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Do Indirect Cost Rates Matter?

Ronald G. Ehrenberg
Cornell University, rge2@cornell.edu

Jaroslava K. Mykula
Cornell University

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This pattern of results is hypothesized to be based upon an institution's indirect cost rate serving primarily as a "price" of research for lesser institutions but serving primarily as a proxy for the quality of the institution's research infrastructure for the major recipients of federal funds. Our findings are consistent with the observation that since 1990 both indirect cost rates and shares of research funding for major private research universities have tended to decline. We find no evidence that faculty at major research universities are disadvantaged in their quests for external research funding by high indirect cost rates.

Keywords
higher education, indirect cost rates, federal research funding, direct cost funding, indirect cost funding

Disciplines
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DO INDIRECT COST RATES MATTER?

Ronald G. Ehrenberg
Jaroslava K. Mykula

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Ronald G. Ehrenberg
Cornell Higher Education Research Institute
Cornell University
256 Ives Hall
Ithaca, NY 14853-3901
and NBER
rge2@cornell.edu

Jaroslava K. Mykula
Cornell Higher Education Research Institute
Cornell University
256 Ives Hall
Ithaca, NY 14853-3901

I. Introduction

Indirect costs and indirect cost rates are viewed differently by different participants in the sponsored research process. Individual faculty members view indirect costs as an overhead charge that is tacked onto their grant applications and worry that high indirect cost rates reduce their probability of winning grant competitions and reduce the funds available to them as direct costs if they do win. University administrators view indirect cost recoveries as reimbursements for expenditures that they have already made to support sponsored research and worry about where they will find the funds to maintain these expenditures if their indirect cost rates are reduced. Finally, funding agencies worry that high indirect cost rates limit the numbers of projects that they can fund and/or the amount that they can spend per project. With all of these conflicting concerns, is it any wonder that tension usually exists between the actors in the system?

Table 1 summarizes data provided to us by the National Science Foundation on how the unweighted mean institutional indirect cost rate has changed over a recent 11 year period. The data show a marked difference in trends between private and public research universities. Focusing on the major research universities, the Carnegie classification Research I and Research II insititutions, the mean rate across 39 private institutions rose from 60 percent on July 1, 1987 to 62 percent on July 1, 1990 and then, over the next seven years, fell back to 56 percent. In contrast, the mean rate across 85 public institutions rose from almost 45 percent to over 47 percent during the period. As can be seen from the table, using average rates in effect during the fiscal year rather than the July 1 rate, or using data for all research and doctorate universities, yields roughly the same patterns.

In FY1988, the seven research universities that received the largest shares of federal funds for research received 18.9 percent of total federal research funding. By FY1996, the share of these seven universities had fallen to 17.4 percent, a 1.5 percentage point decline. Virtually all of this decline, 1.4 percentage points, was due to a decline in the shares of the three private universities in the group. Similarly, the next thirty-four largest recipients of federal funding in FY1988, saw their share fall from 39.9 percent in that year to 38.0 percent in FY1996. Of that 1.9 percentage point drop, over half, 1.0 percentage points, was due to a drop in the shares of the seventeen private universities in the group.

What is the relationship between the patterns of changes in indirect cost rates and research expenditure shares? We shall argue that the reduction in the indirect cost rates experienced by the major private research universities since 1990 helped to free up the funds that allowed the funding agencies to award a greater share of total research funds to faculty members at lower ranked universities. However, the decline in the share of total research funds won by researchers at the top universities did not necessarily mean that the researchers themselves suffered in terms of either facing a reduced probability of grant receipt or lower total direct cost budgets. Rather, it is possible that it was the private research universities who paid the full price of lower indirect cost rates because they recovered lower indirect cost volumes than otherwise would be the case and that researchers at these institutions suffered no loss in their direct cost volume.

We shall test in the paper whether the main cost of the federal funders' "dipping deeper into the institutional barrel" to fund research projects, was born primarily by the private research universities, which had to find ways to finance the indirect cost recoveries that they no longer received. Put another way, we shall test whether lower indirect cost rates hurt the major private research universities but not the individual researchers at them.

The plan of our paper is as follows: Section II discusses the indirect cost rate system and introduces the reader to how it functions. Section III uses panel data from the FY1988 to FY1996 period on federal research funding received and indirect cost rates, by institution, to understand which institutions win and which lose in terms of total volume of research funding when indirect cost rates change. Section IV uses panel data on National Science Foundation awards for all research and doctorate institutions during the FY1988-FY1997 period to see how indirect cost rates influence an institution's total direct cost funding, total indirect cost funding, number of grants and average grant size. Concluding remarks appear in the final section.

II. What Are Indirect Cost Rates?[1]

Most research in science and engineering at universities is funded by the federal government. Typically through a competitive process, federal agencies make grants to university faculty members to help support their research. Research grants have budgets for both the "direct" and "indirect" costs of projects. Direct costs are those costs that can be uniquely attributed to a project. These include, but are not limited to, support for the faculty member's time during the academic year and summer, graduate research assistants, post-doctoral fellows, lab technicians, computers and other durable equipment, expendable equipment (e.g ., chemicals), travel, communications, and clerical assistance.

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[1]Roger G. Noll and William P. Rogerson (1998) present a more complete description of the federal research grant process and indirect cost rates.

