states but not the Congressional districts of House LHHE members. [13] Considering representation by state increases variation in the dependent variable and ensures comparability of House and Senate effects without inducing known biases in my estimates.[14]

Third, one could argue that represented research performers receive additional peer-reviewed grants not because of field level transfers made by LHHE members, but through their use of alternative channels of political influence. For example, bureaucrats at the NIH may award peer-reviewed grants to performers in the constituencies of members in exchange for rewards like promotions or higher appropriations from their political principals. This explanation is hard to reconcile with NIH's consistent receipts of appropriations in excess of the amounts requested in the President's budget. In addition, if LHHE members' distributive preferences are satisfied by NIH bureaucrats outside the formal appropriations process, then we should not observe funding reallocations in appropriations bills and meeting reports.

4.3 Additional results

Do some research performers benefit more than others from committee representation? Public universities represent the single largest category of recipients (refer Figure 2) of NIH support and many of these institutions have a long history of R&D activity that seeks to generate benefits for the local

[13] House members may be influenced by Senatorial ambitions and therefore work to attract federal benefits to their home states. Also, individual states are limited in the number of members that may be seated on any appropriations subcommittee, which might further broaden the relevant locus for indirect transfers of federal benefits to the state from the district level (Bullock 1971).

[14] I also estimated various alternative specifications of the model in (1). A specification that clustered standard errors by interacting state and congressional years (since there are multiple performers per state and representation does not vary by state-year) estimated the HAC-LHHE effect as 6.2% ($p<0.007$). A regression that included year dummies instead of the trend variable estimated the HAC-LHHE effect as 4.6% ($p<0.01$). A specification that included lagged year funding receipts by the research performer on the RHS estimated the LHHE effect as 6.2% ($p<0.001$). These alternative estimates are not statistically different from the "final" estimates reported in the last column of Table 4.

economy (Rosenberg & Nelson 1994). State-level politicians can influence the operations of state universities and lobby on their behalf for federal benefits (Sabloff 1997). A second class of NIH grant recipients that may benefit particularly from representation is single-location small business firms which may be more effective political supporters within a state than branch plants of larger counterparts. Table 7 reports the effects of committee representation on NIH grants to different R&D-performer categories. An additional HAC-LHHE member increases NIH grants to public universities in the member's state by 8.8% and grants to small businesses by 10.3%. Neither public universities nor small businesses benefit from having a representative on the full HAC. Senator Alfonso D'Amato's representation on the SAC appears to have primarily benefitted private universities and other nonprofits (foundations, laboratories, independent hospitals and other health and community organizations), reflecting New York State's abundant endowment of private research universities and nonprofits.

Table 7 here

The NIH awards various types of peer-reviewed grants depending on the type of project and performer. "R-type" grants fund the research projects of individual investigators and comprise about 60% of NIH's total extramural awards. "P-type" grants fund research programs and centers and comprise 17-20% of NIH's total awards. Estimations on these and other types of awards do not suggest that political representatives systematically influence the concentration of any one type of award over the other. [15,16]

5 Political influence and the concentration of federal research funds

The tension between the distributional consequences of the peer review process and those associated with a system more obviously subject to political influence was a key element in the political conflict between Vannevar Bush, former director of the Office of Scientific Research and Development during World War II, and West Virginia Senator Harley Kilgore over Bush's proposal for a "National Research Foundation"

[15] R-type awards are further classified as R01, R02,..R29 and P-type awards as P01,…P07, P09, P11, etc.
[16] The returns on each HAC LHHE members is estimated as 4.4% ($p<0.01$) for R-type grants, but the C.I.s around the positive effect of these representatives on the other types of grants fails to exclude zero.

in 1945. Bush proposed a politically insulated system that was self-regulated by scientists for the distribution of federal research funds. Kilgore argued that such a system would result in the concentration of funds at a few elite institutions and advocated more political control to ensure an equitable geographic distribution of public research resources (Kleinman 1995).[17] Echoing this debate, some recent science policy scholars argue that politically mandated earmarks increase the breadth and number of competitive R&D performers (see for *e.g.* Silber 2002), while others contend that political influence in the allocation of R&D resources shifts funds towards "less deserving" research performers (Savage 1999).[18]

