

The Distribution of Indirect Cost Recovery in Academic Research

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Abstract: Research universities rely heavily on external funding to advance knowledge and generate economic growth. In the US, tens of billions of dollars are spent each year on research and development with the federal government contributing over half of these funds. Yet a decline in relative federal funding highlights the role of other funders and their varying contractual terms. Specifically, non-federal funders provide lower recovery of indirect costs. Using project-level university sponsored research administrative records from four institutions, we examine indirect cost recovery. We find significant variation in the amount of indirect funding recovered – both across and within funders, as well as to different academic fields within a university. The distribution of sponsors in the overall research funding portfolio also impacts indirect cost recovery. The recovery variation has important implications for the sustainability and cross-subsidization of the university research enterprise. Together, our results show where universities are under-recovering indirect costs.

Keywords: Academic R&D, Administrative Costs, Indirect Costs, Federal Funding

I. Introduction

Research universities are important knowledge generating organizations in the economy, contributing new ideas in the form of papers and patents, and generating economic growth through technology licensing and start-up activity. A university's ability to realize these outcomes depends on academic research activity that is influenced by organizational characteristics (1, 2, 3). Rather than a deterministic relationship based simply on the dollar amount of research funding received, the types of incentives offered to faculty and the support provided by the university affect the knowledge-transfer outcomes observed. Further, the motives of the funders themselves may influence research outcomes with noted trade-offs between government and industry funding and the emergence of philanthropic funding (4, 5).

Prior research has examined the amount of funding provided by various sponsors as the amount actually available to the researcher. In practice, however, research awards are distributed between the direct costs of the research project and an allocation to indirect costs – an amount returned to the university to cover fixed costs – effectively reducing the amount of the award the researcher receives to conduct the sponsored research. The latter is typically calculated as a percentage of the direct costs known as the indirect cost rate. In simplest terms, sponsors provide funding to faculty to conduct research who essentially pay a tax to their administration to cover shared and fixed costs. The recovery of indirect costs associated with shared resources is not unique to academic institutions. Multi-product firms spread their shared, joint, or overhead, costs across products. Public agencies cover costs from user fees or taxes and charities cover administrative costs as a percentage of donations and grants. Across sectors, however, the objective is the same: to use an efficient and equitable allocation mechanism.

The cost allocation problem is especially pronounced for universities due to their multiproduct nature. Blending the three activities of teaching, research, and public service, it is difficult to account for indirect costs by output. While multiproduct firms benefit from the economies of scale of joint production, universities complicate cost accounting calculations with their public good orientation (6). Because of their unique mission, universities are not able to jettison unprofitable activities, resulting in cross subsidies between the three outputs of teaching, research, and service (7, p. 1143). Given the multiple sources of revenue, previous studies explore the degree to which undergraduate tuition subsidizes graduate education (8), and the potential cross subsidies between research and teaching (9, 10). Yet less is known about the cross subsidies created by different sources and types of research funding.

Academic institutions in the United States (US) spend tens of billions of dollars a year on research and development (R&D) – nearly \$80 billion in 2018 (11). While the federal government still accounts for the majority of academic R&D funding, its share has been declining over time – down to 53 percent in 2018 from 59 percent in 2010 and 69 percent in 1973 (11). The decline in reliance on federal

funding reflects the uptick in grants from other sources, such as nonprofits, industry, and even internal institution funds. Most importantly, these other funding sources generally provide lower recovery of indirect costs than federal grants. As of 2018, 30.2 percent of indirect costs were unrecovered by academic research (12).

To date, transparency on the indirect cost rates adopted and variances in these rates across universities, funders, and research fields is limited. The research funding accounting system, and its distributional impacts, remains a mystery for many faculty, especially more junior researchers, yielding significant asymmetries of information regarding indirect costs. Understanding and assessing indirect cost recovery research is complicated by the varied nature of systems employed by universities and conflicting incentives of stakeholders. Universities employ different systems to allocate recovered indirect costs between central university administration and school level distributions, thus faculty may be recovering indirect costs of their direct research unit or for the broader institution as well as potentially, other fields. As a result, the incentives either to maximize or minimize indirect cost recovery vary between funders, researchers, and administrators. Indirect cost recovery has been the subject of significant review at the institutional level (see Council of Government Relations archive), through Congressional testimony (e.g. 13, 14), commentary (15, 16) and empirical investigations (17 - 19). These reviews identify a general under-recovery of indirect costs by institutions and a number of relevant factors that impact rate variation across institutions, notably governance structure (e.g. public/private status), activity type, and field.

The research presented here extends this literature stream by considering the factors driving variations in indirect cost rates at the individual grant level. Whereas prior research considered the university characteristics as driving differences between institutional indirect cost variation, this research considers within-university variation, shedding light on how resources are shared across an institution. Using a sample of four research institutions in the US, we analyze project-level sponsored research data over a ten-year period (2003-2012). Regression analyses reveals substantial variation in the indirect cost recovered *within* universities from different sponsor types with notable differences between federal and nonprofit funders. We also document discrepancies of indirect cost recovery across federal departments and agencies. We find additional variation in indirect cost recovery across academic fields, with evidence of cross-subsidies, notably from other disciplines to the biological sciences. These results support prior findings on general under-recovery of indirect cost with greater clarity on the sources of deficits.

Beyond project characteristics, we examine how other sources of research funding and the overall portfolio of research funding impact indirect cost recovery. We find that indirect cost recovery is impacted not just by characteristics of the research project but by the concentration of recovered costs such that center-based projects receive higher indirect cost rates. Further, the overall portfolio impacts indirect cost recovery: when a sufficient level of indirect cost is recovered from federal sources in a field,

other projects accept lower rates of indirect cost recovery from non-federal sponsors. Finally, we reveal a nuanced relationship between how an institution uses internal research funding as a substitute and complement to indirect cost recovery depending on the sponsor type.

Our study is the first to use university administrative data to systematically examine indirect research costs at the award level. While it is documented that universities consistently under-recover indirect cost, we expand the understanding of where these discrepancies originate and inform how the system responds in order to increase indirect cost recovery. Our use of project-level data enables the examination of award and institutional characteristics that drive variation and the paths available to mitigate under-recovery. Further, we contribute to the current policy debate around federal indirect cost recovery through discussion on the sustainability of the current US indirect cost recovery mechanism, the implications for varied indirect cost recovery systems, and the role of cross-subsidization for faculty.

II. Financing the Academic Research Enterprise

Academic research, like any product, consists of both direct costs for production and fixed costs that include shared resources such as utilities, libraries, information technology, building and grounds maintenance, and administrative and compliance support. Alternatively known as indirect costs (IDC), Facilities and Administration (F&A) or overhead, university fixed costs are recovered, in part, from the IDC budgets of individual research projects. To recover the indirect costs of academic research, different countries employ various mechanisms. For example, the United Kingdom, Ireland, Finland, and Sweden all use full cost accounting, which calculates the indirect costs associated with each research project and includes it directly (20). In contrast, Japan uses a flat rate of 30 percent for indirect cost recovery on all research projects (21). American research universities, our specific focus, have evolved a particularly complicated system to recover fixed costs over the last 50 years.

The process of paying IDC in the US was originally established by the federal government. Beginning in 1958, the federal government began to allocate IDC as a percentage of direct costs. In 1966, the IDC rates with universities changed from a fixed percentage to individually negotiated rates (22). These university-specific rates are renegotiated every few years. During these negotiations, universities utilize complicated government accounting systems to calculate rates (16, 23)¹. The dominant driver in setting IDC rates is the goal to break even by covering the shared costs associated with conducting research. However, the complexity of the rules provides an opening for confusion, and misallocation. A prominent example was the 1991-4 Stanford University Yacht scandal where \$1.2 million in depreciation of the university's yacht was incorrectly charged (and then repaid) to a federal research account (24).

¹ See Bourne & Vermillion 2016 for a more extensive history.

Despite such extreme examples, the IDC rate is designed to recover a university's *essential* operating expenses for shared facilities, resources and administrative costs.

While it is well known that there is variation in indirect costs recovered for these expenses, less is known as to why (17). Prior literature on the topic has used institutional-level analyses to identify relevant factors. Key sources of variation at this level include the governance structure of the institution, direct research budgets, and prior indirect cost rates, (18, 19). As of 2014, the average university IDC negotiated rate was 60 percent with a federal cap of 26 percent on the reimbursement of administrative costs. Notably, universities are the only federal funding recipients subject to such a cap (25)². Once a rate is negotiated between a university and the government, the indirect cost share per project is straightforward to calculate as the rate of the direct research expenditures (Equation 1).

$$IDC\ Recovered = Project\ Direct\ Cost * Federally\ Negotiated\ IDC\ Rate\ (1)$$

Yet upon examination, there are certain stipulations which either reduce the project direct costs included in the calculation or reduce the IDC rate used. Individual federal mission agencies have discretion in defining allowable modifications to direct costs. These are similar to itemizing a personal income tax return and deducting mortgage interest payments and charitable donations from your taxable income. These adjustments are driven by organization type, activity type (e.g. research, individuals, students), research type, and discipline (13). Federal agencies define these deductions, such as the cost of equipment, contracts and sub-awards, training stipends and tuition, and exclude them from the calculation of indirect costs. For example, direct budget items like mouse facilities or supercomputer costs, are deducted on the assumption that they are more appropriately included in the negotiation of the institutional IDC rate, rather than allocated to the individual project.

Further, the negotiated federal IDC rate itself can also vary. For example, NIH training grants, are capped at an IDC of eight percent. Additionally, certain federal departments have further restrictions: the U.S. Department of Agriculture (USDA) caps competitive research grants at a 20 percent IDC, while the Department of Defense (DOD) IDC rate is capped at 35 percent. Finally, a lower rate is used for expenses that occur off-campus, as it is assumed these projects are not using the shared resources available on campus.³ These differences in exemptions and applied rates create opportunities for cost-shifting, which results in an effective indirect rate paid that is lower than the federally negotiated IDC rate. The result is

² Federal funders argue that universities need to reduce administrative costs and rebalance federal contributions to research funding (31).

