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AUTHOR Ehrenberg, Ronald G.
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ABSTRACT

This paper discusses the growing resource imbalance that is emerging between public and private institutions of higher education and the growing inequality of resources that is occurring within the public and private sectors. It illustrates implications of some of these changes for patterns of faculty compensation and faculty turnover observed across academic institutions. The paper looks at the growing importance of scientific research to universities and the growing costs that universities are incurring for this research, noting that the enormous costs of scientific research are increasingly being borne by the institutions themselves, and institutions need to understand who actually bears the burden of these costs. The paper suggests that although institutions are increasingly hoping to generate revenue to support their research through the commercialization of faculty members' research findings, very few institutions are generating substantial funding from commercialization activities. It concludes with speculations about the directions in which the U.S. higher education system will evolve over the next few decades and discusses potentially major financial issues facing academic institutions in the future. (Contains 23 references.) (SM)

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Financing Higher Education Institutions in the 21st Century

by

Ronald G. Ehrenberg*

(Invited address prepared for the 2003 annual meeting of the American Educational Finance Association – Orlando Florida, March 29, 2003)

*Irving M. Ives Professor of Industrial and Labor Relations and Economics at Cornell University and Director of the Cornell Higher Education Research Institute (CHERI).
This talk draws on research that I have been conducting at CHERI jointly with Cornell graduate and undergraduate students Michael Rizzo, Andrew Nutting, Liang Zhang, Ching-Mei Chen, Scott Condie, Christopher Smith, Daniel Klaff, and Matthew Nagowski. Without implicating them for what remains, I am grateful to the Andrew W. Mellon Foundation and the Atlantic Philanthropies (USA) Inc for their financial support of CHERI

I. Introduction

My remarks today relate to the "Financing of American Higher Education Institutions in the 21st Century". Although the discussion has some implications for the ability of students and their families to finance college educations, my focus is on institutions of higher education, not on students. I will begin by discussing the growing resource imbalance that is emerging between public and private institutions and then the growing inequality of resources across institutions that is occurring within each of the public and private sectors. As I do this, I will illustrate the implications of some of these changes for the patterns of faculty compensation and faculty turnover that we observe across academic institutions.

I will then turn to a discussion of the growing importance of scientific research to universities and the growing costs that universities are incurring for this research. The enormous costs of scientific research are increasingly being born by the institutions themselves and institutions need to understand who actually bears the burden of these costs. Institutions increasingly are hoping that they will generate revenue to support their research enterprise through the commercialization of their faculty members' research findings, but I shall show that currently very few institutions are generating substantial funding from their commercialization activities.

Finally, if time permits, I will conclude with some speculations about the directions in which our American higher education system will evolve over the next few decades and what some of the major financial issues facing academic institutions will prove to be. Much of my discussion draws on research that I have been conducting jointly with a wonderful group of undergraduate and graduate students associated with the

Cornell Higher Education Research Institute and my great debt to them for help in preparing these remarks will be obvious to you.

II. Starving the Majority

Throughout the past 40 years, roughly 75% of all students enrolled in American colleges and universities and 66% of all students enrolled in 4-year institutions have been enrolled in public institutions. If one focuses on full-time equivalent enrollments, each of these numbers falls by at most one or two percentage points. Put simply, the vast majority of American college students attend public higher education institutions and thus what is happening to public higher education is much more important to our nation's well-being than what is happening to selective private colleges and universities. Current state budget problems brought on by the aftermath of September 11, the recession and the reduction by many states in state tax rates during the 1990s by more than was prudent have exacerbated the problems that public higher education institutions are facing.

Figure 1 displays all level of education's average share of total state expenditures during the 1974 to 2002 period. Census data suggests that education's share declined from 35.2% in FY1973 to 29.6% in FY1994, before rising back to about 32% in FY1998. Data from the National Association of State Budget Officers, which reports higher education shares, suggests that education's share in FY2002 was about the same as its share in FY1998. There is nothing sacrosanct about education's share and we are all familiar with the forces responsible for its decline over the last 30 years – increased pressure for expenditures on Medicaid, welfare and criminal justice and corrections.