The above assertions notwithstanding, the distributional effects of peer review and political control have rarely been tested and remain ambiguous. Here, I test the extent to which an institution's historical strength in research fields mediates the influence of subcommittee members on its NIH funding by using R&D performers' grants from individual NIH Institutes as a proxy for performers' expertise in specific research fields. The empirical model in (1) is extended as follows:

$$\log(GRANT)_{ijkt} = \alpha + \beta REP_{jt} + \delta QUARTILE_{ijkt-1} + \theta(REP_{jt} * QUARTILE_{ijkt-1}) + \chi T_t + C_i + D_k + u_{ijkt} \quad (2)$$

where '*i*' indexes the research performer, '*j*' the state, and '*t*' the years of grant receipts as before. '*k*' represents the biomedical research field (based on the NIH Institute responsible for the grants). The dependent variable is a logged measure of the research funding received by performer '*i*' in field '*k*' and year '*t.*' *REP* is the number of HAC members. *QUARTILE* is a variable that proxies for a performer's relative expertise in a particular biomedical field, based on the performer's share of previous funding from a given Institute.[19]

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[17] The debate significantly altered Bush's proposal and delayed the creation of what is now the National Science Foundation until 1953.

[18] Chubin and Hackett (1990) offer an alternative explanation for the link between peer review and concentration: peer reviewers are more likely to view research proposals from long-standing and reputed recipients as safe bets. Also, peer reviewers are either drawn from established research institutions, or are friends with researchers affiliated to established institutions, and favor members of this "old boys network." Hence peer review leads to "the narrow channeling of an excessive percentage of federal research support to only a handful of established universities" (Silber 2003, p 108).

[19] Rather than drop observations for 1983-1984 because of the non-availability of lagged variables, I used funding data from 1981-82 to construct the quality variable for the corresponding records.

Table 8 illustrates the construction of the *QUARTILE* variable -- the Fred Hutchinson Cancer Research Center and Louisiana State University A&M College at Baton Rouge are among the top recipients of NCI grants in the years 2000-01 and based on this, are placed in quartile 4 (the highest quartile) for 2002-03. LSU is also assigned to quartile 2 for "heart and lung-related R&D," based on its funding from the NHLBI for 2000-2001. *QUARTILE* thus is a vector of four binary variables indicating the quartile placement for each performer-field-congressional year observation.[20]

Table 8 here

The right hand side includes variables that capture trends in NIH grants that are common across all recipients. Research performer effects 'C_i'control for time-constant performer- and state-level characteristics related to representation, as was discussed in a previous section. Intercepts for the different institutes at the NIH 'D_k' hold constant unobserved research field-specific attributes such as the health burden or importance of biomedical research fields that influence grant receipts and LHHE membership.

Table 9 here

Table 9 shows that biomedical fields in the represented research performers are not randomly chosen by committee members for support; research performers that are in the bottom quartiles for a given field, average increases in NIH funding of 3.6% (for first-quartile institutions) and 6.4% (second-quartile institutions).[21] Political representation appears to have little incremental effect on NIH grant awards to institutions that rank relatively high in specific fields.

[20] A chief advantage of the proxy for research expertise based on the lagged receipt of field-level funding for performers is that it captures field-level differences in expertise within research institutions for the performers in my sample. External measures of research expertise like the National Research Council's departmental ratings are available only for a limited number of research performers (fewer than 900 of the 8310 performers in my data), departments and years during the period of my study. One criticism of the proxy could be that since current funding levels are predicted by a measure based on previous funds, the estimates are susceptible to serial correlation in the error term. However, current funding levels are predicted here by previous year funding shares captured by quartiles that tend to be stable across time.

[21] The modal lagged year funding for fields in the first quartile was \$0, suggesting that political benefits are maximized for fields in which performers have some research presence (*i.e.*fields in the 2nd quartile).

6 Concluding observations

Politicians use their power over the federal purse to transfer public resources to special interest groups. In the case of biomedical R&D, Congressional appropriators allocate federal funds to specific research fields and projects. These transfers could be motivated by the public interest, appeasement of disease-specific lobbying groups, personal experience with certain diseases, or the concentration of benefits in members' states. Although all of these motives assuredly play some role, I have here argued that a significant factor in the support of specific research fields by committee members is the transfer of funds to research performers in their states. Representatives may prefer to rely on indirect methods to transfer these public resources, rather than earmarking funds for particular research performers, to avoid any appearance of interference with a system that is renowned for rewarding the scientific excellence of performers.