³ Another aspect to cost allocations is the use of cost sharing to expand direct costs of a project. The NSF limits the use of cost-sharing; unless allowed in the program solicitation, voluntary committed cost sharing is prohibited in proposals. Uncommitted cost sharing is permissible (27). The Office of Management and Budget sets policy which applies to the NIH, and Department of Defense. It does not expect voluntary committed cost sharing and prohibits it from being used as a factor in the review of applications, or proposals. However, it may be considered if it is in accordance with the awarding agency regulations and specified in the notice of the funding opportunity (28).

that every research project pays a different effective indirect cost (EIDC) rate, which can be calculated from project-level budget data (Equation 2).

$$\overline{EIDC\ Rate} = Total\ Modified\ IDC / Total\ Direct\ Cost\ (2)$$

Equation 2 can also be used for non-federal research projects. US universities are receiving a growing share of R&D funding from non-federal sources, specifically industry and nonprofit funders. IDC recovery from non-federal funders is even less standard. State government agencies have administrative rules that provide indirect cost recovery at lower than federal rates, reasoning that their contribution is offset by state annual appropriations to universities. However, these rates have not increased in-line with the recent state funding reductions to education (26). As an additional distortion, state legislatures often exert oversight on the setting of IDC recovery rates for state universities.⁴

The lack of transparency to these variations leads to “few administrators, and virtually no scientists, understand[ing] the maze of complex, arbitrary rules” (23, page 32), creating contention within the university (23, 30) and concerns over misaligned incentives and equity. University administrators are focused on recovering fixed costs and have the incentive to increase the total indirect cost recovered, causing these administrators to seek higher indirect cost recovery rates. Mandated regulations have increased universities’ research oversight costs, while federal funding of research has simultaneously declined, resulting in a loss for indirect cost recovery (21). Further, universities vary in how they distribute recovered indirect costs. Some universities centralize IDC recovery and distribute funds to various cost centers across the university. Other institutions have a decentralized system where each academic unit maintains control of their recovered IDC. The latter system incentivizes local administrators to increase the IDC recovered by their faculty since it will stay within the unit.

Funding agents have the incentive to ensure the highest proportion of their grant expenditures are spent on direct costs of the project, rather than funding indirect costs. Nonprofit funders, such as private foundations, have raised objections to paying full federal IDC. Many nonprofits have blanket statements about maximum IDC rates, with some organizations not allowing any IDC recovery. In response to university protests to these policies, some funders allow selected facilities and administrative costs to move ‘above the line’, becoming part of the direct cost budget. For example, some nonprofits will allow a usage charge for faculty office and equipment that are required for performing research while not reimbursing other shared costs such as utilities and libraries. Moving costs above the line may allocate greater control of funds to the PI and reduces what were previously university or department allocations. If funding sources continue to shift away from federal sources (29) and towards those with lower indirect cost rates, there will be substantial implications for the sustainability of academic research enterprises and

⁴ See for example, General Assembly of North Carolina, Session 2013; Session Law 2013-360; Senate Bill 402

a subsequent correction to its funding (30, 31). In sum, the incentive structure of the current system may lead to an unsustainable research enterprise.

Researchers or principal investigator (PI) are focused on funding the direct cost of their research projects as they ‘try to keep [the] lab going at the same level any way possible,’ (34, page 71). When given the choice, researchers have the incentive to increase the resources available to conduct research, causing them to seek funders that negotiated lower indirect cost rates. Researchers may find non-federal funding sources more attractive as the reduced indirect rate provides the allure of more direct funding for any given total award amount. This increased portion of direct costs claimed by the PI is at the expense of recovering fixed costs paid by the department or university.

Some faculty view IDC as taking away funds from their direct research budgets since the amount available to the researcher is less than amount provided by the funder. Other faculty members express suspicion given the lack of transparency around IDC accounting (21). One of the suspicions voiced by those researchers paying higher IDC rates is that they may be subsidizing the overhead contribution of researchers supported by grants with lower IDC rates. Some projects and disciplines require specialized equipment, such as animal containment facilities wet lab space or access to computer resources that are included in the IDC rate negotiations but not used by all projects. If some researchers paying higher IDC rates are not using such shared resources, they may be over-paying their share of IDC and potentially subsidizing researchers that do, raising concerns about equity.

III. Data

To understand the implications of these varying IDC rules, we compile a unique, project-level dataset of research awards over a ten-year period from 2003 to 2012. The comprehensive dataset uses data from four prominent US research institutions. These institutions are a mix of public and private, but each contain a medical school. This project-level dataset provides the opportunity to conduct fine-grain, in-depth analyses at the expense of generalizability. Given our limited sample of institutions, we take caution in interpreting our results and note they are representative of the top 30 US institutions in science and engineering (S&E) R&D but not of the entire set of academic institutions. We provide a more extensive discussion of generalizability in the *Representativeness of the Sample* section (3.2).

We obtained these confidential data from the institutions for the purpose of evaluating the funding landscape faced by their researchers. The data provide a complete picture of award activity from 2003 to 2012 in S&E fields. The final sample for this analysis is comprised of 42,007 award-observations. The sample includes 3,464 awards with start dates prior to 2003 but with expenditures during our timeframe. There is then an average of 3,854 awards beginning each year from 2003 to 2012 with an

average of 963 awards per institution per year. To clarify, these data reflect only awarded projects, not proposals.

The starting dataset only retains sponsored research awards. Training and clinical trial-related awards and contracts were removed. This was done using award activity type variables provided by the institutions. Table 1 documents the flow of sample size reductions. First, we remove projects related to the field of Agricultural Sciences. Projects in that field were only associated with one of our institutions. Second, we dropped less frequent sponsor types of state and local government, foreign governments, and individual sponsors. Also included in this set are projects where the sponsor listed is another university. These projects are likely sub-awards, but no prime sponsor was reported. In instances where a prime sponsor is listed, that organization is used to classify sponsor type. Next, we removed observations with inaccurate project lengths. These included issues of missing end dates, negative lengths, or inaccurate start dates (1900). To clarify, all award dates refer to academic year. For example, an academic year of 2000 corresponds to an award date between 1 July 1999 and 30 June 2000. Regarding award amount, we removed observations with negative or zero award totals as well as the bottom five percent of awards, those with totals of \$7,875 and below. We also Winsorize upper outliers by removing observations in the top 0.05 percent, those over \$24.2 million. Finally, observations were removed if they had front-loaded indirect charges (indirect rates of 100 percent with no direct expenditures) or null indirect charges. In addition, we Winsorize the sample by removing projects in the top one percent of IDC rates, those over 79 percent. We estimated a sensitivity analysis relaxing some of these sample restrictions yielding consistent and robust results.⁵

<Table 1>

3.1 Classifying Sponsored Research

Analyzing administrative data from multiple institutions requires a consistent set of classification systems and crosswalks. Regarding academic fields and departments, a crosswalk was created to classify each university's departments to a uniform set of department names using the National Science Foundation (NSF) field categories and the National Center for Education Statistics (NCES) CIP codes. The sample was restricted to those departments in S&E fields, and fields were categorized based on the lead PI's home department. The department codes were then collapsed to their corresponding broad academic fields, as used by NSF. We also coded an indicator variable for whether the grant is housed in a research center or institute, instead of an academic department. In these cases, field is still categorized

⁵ The broader sample consists of 44,628 observations. It maintained removal of agricultural science projects, smaller frequency sponsor types, inaccurate lengths, zero or negative award values, and front-loaded or null indirect cost values.

based on the PI's home department. The distribution of fields is listed in Table 2, Panel A. Due to the medical schools of our institutions, *Biological Sciences* account for the majority of our sample (64.3 percent). *Engineering* is the second most prevalent field and accounts for roughly 16.4 percent of the sample.

<Table 2>

Assigning sponsor type requires a more nuanced approach. In our final sample, there are over 3,000 unique sponsors. We reviewed each of the sponsors and finalized the sponsor type into one of six specific and consistent categories. A crosswalk was developed to convert each institution's list of sponsors to a uniform and appropriate classification system. As noted in Table 1, we removed less frequent sponsor types for analysis. For this analysis we are interested in the behavior of federal, industry, and nonprofit sponsors. Panel B of Table 2 provides the distribution of sponsors of these projects. As noted previously, when a prime sponsor is listed, the sponsor type is assigned based on the prime sponsor. We also created an indicator variable for whether the award had a prime sponsor.

The most frequent sponsor type in the sample is *Federal*, representing nearly three-quarters of our final sample. This sponsor type was further classified with a sub-category of federal department, and then federal agency. Table 3 shows the classification from department to agency and frequency of each department. The Department of Health and Human Services (DHHS) is the most prevalent department in our sample, comprising 56.4 percent of federally funded awards. The Department of Defense (DOD) is the second most prevalent department in our sample, funding 9.5 percent of federally funded awards. Independent agencies collectively account for another 26.1 percent. Regarding federal agencies, of federally funded awards, 53.6 percent are funded by the National Institute of Health (NIH). The National Science Foundation (NSF) funds the second largest share, accounting for 20.7 percent. There are fifty three unique federal agencies and department funders in the data.

<Table 3 >

3.2 Sample Representativeness

This study uses a sample of four institutions within the top thirty of S&E R&D activity. In this section, we illustrate how this sample compares to the set of thirty institutions. It is important to note, this sample is not generalizable to the overall population of universities, which has substantial heterogeneity in their R&D practices (35). Thus, we do not generalize our results to the population, but rather they are reflective of trends within the most research active set of universities.

To demonstrate comparability, we compare our sample institutions to the top thirty US research institution. Currently, the NSF academic R&D survey data provided through WebCASPARE are the best publicly available data on university-level R&D expenditures. These data are quite informative and have

been used by researchers to provide important insight into the funding of academic research. Using data from the NSF Survey of R&D Expenditures at Universities and Colleges, we use the sample of the top thirty universities ranked by total S&E R&D expenditures.

Appendix Table 1 details how our sample compares to the top thirty sample using NSF R&D reporting over each year of our timeframe. We report the average expenditures in thousands and inflated to 2012 dollars by sponsor type for the top thirty sample and for our sample of institutions. The average funding levels for our sample are generally similar to those of the top thirty sample. Our sample tends to have more funding from federal and industry sponsors and less from state and local governments and other sponsor types. Our institutions are included in the top thirty list for all years with one exception: in 2006 only three of our four rank within the top thirty.