What is less well known and is displayed in Figure 2 is that the average share of state education budgets that has been allocated to higher education has declined for most of the period. After peaking at 22.5% in FY1983, higher education's share of state education budgets declined to 16.8% in FY1999. A different data source, which reports slightly higher shares, indicates that higher education's share continued to decline after FY1999.

The major components of state higher education budgets are appropriations to public higher education institutions and the provision of need based and non-need based grant aid to students. As figure 3 displays, since the 1976-77 academic year the share of state higher education expenditures out of states' general funds going directly to students in the form of need based and non-need based financial aid has more than doubled, rising from 2.8% in FY1977 to 6.0% in FY2001. Hence, the share of appropriations to public higher education institutions in state education budgets is declining even more rapidly than figure 2 suggests. Put simply, state appropriations to higher education institutions are a declining share of state expenditures on education, which itself is a declining share of the state budgets.

Explaining the changes described in these three figures and, more importantly, the wide variation across states in the measures described in each figure is the subject of Michael Rizzo's Cornell Ph.D. dissertation in progress, "State Funding for Education: Why Public Higher Education Institutions Have Lost". What I want to emphasize here is simply that these changes might lead one to expect that state appropriations per student to higher education institutions probably did not increased substantially over the period and this expectation is correct.

Figure 4 displays the average real (in 2000 dollars) state appropriations per student in public higher education institutions from FY1974 to FY2000. During the period per FTE student appropriations grew in real terms by about 24% from $4,042 to $5,004. This overall growth includes a period of decline that took place in the late 1980s and early 1990s. While the overall rate of growth in state appropriations per student was 23.8% during the period, the cumulative annual average growth rate was only 0.8% a year.

Institutions' sources of revenue differ in public and private higher education. Simplifying greatly and ignoring funding for research expenditures, which I will return to in the second part of my talk, expenditures per student in private higher education are driven primarily by tuition levels and external gifts and endowment income, while expenditures per student in public higher education are driven primarily by tuition levels and state appropriations per student.

Viewed in terms of real (2002) dollars, the average tuition and fees at private four-year institutions grew by 229% during the 1971-72 to 2002-03 period, an annual rate of growth of 2.7%. Average tuition and fees at public four-year institutions grew by 248%, an annual growth rate of 2.9%. So during the past 31 years tuition and fees have grown at a slightly higher rate in the public sector than in the private sector. However, where an institution starts matters and the slightly higher growth rate for public institutions in no way compensated for their much lower initial average level of tuition and fees ($1,646 versus $7,966). As a result, viewed in terms of 2001-2002 dollars, the difference between the average private and average public four-year institution's tuition and fees, which was $6320 in 1972-73, more than doubled to $14,192 in 2002-2003. Put another way, private institutions gained much more in terms of absolute dollars per student from raising tuition than their public institutions counterparts did during the period.[1]

[1] The pattern for 2-year institutions was similar. The average annual growth rate of tuition and fees at the publics during the period, 2.4% exceeded the average annual growth rate of tuition and fees at the privates, 2.1%. Even so, in real terms the absolute gap in real tuition and fees between the privates and the publics almost doubled from $4,289 to $8,165

Given the slow rate of growth of state appropriations per student at the publics, which was the driving force that led to much of the public institutions' tuition increases, it should not be surprising to you that between 1970-71 and 1995-96, real current expenditures per student at 4-year institutions grew at a faster rate, 43%, in the private sector than it did in the public sector, 34%.[2] As a result, while the difference in real terms between the two sectors in expenditure per student was about $4,700 in 1970-71, by 1995-96 it had reached over $8,000. Private institutions increasingly have more resources to spend per student than public higher education institutions have.