I find that research performers from states with members on the HAC-LHHE subcommittee receive 5.9 – 10.3% more NIH peer-reviewed funding. These estimates, drawn from a period during which the total NIH budget grew from $4.6 billion in 1984 to $26 billion in 2003, are comparable in magnitude to estimates of political influence in the allocation of military contracts during the Cold War era (Rundquist *et al* 1996), and to the results of Ferejohn's study of political influence in the allocation of federal funds for rivers and harbors projects. I estimate that representation on the relevant committee or subcommittee influences the allocation of 5.3% of the NIH overall extramural R&D awards on average during the period of this study. In the year 2003 alone, this amounted to $0.9 billion – about half the value of all federal performer-specific earmarks identified by the *Chronicle of Higher Education* for that year.

What are the implications of my findings for the "efficiency" of the public biomedical R&D system in the U.S.? The answer to this question depends on the extent to which political influence distorts the structure of allocations implied by a socially optimal funding criterion. If we define an optimal rule as one that allocates funds based on the scientific opportunity and societal burden associated

with different diseases, then any intervention that results in a different pattern of allocations will be inefficient.[22] If, on the other hand, the allocation of public R&D resources is constrained to be a "second best" process, reflecting uncertainties regarding the benefits of ameliorating different diseases, then subcommittee members may have a role in resolving uncertainty by advocating funding for research in specific disease areas (Gilligan & Krehbiel 1990). My findings however, on the location of beneficiaries and inferior nature of R&D projects supported by political representatives are inconsistent with a purely informational perspective of the role of subcommittee members. Important areas for future research include investigating whether other federal allocations that are considered to be unaffected by distributive politics are subject to cleverly concealed transfers and estimating the deadweight losses associated with such indirect transfers.

[22] Scientific opportunity and disease burden (public health need) are stated by NIH officials as the two main inputs to decisions regarding the allocation of funds for research in different diseases (McGeary & Smith 2002).

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Figures & Tables

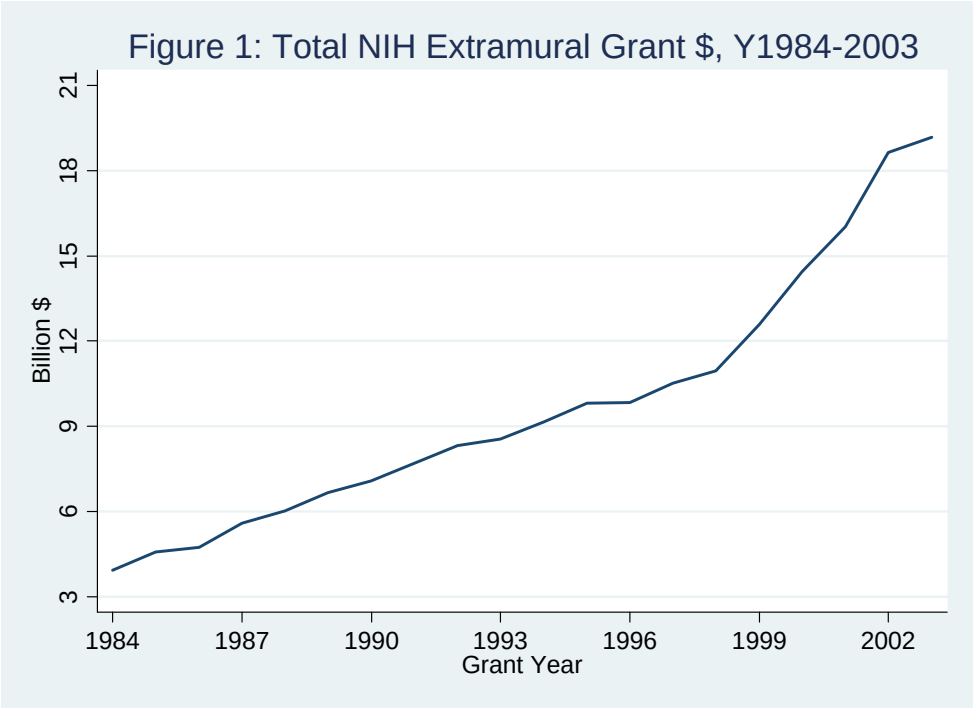

Figure 1 Note: This figure plots NIH grants during the years 1984-03 for extramural research performers in my dataset. Source of data: author calculations from CGAF.