We also include the proportion of total expenditures of the top thirty universities which is provided from our sample institutions. On average, our sample accounts for approximately nine to nineteen percent of S&E R&D expenditures (if funds were distributed evenly across the thirty institutions, our sample would account for thirteen percent). NSF reports R&D funding across the following categories: total, federal, state & local government, industry, own institution⁶, and other. The other category includes funds provided by nonprofit sponsors.

In 2010, the NSF re-launched their academic survey as the Higher Education R&D (HERD) Survey. In this new version, NSF recognized the growth and importance of nonprofits as funders and pulled them out as a separate sponsor category. For this shorter timeframe, we compare our sample again to the sample of top thirty institutions in Appendix Table 2. Similarly, to the findings from Appendix Table 1, our sample of institutions accounts for approximately six to twenty-one percent of S&E R&D funding from top 30 universities. In addition, our sample receives more funding from federal and industry sponsors and less from nonprofit and state & local governments. Based on these comparisons, we find general support for the representativeness of our sample to the top thirty US research institutions by S&E R&D funding. While not perfect, given the paucity of fine-grained, project-level data, analysis of these data provides valuable insights into the operation of indirect cost recovery.

3.2.1 Administrative versus Public Data

Given the prevalent use of the NSF survey data in analysis of R&D-related questions, it is worth comparing the publicly available data to the confidential administrative data. Appendix Table 3 compares the funding levels of our primary sponsor between the two datasets. As seen from the table, our data

⁶ Own institutions funds are those provided for research from internal university sources. The interpretation of this category varies across institutions but generally includes funds provided for start-up packages and university centers.

always exhibits a lower value of funding than what is reported to NSF. Column 3 shows the proportion of NSF expenditures not in our sample. Notably, our sample of sponsored research projects shows significantly lower funding levels from industry sponsors. This is driven by the exclusion of non-research projects from our sample. We exclude clinical-trial related awards and contracts from our sample of research awards. These alternate types of projects are predominately funded by industry. These discrepancies highlight the limitations of publicly available data. Because there are not set standards on the category definitions, there is university variation in what types of projects and sponsors are reported, such as universities including projects such as clinical trials.

In addition, as discussed above, NSF has only broken out data on nonprofit funding levels since 2010. The previous Survey of R&D Expenditures at Universities and Colleges provides data back to 1972, but nonprofit funding is reported in the ‘other’ category of funding, along with foreign governments and individuals. Nonprofit funding is an important category of funding which now accounts for more expenditures than industry or state and local governments (11), but our understanding of nonprofit funding is more limited, in part due to the short timeframe of data surrounding it. While the NSF data are very useful and capture general trends, they do not illuminate the nuances of academic R&D funding provided by fine-grain administrative data.

3.3 Descriptive Statistics

To assess general trends, we examine the descriptive statistics. Table 4 provides descriptive statistics for the full sample and stratified by sponsor type including federal, nonprofit, and industry types, as well as the prominent federal funders of NIH, NSF, and DOD. The cleaned dataset provides details on sponsored-research awards for 42,007 projects active from 2003 through 2012.

<Table 4>

Of note, average total project expenses are just under \$480,000. This is led by federally funded projects with an average of roughly \$585,000. Of the most prevalent federal sponsors, NIH awards are significantly larger, around \$795,000 compared to \$300,000 for NSF. Nonprofit and Industry funders provide significantly lower awards, both with averages under \$200,000. Using Equation 2, we calculate the EIDC rate for each project in our sample. The average EIDC rate paid across all projects and sponsors was 35.2 percent. Nonprofits sponsors paid the lowest indirect rates with averages of 9.8 percent. Industry sponsored projects were close to the overall average, paying 34.3 percent, while federal sponsors paid the highest rate, with an average of 41.2 percent. Figure 1 visually highlights these variations in EIDC rates across sponsor and academic fields.

<Figure 1>

However, over our timeframe, the average federally negotiated rate for our sample of institutions was 54 percent. Over three-quarters of projects in our sample have EIDC rates below their negotiated rate. The rate of under-recovery is 95.3 percent for nonprofit-funded projects. This is consistent with our expectations of under-recovery.

Regarding other elements of projects, Industry and DOD sponsored projects have the highest likelihood of being a prime-sponsored project with approximately 30 percent falling within this category and the highest proportion of being based in a center or institute rather than department (15.6 to 18.7 percent). Projects last for an average of roughly three years with NIH projects lasting nearly four years on average compared to just two years for nonprofit and industry sponsored projects.

Appendix Table 4 provides a similar set of descriptive statistics stratified by academic field. Average project totals are above the mean for projects in Biological Sciences and Psychology, near the mean for Chemistry, and below the mean for all other fields. Fields paying the highest IDC rates include Computer Sciences and Mathematics, both at 46 percent. Environmental Science and Psychology based projects pay the lowest rates of 29.1 and 31 percent, respectively. Rates of prime sponsorship vary significantly by field. Center-based projects also vary by field, but only Engineering-related projects have a rate significantly above the mean with 21.7 percent for projects based in centers.

Figure 2 shows the distribution of fields by sponsor type with respect to total funding and indirect recovery. Fields have approximately 89 to 97 percent of their total sponsored research from federal sources in this sample with industry accounting for 0.4 to 6.2 percent. Nonprofit's fund between 1.2 and 7.3 percent. However, indirect recovery proportions differ. Nonprofits provide only 0.2 to 4.8 percent of overall indirect recovery. Industry is more balanced in their relative proportions, while federal recovers at least 91 percent for each field.

<Figure 2>

IV. Methods

4.1 Effective Indirect Cost Rates

Using these project-level data, we perform a series of regression analyses to illuminate the trends between project characteristics and EIDC rates. While it is known that there is under-recovery of IDC within universities, how this deficit occurs is less understood. Differences observed could reflect several phenomena including subsidization, cost calculation differences, or indirect cost differences, which are not mutually exclusive. The analyses conducted here does not distinguish between these mechanisms but identifies where these variations occur, providing a nuanced understanding of how IDC recovery varies across projects. Our primary model is illustrated in Equation 3:

$$\begin{aligned}
EIDC\ Rate = & \beta_0 + \beta_z Sponsor + \beta_y Field + \beta_1 UniFieldProp_{t-1} + \beta_2 Center + \beta_3 Prime \\
& + \beta_x StartYearBin + \beta_5 Length + \beta_6 \ln(DirectCost) + \beta_w University + \varepsilon
\end{aligned}
\tag{3}$$

Equation 3 uses OLS to estimate the project *EIDC Rate* as a function of sponsor type and field. Again, the sponsor types of interest for this study are *Federal*, *Industry*, and *Nonprofit*. Federally sponsored projects are the referent category. Field captures the academic department of the PI (Table 2, Panel A). The referent field is *Biological Sciences*. In addition, we include the lagged proportion of sponsored research funding the institution receives for that field in the start year of the award⁷. While the field logged is that of the PIs, many research projects are administered through interdisciplinary or specialized research centers of institutes. We include a binary indicator for whether the grant is housed in a research center or institute, instead of an academic department. Additional controls include whether it is a prime-sponsored project, the length of the project in years, and the logged direct cost of the project. Start year is included as a categorical control with bins of *Prior to 2001*, *2001-2007*, *2008-2009*, and *2010-2012*, with the latter as the referent category. Finally, there is a control for institution which is not reported due to the confidential nature of the data. All models are estimated using robust standard errors.

The model is estimated on a variety of samples to capture additional variation. First, we stratify the sample by sponsor type to assess if project characteristic effects vary by sponsor. Second, given the prevalence of biological sciences projects, we stratify the sample by this field. In the non-biological sample, the referent field is *Engineering*, the second most prevalent field. Given the prevalence of federally funded projects, we also estimate a series of regressions on this sub-sample controlling for the sponsoring department or agency. In the estimations by federal department (agency), DHHS (NIH) is the referent sponsor for the federal and federal-biological sub-samples. For the federal-non-biological sub-sample, DOD (NSF) is the referent sponsor.

We also conducted a series of robustness and sensitivity estimations to validate our primary model. As described above, we control for start year using categorical bins. We also estimated the model using continuous year. In addition, we have a smaller sample of 2012 projects that may mean the data is not complete for that year. To test for any bias, we reduced the timeframe to 2003-2011. Both tests are consistent. Both are presented in Appendix Table 6. In the primary model we also control for whether the project is prime sponsored, meaning the project in our sample is a sub-contract to a larger, multi-university award. Indirect rates for these projects are likely tied more closely to the traits of the intermediary organization. We estimate a model excluding these prime sponsored projects and find

⁷ For grants that begin prior to our study period, we use the first year available.

consistent results (Appendix Table 7). Finally, as discussed in Section 3, we also estimated our primary model on a broader sample that did not remove outliers and find consistent results.

4.2 University Response to Under-Recovery

In addition to documenting how indirect cost recovery falls short, we investigate how universities respond to, and potentially mitigate, these deficits. First, we stratify the sample by projects that are based in research centers or not. Research centers often draw upon private funding sources to cover administrative costs, providing in-house researchers with greater flexibility to apply for funding with lower IDC recovery. Thus, we expect researchers in these centers to have higher rates of under-recovery than the full sample. Such a difference would indicate support for the response of universities using private funds to supplement IDC recovery.

Next, we further explore the role of alternate funding as a supplement to IDC recovery through institution's own funds. As defined previously, own institution funding is provided by the university directly to their researchers. These funds originate from a variety of sources and are used for multiple purposes, depending on the institution. It may be a combination of interest income from endowments, gifts, bequests, and other contributions to the university that are not counted as sponsored research but are subsequently allocated to research funding. Some universities with centralized IDC recovery may use recovered IDC payments in this category. Generally, this source is the second largest funder of R&D at universities (Appendix Table 1, NSF Academic R&D Survey).

Universities may use the funds in response to IDC recovery in opposing directions. Universities may reward fields with higher IDC recovery with more internal funding or alternatively, fields with lower recovery may be supplemented with additional internal funding to balance the difference. Because the projects receiving these funds are not externally sponsored, they are not in our sample. Instead, we use the NSF reported values of institution-own funding by field. Unfortunately, this granularity by field within a university was only incorporated in NSF reporting beginning in 2012, overlapping with our timeframe for just one year. Because both sources are from the same year, we are not able to control for any lags, so the results are purely associational, yet can inform whether universities may be using these funds as a supplement, or a reward.