Faculty members' salaries represent a major use of academic institution's current revenues. A number of researchers, including me, have used data from the annual AAUP survey of faculty salaries to document that faculty salaries of faculty in public academic institutions have fallen relative to the salaries of faculty at private academic institutions since 1978-79.[3] The decline has been largest for doctoral level institutions and for faculty in senior ranks. For example, the ratio of average salaries of full professors in public doctoral level institutions to the average salaries of full professors in private doctoral level institutions fell from about .91 in 1978-79 to .79 in 1993-94.

As state appropriations per student began to increase in real terms in the mid 1990s (figure 4), the ratio then remained roughly constant through 2001-2002. However, state appropriations per student fell in real terms in fiscal year 2002-2003; thirteen states actually cut their appropriations to higher education in current dollar terms this past year.[4] It should come as no surprise to you then that this year's annual AAUP salary report that

[2] U.S. Department of Education (2002), table 343.
[3] F. King Alexander (2001), Ronald G. Ehrenberg (2000, 2003a, 2003b), Daniel Hamermesh (2002), Cynthia Zoghi (2003)
[4] Michael Arnone (2002)

I authored, which will be published on April 9, will indicate that the salaries of faculty at public doctoral institutions had fallen relative to those of their counterparts at private doctoral institutions by another 1 to 2 percentage points this year.[5]

The decline in the ratio of public academic institutions' faculty members' salaries to private academic institutions' faculty members' salaries that has taken place likely makes it more difficult for the public institutions to hire and retain top faculty, especially at the senior level. However, while anecdotal stories about public academic institutions being "raided" by private academic institutions for tenured faculty members can be found, there has been little systematic evidence to confirm that this is occurring.[6]

Each year the annual AAUP salary survey collects (but does not publish) institutional level data on the number of *continuing* faculty members. Continuing faculty members in a rank are defined as full-time faculty members employed in the rank in the previous year that are also employed by the institution in the current year, regardless of their rank in the current year. So for example, a faculty member who was an associate professor last year and is promoted to full professor this year is counted as a continuing associate professor this year. Information that is reported by institutions on the numbers of continuing faculty members in each rank and these faculty members' total salaries in both the previous and current year are used by the AAUP to compute the estimates of average salary increases for continuing faculty that appear in *Academe* each year.

Subject to some qualifications, information on the number of continuing faculty members at an institution in a rank one year, coupled with information on the number of faculty members at the institution in the rank the previous year, permits one to compute a

[5] Ronald G. Ehrenberg (2003b)
[6] Scott Smallwood (2001)

continuation rate for faculty members in each rank at the institution. This is done by dividing the number of continuing faculty members in the rank one year by the total number of faculty members in the rank in the previous year.[7] The continuation rate, or more precisely one minus the continuation rate, is a measure of faculty turnover from year to year in the rank.

The continuation rate cannot be used as a measure of voluntary turnover for assistant professors because some assistant professors leaving an institution do so involuntarily when they are turned down for tenure. Similarly, the continuation rate for full professors is "contaminated" by faculty departures due to retirement, disability or death. The continuation rate for associate professors, most of who are tenured faculty members, comes closest to approximating a measure of voluntary turnover that is likely to be influenced by average salaries at an institution.

Over a decade ago, Herschel Kasper, Daniel Rees and I used institutional level information on continuation rates for the 1988-89 academic year from the AAUP to analyze the relationship between an institution's associate professors' continuation rate and its average associate professors' salary.[8] We found, other factors held constant, that institutions with higher average salaries tended to have higher continuation rates (lower voluntary turnover rates) than their competitors. Moreover the magnitude of this relationship was largest for the AAUP doctoral university category. Recently, Cornell undergraduate Matthew Nagowski and I replicated these analyses, using data for the 1996-97 to 2002-2003 period. We again found that higher average salaries are associated

[7] These qualifications relate to the treatment of faculty who are serving as administrators or who are on leave in either the current or previous year. The presence of such individuals introduces possible measurement error into the continuation rate calculation.
[8] Ehrenberg, Kasper and Rees (1991).

with higher continuation rates, other factors held constant.[9] So given the pattern of public/private salary differentials that has existed recent years, it is reasonable to expect that we would observe that private higher education institutions would have higher average associate professor continuation rates, and thus lower voluntary turnover rates, than their public counterparts during the period.