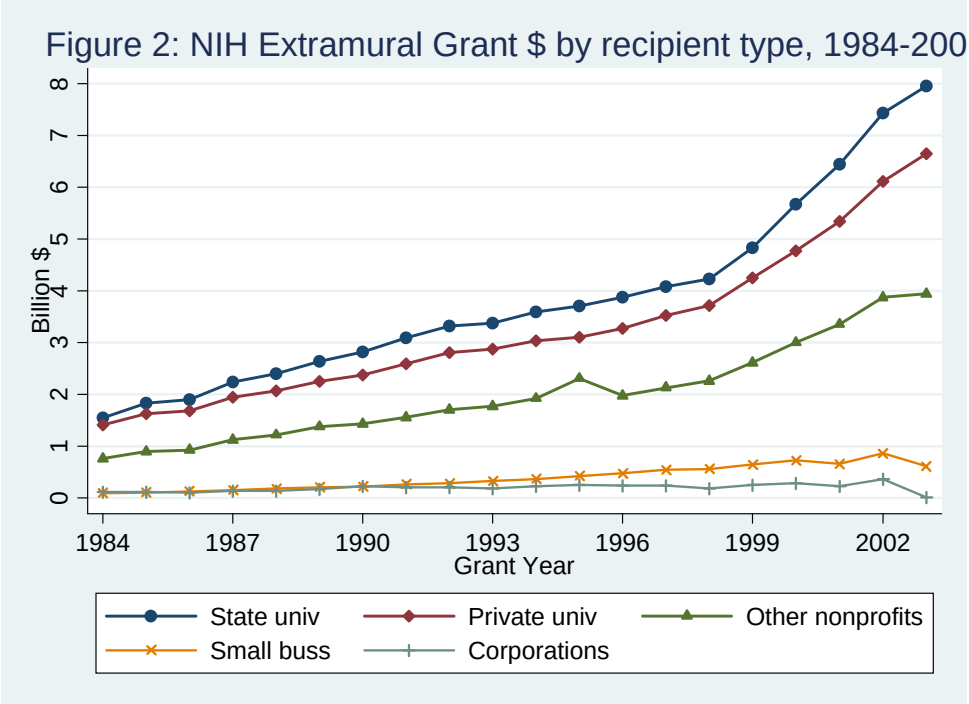

Figure 2 Note: This figure plots NIH grants for different extramural research performer types during the years 1984-03 in my dataset. Source of data: author calculations from CGAF.

TABLE 1: INSTITUTES AND CENTERS AT THE NATIONAL INSTITUTES OF HEALTH

INSTITUTE/CENTER	EST. YEAR	GRANTS B$ (1984-2003)
National Cancer Institute (NCI)	1937	326.34
National Heart, Lung, & Blood Institute (NHLBI)	1948	236.39
National Institute of Allergy & Infectious Diseases (NIAID)	1948	183.32
National Institute of General Medical Sciences NIGMS)	1962	178.55
National Institute of Diabetes & Digestive & Kidney Diseases (NIDDK)	1948	132.76
National Institute of Neurological Disorders & Stroke (NINDS)	1950	114.52
National Institute of Mental Health (NIMH)	1949	97.78
National Institute of Child Health & Human Development (NICHD)	1962	94.30
National Center for Research Resources (NCRR)	1962	89.48
National Institute on Aging (NIA)	1974	69.10
National Institute on Drug Abuse (NIDA)	1973	66.45
National Eye Institute (NEI)	1968	53.40
National Institute of Environmental Health Sciences (NIEHS)	1969	45.21
National Institute of Arthritis & Musculoskeletal & Skin Diseases (NIAMS)	1989	38.63
National Institute on Alcohol Abuse & Alcoholism (NIAAA)	1970	31.08
National Institute of Dental & Craniofacial Research (NIDCR)	1948	26.84
National Institute on Deafness & Other Communication Disorders (NIDCD)	1988	25.90
National Human Genome Research Institute (NHGRI)	1989	24.67
National Institute of Biomedical Imaging & Bioengineering (NIBIB)	2000	3.53
Others including:		32.60
National Institute of Nursing Research (NINR)	1986	
National Library of Medicine (NLM)	1956	
Center for Information Technology (CIT)	1964	
Center for Scientific Review (CSR)	1946	
John E. Fogarty International Center (FIC)	1968	
National Center for Complementary & Alternative Medicine (NCCAM)	1999	
National Center on Minority Health & Health Disparities (NCMHD)	1993	
NIH Clinical Center (CC)	1953	