Finally, we assess the portfolio of IDC recovery from another perspective. Again, stratifying our sample by sponsor type, we control for the proportion of field funding by other funders. Specifically, on our federal sub-sample we control first for the proportion of funding from nonprofit sponsors and second from industry sponsors. Then for our sub-samples of nonprofits and industry sponsors we control for the proportion of field funding by federal sponsors. Results for these estimations inform how IDC recovery varies with changes to the broader portfolio within divisions.

V. Results

5.1 EIDC Rates by Sponsor and Field

Table 5 presents the estimation results of Equation 3 on the full sample and stratified by sponsor type as well as stratified by the Biological Sciences field. The results are visually presented in Figures 3 and 4. As shown in the descriptive statistics, there is significant variation between sponsors and fields of EIDC Rates (Panel A). Specifically, industry funded projects yield a 6.2 percentage point lower rate than federal projects. However, nonprofit funded projects show a 28.4 percentage point difference from federal projects. These results are similar when stratified by Biological Science projects.

<Table 5>

Regarding field, in comparison to the Biological Sciences, all other fields yield higher EIDC rates overall. However, when stratified by funder, differences emerge. Federally funded projects show significant variation in rates across fields compared to those in the Biological Sciences. Industry funded projects however have far less field variation in EIDC rates. Compared to the Biological Sciences, only projects in Computer Science and Mathematics yield significantly higher EIDC rates. In fields where rates vary across sponsor, effect sizes differ. Most significantly, federally funded Engineering projects are only 4.1 percentage points above Biological Sciences projects but 9.3 percentage points higher when comparing nonprofit funded projects. Also of note, projects in Mathematics yield a nine to eleven percentage point higher EIDC rate, compared to the Biological Sciences, for nonprofit and federally funded projects, respectively, but a thirteen-percentage point higher rate for industry sponsored projects. When we exclude the Biological Sciences, other fields are also yielding higher rates when compared to Engineering but by lower levels, on average.

<Figure 3>

The estimations also reveal other interesting differences. These are illustrated in Figure 4 (and Panel B of Table 5). Not surprisingly, prime sponsored projects yield higher EIDC rates across the sub-samples, an effect led by nonprofit and industry sponsors, reducing IDC loss from these sponsors. The lagged proportion of university funding in the field also yields higher EIDC rates in federal projects so that as a university has more prevalence in R&D in a given field, their corresponding federal awards pay higher EIDC rates. Also, of note, there were no economically significant differences by project length or direct project expenses.

Overtime, EIDC rates have increased, with industry sponsored projects have increased the most during the period of study. Nonprofit sponsored projects, however, have changed the least with no economically significant variation in their rates over the sample period. The limited results for the nonprofit sample point to a stark contrast in how nonprofits accept the indirect cost burden. By applying

similar rates across time, nonprofits are following their own norms on the costs of research, avoiding the additional expense of indirect costs, which universities have in turn accepted.

Finally, center-based projects also yield higher EIDC rates, with the largest effect by industry sponsored projects. This points to differences in how industry sponsors view the institutional home of a research project, the type of project, and the required resources. It also previews how the use of private funding may be complementing rather than substituting for IDC recovery, as we suspected. These results are explored further in the next section.

<Figure 4>

Finally, we explore the sub-sample of federally funded projects. Appendix Table 5 provides these results including the funding federal department. The results by department and agency are illustrated in Figure 5.⁸ The baseline federal department for the full federal sample and biological federal sample is the Department of Health and Human Services (DHHS), which includes NIH, the most common sponsor in our sample. The referent department for non-biological sciences sample is the Department of Defense (DOD). Across the full set of federally funded projects as well as stratified by the Biological Sciences, federal departments generally pay lower EIDC rates compared to DHHS. DOT is the only exception with a significant positive difference from DHHS and DOD. Regarding federal agencies, compared to NIH and NSF, most agency pay lower EIDC. However, in the sub-sample excluding biological sciences, HRSA and Medicare/Medicaid pay lower EIDC rates than NSF.

<Figure 5>

5.2 Role of Alternative Funding in IDC Recovery

These differences in IDC recovery across sponsor and field raise questions as to how universities compensate or respond to these disparities. While there are limitations to assessing such a response through data, we examine possible venues universities may employ to mitigate the deficits. We first examine our results on the sub-sample of projects based in research centers or institute. These organizations typically receive private funding to cover some of their administrative costs. These funds can in turn allow researchers greater flexibility in the amount of IDC recovery they need to bring in. Thus, we suspected center-based projects will have lower EIDC rates. However, the results of Table 5 show that on average, center-based projects actually yield slightly higher EIDC rates, by 2.1 percentage points. This is driven by industry-sponsored projects.

Table 6 investigates these findings further with the sub-sample analysis. The results find no difference in industry EIDC rates from federal rates while nonprofit sponsored projects are still

⁸ Full regression results by federal agency are not provided due to size but are available upon request.

significantly lower than federal, but no more so than in the full sample. There are field differences though that vary from the full sample. Regarding federally sponsored projects, there are no longer significant differences across fields. For industry sponsored projects the field differences from biological sciences are amplified such that computer science and engineering have larger differences than in the full sample. For nonprofits, the result shift significantly. Unlike the full sample and other sponsors, other fields have significantly lower rates compared to biological sciences of nonprofit funded projects. It appears that research centers are able negotiate higher IDC rates with industry sponsors as are centers based in the biological sciences with nonprofit funders. This may be because funders see the administrative funds as staying closer to the research project, they are willing to pay for more indirect costs. Either way, it does not appear that private donor dollars are supplementing for IDC loss, but rather are complementing recovered costs.

<Table 6>

We further explore the role of internal funding through the use of institution's own funds. As previously discussed, these funds vary in their original source but are used to fund a significant share of R&D within the university. We explore whether these own funds are a substitute or complement to IDC recovery with an analysis on projects in fiscal year 2012, the year for which we can access institution own funding by field. Table 7 presents these results. Overall, institutions own funding in a field is positively associated with EIDC rates. This finding is driven by the federally funded projects. There is then a negative association between own funds and EIDC rates in industry funded projects and a null finding for nonprofit sponsored projects. Thus, there is evidence of a nuanced relationship between own funding and IDC recovery. In federal projects, which tend to have higher rates, own funds complement EIDC rates; this could be a reward for bringing in full-freight recovery through a return of a portion. However, in industry funded projects, which are lower than federal, own funds are a substitute for IDC recovery. These findings warrant additional investigation with future data.

<Table 7>

Finally, we examine the way the portfolio of sponsors within a field may impact EIDC rates. Table 8 shows the results of four sub-samples. Columns 1 and 2 are of federally sponsored projects and control for the proportion of sponsored research funding for nonprofit and industry sources, respectively. Column 3 is of nonprofit sponsored projects and controls for the proportion of research in the field provided by federal sources. Column 4 includes the same control but in the sample of industry sponsored projects. For federally funded projects, as the share of funding from industry increases, federal EIDC rates increase, yet there is no effect from changes in nonprofit funding. Alternately, as the share of funding from federal sources increases, EIDC rates decrease for both nonprofit and industry sponsored projects. These results may reflect a greater willingness to accept lower EIDC rates from non-federal sources if a

sufficient level of IDC is recovered through the higher, federal levels. Overall, it does appear that the balance of the portfolio of funding affects EIDC rates and IDC recovery.

<Table 8>

VI. Discussion

Using project-level administrative data, we examine how indirect cost recovery varies across sponsor type, field, and project characteristics. While it is generally known that universities under recover IDC and that certain sponsors, like nonprofits pay lower rates, nuance is lacking into what shapes these variations and how universities respond to them. In general, nonprofit sponsored projects pay significantly lower IDC rates than federal sponsors while projects in the biological sciences under-recover IDC compared to most other fields. Center-based projects, however, yield higher EIDC rates, driven by industry sponsors, potentially because administrative expenses are local to the topic, sponsors are willing to pay a higher rate of return. Interestingly, for nonprofit sponsored projects in centers, biological sciences pay higher rates than other fields. In terms of own funds, institutions appear to complement higher EIDC rates on federal projects with more own funding in that field yet for industry projects, own funds are a substitute for IDC recovery. Finally, the balance of the portfolio matters. Fields with more federal funding, and thus generally greater IDC recovery, accept lower EIDC rates from nonprofit and industry sponsors. Together, these results reveal the complicated relationship between research and IDC recovery.

6.1 Efficient & Equitable? A Story of Misaligned Incentives

In the simplest conceptualization, IDC rates fund shared university resources and fixed costs. If the negotiated federal IDC rate is required to recover true indirect costs, then any deviation from this rate would be characterized as a loss of efficiency. Yet our results reveal under recovery across sponsor type that vary by field and other project characteristics that are unlikely to reflect true use of indirect costs. There are significant implications to the academic research enterprise of this under recovery. Consider the challenge that nonprofit-funded projects create for university administrators: research administrators have obligations to ensure that sufficient funds are available in the general fund to support faculty salaries and laboratory start-up costs, as well as facilities and operational budgets to cover equipment and buildings, energy, and other costs (36). While some of these expenses (e.g. faculty salaries) are not included in the IDC calculation, the funds recovered through IDC may be used for these additional expenses. If research budgets continue to see shifts towards nonprofit funders, universities will lose significant returns of IDC. For example, the difference between a \$100M in research funding from nonprofit funders with the average nonprofit EIDC rate (10 percent in our dataset), as compared to funding from federal sponsors

with the average federal EIDC rate (41 percent) would result in a loss of approximately \$20M in the recovery of IDC to the institution.

Further analysis reveals differences in sponsor type by career stage. One institution in our dataset provided PI titles. Although the capacity to generalize based on a single institution is limited, several results are notable, and worth discussion. Associate professors are less likely to receive research funding from nonprofits. Nonprofits appear to fund promising assistant professors with the hope that initial research successes will catalyze follow-on federal funding (37), while also funding well-established researchers to optimize anticipated outcome returns, and benefit from positive reputation association. Associate professors, beyond the blush of untapped potential but not yet at the pinnacle of their research careers, may find themselves shouldering more of the institutional burden. Although the generalizability of these results is limited, the results point to the need for future research.