Indirect costs are those costs that a university incurs because it is a research university, but which can not be easily assigned to any specific project. Included in this category are the central university, college and departmental research administration infrastructure, depreciation on both the space in buildings that is used for sponsored research and on research equipment, maintenance and utility costs for space used for sponsored research, research infrastructure support, and the portion of library costs that can be attributed to the existence of sponsored research on campus.

Each year each university estimates what its indirect costs are likely to be in the forthcoming year. It next estimates what its likely volume of direct costs on all externally sponsored research will be. Following government directives, it subtracts estimates of the portion of the direct costs that are assumed not to be associated with any indirect costs – namely those due to equipment costing more than $500, subcontracts that are greater than $25,000 and graduate student tuitions – to obtain an estimate of what its "modified total direct costs" (MTDC) will be. It then divides its estimated indirect cost by its estimated MTDC to obtain a proposed indirect cost rate for the year and requests that this indirect cost rate be established for it in the year ahead.

This is only a request and auditors from the agency that is responsible for setting the rate for an insititution, usually either the Department of Defense or the Department of Health and Human Services, and the institution itself pour over the data and eventually come to a negotiated agreement on what the actual rate will be. If the rate chosen turns out to generate more revenue than expected because the institution proved to have a higher value of modified total direct costs than it expected during the year, then the excess amount that the university achieved in indirect cost recoveries will be deducted from the institution's permissible indirect cost recovery in future years until the excess is paid back. Thus, the university's indirect cost rates during subsequent years will be lower than the data for those years alone would indicate that it should have been. Many faculty do not understand that a university is not permitted to over-recover its indirect costs and believe that, at the margin, their grant imposes no extra indirect costs on a university but generates indirect cost recovery for it.

If, on the other hand, the university under-recovers its indirect costs in a year because its volume of modified total direct cost funding proves lower than expected, sometimes, but not ususally, the university gets permission to carry forward the amount that it under-recovered to the next year. If this occurs, its indirect cost rates would be temporarily higher in the next year.

In a well-documented case involving Stanford University during the early 1990s, federal auditors alleged that items were being charged as indirect costs that were not legitimate cost items. While much media attention was directed at this case, ultimately the two parties settled the dispute by Stanford's returning a total of $1.5 million dollars to the federal government for inappropriate recoveries that it had been alleged that it had made over a ten year period. Inasmuch as the University's total volume of federal research funding exceeded an average of $200 million a year during the period, the repayment was minuscule and of no real consequence.[2]

What was of consequence going forward was that the federal auditors took a much harder look at what universities had been including as indirect cost expenditures and increasingly either disallowed items that previously had been allowed, or simply "capped" the amounts that they

[2]Donald Kennedy (1997) provides a participant's view of the dispute.

would be willing to pay for some categories of indirect cost expenditures, regardless of the actual expenditure that a university had made. Institutions had been allowed to conduct special studies to estimate the fraction of their utility and maintenance costs, as well as the fraction of their library costs, that were attributable to sponsored research. The federal auditors now more aggressively challenged the results of those studies pushing indirect cost rates for these areas down at universities that had high indirect cost rates.

Similarly, the administrative cost portion of the indirect cost rate was capped at 26 percent, which also reduced the rate at a number of high indirect cost rate institutions. A 26 percent rate may seem high for research administration until one realizes that included in this rate is not just the cost of administrators of research grants at all levels of the university, but also the fraction of each administrator's time in the university that was attributable to sponsored research. So, for example, a portion of the time of the university's president (who talks to Congress and agencies about sponsored research) and the university lawyers (who prepare contracts and defend researchers against civil charges by other parties) are both included in this rate.

As noted above, the indirect cost rates at private universities tended to be higher than those at public universities, so it was at the former that rates fell, on average, during the 1990s.[3] A reduction in indirect cost recoveries "costs" the university real dollars to support its operations.

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[3]Much of the difference between indirect cost rates at public and private universities exists because the privates have always tried to document as much of the indirect costs that they incur as possible. The publics have tended to document less of their costs because funding for their indirect costs often comes from state governments, which do not always require repayment of these costs if external research funding and indirect cost recoveries are obtained. Given the perceptions by faculty members that high indirect cost rates reduce direct cost funding, the publics have had incentives to hold their indirect cost rates down. As budgets of public universities become tighter, the publics increasingly are seeking to enhance indirect cost recoveries and this has led them to do more documentation of expenses to increase their rates.

A university can react by trying to cut its indirect costs, but unless the cutting occurs in areas that are over the "caps", doing so will lower permitted indirect cost recoveries in the following years. Hence, it appears at first glance that the private research universities were the big losers during the 1990s because of the decline in their indirect cost rates. However, lower indirect cost rates are often believed by faculty to make their grant applications more competitive and/or to enhance the size of the direct costs that they can receive on funded grants. If this belief is true, faculty at these institutions may have actually gained from having lower indirect cost rates.

We must caution, however, that the level fo the indirect cost rate at an institution may also serve as a proxy for the availability of research infrastructure at the institution. If a decline in an institution's indirect cost rate is associated with a reduction in its research infrastructure, this may make its faculty members' grant applications less competitive. Hence, if the private universities responded to the reduction in their indirect cost rates by reducing their research infrastructures, faculty at these institutions may have lost from having lower indirect cost rates. Like most propositions in economics, the impact of changing indirect cost rates is an empirical question and it is to answering that question that we now turn.