Table 1 Note: This table lists the 20 institutes and 7 centers at the National Institutes of Health, and the years during which each was established. The third column lists the total amount of grants made by each institute/center during the years of my study (grant years 1984 through 2003 or appropriation years 1982 through 2002). The category "Others" combines the allocations of the smaller (by R&D grant $) institutes/centers at the NIH. Information in the first 2 columns were gathered from the NIH's website (http://www.nih.gov/icd/) and figures in the last column represent author calculations from the "Computer Retrieval of Information on Scientific Projects" database.

TABLE 2: NUMBER OF APPROPRIATIONS COMMITTEE MEMBERS BY CHAMBER OF CONGRESS (98th – 107th CONGRESS)

Congress Years	HAC	States represented	House-LHHE	States represented	SAC	States represented	Senate-LHHE	States represented
1983-84	57	30	13	11	29	26	15	14
1985-86	57	30	13	11	29	26	15	14
1987-88	57	31	13	12	29	26	15	15
1989-90	57	31	13	12	29	28	15	15
1991-92	59	31	12	12	29	28	14	13
1993-94	60	31	13	11	29	28	14	13
1995-96	56	30	13	11	28	26	15	15
1997-98	60	32	14	13	28	27	15	14
1999-00	61	33	15	12	28	27	15	14
2001-02	64	33	17	14	29	29	15	15

Table 2 Note: Years 1983 & 1984 correspond to the 97th Congress. The 2nd column lists the number of House appropriations committee members for the corresponding years. Column 3 reports the number of unique states represented by the members. Column 4 lists the number of HAC members that were in the LHHE subcommittee and Column 5, the respective number of represented states. Column # 6, 7, 8 and 9 report corresponding numbers for the Senate. These data were collected from the yearly Congressional directories.

TABLE 3A: STATES REPRESENTED IN THE HOUSE LHHE SUBCOMMITTEE OF THE APPROPRIATIONS COMMITTEE (98th – 107th CONGRESS)

STATE NAME	1983	1985	1987	1989	1991	1993	1995	1997	1999	2001
ARKANSAS							1	1	1	
CALIFORNIA	1	1	1	1	1	1	2	1	2	2
CONNECTICUT						1		1	1	1
FLORIDA	1	1	1	1	1	1	2*	2	2	2
ILLINOIS	2	2	1	1	1	1	1	1*	2*	1
IOWA	1	1	1	1	1	1				
KENTUCKY	1*	1*	1*	1*	1*	1*		1	1	1
MARYLAND	1	1	1	1	1	2	1	1	1	1
MASSACHUSETTS	2	2	2	2	1					
MICHIGAN	1	1	1	1	1					
MINNESOTA			1	1	1					
MISSISSIPPI							1	1	1	1
NEW JERSEY	1	1	1	1						
NEW YORK					1	2	1	1	1	1
OHIO	1	1	1	1	1	1	1	1		1*
OKLAHOMA							1	1	1	1
PENNSYLVANIA										2
RHODE ISLAND										1
TEXAS						1	1	1	1	1
WISCONSIN	1	1	1	1	1	1	1	1	1	1

Note: * indicates House LHHE subcommittee chair

TABLE 3B: STATES REPRESENTED IN THE SENATE LHHE SUBCOMMITTEE OF THE APPROPRIATIONS COMMITTEE (98th – 107th CONGRESS)