Figure 5 plots the weighted (by faculty size) average associate professor continuation rates for a sample of 57 doctoral institutions that reported continuing faculty data for each year during the 1996-97 to 2001-2002 period to the AAUP. The average continuation rate for private doctoral institutions was always greater than that for their public counterparts. Using a larger sample consisting of all of the doctoral institutions that reported continuing faculty data in any year during the period yielded similar results. While one cannot infer causation from these simple comparisons, they do suggest that one cost to public higher education institutions of having lower faculty salaries than their private competitors is higher voluntary turnover of their tenured faculty.

III. Growing Inequality

While it is well known that the ratio of average faculty salaries at public higher education to average faculty salaries at private higher education institutions has fallen, what is less recognized is that within each of the public and private higher education sectors, an increase in the dispersion of average faculty salaries has taken place. Figure 6 plots the variance of the logarithm of average real (constant dollar) full professor salaries across doctoral level institutions at 5-year intervals between 1962-63 and 2001-2002 for a sample of 96 institutions that reported data in every year.[10] The variance of the logarithm

[9] Nagowski and Ehrenberg (2003)
[10] Using a larger sample of all institutions that reported data in any year yields similar results.

of average salaries is a measure of dispersion that is invariant to the nominal level of salaries. For example, if each institution doubled its average faculty salary, the variance of the logarithm of average faculty salary would remain constant.

As the figure indicates, the dispersion of average full professor salaries across these institutions decreased in both the public and private institution samples between the early 1960s and late 1970s but has increased fairly steadily ever since. Similar patterns are present for associate and assistant professors. Moreover, this increasing dispersion is not confined to the doctoral institutions. Figure 7 presents similar data for the variances in the logarithms of average faculty salaries by rank for a set of private bachelor's colleges that reported average salary data each sample year. Again, starting in the mid to late 1970s, the dispersion across institutions in the logarithm of average faculty salaries increased for all ranks, with the increase being the greatest at the senior levels.

In research summarized elsewhere, Cornell graduate student Andrew Nutting and I have estimated logarithm of average faculty salary equations by rank separately for public and private doctoral institutions and private bachelor's institutions using panel data for the 1972-73 to 1997-98 period.[11] The explanatory variables included in our analyses were endowment per student, tuition and state appropriations per student, as well as a set of institution specific dichotomous variables. The inclusion of the latter variables makes what we did equivalent to specifying that the change in the logarithm of average faculty salary at an institution is a function of the change in endowment per student at the institution, the change in tuition at the institution and the change in state appropriations per student at the institution. We then use these estimates to understand

[11] Ehrenberg (2003a)

which factors have been responsible for the growing dispersion in faculty salaries across institutions.

Our models attribute the vast majority of the growing dispersion in average faculty salaries across private doctoral institutions and across private bachelor's institutions at each rank to the growing dispersion of endowment wealth that took place during the period. To understand why this is true, it is important to realize that even if two institutions experienced the same percentage increase in endowment per student during a period, the institution that had the highest initial level of endowment per student will gain more absolutely in endowment per student than the institution with the lower initial level of endowment per student. If other sources of institutional income, such as tuition were growing at rates that were lower in percentage terms than the rate at which endowment were growing, the institution with the largest initial endowment per student would see its total income per student grow by a larger percentage than its relatively poorer counterpart. Thus it would be able to increase its average faculty salary level by a greater percentage during the period.