III. Empirical Analyses of IPEDS Data: FY1988-FY1996

Our first analyses look at how changes in indirect cost rates affect the total level of research funding received by different institutions. From the Integrated Post Secondary Educational Data System (IPEDS), information is available on the volume of total federally funded research expenditures at each academic institution for fiscal years 1988 through 1996 in the aggregate and by funding agency. Data are also available from this source on the number of faculty employed at each institution each year. These data, along with indirect cost rate data by institution and year, as well as information on the stature of each institution's PhD programs as of the early 1980s, permit one to estimate equations of the form

$$(1) \qquad logT_{ijt} = a_{0j} + a_{1j}P_i + a_{2j}R_i + a_{3j}N_i + a_{4j}logF_{it} + a_{5j}ICR_{it} + \sum_{k=1}^{T} a_{6kj}d_k + \varepsilon_{ijt}$$

Here T_{ijt} is the level of federal funded research expenditures from agency j at institution i in year t, P_i equals one of the institution is public and zero otherwise, R_i is the average rating of the institution's PhD programs as reported in the Jones, Lindzey and Coggeshall (1982) assessment, N_i is the number of the institution's programs that were assessed in that study, F_{it} is faculty size at institution i in year t, ICR_{it} is the indirect cost rate in effect at institution i in year t, the d_k are a set of year dichotomous variables, the ε_{ijt} is a random error term, and the a's are coefficients to be estimated.

As specified, equation (1) implies that larger institutions, as measured by faculty size, will get more research funding. The year dichotomous variables control for the aggregate level of sponsored research from the agency in the year and any other year-specific factors. Estimates of the coefficient a_{5j} provide estimates of the percentage impact on research funding at the institution from agency j, when there is a one point increase in the institution's indirect cost rate, other factors held constant.

The average quality and number of an institution's PhD programs are included as proxies for the inherent quality of the institution's research faculty and are expected to be positively associated with its level of research funding. Finally, because public institutions often do not seek to fully recover their indirect cost recoveries, they are likely to have better research infrastructures than private research universities with comparable reported indirect cost rates. Hence, after controlling for indirect cost rates, we expect public institutions to have higher levels of research funding.

While one could estimate equation (1), simple introspection suggests that it can not be the correct model to use. The reason for this is that in each year the total volume of research expenditures made by a federal agency is fixed, and changes in the indirect cost rate at any institution can not affect the total level of sponsored research expenditures that an agency makes. Hence, the coefficient on the indirect cost variable in equation (1) can not be the same for all institutions unless it is uniquely equal to zero. Imposing such a constraint would prevent us from addressing the question of interest to us, namely how changes in indirect cost rates differentially affect different institutions.

Suppose we allow the coefficient of the indirect cost rate variable in equation (1) to vary across institutions. It is straightforward to show that the following constraint must hold,

$$\sum_{i=1}^{n} s_{ij} a_{5ij} = 0 \qquad (2)$$

Here s_{ij} is the share of total research funding from agency j received by institution i, a_{5ij} measures the percentage impact of a one point increase in the indirect cost rate on the volume of sponsored research funding that institution i receives from agency j and n is the total number of institutions receiving funding from the agency. For total agency research funding to remain constant in the face of a change in indirect cost rates, it must be the case that the sum of the a_{5ij} each weighted by the share of sponsored research funding from agency j that the corresponding institution receives, equals zero.

In principle, one could specify that each institution has a separate a_{5ij} and, exploiting the panel nature of the data, estimate a separate coefficient for each institution. In practice, because of colinearity problems, that proved difficult to implement. Instead, some structure was placed on how the coefficients differ. One strategy was to sort institutions by their share of research funding from an agency, assign them to the funding quintile into which they fell (institutions receiving the top fifth of funding, institutions receiving the second fifth of funding and so on), and assume that the coefficient of the indirect cost rate variable was the same for all institutions within a funding quintile, but varied across quintiles (symbolically $a_{5ij} = a^q{}_{5i}$ where q is the quintile institution i was in). Under this set of assumptions, equation (5) reduces to

(3) $$a^1_{5j} + a^2_{5j} + a^3_{5j} + a^4_{5j} + a^5_{5j} = 0$$

Whether this constraint is satisfied can easily be tested during the estimation process.

Table 2 contains estimates of this variant of equation (1) that were obtained using data on all Carnegie Category Research I and II and Doctorate I and II institutions for the FY1988-FY1996 period. Equations were estimated separately for all federally funded research expenditures, National Science Foundation (NSF) funding, Department of Defence (DOD) funding and Department of Health and Human Service (HHS) funding at the institutions. Institutions were assigned to quintiles based upon their base year (FY1988) funding shares of total federal sponsored research expenditures and each agency's sponsored research expenditures.[4] Equations were also estimated that included the square of the logarithm of faculty size to allow the relationship between faculty size and research funding to be nonlinear. In as much as they yielded virtually identical indirect cost rate coefficients, only the simpler specifications are reported here.

Turning to the results in panel A of table 2, as expected, ceteris paribus, public institutions do receive more external grant funding in the aggregate and from NSF than to comparable private institutions. The average quality and the number of an institution's PhD programs that were included in the early 80s rating are also positively associated with the level of grant funding. Similarly, institutions with more faculty receive more grant funding, both in the aggregate and from two of the three agencies. The constraint that the sum of the indirect cost rate coefficients should equal zero is not rejected for the overall and NSF analyses but is rejected for the analyses of DOD and HHS data.