STATE NAME	1983	1985	1987	1989	1991	1993	1995	1997	1999	2001
ALASKA	1	1	1	1	1	1			1	1
ARIZONA									1	
ARKANSAS			1	1	1	1	1	1		
CALIFORNIA									1	
CONNECTICUT	1*	1*	1							
FLORIDA	1	1	1*			1	1			
HAWAII	1	1	1	1	1	1	1	1	1	1
IDAHO	1	1	1	1				1	1	1
IOWA		1	1	1	1*	1*	1	1	1	1*
LOUISIANA										1
MISSISSIPPI				1	1	1	1	1	1	1
MISSOURI	1						1	1		
NEVADA				1	1	1	1	1	1	1
NEW HAMPSHIRE	1	1	1	1	1		1	1	1	1
NEW MEXICO	1	1	1							
NORTH CAROLINA								1		
NORTH DAKOTA	2	2	1	1	1					
OHIO										1
OREGON	1	1	1	1		1	1			
PENNSYLVANIA	1	1	1	1*	1	1	1*	1*	1*	1
SOUTH CAROLINA	1	1	1	1	1	1	1	1	1	1
TEXAS				1	1			1	1	1
VERMONT							1			
WASHINGTON				1	2	2	1	2	2	1
WEST VIRGINIA	1	1	1	1	1	1	1			1
WISCONSIN	1	1	1			1	1	1	1	1

Note: * indicates Senate LHHE subcommittee chair

Tables 3A & 3B Notes: The two tables respectively list the states represented in the LHHE subcommittee of the House and Senate appropriations committees, and the number of representatives from these states on the subcommittees for the 10 Congressional years between 1983 and 2002. Data source: Congressional Directories.

TABLE 4: LEAST SQUARES REGRESSION ESTIMATES OF RETURNS TO HOUSE AND SENATE COMMITTEE REPRESENTATION
(98^{th} – 107^{th} CONGRESS OR 1984-2003)

dependent variable = log of Total NIH grant $			
	1	2	3
HAC LHHE members	0.005	0.053	0.059
	[0.020]	[0.018]**	[0.018]**
Other HAC members	0.016	0.024	0.027
	[0.008]	[0.013]	[0.013]*
SAC LHHE members	0.003	-0.002	-0.024
	[0.032]	[0.030]	[0.031]
Other SAC members	-0.026	0.053	0.009
	[0.030]	[0.023]*	[0.025]
Al D'Amato			0.25
			[0.063]**
trend	0.077	0.14	0.144
	[0.005]**	[0.004]**	[0.004]**
Constant	12.605	12.166	12.138
	[0.035]**	[0.038]**	[0.039]**
Research performer FE	N	Y	Y
N of performers	8310	8310	8310
Observations	24492	24492	24492
R-squared	0.01	0.88	0.88
Robust standard errors in brackets			
* significant at 5%; ** significant at 1%			

Table 4 Notes: The table contains estimates from Least Squares regressions of the logged R&D dollars received by research performer-years (1 Congressional year = 2 grant years) on the number of representatives in the research performer's states for the various appropriations committee offices. Column 1 reports estimates of House & Senate representation without performer-fixed effects and Columns 2 & 3 with performer-fixed effects. Column 3 estimates separately the effect of Senator Alfonso D' Amato (NY state, Other SAC member b/w 1984-1994 in the dataset).

TABLE 5: ESTIMATES OF HOUSE AND SENATE COMMITTEE REPRESENTATION EFFECTS IN BILLION $ (98th – 107th CONGRESS OR 1984-2003)

Congress year	HAC-LHHE effect (B$)	Al D'Amato effect (B$)	Total political effect (B$)	Total allocations (B $)	Political effect as% of Total
1983-84	0.29	0.28	0.57	8.46	6.74
1985-86	0.35	0.33	0.68	10.45	6.50
1987-88	0.43	0.39	0.81	12.80	6.33
1989-90	0.49	0.42	0.91	14.95	6.09
1991-92	0.55	0.46	1.01	16.81	6.01
1993-94	0.7	0.48	1.18	18.73	6.30
1995-96	0.74	0	0.74	20.43	3.62
1997-98	0.69	0	0.69	24.24	2.85
1999-00	1.13	0	1.13	30.44	3.71
2001-02	1.66	0	1.66	37.35	4.44

Table 5 Notes: This table uses the statistically significant (at 99% or above CI) estimates of appropriations committee representatives on the receipts of represented research performers (from Column 4 of Table 4) to calculate the additional amounts received by represented institutions due to committee members (SAC, Non-LHHE member representing New York State from 1984-1994 in my dataset). The first column computes the amounts due to HAC-LHHE representation (5.9%) and the second due to Senator Al D'Amato's tenure (25%). The third column sums these two effects.