Our estimates suggest that the growing variance of the logarithm of average faculty salaries at each rank for public doctoral institutions is due both to growing differences in endowment per student and growing differences in state appropriations per student. However for all three ranks, changes in endowment per student played at best a minor role. Most of the increase in the variances of the logarithms of average real faculty salaries across public doctoral institutions is due to the growing differences in the rates of growth of state appropriations per student across institutions. Indeed, at the assistant and the associate professor levels, virtually all of the growth in the dispersion of average faculty salaries can be explained by growing differences in the level of state appropriations per student across institutions.

The increased dispersion of average faculty salaries across institutions in both the public and private sectors parallels the increases in income inequality that are occurring more broadly in American society. They further suggest that it is probably becoming increasingly difficult for some institutions in both sectors to attract and retain high quality faculty. Numerous studies have suggested that where students go to college significantly influences their future earnings.[12] If faculty quality now differs more across institutions than it did in the past, where students choose to go to college may matter even more in the future than it has in the past.

IV. The Growing Cost of Science

Scientific research has come to dominate many American university campuses. The growing importance of science to our society has been accompanied by a growing flow of funds to universities from the federal and state governments, corporations and foundations to support research. As a result, viewed in terms of 1998 dollars, the weighted (by faculty size) average volume of total research and development expenditures per faculty member across 228 American research and doctoral universities increased from about $70,000 per full-time professorial faculty member in 1970-71 to $142,340 per full-time professorial faculty member in 1999-2000.[13]

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[12] See for example, Brewer, Eide and Ehrenberg (1999) and Eide, Brewer and Ehrenberg (1999) who find that differences in early career earnings and probabilities of enrolling in graduate school that are associated, other factors held constant, with the average SAT score of students at an institution and Dale and Kruger (2002) who conclude that students who attend institutions that have higher expenditures per student have higher post college earnings than other students.

[13] These figures and the ones that follow immediately are all computed from the NSF WEBCASPAR system (http://caspar.nsf.gov). Professorial faculty include assistant, associate and full professors.

What is not well recognized, however, is that in spite of the generous external support that has been provided to universities for research, increasingly the costs of research are being borne by the universities themselves. During the 1970-71 to 1999-2000 period, the weighted average of institutional expenditures on research per full-time professorial faculty member at the 228 universities more than tripled. As a result the weighted average percentage of universities' total research expenditures being financed out of internal funds rose from about 11 to 20 percent during the period. Increasingly academic institutions themselves are bearing a greater share of the ever-increasing costs of scientific research.

There are a number of forces that have led to the costs of research being borne by universities to soar over the past few decades.[14] Theoretical scientists, who in a previous generation required only desks and pencils and papers, now often require supercomputers. Experimental scientists increasingly rely on sophisticated laboratory facilities that are increasingly expensive to build and operate. Research administration now includes strict monitoring of financial records and environmental safety, as well as the detailed review and monitoring of human subjects. At the same time that these research administration costs were increasing, the average indirect cost rate at private research and doctoral universities, which was over 60% in 1983, fell to about 55% in 1997 and has remained near that level since then (Ehrenberg 2000, 2003).[15] So, on

[14] Ehrenberg (2000) discusses these forces in much more detail.

[15] Average indirect cost rates are lower at public research universities than they are at privates. This does not imply that the publics spend less on research infrastructure and administration than their private counterparts do. Rather much of the funding that the publics receive for infrastructure comes from the states in the form of financial support for buildings and the states often do not require their public universities to recoup these costs in indirect cost recoveries and then reimburse the state governments for them. Inasmuch as faculty members believe that high indirect cost rates result in a reduction in the probability that they will win grants and/or a reduction in the magnitudes of the amount of direct costs that they can apply for, the faculty puts pressure on public university administrators to keep their indirect cost

average, for any given level of direct cost funding that their faculty members received, private universities received 8.3% less funds from the federal government to support their research infrastructure and administration costs in the late 1990s than they did in the early 1980s. In recent years the federal government has also placed increasing pressure on universities to provide "matching" institutional funds for any research proposals that they submit.