Quite strikingly, the pattern of indirect cost coefficients is the same in each equation. Higher indirect cost rates are associated with higher levels of grant funding for all but the bottom quintile (in terms of initial external research funding) of these institutions. Conversely, lower indirect cost rates are associated with higher levels of research funding for only the bottom quintile of institutions. Put simply, indirect cost rate coefficients appear to capture

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[4]The IPEDS system only contains data for academic institutions. Hence, the quintiles which the institutions were assigned are actually based on their shares of total academic funding and the constraint in equation (3) is strictly valid only if the share of research funding received by academic institutions remained constant over time.

"infrastructure" effects at the top four quintiles of institutions but "price" effects at the bottom quintile of institutions.[5]

Equation (1) actually specifies that the only indirect cost rate to influence an institutions funding is the indirect cost rate for the institution itself. The effect of all other institution's indirect cost rates is captured by the year dichotomous variables that are included in the model. While this is a perfectly reasonable estimation strategy, a more general strategy allows the research funding at each institution to also depend upon the total level of federal research funding available nationwide and the average indirect cost rate in the year. That is, we replace the year dichotomous variables in equation (1) by the logarithm of the total level of research funding (T_{jt}) and the average indirect cost rate in the year ($ICR_{t)}$ and estimate

$$(4) \quad logT_{ijt} = a_{0j} + a_{1j}P_{i} + a_{2j}R_{i} + a_{3j}N_{i} + a_{4j}logF_{it} + a_{5j}ICR_{it} + a_{6j}\overline{ICR}_{t} + a_{7j}logT_{jt} + \epsilon_{ijt}$$

where $\overline{ICR}_t$ is the mean indirect cost rate in year t across institutions and T_{jt} is the total level of external research funding from agency j available nationwide in the year.

Ideally, one would like to allow the coefficients of the mean indirect cost rate and the total level of research funding to vary across the research funding quintiles of institutions as we did for the institutions' indirect cost rate coefficients. However, doing so introduces serious colinearity problems into the model. Hence, these are treated as being constant across institutions. When one does this one obtains the results shown in panel B of Table 2. The

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[5]An increase in the indirect cost rate increases indierct cost funding, and hence total external research funding, holding constant direct cost volume. Thus, as long as direct cost volume increases, or decreases by a smaller absolute amount than indirect cost funding increased, total external research funding will increase. Strictly speaking then, the estimated indirect cost coefficients we obtain for the top four quintiles of institutions may reflect only that funders' "price elasticity" of demand for research from these institutions is inelastic.

pattern of institutional indirect cost coefficients is very similar to those found in panel A. Higher indirect cost rates are associated with higher levels of total external grant funding for institutions in the top four quintiles of recipients, but lower levels of total external grant funding for institutions in the bottom quintile.[6] The coefficients in these equtions of the mean indirect cost rate variable are insignificantly different from zero and those for the log of total research funding are insignificantly different from one. It is straightforward to show that under the assumptions that these two variables' coefficients are constant across quintiles of institutions, these coefficient values must be obtained if the model is to be logically consistent. It is also true that there is a relationship that must hold between the institutional and average indirect cost rate coefficients. In particular, it must be the case that

$$a_{5j}^{1} + a_{5j}^{2} + a_{5j}^{3} + a_{5j}^{4} + a_{5j}^{5} + 5a_{6j} = 0 \tag{5}$$

[6]It has been suggested to us that if the positive association between indirect cost rates and total research funding observed in Table 2 is due to high indirect cost rates indicating better research infrastructure, then if one disaggregates the analyses by field, one should observe different results for fields depending upon whether the research of faculty members in the field make heavy use of infrastructure.

To see if this occurs, we reestimated models similar to those found in both panels of Table 2 for total federal research expenditures, using field specific data. The fields chosen for investigation were engineering, life sciences, physical sciences, psychology, and social sciences. Our conjecture was that the first three fields make heavy use of research infrastructure and the last two make much less use. Thus, we hypothesized that the results for the first three fields would be much more similar to the aggregate results than the results for the latter two fields.

The pattern of indirect cost rate coefficients that we obtained for engineering and the life sciences were in fact identical to the aggregate results reported in Table 2. For physics, the coefficient for top quintile institutions was positive and statistically significant and the coefficient for bottom quintile institutions was negative and statistically significant, with the other three coefficients being statistically insignificantly different from zero. For psychology, all of the indirect cost rate coefficients were insignificant. Hence, the results for these four fields did provide support for our "infrastructure" hypothesis.

However, we obtained results for the social sciences that were very similar to those for engineering and the life sciences. With psychology pulled out as a separate field, the lion's share of funding for social science goes to economics. While economists do make some use of research infrastructure (e.g., supercomputers, data archives), we were somewhat surprised by the social science results.

This constraint is not rejected in either the total research funding equation or any of the individual agency funding equations.