This discussion around sponsor type has presupposed that the award amount remains constant between funding sources, and that the difference in indirect cost rate goes to the researcher. However, lower value grants typically have lower IDC rates. Thus, in the short term, researchers may retain the incentive to pursue larger grants. However, higher IDC sources (e.g. the government) are becoming increasingly competitive, and lower IDC sources (e.g. nonprofits) may increase their presence through increased grant sizes. Thus, in the long term, the indirect cost rate differential, coupled with funding source trends, may cause researchers to shift away from high IDC rate sources, and towards lower IDC rate sources. This trend is in-line with the declining federal share in research funding that we have been seeing over the last several decades, even as the federal research expenditures increase. Thus, if government funding were cut, institutions that are successful in raising funds from the nonprofit sector may face a “winner’s curse” with abundance for the individual PIs, but scarcity for supporting the fixed costs associated with that research. Because of the lack of return of fixed costs, some institutions have discouraged researchers from applying for funding that provide lower IDC rates (21, 38). But this is not the only financial hit associated with nonprofit funders, as nonprofit funders are increasingly claiming a share of the royalties accruing to licenses that arise from their funded research. In one sample, royalty rights were included in two-thirds of the sponsored research agreements between nonprofit funders and universities (39), suggesting that the structure and terms of nonprofit-sponsored research agreements reduce both the current and future flow of funds to the university.

Beyond sponsors, our results demonstrate disparities in EIDC across departments. To be clear, this reflects differences in the amount paid to universities to cover indirect costs, rather than differences in the indirect costs themselves. These differential rates may cause cross subsidies across researchers. In this scenario, the IDC rates differ across the university relative to the indirect costs, and indirect costs are shared across the university. We provide evidence that indirect cost recovery rates differ across

disciplines, thus subsidization may be occurring. If all research activity benefits from common resources, but only some grants recover the costs of those common resources, then the result is cross-subsidization between different research projects. Those PIs and departments which receive government funding with higher IDC recovery, especially NIH or NSF funding, provide a subsidy to those who receive greater funding from nonprofit and industry sources with lower recovery.

To further this argument, we also provide evidence that disciplines with apparently lower demands on university resources (mathematics and computer science) bear higher indirect cost rates when compared to disciplines that require lab space and have greater demands on overhead (chemistry, engineering, and physics). This further supports the argument of subsidization. As an example, consider a lab-based scientist, such as an engineer, who requires more equipment and subtracts those costs from their IDC calculation. That very equipment will cost more, requiring utilities and building maintenance. Contrast this with a researcher with a higher IDC rate with a smaller share of facility use, say a mathematician. Here, the mathematician subsidizes the engineer by paying the higher effective IDC rate. This could be further exacerbated by the fact that some lab-based facilities costs are included in the negotiated rate calculations. For example, mouse/rat facilities and reactors are often included in the indirect cost calculations but are only used by a subset of departments. Thus, the cross-subsidy is twofold as lab-based sciences pay a lower IDC rate *and* receive a greater share of the IDC recovered. This is an important point that varies by university and the system of distribution they use, however, so it is difficult to dissect and warrants further research.

As discussed previously, there are two primary models used: a centralized system where recovered IDC is collected by central administration and distributed to the shared and fixed costs, or a decentralized system where IDC recovery is kept locally by schools or departments and used to cover internal fixed and shared costs, potentially with some tax paid to the central administration. Take for example this paper, which subsidized life science research and social science administration across three universities. Was that the intention of the negotiated federal IDC rate? For institutions using the central recovery, yes. Lower IDC-cost research subsidizes biological science research at universities through the coverage of certain costs used by biological science researchers. The appropriateness of this subsidization is an independent issue subject to debate within institutions and prompts greater conversation about the public good provision of universities.

For de-centralized universities the answer, however, is no. The negotiated rate of IDC was based on costs not used nor allocated for this research. The consequences of this misallocation of recovered IDC are more complicated. Should sponsors negotiate multiple rates across fields within decentralized institutions? Should faculty in lower-cost fields negotiate with their administration for a share or returned recovery? Local administrators are unlikely to be supportive of losing a stream of revenues that subsidize

other administrative costs, yet faculty are also unlikely to like subsidizing such administrative costs. Ultimately, these misaligned incentives create tensions which question the sustainability of the funding model.

6.2 Alternate IDC Systems

These issues raise the point that alternative indirect cost recovery systems may be more efficient. Here, we consider possible alternative systems. We do not advocate for any particular system, but rather review each as examples to consider against the intent of IDC recovery. We first consider the option of fixed costs and moving indirect costs above the line. As mentioned previously, some countries do not provide indirect cost recovery and maintain productive research universities. The United Kingdom, Ireland, Finland, and Sweden each use the full cost accounting method (20). With no indirect recovery rate, each project calculates the indirect costs used with the project and includes them “above the line” in the direct budget. This is in line with the preferences of many nonprofit funders, which make up in part for their lower IDC rates by allowing some indirect costs to be accounted for directly. Such a model would increase transparency of research costs for both researchers and sponsors while creating increased tension between researchers and administrators in the allocation of fixed and shared costs. University costs have increased substantially overtime with increasing pressure to lower them. Full cost accounting may lead to reduced costs as universities more clearly allocate their use. However, if IDC recovery is being used to subsidize other “products” of the university, such as teaching, there could be negative consequences to the academy.

Second, we consider the option of an equitable and efficient tax. Rather than negotiating indirect cost rates, a single, flat, indirect cost rate could be defined. This system is used by Japan with a flat rate of 30 percent for recovery on all projects (21). If we assume this rate is an approximate average of the current rate, then for institutions with lower indirect costs, available resources would increase, while available resources would decrease for institutions with higher indirect costs. A variant of this system could use an index to account for geographic variation in costs, similar to a cost-of-living index. Noll and Rogerson (1998) outline another alternative, wherein the indirect cost rate for a given institution is calculated using a random sampling of accounting costs at peer institutions (16). Under this option, points of negotiation would reduce and the issues of cross-subsidization across field would not be pre-determined but tied to how the university allocates recovered IDC. There would still be the issue of under recovery from sponsors who do not agree to the flat rate.

Each of the above options removes the indirect cost rate negotiation, increasing efficiency. However, failing to account for idiosyncratic differences between university costs may adversely affect a range of institutions. A final alternative would require a less radical change to the current system.

Institution-level indirect cost rates could either be negotiated once and held constant in perpetuity or negotiated at less frequent intervals. Each would allow the idiosyncrasies of each institution to be considered, though with less frequency, while increasing the system efficiency. This model, while least dramatic in change, also fails to directly address some of the equity issues raised by the cross-subsidization and still allows for under recovery for sponsors that opt out of the negotiated rate.

6.3 The Real Costs of Academic Research

The indirect costs of academic research are real and need to be recovered. The current cost recovery system has a reasonable economic justification, but its implementation reflects historical precedent and compromise within a changing funding and political landscape. This analysis uses detailed university administrative data to examine variation in the burden of IDC recovery across faculty and departments. Our results demonstrate significant variation in the recovery of university indirect costs from different sponsors, by different disciplines, and at different stages of academic careers.

The challenge of recovering fixed costs associated with shared resources is not unique to academic institutions, yet our public good orientation complicates it. Without economies of scale from joint production and the inability to abandon unprofitable activities, cross-subsidies across and within “products”, is inevitable. This further complicates the ability to create an efficient and equitable cost recovery mechanism. Our study begins to fill this gap and documents the existing variation of IDC rates across and within different funding types, as well as to different academic fields within a university, an important step in improving the cost recovery mechanism. Before adjustments can be made, we need to understand the consequences and spillovers created by our current system.

Our results highlight three critical challenges with the current IDC recovery system. First, variations in accepted IDC rates may undercut the financial justification and weaken the institution’s negotiating position across all funding sources. By accepting different IDC rates from different sponsors, universities may contribute to the perception that indirect cost recovery is not essential to maintain research activities. This is demonstrated most notably by the significantly lower rate paid by nonprofits, while their share of funded projects is increasing. While the reduced cost may encourage nonprofit research funding in the short run, in the long run, this trend could ultimately decrease the resources available to the research enterprise for indirect cost recovery. Further, the acceptance of different IDC recovery from different funders recasts essential operating income for universities as an unnecessary expense. This is certainly one of the justifications articulated in reoccurring efforts to reduce federal indirect recovery.

Notably, this perspective is inconsistent with the incentive structure articulated by university officials. James Luther, the Associate Vice President of Finance at Duke University, in 2017

Congressional testimony argues nonprofit funding serves a narrow purpose and that these sponsors are funding areas of research with limited funding opportunity (14). Despite the growth of nonprofit funding, administrators still view the source as more of a supplement rather than a substitute and thus do not perceive it as influencing broader trends.

Second, variation in EIDC rates may result in cross subsidies between fields and PIs. If one assumes that indirect costs are the same or similar across researchers, and costs are shared across the university, those projects that pay higher rates provide greater returns to institutions and subsidize the projects and departments that pay lower EIDC rates. These distortions may demonstrate a lack of transparency in the cost recovery mechanism, which may be amplified in the inclusion of certain facilities in the overhead rate calculations. In addition, PI-sponsor composition differences highlight the fact that there are PI-IDC rate differences. Future research, augmented with personnel records, could examine if EIDC affects PI base salaries, which would then increase the direct costs for those PIs, and the impacts on hiring allocations over time. Future research could also investigate if, and how, variation in IDC rates influences PI choices in grant proposal submissions across their careers.

Finally, these potential cross-subsidizations of IDC costs fuel the perception of fungibility in IDC accounting. Previous researchers have highlighted the belief that university administrators' view recovered IDC as "free money" as it is not obligated to the extent of other revenues. Thus, they may allocate it to new projects or to fill deficits (10, 23, 40). For example, the growth of research funding by internal support raises opportunities for further investigation. The source of these funds varies by university but may include recovered indirect costs. The allocation of recovered indirect costs warrants further investigation.

Proposed arbitrary constraints on federal cost recovery (33) will only further complicate cross-subsidization and starve academic research. Given the threat of decreased federal funding and reduced indirect recovery, universities need to consider reducing administrative costs (41) or shifting to an alternative model of IDC recovery. University administrators could use their administrative data to evaluate research costs and cross-subsidies, increase transparency around fixed costs, and revise their recovery systems to ensure the solvency and longevity of the research enterprise. To understand the real costs of academic research, additional analysis is needed of university expenses, including the administrative oversight burden imposed by the federal government. Such administrative data can provide better information about the real costs of IDC associated with conducting research, and result in university indirect cost rates based on sound accounting principles that balance the opposing incentives of funders, faculty, and administrators.