Finally, as scientists' equipment became more expensive and the competition for top-quality scientists intensified, the start-up funding that universities needed to provide to attract both young and senior scientists intensified. Universities typically cannot recover these expenses in their indirect cost billings, because new young scientists rarely have their own external funding when they first arrive at a university. During the late 1990s, it was often alleged, although no systematic data existed to support this claim that the universities were providing young scientists in the range of $250,000 to $500,000 to set up their labs. The start-up costs of attracting distinguished senior scientists was often alleged to be much greater and even if these scientists brought their own federally funded research grants with them, their start-up costs too were often not recoverable in indirect cost recovery pools because the institutions faced caps on their recoveries in a number of categories.

Because no systematic data on start-up costs has previously been collected, the Cornell Higher Education Research Institute conducted a *Survey of Start- Up Costs and Laboratory Space Allocation Rules* during the late spring and summer of 2002.[16] Three

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rates low. The administrators have tended to oblige them but as state support for public higher education tightened in the 1990s, many publics allowed their indirect cost rates to float up a bit.

[16] Laboratory space allocation rules were also a focus of the survey because many scientists and engineers are approaching ages when they might consider retiring and the promise of being able to keep their labs

to six science and engineering departments were identified at each of the 222 universities classified as research and doctoral universities in the 1994 Carnegie Foundation classification of academic institutions (Carnegie Foundation 1994). Separate surveys were sent to the chairs of each department, the deans of the colleges in which each of these departments were located and the vice president/vice provost for research in each university.

In total 1031 chairs, 408 deans and 206 vice presidents/vice provosts received copies of the surveys. Usable responses were received from 572 (55%) of the chairs, 216 (53%) of the deans and 85 (38%) of the vice provosts/vice presidents.[17] In what follows, I briefly summarize some of what we learned about start-up costs from the three surveys. Copies of the three survey questionnaires and tabulations of the responses to each question from each survey, cross-tabulated by Carnegie Category and form of control (public/private) are available on the CHERI web site (http://www.ilr.cornell.edu/cheri).

At the new assistant professor level, with few exceptions, Carnegie Research I universities provided large start-up packages than other universities and private universities provided larger start-up packages than public universities. Table 1 summarizes some of the differences we found, when the respondents are broken down into four broad fields - physics/astronomy, biology, chemistry and engineering. The average assistant professor start up package at Research I universities varied across fields from a low of $337,000 in engineering to a high of just over $475,000 dollars in chemistry. Estimates of the average high-end (most expensive) assistant professor start-

after retirement may be a powerful tool to encourage them to retire. Such promises, however, are also very costly.

[17] The response rates to the survey varied across type of institution. In particular, response rates were higher for departments and deans associated with public institutions than from those associated with private institutions.

up packages at these institutions varied across fields from $416,875 in engineering to $580,000 in chemistry.

Start-up cost packages for senior faculty members are considerably larger. For example, again in the private Research I universities, the average start-up cost package ranged from about $570,000 in Physics to $1.5 million in engineering; the comparable range for the average high-end senior faculty start-up cost package at private Research I universities ranged from $1.0 million in physics to $1.8 million in engineering. The average high-end senior faculty start-up cost package was larger in two fields (physics and chemistry) at public Research I universities than it was at private Research I universities, this may reflect efforts by a number of the publics to move their departments to a higher level by hiring a few key senior faculty members.

Estimates of average start-up cost packages provided by the deans who responded to our survey were similar to those provided by the chairs. Where the deans probably were better informed than the chairs, however, was on the sources of start-up funds. On average, deans reported that the largest source of start-up cost funds was the general budgets of the college and university, with 45% of start-up costs coming from these sources. Deans reported that of the remaining 55%, 20% came from sources other than keeping positions vacant (and thus using budgeted salary dollars), endowment income and gifts, state appropriations, and the operating budgets of their departments. In notes that often accompanied their answers, they often indicated that the "other sources" were indirect cost recoveries. As we noted above, unless new faculty members bring external research funding with them, most start-up costs cannot be included in the indirect cost base. So what the deans really mean is that their universities incur expenses from their general budgets for research administration and infrastructure and when these costs are reimbursed through the indirect cost pool, this permits the universities to spend funds from their own general budgets on start-up costs.