An alternative estimation strategy to assuming that the response of federal research funding to indirect cost changes is the same for all institutions within a funding quintile, but varies across quintiles, is to assume that the response varies across institutions systematically with an institution's initial share of research funding. That is, to specify that

$$(6)\ \log T_{ijt} = b_{0j} + b_{1j}P_i + b_{2j}R_i + b_{3j}N_i + b_{4j}logF_{it} + b_{5j}ICR_{it} + b_{6j}ICR_{it}S_{ij} + \sum_{k=1}^{T} b_{7jk}d_k + \varepsilon_{ijt}$$

We expect that b_{5j} will be negative and b_{6j} will be positive. Hence, $-b_{5j}$ divided by b_{6j} will indicate the "cross-over" share. Institutions with initial shares of an agency's federal research expenditures in a year that are larger than this cross-over share will find their total research funding from the agency positively associated with their indirect cost rates, while institutions with smaller initial shares that this cross-over share will observe a negative association.

Panel A of Table 3 presents the indirect cost rate coefficients that were obtained when this model was estimated using total federal research funding expenditures and research funding received from each of the three agencies by the institution. Panel B presents analogous coefficients obtained when the year dichotomous variables were replaced by the average indirect cost rate in the year and the logarithm of total (or total agency) external research funding in the year. The indirect cost rate coefficients proved to be identical in the two model specifications.

As expected, the indirect cost rate coefficient (b_{5j}) is negative and the coefficient of the interaction of the institution's indirect cost rate and its 1988 funding share (b_{6j}) is positive in all four data sets. The largest estimated cross-over share occurs in the total federal research funding equation and is .014. In FY1988, 18 universities had share of total federal research funding that was at least that large and their cumulative share of total external federal research funding was about 37 percent.

This cross-over share model thus yields results that are qualitatively similar to those of the previous model. Total federal research funding obtained by an institution is positively associated with the institution's indirect cost rates for research and doctorate universities initially near the top of the distribution of funding recipients and negatively associated for universities that are not among the top recipients intially. However, in this specification, a smaller fraction of institutions (those with roughly 40 percent of initial funding rather than the 80 percent of the previous model) benefit from having high indirect cost rates. Cross-over shares for DOD and HHS funding were much lower and thus these models yielded very similar results to the previous specification, in terms of the number of institutions that benefit from higher indirect cost rates.

The astute reader will note that we have yet to exploit the panel nature of the data. An obvious estimation strategy is to add institutional fixed effects to the model, difference them out, and then estimate the model in first difference form. When we did this, primarily insignificant coefficients were obtained. One reason for this is that many federal research grants are multi-year. Federal research expenditures at an institution in a year are the sum of expenditures from new research grants awarded to the institution in the year and research grants awarded to the institution in previous years. Changes in indirect cost rates in a year should influence research expenditures from grants awarded in the year, not expenditures from grants received in previous years. Hence, because IPEDS reports only total federal research expenditures by an institution in a year, not research expenditures from grants newly awarded during the year, we have considerable measurement error in our dependent variable. As is well known, first differencing when measurement error is present exacerbates measurement error problems.[7]

IV. Empirical Analyses: National Science Foundation Data 1988-97

A weakness of the analyses presented in the previous section is that they refer only to total federal research funding received by an institution in the aggregate from an agency. The IPEDS data do not contain separate information on direct cost funding, indirect cost funding, number of grants received by institution, and average award per grant. Hence, they can not be used to ascertain how changes in indirect cost rates influence each of these outcomes at different types of institutions. Such an analyses is necessary if one wants to disentangle the effects on institutions and individual researchers of indirect cost rate changes.

Table 4 presents the indirect cost rate coefficients obtained from models similar to those found in Table 2, that make use of unpublished data provided to us by the National Science Foundation that cover the FY1988-1997 period. While Table 2 contained results only for an

[7]Several strategies were pursued to take account of this problem. Indirect cost rates for the current and two lagged years were included in the model rather than just the current rate. A three year average rate was also used. Finally, we estimated models using five year differences rather than one year differences and a model using a ten-year difference. None of these efforts substantially improved the performance of the fixed effects models.

A second type of "measurement error" arises in the indirect cost rate variable itself. Some adjustments in an institution's rate occur over time because of over-recoveries of indirect costs by the institution in previous years. Such changes in the rate affect the "price" of research at an institution, but not its research infrastructure. We can not isolate such changes in our data.

institution's total research funding from the federal government, this table presents results for total funding, indirect cost funding, direct cost funding, numbers of grants per faculty member, and grant dollars per grant, all from the National Science Foundation. Our analyses again address only research and doctorate universities. Unlike, IPEDS, the NSF data had information on the entire set of funding recipients, not just academic recipients. No research or doctorate institution fell in the bottom quintile of all funding recipients in FY88, so indirect cost rate coefficients for only the top four quintiles of institutions are reported.

Ceteris paribus, a higher indirect cost rate at an institution is associated with higher total NSF funding, higher indirect cost funding, higher direct cost funding, more grants per faculty member, and a higher dollar value per grant for institutions in the top three quintiles funding recipients. Only for the institutions in the fourth quartile is there evidence that higher indirect cost rates are associated with lower total NSF funding, lower direct cost funding, lower indirect cost funding, fewer grants per faculty member and a lower dollar value per grant.[8]

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[8]Jeffrey Sundberg (1994) collected and analyzed information on 65 institutions receiving NSF research grants during the FY1985-88 period and 109 institutions receiving Public Health Service (PHS) research grants during the FY1984-87 period. Sundberg found that higher indirect cost rates were associated with fewer awards per faculty member and a lower institutional direct cost volume. However, the estimated elasticities were quite small. Hence, he concluded that faculty researchers, as a group, were marginally made worse off by higher rates. He also concluded that increases in indirect cost rates hurt faculty at high-quality schools more than faculty at low-quality schools.