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7 Tables

Table 1: *Data Cleaning Sample Reductions*

	Reductions	Sample Size
Sample of Sponsored-Research Awards		59,576
Cleaning Dimension		
Agricultural Science	-697	58,879
State & Local, Education and Other Sponsors	-5040	53,839
Length < 0 years or 40 years	-14	53,825
Negative Award Amounts	-4	53,821
Zero Award Amounts	-9,103	44,718
Award Amount Outliers		
Bottom 5% (<\$7,875)	-2,233	42,485
Top 0.05% (>\$24.2M)	-23	42,462
IDC Rate Exceeds 100%	-20	42,442
Front-Loaded IDC	-12	42,430
Top 1% of IDC Rates (>79.0%)	-423	42,007

Notes: Dataset reflects sponsored-research award activity from four institutions from 2003-2012. Awards dropped for zero-award amounts include grants with time periods before our starting point of 2003. Front-loaded IDC rates include those with rates of 100% and no direct expenditures.

Table 2: Academic Field & Sponsor Type Frequency

Panel A: Field Distribution	Count	Proportion
Biological Sciences	27,015	64.3%
Chemistry	1,144	2.7%
Computer Science	1,392	3.3%
Engineering	6,895	16.4%
Environmental Science	1,089	2.6%
Geosciences	556	1.3%
Mathematics	1,184	2.8%
Physics	2,134	5.1%
Psychology	598	1.4%
Full Sample	42,007	

Panel B: Sponsor Distribution	Count	Proportion
Federal	31,127	74.1%
Nonprofit	7,291	17.4%
Industry	3,589	8.5%
Full Sample	42,007	

Notes: Data reflect cleaned sample of sponsored-research awards with activity from 2003-2012 for four institutions. Fields were classified based on PI's home department and the corresponding CIP code. Sponsor type is based on reported sponsor or prime sponsor.

Table 3: Federal Department & Agency Crosswalk

Federal Mission Agencies & Department	Share of Federal Awards	Sub-Agencies
Agriculture (USDA)	0.93%	Forest Service
Commerce	0.72%	EDA, NIST, NOAA
Defense (DOD)	9.46%	Air Force, Army, Navy, NSA
Education	0.42%	
Energy	3.88%	National Laboratories
Health & Human Services (DHHS)	56.39%	AHRQ, CDC, FDA, HRSA, Medicare & Medicaid, NIH, SAMHSA, Toxic Substances
Homeland Security (DHS)	0.18%	Coast Guard
Housing & Urban Development (HUD)	0.01%	
Interior	0.53%	Fish & Wildlife, Geological Survey, National Park Service
Justice (DOJ)	0.02%	
State	0.01%	
Transportation (DOT)	0.40%	Federal Aviation, Federal Highway, Highway Traffic Safety, Federal Railroad, Maritime
Veterans Affairs (VA)	0.96%	
National Science Foundation (NSF)	20.67%	
All Others Independent Agencies	5.42%	Archives, Central Intelligence Agency, Director of National Intelligence, Endowment for the Humanities, Environmental Protection Agency, Library of Congress, Museum and Library Services, National Aeronautics and Space Agency, National & Community Service, Nuclear Regulatory Commission, Postal Service, Small Business Administration, Smithsonian, Transportation Safety Board, US Agency for International Development

Notes: Federal sponsors were sub-categorized by federal department and agency following the national department classifications. Independent agencies were grouped together at the department level including NSF.

Table 4: Descriptive Statistics by Sponsor Type

	Full Sample	Federal	Nonprofit	Industry	NIH	NSF	DOD
Total Project Expenses (\$)	479,960 (1,019,518)	585,048 (1,131,779)	182,813 (451,732)	172,197 (521,731)	794,739 (1,308,970)	300,923 (622,565)	426,492 (955,255)
Direct Project Expenses (\$)	351,934 (781,274)	421,398 (864,743)	165,125 (412,478)	128,983 (388,382)	566,653 (988,265)	216,269 (501,955)	315,729 (759,539)
Indirect Project Expenses (\$)	128,026 (273,841)	163,650 (304,918)	17,688 (57,710)	43,214 (147,126)	228,087 (365,622)	84,654 (141,294)	110,763 (222,176)
Project EIDC Rate	0.35 (0.22)	0.41 (0.19)	0.10 (0.15)	0.34 (0.21)	0.43 (0.18)	0.44 (0.20)	0.41 (0.19)
Below Negotiated IDC Rate	0.78 (0.41)	0.73 (0.44)	0.95 (0.21)	0.75 (0.44)	0.71 (0.45)	0.70 (0.46)	0.80 (0.40)
Prime Sponsored	0.18 (0.38)	0.19 (0.39)	0.60 (0.25)	0.30 (0.46)	0.17 (0.38)	0.06 (0.25)	0.29 (0.46)
Center-Based	0.11 (0.31)	0.10 (0.30)	0.13 (0.33)	0.16 (0.36)	0.10 (0.30)	0.08 (0.28)	0.19 (0.39)
Project Length (Years)	3.13 (2.36)	3.50 (2.46)	2.09 (1.56)	2.05 (1.80)	3.98 (2.93)	3.36 (1.42)	2.60 (1.52)
Project Start Year	2007.03 (3.42)	2006.85 (3.53)	2007.58 (3.03)	2007.41 (3.00)	2006.70 (3.71)	2006.92 (3.36)	2007.19 (3.21)
Observations	42,007	31,127	7,291	3,589	16,673	6,433	2,945

Notes: Means (Standard Deviations) or Proportions presented; expenditure averages inflated to 2012 dollars before averaging.

Table 5: Regression Results Stratified by Sponsor Type and Field

Panel A: Sponsor & Field	(1)	(2)	(3)	(4)	(5)	(6)
	Full	Federal	Nonprofit	Industry	Non-Bio	Bio
<i>Sponsor Type (Referent: Federal)</i>						
Industry	-0.062*** (0.004)				-0.043*** (0.006)	-0.079*** (0.004)
Nonprofit	-0.284*** (0.002)				-0.273*** (0.006)	-0.288*** (0.003)
<i>Field (Referent: Biological Science^)</i>						
Chemistry	0.068*** (0.010)	0.072*** (0.011)	0.012 (0.020)	0.015 (0.042)	0.016* (0.009)	
Computer Science	0.112*** (0.009)	0.102*** (0.011)	0.110*** (0.030)	0.073** (0.037)	0.049*** (0.007)	
Engineering	0.058*** (0.007)	0.041*** (0.009)	0.093*** (0.019)	0.038 (0.027)		
Environmental Science	0.026*** (0.010)	-0.003 (0.012)	0.079*** (0.024)	-0.042 (0.042)	-0.014 (0.009)	
Geosciences	0.078*** (0.012)	0.061*** (0.013)	0.080** (0.036)	0.061 (0.053)	0.043*** (0.012)	
Mathematics	0.119*** (0.009)	0.109*** (0.011)	0.090*** (0.035)	0.130*** (0.040)	0.064*** (0.008)	
Physics	0.075*** (0.008)	0.066*** (0.010)	0.016 (0.022)	0.061 (0.038)	0.038*** (0.007)	
Psychology	0.042*** (0.011)	0.038*** (0.014)	0.006 (0.022)	-0.061 (0.062)	0.004 (0.011)	

Panel B: Project Characteristics	(1) Full	(2) Federal	(3) Nonprofit	(4) Industry	(5) Non-Bio	(6) Bio
University Field Funding Proportion (Lagged)	0.065*** (0.011)	0.058*** (0.013)	0.048 (0.031)	-0.033 (0.041)	0.174*** (0.056)	0.093* (0.050)
Center-Based Project	0.021*** (0.003)	0.015*** (0.004)	-0.001 (0.005)	0.061*** (0.009)	0.024*** (0.005)	0.008** (0.003)
Prime Sponsored Project	0.054*** (0.003)	0.059*** (0.003)	0.140*** (0.010)	0.122*** (0.012)	0.049*** (0.004)	0.061*** (0.003)
Project Length (Years)	0.007*** (0.000)	0.010*** (0.001)	-0.003** (0.001)	-0.009*** (0.002)	0.013*** (0.001)	0.005*** (0.001)
Direct Project Expenses (Inflated, Logged)	0.006*** (0.001)	0.006*** (0.001)	0.007*** (0.002)	-0.002 (0.003)	0.002 (0.002)	0.008*** (0.001)
<i>Period of Project Start (Referent: 2009 - 2012)</i>						
Prior 2001	-0.036*** (0.007)	-0.049*** (0.007)	-0.011 (0.021)	-0.158*** (0.042)	-0.032*** (0.011)	-0.035*** (0.009)
2001-2007	-0.018*** (0.002)	-0.018*** (0.003)	-0.011*** (0.004)	-0.039*** (0.007)	-0.014*** (0.004)	-0.020*** (0.003)
2008-2009	-0.011*** (0.003)	-0.009*** (0.003)	-0.008* (0.005)	-0.026*** (0.009)	-0.003 (0.004)	-0.016*** (0.003)
Constant	0.296*** (0.013)	0.298*** (0.016)	0.029 (0.032)	0.446*** (0.046)	0.397*** (0.019)	0.249*** (0.045)
Observations	42,007	31,127	7,291	3,589	14,992	27,015
Institution Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.350	0.0969	0.137	0.204	0.288	0.384

Note: Full regression results corresponding to Figures 3 and 4. OLS estimation with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. ^ Model (5) Referent field is Engineering. Model (5) excludes projects in the biological sciences; while model (6) only includes projects in the biological sciences.