TABLE 6: POOLED LEAST SQUARES ESTIMATES OF RETURNS TO HOUSE COMMITTEE REPRESENTATION ON ENTRY AND EXIT OF MEMBERS (98^{th} – 107^{th} CONGRESS OR 1984-2003)

dependent variable = log of Total NIH grant $		
	All	Represented only
HAC LHHE members	0.059	
	[0.018]**	
Current HAC LHHE members		0.06
		[0.024]*
Post HAC LHHE members		-0.002
		[0.057]
Other HAC members	0.027	0.032
	[0.013]*	[0.015]*
SAC LHHE members	-0.024	0.012
	[0.031]	[0.040]
Other SAC members	0.009	0.039
	[0.025]	[0.031]
Al D'Amato	0.25	0.211
	[0.063]**	[0.069]**
trend	0.144	0.142
	[0.004]**	[0.005]**
Constant	12.138	12.113
	[0.039]**	[0.055]**
Research performer FE	Y	Y
N of performers	8310	5930
Observations	24492	17487
R-squared	0.88	0.88
Robust standard errors in brackets		
* significant at 5%; ** significant at 1%		

Table 6 Notes: This table reports estimates from OLS regressions of the logged R&D dollars received by research performer-years (1 Congressional year or 2 grant years) on the status of representatives in the research performer's states for the House appropriations committee offices. Column 2 utilizes observations from states that were at least once represented in the House LHHE subcommittee during the period of my study. For these institutions, the estimates present the effect of members before (base group which is omitted), during, and after representation on research performers. Column 1 reproduces for comparison, estimates from Column 4 of Table 4.

TABLE 7: POOLED LEAST SQUARES ESTIMATES OF RETURNS TO COMMITTEE REPRESENTATION BY RESEARCH PERFORMER TYPE
(98^{th} – 107^{th} CONGRESS OR 1984-2003)

dependent variable = log of Total NIH grant $					
	Public U.	Private U.	Small B.	Large B.	Nonprofits
HAC LHHE members	0.088	0.02	0.103	-0.233	0.031
	[0.032]**	[0.033]	[0.034]**	[0.263]	[0.030]
Other HAC members	0.018	0.044	0.012	0.202	0.01
	[0.019]	[0.023]	[0.026]	[0.219]	[0.023]
SAC LHHE members	0.046	-0.066	-0.099	0.043	0.008
	[0.042]	[0.077]	[0.060]	[0.488]	[0.053]
Other SAC members	-0.015	-0.057	-0.007	0.519	0.041
	[0.034]	[0.058]	[0.050]	[0.298]	[0.049]
Al D'Amato	0.185	0.322	-0.004	-0.175	0.25
	[0.104]	[0.125]*	[0.153]	[0.604]	[0.099]*
trend	0.15	0.103	0.193	-0.096	0.13
	[0.005]**	[0.007]**	[0.009]**	[0.056]	[0.007]**
Constant	13.841	13.251	11.049	13.569	12.594
	[0.044]**	[0.077]**	[0.088]**	[0.488]**	[0.072]**
Research performer FE	Y	Y	Y	Y	Y
N of performers	438	433	5311	175	1953
Observations	2963	2210	12050	517	6752
R-squared	0.94	0.95	0.71	0.75	0.88
Robust standard errors in brackets					
* significant at 5%; ** significant at 1%					

Table 7 Notes: This table reports estimates from Pooled Least Squares regressions of the logged R&D dollars received by research performer-years on the number of representatives in the research performer's states for various appropriations committee offices. Each column reports the effects of representation on the type of research performer indicated in the column headers.