Sundberg defined an institution's quality by the fraction of its faculty that had won prestigious awards (e.g., elected to the National Academy of Sciences). When we instead defined institutional quality as we have throughout this paper (share of funding in the base year), used our model specifications (that allows testing of the adding up constraint that exists across institutions), and used his NSF data set (which he very kindly provided to us) to reestimate the models reported in Table 4, we obtained results similar to those found in Table 4. In particular, higher indirect cost rates were associated with higher direct cost funding for institutions in the top two quintiles of funding recipients and lower direct cost funding for institutions in the third and fourth quintiles. So even in the earlier period's data (FY1985-88), we find no evidence that faculty at institutions that initially receive the largest shares of NSF funding lose when indirect cost rates are raised.

While a negative relationship between an institution's indirect cost and its level of direct cost funding is consistent with faculty members' often stated view that higher indirect cost rates hurt them, this appears to occur only at lesser (in terms of initial NSF funding) institutions. At institutions which are the major recipients of NSF funding, higher rates appear to signal better research infrastructure and are associated with more direct cost funding.

Table 5 presents similar estimates for a "share" specification, whose explanatory variables are similar to those found in the models underlying Table 3. The coefficient estimates are very similar to those found in that table. An increase in the indirect cost rate is associated with higher total NSF funding, direct cost funding, indirect cost funding and grants per faculty member for large "initial share" institutions and a decrease in each outcome for small initial share institutions. What constitutes a large initial share depends upon the outcome in question. However, the estimates suggest that the benefits of have a higher indirect cost rate accrue only to institutions that are among the top 60 to 110 in terms of their initial share of NSF research funding. Conversely then, these are the institutions that lose when their indirect cost rates are reduced.

VI. Concluding Remarks

Our analyses of the IPEDS and NSF data sets yield a consistent set of conclusions. Changes in indirect cost rates do influence the allocation across different institutions of total federal research funding, direct cost funding, indirect cost funding and numbers of grants. On balance, increases in indirect cost rates benefit institutions that are already large recipients of federal research funding and their faculty. In contrast, institutions that are not initially large recipients of funding and their faculty, benefit from reductions in indirect cost rates. Federal funders appear to use the funds that are freed up by reductions in indirect cost rates to "spread" their research funding over a larger set of institutions and faculty. Reductions in average indirect cost rates at private institutions that have taken place during the 1990s can be seen as part of this process.

We find no evidence in our analyses that faculty members at major research universities that have high indirect cost rates are penalized for these high rates by lower probabilities of grant receipt or lower volumes of direct cost awards. Put another way, we find no evidence to support the common perception of faculty members at these institutions that high indirect cost rates hurt them.[9] This perception appears true, however, at lesser institutions (in terms of federal funding received) because federal funders appear to "dip deeper" into the pool of potential fundees when indirect cost rates are lower and this frees up more funds to be allocated to proposals from lesser institutions. Faculty members at these institutions are hurt by high indirect cost rates overall and high indirect cost rates at their own institutions.

Our conclusions need to be tempered, of course, because the data used in our analyses were based upon institutional research expenditures out of federal funds and numbers of federal

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[9]One possible reconciliation of faculty perceptions with our empirical results was suggested to us by Eric Hanushek. Suppose that higher indirect cost rates do reduce the ability of existing faculty at a university to obtain grants. Suppose also that to attract a distinguished senior scientist, a university invests millions of dollars in lab space. Such expenditures will find their way into the indirect cost base and lead to an increase in the institution's indirect cost rate. If the professor proves as productive as anticipated, he may attract large grant funding, which more than offsets the lost funding experienced by existing faculty at the institution due to the higher indirect cost rate. In this situation, one would observe a positive relationship between indirect cost rates and volume of research funding for an insitution; however, professors other than the new arrivee would have lost from having the higher rate.

research grants active in a year. They were not based upon new grant awards and expenditures from new grants. The latter are presumably the outcomes that changes in indirect cost rates in a year should influence, but we are unable to directly observe them with the data at hand. Because of this, attempts to control for unobserved institution specific variables using a fixed effects approach did not prove successful. As is well known, measurement error in outcome variables is compounded by using fixed effects methods. The availability of institution level data on new grants and their funding levels each year would greatly improve the analyses conducted here.

References

Donald Kennedy, *Academic Duty* (Cambridge, MA: Harvard University Press, 1997): 164-175.

Roger G. Noll and William P. Rogerson, "The Economics of University Indirect Cost Reimbursement in Federal Research Grants" in Roger G. Noll, ed., *Challenges to Research Universities* (Washington, DC: Brookings Institution Press, 1998): 105-147.

Jeffrey O. Sundberg, "Research Grants: Who Pays the Overhead?," *Education Economics* 2, no.1 (1994): 45-64.