Table 6: Regression Results on Research Center-Based Sub-Sample

	(1) Center- Based Sample	(2) Federal	(3) Industry	(4) Nonprofit
<i>Sponsor Type (Referent: Federal)</i>				
Industry	0.006 (0.009)			
Nonprofit	-0.281*** (0.007)			
<i>Academic Field (Referent: Biological Science)</i>				
Computer Science	-0.023 (0.035)	-0.018 (0.040)	0.210** (0.084)	-0.313** (0.125)
Engineering	-0.016 (0.023)	-0.018 (0.028)	0.157** (0.066)	-0.273*** (0.061)
Environmental Science	-0.023 (0.031)	0.007 (0.036)	0.061 (0.088)	-0.442*** (0.095)
Physics	-0.048 (0.043)	-0.050 (0.049)		
University Field Funding Proportion (Lagged)	-0.062* (0.034)	-0.033 (0.040)	0.135 (0.097)	-0.632*** (0.106)
Prime Sponsored Project	0.054*** (0.007)	0.068*** (0.009)	0.068* (0.035)	0.043 (0.028)
Project Length (Years)	0.007*** (0.001)	0.010*** (0.002)	-0.011* (0.006)	0.002 (0.003)
Direct Project Expenses (Inflated, Logged)	-0.004 (0.002)	-0.006** (0.003)	-0.001 (0.006)	0.009** (0.004)
Constant	0.526*** (0.037)	0.524*** (0.046)	0.411*** (0.092)	0.570*** (0.099)
Observations	4,642	3,132	559	951
Institution Fixed Effects	Yes	Yes	Yes	Yes
Project Start Year Controls	Yes	Yes	Yes	Yes
Adjusted R-squared	0.441	0.113	0.371	0.264

Note: OLS estimation with robust standard errors in parentheses on sub-sample of projects tied to research centers. *** p<0.01, ** p<0.05, * p<0.1. Insufficient observations for fields of Chemistry, Geosciences, Mathematics and Psychology.

Table 7: Regression Results – Institution-Own Field Funding

	(1) 2012 Sample	(2) Federal	(3) Industry	(4) Nonprofit
Institution's Own Field Funding	0.042*** (0.015)	0.051*** (0.019)	-0.119* (0.063)	0.015 (0.031)
<i>Sponsor Type (Referent: Federal)</i>				
Industry	-0.029*** (0.011)			
Nonprofit	-0.294*** (0.008)			
<i>Academic Field (Referent: Biological Science)</i>				
Chemistry	0.087*** (0.027)	0.101*** (0.033)	-0.028 (0.090)	0.004 (0.050)
Computer Science	0.081*** (0.027)	0.096*** (0.031)	-0.125 (0.112)	0.058 (0.071)
Engineering	0.049** (0.022)	0.052* (0.027)	-0.107 (0.096)	0.026 (0.057)
Environmental Science	0.087*** (0.030)	0.077** (0.037)	-0.086 (0.092)	0.078 (0.070)
Geosciences	0.110*** (0.040)	0.116** (0.046)	-0.118 (0.100)	0.080 (0.111)
Mathematics	0.112*** (0.029)	0.109*** (0.033)	-0.029 (0.072)	0.198** (0.094)
Physics	0.068** (0.030)	0.075** (0.035)	-0.014 (0.080)	0.010 (0.075)
Psychology	0.047 (0.043)	0.060 (0.055)		-0.006 (0.060)
Constant	0.329*** (0.043)	0.260*** (0.056)	0.555*** (0.120)	0.148* (0.080)
Observations	3,335	2,251	311	773
Institution Fixed Effects	Yes	Yes	Yes	Yes
Project Controls	Yes	Yes	Yes	Yes
Adjusted R-squared	0.388	0.108	0.260	0.124

Note: OLS estimations with robust standard errors in parentheses on sample of 2012 projects. *** p<0.01, ** p<0.05, * p<0.1. Control variables included in the models but not presented include start year categorical bins, project length, direct expenses, center-based project indicator, and prime-sponsored project indicator. Institution-Own Field Funds represents the value of the institutional funds at the institution-field-year level in \$100M.

Table 8: Regression Results Stratified by Sponsor Type – Proportion of Sponsor Funding

	(1) Federal	(2) Federal	(3) Nonprofit	(4) Industry
<i>Proportion of Sponsor Funding (University-Field)</i>				
Nonprofit	0.018 (0.030)			
Industry		0.195*** (0.045)		
Federal			-0.162*** (0.047)	-0.135* (0.069)
<i>Academic Field (Referent: Biological Science)</i>				
Chemistry	0.073*** (0.011)	0.072*** (0.011)	0.011 (0.020)	0.016 (0.042)
Computer Science	0.104*** (0.011)	0.100*** (0.011)	0.098*** (0.030)	0.060 (0.038)
Engineering	0.042*** (0.009)	0.033*** (0.009)	0.080*** (0.020)	0.028 (0.028)
Environmental Science	-0.003 (0.012)	-0.005 (0.012)	0.061** (0.024)	-0.057 (0.043)
Geosciences	0.062*** (0.013)	0.060*** (0.013)	0.066* (0.035)	0.037 (0.054)
Mathematics	0.111*** (0.011)	0.113*** (0.011)	0.102*** (0.034)	0.141*** (0.040)
Physics	0.068*** (0.010)	0.066*** (0.010)	0.018 (0.022)	0.064* (0.037)
Psychology	0.038*** (0.014)	0.039*** (0.014)	0.011 (0.022)	-0.055 (0.062)
Constant	0.296*** (0.017)	0.291*** (0.016)	0.172*** (0.053)	0.561*** (0.078)
Observations	31,127	31,127	7,291	3,589
Institution Fixed Effects	Yes	Yes	Yes	Yes
Project Controls	Yes	Yes	Yes	Yes
Adjusted R-squared	0.0969	0.0974	0.139	0.205

Note: OLS estimations with robust standard errors in parentheses stratified by sponsor type. *** p<0.01, ** p<0.05, * p<0.1. Control variables included in the models but not presented include start year categorical bins, project length, direct expenses, center-based project indicator, and prime-sponsored project indicator. Proportion of sponsor funding is the share of sponsored research in the field of the project by specified sponsor in the university at the start year of the project.

APPENDIX

Appendix Table 1: NSF Academic R&D Survey Sample Comparison of S&E R&D Funding

Year	Academic Institution Sample	Total	Federal	State & Local	Industry	Own Institution	Other
2003 to 2012	Top 30 S&E Average	783,338	506,163	39,314	46,347	126,178	65,336
	Sample Average	874,321	550,626	26,215	68,473	184,219	44,788
	Sample/Top 30 Share	14.5%	14.1%	8.9%	19.2%	18.9%	8.8%
2003	Top 30 S&E Average	693,470	452,582	33,188	37,226	115,785	54,688
	Sample Average	766,636	476,512	33,732	57,310	160,385	38,697
	Sample/Top 30 Share	14.7%	14.0%	13.6%	20.5%	18.5%	9.4%
2004	Top 30 S&E Average	713,981	486,441	33,451	35,044	105,570	53,474
	Sample Average	763,109	496,191	30,946	46,113	157,102	32,757
	Sample/Top 30 Share	14.3%	13.6%	12.3%	17.5%	19.8%	8.2%
2005	Top 30 S&E Average	733,634	494,519	32,965	37,805	113,104	55,240
	Sample Average	790,595	509,608	28,807	56,792	161,384	34,003
	Sample/Top 30 Share	14.4%	13.7%	11.7%	20.0%	19.0%	8.2%
2006	Top 30 S&E Average	732,095	482,590	36,022	40,125	114,765	58,593
	Sample Average*	857,219	548,043	26,171	70,134	175,510	37,360
	Sample/Top 30 Share	11.7%	11.4%	7.3%	17.5%	15.3%	6.4%

Year	Academic Institution Sample	Total	Federal	State & Local	Industry	Own Institution	Other
2007	Top 30 S&E Average	738,226	471,156	38,353	47,930	124,294	56,492
	Sample Average	796,676	509,777	24,764	68,379	159,275	34,481
	Sample/Top 30 Share	14.4%	14.4%	8.6%	19.0%	17.1%	8.1%
2008	Top 30 S&E Average	758,168	468,369	42,351	50,447	135,850	61,150
	Sample Average	813,340	508,917	26,277	62,892	178,311	36,943
	Sample/Top 30 Share	14.3%	14.5%	8.3%	16.6%	17.5%	8.1%
2009	Top 30 S&E Average	803,100	485,232	45,889	54,397	146,296	71,287
	Sample Average	899,762	532,736	36,914	69,880	214,285	45,947
	Sample/Top 30 Share	14.9%	14.6%	10.7%	17.1%	19.5%	8.6%
2010	Top 30 S&E Average	859,049	547,444	45,144	55,295	133,373	77,793
	Sample Average	984,182	612,895	20,333	84,286	198,237	68,431
	Sample/Top 30 Share	15.3%	14.9%	6.0%	20.3%	19.8%	11.7%
2011	Top 30 S&E Average	899,418	589,923	44,243	51,853	131,563	81,836
	Sample Average	1,034,760	660,235	21,890	83,665	208,644	60,325
	Sample/Top 30 Share	15.3%	14.9%	6.6%	21.5%	21.1%	9.8%
2012	Top 30 S&E Average	902,240	583,368	41,537	53,352	141,180	82,803
	Sample Average	1,036,935	651,349	12,319	85,275	229,053	58,938
	Sample/Top 30 Share	15.3%	14.9%	4.0%	21.3%	21.6%	9.5%

Notes: The table presents the average annual S&E R&D funding for the top 30 institutions ranked by total S&E R&D expenditures and for the four institutions that comprise our sample. We also report the portion of total S&E of the top 30 accounted by our sample institutions. Averages are in thousands and inflated to 2012 dollars. Data were pulled from WebCASPARE are reported by the institution to NSF in the annual Academic R&D Survey. The rankings are based off of total S&E R&D funding but closely resemble the ranking by total R&D funding. In 2006, only 3 of the 4 institutions in our sample ranked in the top 30 by S&E funding so sample statistics reflect the average for only those three. The other category includes nonprofit funders.

Appendix Table 2: NSF HERD Survey Sample Comparison

Year	Academic Institution Sample	Total	Federal	Nonprofit	Industry	State & Local
2010	Top 30 S&E Average	882,628	556,474	61,451	56,499	47,379
	Sample Average	1,009,903	622,411	58,132	84,693	21,473
	Sample/Top 30 Share	15.3%	14.9%	12.6%	20.0%	6.0%
2011	Top 30 S&E Average	926,088	600,871	67,007	52,992	46,423
	Sample Average	1,066,913	671,348	57,945	84,118	23,365
	Sample/Top 30 Share	15.4%	14.9%	11.5%	21.2%	6.7%
2012	Top 30 S&E Average	933,105	595,125	71,115	54,412	43,209
	Sample Average	1,070,870	662,166	58,794	86,331	13,546
	Sample/Top 30 Share	15.3%	14.8%	11.0%	21.2%	4.2%

Notes: The table presents the average annual S&E R&D funding for the top 30 institutions ranked by total S&E R&D expenditures and for the four institutions that comprise our sample. We also report the portion of total S&E of the top 30 accounted by our sample institutions. Averages are in thousands and inflated to 2012 dollars. Data were pulled from WebCASPARE are reported by the institution to NSF in the annual HERD Survey, which began in 2010 and separated reporting of nonprofits to their own category. The rankings are based off of total S&E R&D funding but closely resemble the ranking by total R&D funding.