TABLE 8: ILLUSTRATION: THE QUALITY/QUARTILE VARIABLE (98th – 107th CONGRESS OR 1984-2003)

FY (t)	Research performer (i)	Institute (j)	2Y R&D$	Last 2Y R&D$	Quartile1	Quartile2	Quartile3	Quartile4
2002-03	NATIVE AMERICAN CANCER RES	NCI	152966	0	1	0	0	0
2002-03	UNIVERSITY OF NORTH FLORIDA	NCI	133825	0	1	0	0	0
2002-03	RADIATION RESEARCH SOCIETY	NCI	13000	5000	0	1	0	0
2002-03	CLARKSON UNIVERSITY	NCI	78500	74618	0	1	0	0
2002-03	PHYLOS, INC.	NCI	847187	282215	0	1	0	0
2002-03	UNIV OF HOUSTON-UNIV PARK	NCI	148500	295000	0	0	1	0
2002-03	UTAH STATE UNIVERSITY	NCI	69500	315295	0	0	1	0
2002-03	NEORX CORPORATION	NCI	606246	1365207	0	0	1	0
2002-03	LOUISIANA STATE UNIV A&M COL BR	NCI	1391343	1384197	0	0	0	1
2002-03	JOHNS HOPKINS UNIVERSITY	NCI	1.5E+08	1.19E+08	0	0	0	1
2002-03	U OF TEXAS MD ANDERSON CAN CTR	NCI	1.79E+08	1.39E+08	0	0	0	1
2002-03	FRED HUTCHINSON CANCER RES CTR	NCI	1.6E+08	1.45E+08	0	0	0	1
2002-03	WAKE FOREST U HEALTH SCIENCES	NHLBI	35592265	0	1	0	0	0
2002-03	L-TWO DIAGNOSTICS, LLC	NHLBI	238237	0	1	0	0	0
2002-03	A.S.T.H.M.A., INC.	NHLBI	181792	1	0	1	0	0
2002-03	NATIONAL HEMOPHILIA FOUNDATION	NHLBI	10000	25000	0	1	0	0
2002-03	LOUISIANA STATE UNIV A&M COL BR	NHLBI	367500	285000	0	1	0	0
2002-03	MRI INSTITUTE FOR BIOMEDICAL RES	NHLBI	688998	358000	0	0	1	0
2002-03	UNIV OF MD BIOTECHNOLOGY INST	NHLBI	1942448	1982152	0	0	1	0
2002-03	BURNHAM INSTITUTE	NHLBI	5151249	2034283	0	0	1	0
2002-03	UNIVERSITY OF WASHINGTON	NHLBI	1.11E+08	9.76E+07	0	0	0	1
2002-03	BRIGHAM AND WOMEN'S HOSPITAL	NHLBI	1.17E+08	1.02E+08	0	0	0	1
2002-03	JOHNS HOPKINS UNIVERSITY	NHLBI	1.41E+08	1.13E+08	0	0	0	1

Table 8 Notes: The records presented in this table are illustrative and not complete. They clarify the construction of the quartile variable. Data source: Author calculations from CGAF records.

TABLE 9: RETURNS TO HOUSE COMMITTEE REPRESENTATION BY RESEARCH QUALITY OF BIOMEDICAL RESEARCH FIELD (98^{th} – 107^{th} CONGRESS OR 1984-2003)

dependent variable = log of Total NIH grant $	
HAC LHHE X QUARTILE1	0.036
	[0.016]*
HAC LHHE X QUARTILE2	0.064
	[0.015]**
HAC LHHE X QUARTILE3	-0.002
	[0.013]
HAC LHHE X QUARTILE4	-0.004
	[0.012]
QUARTILE2	0.286
	[0.016]**
QUARTILE3	0.904
	[0.017]**
QUARTILE4	2.335
	[0.019]**
OTHER HAC MEMBERS	0.013
	[0.006]*
SAC LHHE members	0.003
	[0.015]
Other SAC members	-0.002
	[0.013]
Al D'Amato	0.096
	[0.031]**
TREND	0.103
	[0.002]**
Constant	12.037
	[0.073]**
PERFORMER FE	Y (8310)
INSTITUTE FE	Y (20)
Observations	70706
R-squared	0.77
* significant at 5%; ** at 1%	

Table 9 Notes: This table reports estimates from OLS regressions of the logged R&D dollars received by research performer-biomedical field-years (1 Congressional year or 2 grant years) on the number of LHHE and other appropriations committee representatives in the research performer's states. Quartiles are based on lagged receipts of R&D dollars received by the research performer in the biomedical field. Quartile-1 represents the lowest recipient group (omitted base group) and Quartile-4 the highest. The coefficients on the interaction terms of the four quartiles with HAC LHHE membership capture the relationship between historical strength of fields of performers and effects of representation.