Table 1
Changes in Mean Indirect Cost Rates[a]
(standard deviation)

Year	In Effect on July 1, Year			Average During Fiscal Year Starting July 1, Year[b]		
	All	Private	Public	All	Private	Public
A) Research I and Research II Institutions						
	[n=124]	[n=39]	[n=85]	[n=124]	[n=39]	[n=85]
1987	50.0 (11)	60.0 (11)	44.8 (7)	50.2 (11)	60.0 (11)	45.1 (7)
1988	50.4 (11)	60.0 (10)	45.4 (7)	50.4 (11)	60.5 (10)	45.5 (7)
1989	50.9 (10)	61.0 (10)	46.1 (6)	51.3 (10)	61.0 (9)	46.7 (6)
1990	51.6 (10)	62.0 (9)	47.1 (6)	51.4 (9)	61.5 (8)	46.9 (5)
1991	51.6 (9)	60.5 (8)	47.2 (5)	51.6 (9)	60.5 (8)	47.2 (5)
1992	50.0 (9)	58.0 (13)	46.9 (5)	49.7 (9)	58.0 (12)	46.6 (5)
1993	50.0 (9)	57.0 (12)	47.0 (9)	49.6 (8)	57.5 (11)	46.6 (4)
1994	49.5 (8)	57.0 (11)	46.6 (4)	49.7 (8)	57.0 (11)	46.7 (4)
1995	49.9 (8)	57.0 (11)	46.9 (4)	49.9 (8)	56.0 (11)	46.9 (4)
1996	49.9 (8)	56.0 (11)	47.0 (4)	49.3 (9)	56.0 (14)	47.0 (4)
1997	49.8 (8)	56.0 (12)	47.2 (4)	48.4 (9)	54.5 (14)	46.5 (4)
B) Research I, Research II, Doctorate I and Doctorate II Institutions						
	[n=226]	[n=80]	[n=146]	[n=226]	[n=80]	[n=196]
1987	51.3 (12)	61.0 (11)	46.3 (9)	51.5 (12)	60.6 (11)	46.6 (9)
1988	51.7 (12)	60.8 (11)	46.8 (9)	51.6 (11)	60.1 (11)	96.9 (8)
1989	52.0 (11)	60.8 (10)	47.3 (8)	52.2 (11)	60.7 (10)	47.6 (8)
1990	52.2 (10)	60.4 (9)	47.7 (8)	52.1 (10)	60.2 (9)	47.7 (8)
1991	52.1 (10)	59.9 (9)	47.9 (8)	52.1 (10)	59.9 (9)	47.8 (8)
1992	50.4 (10)	57.3 (12)	46.7 (7)	50.4 (10)	57.1 (11)	46.7 (6)
1993	50.6 (9)	57.1 (11)	47.0 (6)	50.2 (9)	56.8 (11)	46.6 (5)
1994	50.1 (9)	56.8 (11)	46.4 (5)	50.1 (9)	56.9 (10)	46.4 (5)
1995	50.0 (9)	56.5 (11)	46.4 (5)	50.0 (9)	56.4 (11)	46.5 (5)
1996	50.0 (9)	56.6 (10)	46.4 (4)	49.2 (9)	55.1 (12)	46.0 (6)
1997	49.8 (9)	56.7 (10)	46.5 (4)	48.3 (9)	53.7 (12)	45.6 (6)

[a] Indirect cost rate for on-campus research
[b] Fiscal year t starts on July 1, year t - 1.
Source: Authors' calculations from unpublished data provided to the authors by the National Science Foundation's Economics Program.

Table 2

Impact of Indirect Cost Rate on the Logarithm of
Federal Research Expenditures, FY88-FY96:
All Research and Doctorate Institutions
(absolute value of t statistics)

	All	NSF	DOD	HHS
A) Includes Year Dichotomous Variables				
PUB	.252 (3.8)	.225 (3.6)	.086 (1.0)	-.028 (0.9)
RANK	.543 (11.0)	.446 (10.0)	.445 (9.1)	.699 (15.3)
NRANK	.066 (6.9)	.091 (9.9)	.137 (11.7)	.101 (10.0)
LFAC	.352 (7.5)	.342 (7.9)	.059 (1.0)	.262 (5.1)
ICR1	.016 (3.8)	.012 (2.7)	.069 (9.3)	.036 (8.2)
ICR2	.008 (2.1)	.008 (2.1)	.039 (6.7)	.026 (6.8)
ICR3	.009 (2.7)	.006 (1.6)	.027 (5.4)	.034 (8.6)
ICR4	.002 (0.4)	.001 (0.2)	.012 (2.7)	.028 (7.8)
ICR5	-.021 (6.7)	-.018 (6.1)	-.009 (2.1)	-.009 (2.7)
$\bar{R}^2$	.714	.702	.559	.746
n	1961	1889	1670	1844
Test that Sum of Coefficients Equals Zero	.01 (0.9)	.01 (0.5)	.14 (6.1)	.11 (6.7)
B) Excludes Year Dichotomous Variables				
LTOT	1.564 (3.5)	1.105 (4.3)	.339 (0.4)	1.004 (2.3)
ICRA	.042 (1.1)	-.007 (0.3)	-.109 (1.8)	.033 (0.8)
PUB	.251 (3.8)	.225 (3.7)	.087 (1.0)	-.028 (0.4)
RANK	.543 (11.0)	.447 (10.0)	.445 (9.1)	.700 (15.3)
NRANK	.066 (6.9)	.090 (9.9)	.137 (11.7)	.101 (10.0)
LFAC	.353 (7.6)	.344 (7.9)	.058 (1.0)	.263 (5.1)
ICR1	.016 (3.8)	.012 (2.7)	.067 (9.2)	.037 (8.2)
ICR2	.008 (2.1)	.008 (2.1)	.039 (6.7)	.026 (6.8)
ICR3	.010 (2.7)	.006 (1.6)	.027 (5.4)	.033 (8.6)
ICR4	.002 (0.5)	.001 (0.2)	.012 (2.8)	.028 (7.8)
ICR5	-.021 (6.7)	-.018 (6.1)	-.009 (2.1)	-.009 (2.7)
$\bar{R}^2$	.714	.702	.570	.746
n	1961	1889	1670	1844
Test That Sum of Coefficients Equals Zero	.228 (1.3)	-.029 (0.2)	-.410 (1.3)	.282 (1.4)