Appendix Table 3: Comparison Statistics of Sample Data to NSF Reporting of Sample Institutions

	(1) NSF R&D Data	(2) Sample Data	(3) NSF Surplus
Total Federal Funds	21.5 B	19.9 B	7%
Total Industry Funds	2.7 B	631 M	76%
Total Nonprofit/Other Funds	1.8 B	1.4 B	19%

Notes: Sample totals reflect annual total project funding by sponsor type. Total Nonprofit funds for NSF include miscellaneous sponsors while the sample data is only nonprofit sponsors. Column 2 uses the sample data with the data cleaning outlined in Table 1, except for the removal of size outliers resulting in an increased sample size of 59,576. Both sample and NSF data are inflated to 2012 dollars and reflect reporting from 2003 to 2012. NSF data are pulled from WebCASPAR NSF Academic R&D (HERD) Survey.

Appendix Table 4: Descriptive Statistics by Academic Field

	Biological Sciences	Chemistry	Computer Science	Engineering	Environment	Geosciences	Mathematics	Physics	Psychology
Total Project Expenses (\$)	568,074 (1,140,874)	454,414 (728,639)	376,477 (713,076)	331,582 (744,247)	293,046 (765,594)	217,608 (327,295)	276,014 (1,017,395)	307,447 (847,355)	515,063 (865,971)
Direct Project Expenses (\$)	416,882 (877,331)	322,629 (534,770)	270,417 (575,301)	243,846 (575,556)	230,573 (610,186)	156,629 (258,493)	198,112 (733,941)	223,667 (638,090)	382,198 (697,394)
Indirect Project Expenses (\$)	151,192 (306,160)	131,786 (206,156)	106,060 (172,378)	87,736 (187,216)	62,473 (181,996)	60,979 (89,336)	77,902 (316,234)	83,779 (219,913)	132,866 (210,561)
Project EIDC Rate	0.33 (0.22)	0.38 (0.23)	0.46 (0.22)	0.39 (0.21)	0.29 (0.22)	0.38 (0.22)	0.46 (0.18)	0.40 (0.19)	0.31 (0.24)
Below Negotiated IDC Rate	0.78 (0.41)	0.77 (0.42)	0.58 (0.49)	0.76 (0.43)	0.85 (0.35)	0.76 (0.43)	0.66 (0.47)	0.82 (0.39)	0.79 (0.41)
Prime Sponsored Project	0.14 (0.35)	0.08 (0.27)	0.12 (0.32)	0.21 (0.40)	0.24 (0.43)	0.22 (0.42)	0.05 (0.22)	0.29 (0.46)	0.13 (0.33)
Center-Based Project	0.11 (0.32)	0.00 (0.00)	0.05 (0.22)	0.22 (0.41)	0.07 (0.26)	0.00 (0.00)	0.00 (0.00)	0.03 (0.05)	0.00 (0.00)
Project Length (Years)	3.28 (2.60)	3.47 (2.50)	3.16 (1.58)	2.82 (1.71)	2.64 (1.90)	2.86 (1.74)	3.17 (1.47)	2.92 (1.86)	3.42 (2.50)
Project Start Year	2007.07 (3.47)	2006.87 (3.68)	2006.92 (3.41)	2006.94 (3.24)	2006.64 (3.40)	2006.45 (3.45)	2007.23 (3.25)	2006.82 (3.36)	2006.39 (3.68)
Observations	26,616	1,117	1,369	6,272	1,069	553	1,177	2,089	596

Notes: Means (Standard Deviations) or Proportions presented; expenditure averages inflated to 2012 dollars before averaging.

Appendix Table 5: Regression Results by Federal Department Stratified by Field Sample

	(1) Federal Sample	(2) Non-Bio Projects	(3) Bio Projects
<i>Federal Department</i> ^			
Commerce	-0.090*** (0.013)	-0.061*** (0.015)	-0.103*** (0.021)
DHHS		0.001 (0.006)	
DHS	-0.033 (0.021)	-0.016 (0.023)	-0.008 (0.066)
DOD	-0.011** (0.004)		0.001 (0.008)
DOJ	-0.053 (0.065)	0.078*** (0.020)	-0.132 (0.085)
DOT	0.067*** (0.014)	0.086*** (0.015)	0.081*** (0.027)
Education	-0.140*** (0.018)	-0.283*** (0.029)	-0.091*** (0.019)
Energy	-0.019*** (0.006)	-0.011* (0.006)	0.021 (0.017)
HUD	-0.181** (0.091)	0.004 (0.041)	-0.385*** (0.004)
Independent	-0.001 (0.004)	0.010** (0.005)	-0.009 (0.005)
Interior	-0.155*** (0.014)	-0.111*** (0.017)	-0.223*** (0.027)
State	-0.340*** (0.006)	-0.322*** (0.006)	-0.338*** (0.006)
USDA	-0.243*** (0.008)	-0.272*** (0.018)	-0.215*** (0.009)
VA	-0.357*** (0.004)	-0.138* (0.083)	-0.357*** (0.004)
Constant	0.360*** (0.016)	0.413*** (0.021)	0.263*** (0.054)
Observations	31,126	12,433	18,693
Institution Fixed Effects	Yes	Yes	Yes
Field Controls	Yes	Yes	No
Project Controls	Yes	Yes	Yes
Adjusted R-squared	0.149	0.217	0.124

Note: OLS estimations with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

^ Referent category is DHHS I Models (1) & (3) and DOD in Model (2). Project level controls include University field funding proportion lagged, center indicator, project length in years, direct project expenses lagged, prime sponsor indicator, and project start period.

Appendix Table 6: Time Sensitivity Analyses

	(1) Cont. Start Year	(2) 2003-2011
Project Start Year	0.003*** (0.000)	
<i>Sponsor Type (Referent: Federal)</i>		
Industry	-0.062*** (0.004)	-0.065*** (0.004)
Nonprofit	-0.284*** (0.002)	-0.282*** (0.003)
<i>Field (Referent: Biological Science)</i>		
Chemistry	0.065*** (0.009)	0.065*** (0.010)
Computer Science	0.109*** (0.009)	0.113*** (0.010)
Engineering	0.056*** (0.007)	0.059*** (0.007)
Environmental Science	0.025** (0.010)	0.019* (0.010)
Geosciences	0.076*** (0.012)	0.076*** (0.012)
Mathematics	0.116*** (0.009)	0.119*** (0.010)
Physics	0.073*** (0.008)	0.076*** (0.009)
Psychology	0.039*** (0.011)	0.041*** (0.011)
University Field Funding Proportion (Lagged)	0.062*** (0.011)	0.061*** (0.011)
Center-Based Project	0.021*** (0.003)	0.023*** (0.003)
Prime Sponsored Project	0.054*** (0.003)	0.054*** (0.003)
Length (Years)	0.008*** (0.000)	0.007*** (0.001)
Direct Project Expenses (Inflated, Logged)	0.006*** (0.001)	0.007*** (0.001)
Constant	-6.724*** (0.576)	0.291*** (0.014)
Observations	42,007	38,672
Institution Fixed Effects	Yes	Yes
Project Start Year Bins	No	Yes
Adjusted R-squared	0.351	0.348

Notes: OLS estimations with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Column 1 uses a continuous measure of start year instead of categorical bins. Column 2 reduces the study timeframe to 2011.

Appendix Table 7: Regression Results Stratified by Sponsor Type – Excluding Prime Sponsored Projects

	(1) Exclude Prime	(2) Federal	(3) Industry	(4) Nonprofit
<i>Sponsor Type (Referent: Federal)</i>				
Industry	-0.049*** (0.005)			
Nonprofit	-0.285*** (0.003)			
<i>Field (Referent: Biological Science)</i>				
Chemistry	0.070*** (0.010)	0.080*** (0.012)	0.105** (0.053)	0.005 (0.019)
Computer Science	0.121*** (0.010)	0.116*** (0.011)	0.177*** (0.049)	0.059* (0.033)
Engineering	0.074*** (0.008)	0.060*** (0.009)	0.165*** (0.041)	0.078*** (0.019)
Environmental Science	0.043*** (0.011)	0.020 (0.014)	0.039 (0.055)	0.071*** (0.024)
Geosciences	0.100*** (0.012)	0.092*** (0.014)	0.224*** (0.078)	0.045 (0.034)
Mathematics	0.129*** (0.010)	0.122*** (0.011)	0.216*** (0.052)	0.075** (0.034)
Physics	0.078*** (0.009)	0.075*** (0.011)	0.167*** (0.052)	0.013 (0.021)
Psychology	0.036*** (0.012)	0.034** (0.014)	-0.005 (0.065)	0.010 (0.020)
University Field Funding Proportion (Lagged)	0.065*** (0.012)	0.061*** (0.014)	0.077 (0.054)	0.021 (0.031)
Center-Based Project	0.020*** (0.003)	0.012*** (0.004)	0.061*** (0.010)	0.005 (0.005)
Project Length (Years)	0.006*** (0.001)	0.009*** (0.001)	-0.016*** (0.002)	-0.003** (0.001)
Direct Project Expenses (Inflated, Logged)	0.009*** (0.001)	0.010*** (0.001)	0.004 (0.003)	0.005*** (0.002)
Constant	0.252*** (0.015)	0.234*** (0.019)	0.274*** (0.059)	0.079** (0.032)
Observations	34,368	25,017	2,527	6,824
Institution Fixed Effects	Yes	Yes	Yes	Yes
Project Start Year Controls	Yes	Yes	Yes	Yes
Adjusted R-squared	0.377	0.103	0.158	0.0977

Note: OLS estimation with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The estimations exclude observations that have a prime sponsor.