where
Total - all federal research expenditures at the institution
NSF - National Science Foundation funded expenditures
DOD - Department of Defense funded expenditures
HHS - Department of Health and Human Service funded expenditures

and

Indirect cost rate for institutions that are in the j^{th} quintile (1=top) of funding recipients in FY88. Quintiles are measured in terms of percentage shares, not percentages of institutions, and are defined separately for each agency.

PUB - 1=public institution, 0=private institution

RANK - average rating of institution's PhD programs in the Jones, Lindzey and Coggeshall (1982) assessment (1=low, 5=high)

NRANK - number of the institution's PhD programs assessed in Jones, Lindzey and Coggeshall (1982)

LFAC - logarithm of faculty size

LTOT - logarithm of all federal research expenditures nationwide (All column) or all agency research expenditures nationwide (other columns) in the year

ICRA - average indirect cost rate in the nation in the year

Source: Research Expenditures, Faculty Size and Program Ratings (CASPAR), Indirect Cost Rates (NSF).

Table 3

Impact of Indirect Cost Rate on the Logarithm of Federal Research Expenditures, FY88-FY96: Share Specification[a] (absolute value of t statistics)

	Total	NSF	DOD	HHS
A) **Includes Year Dichotomous Variables**				
ICR	-.018 (5.7)	-.016 (5.4)	-.003(0.7)	-.009 (2.6)
ICRS	1.28 (14.5)	1.26 (12.0)	.41 (14.1)	2.19 (23.1)
$\bar{R}^2$	.702	.694	.511	.718
n	1952	1880	1661	1835
Cross Over Share	.014	.013	.007	.004
B) **Excludes Year Dichotomous Variables**				
ICR	-.018 (5.7)	-.016 (5.5)	-.003 (0.7)	-.009 (2.7)
ICRS	1.28 (14.5)	1.26 (12.0)	.41 (14.1)	2.19 (23.1)
$\bar{R}^2$	.702	.695	.512	.718
n	1952	1880	1661	1835
Cross Over Share	.014	.013	.007	.004

ICR - indirect cost rate coefficient

ICRS - coefficient of the product of the indirect cost rate and the institution's 1988 share of total research funding from the agency.

[a] See Table 2 for model specification and notes.

Table 4

Impact of Indirect Cost Rates on Institutions' National Science Foundation Funding: FY88-FY97 (absolute value of t statistics)

	Log Total Expenditures	Log Indirect Cost Expenditures	Log Direct Cost Expenditures	Log Grants Per Faculty Member	Log Grant Dollars Per Grant
A) Includes Year Dichotomous Variables[a]					
ICR1	.023 (5.3)	.025 (5.5)	.023 (5.3)	.016 (4.9)	.007 (2.9)
ICR2	.013 (3.9)	.016 (4.5)	.013 (3.8)	.008 (3.2)	.005 (2.6)
ICR3	.009 (2.8)	.013 (3.9)	.008 (2.7)	.005 (2.3)	.003 (1.9)
ICR4	-.019 (6.6)	-.013 (4.2)	-.019 (6.7)	-.016 (7.6)	-.002 (1.5)
$\bar{R}^2$	.611	.581	.611	.519	.197
n	2009	1926[b]	2009	2009	2009

See Table 2 for model specifications.

[a] Models that excluded year dichotomous variables and added the average indirect cost rate and the logarithm of total NSF research expenditures nationwide yielded virtually identical indirect cost rate coefficients.

[b] Some insitutions received direct cost only funding from NSF in some years which reduced the number of observations.

Table 5

Impact of Indirect Cost Rate on Institutions National Science Foundation Funding, FY88-FY97: Share Specification

	Logarithm of				
	Total Funding	**Indirect Cost Funding**	**Direct Cost Funding**	**Grants Per Faculty Member**	**Average Funding Per Grant**
A) <u>Includes Year Dichotomous Variables</u>					
ICR	-.016 (5.2)	-.010 (3.0)	-.016 (5.4)	-.014 (6.2)	-.002 (1.1)
ICRS	1.462 (10.0)	1.273 (8.3)	1.473 (10.1)	1.145 (10.4)	.317 (4.1)
$\bar{R}^2$	.557	.531	.562	.447	.182
n	2009	1926[b]	2009	2009	2009
Crossover Share	.011	.008	.011	.012	.006

See Table 2 for model specifications.

[a] Models that excluded year dichotomous variables and added the average indirect cost rate and the logarithm of total NSF research expenditures nationwide yielded virtually identical indirect cost rate coefficients.

[b] Some insitutions received direct cost only funding from NSF in some years which reduced the number of observations.