One point of concern is the extent to which institutions generate start-up costs by keeping faculty positions vacant. Deans at public institutions reported that they generated a greater percentage (13%) of their start-up cost funding from keeping positions vacant than deans at private universities did (7%). Hence the need to generate start-up cost funding appears to adversely influence the teaching programs of public universities more than it does the teaching programs of private universities.

This leads more broadly to the question of who actually bears the costs of the increased expenditures that universities are making out of institutional funds for research. In research in progress, Michael Rizzo, my faculty colleague George Jakubson and I are analyzing the extent to which increased research expenditures of out of internal institutional funds are associated with higher student/faculty ratios, lower rates of faculty salary growth or higher rates of tuition growth, holding constant all other sources of revenue coming into the university (including state appropriations, endowment income and gift income).[18] Our findings to date suggest that increased internal research expenditures per faculty member are associated with increases in the student/faculty ratio, in faculty salaries and in undergraduate tuition levels, but that these increases are quite modest.

Our analyses, however, hold many of the sources of income coming into the university, including state appropriations per student, endowment income, and annual giving constant. Some state systems, for example the SUNY system in New York,

[18] Ehrenberg, Rizzo and Jakubson (2002)

provide additional funding for institutions based upon the volume of the institutions' external research funding. To the extent that institutional expenditures on research help to generate external research funding, our estimates of even modest effects may overstate the negative impact of institutional expenditures on research on students. Similarly, we know from the recent research that I conducted with Cornell undergraduate Christopher Smith on the sources and uses of annual giving, that increases in research per faculty member are associated with higher levels of annual giving, which gain could cause our estimated impacts of increases in institutional expenses on research to be too large.[19] However, when we treated changes in state appropriations and changes in annual giving as endogenous and dependent, in turn, on research expenditures from external funds and total research expenditures, and made changes in external research expenditures dependent on changes in institutional research expenditures, our findings were not significantly altered.

It is also possible that the increasing costs of research that are borne by universities may be eventually at least partially offset by revenues that the universities receive from increased commercialization of their faculty members' research. The Association of University Technology Managers (AUTM) reported in their fiscal year 2000 survey of their members that American colleges and universities received more than $1 billion dollars in licensing income and other forms of royalties relating to patents that year. While this figure seems large, it was concentrated in a few large "winners"; 90% of the

[19] Ehrenberg and Smith (2003)

universities in their sample received less than $2 million and almost half received less than $1 million.[20]

Licensing income received in one year depends upon the flow of investments in research that universities have made in the past. If we ignore this and the fact that the return on any particular research project may occur for a number of years in the future, a simple way of looking at the commercial returns that universities receive from their faculty members' research is to ask how the licensing income received by a university in one year relates to its own expenditures on research in that year. Licensing income received in fiscal year 2000 averaged 3.23% of total research expenditures in the year across the institutions in the AUTM sample. Universities fund nearly 20% of their research expenditures out of their own resources, which suggests that licensing income averaged about 16% of institutions' research expenditures out of internal university funds in the year.

At first glance this seems like a significant return but this calculation is misleading for at least three reasons. First, the licensing income that universities receive is divided between the university and the researchers. So only a share of the revenue actually comes to the university itself. Second, focusing on the average ratio ignores the skewness in the distribution of research returns. The median institution in the sample licensing income was 0.83% of its total research revenue, which is about 4.2% of its internal volume of research expenditures.

Third, given the volume of a university's research, licensing income and other forms of revenue from patents that are related to this research do not simply fall off trees.

[20] See Blumenstyk (2002a). Some of these large winners were universities that cashed in equity positions that they had taken in companies, in lieu of receiving licensing income.

Rather, they must be "harvested". Considerable efforts must be made by universities and their faculty members to decide if faculty members' discoveries have potential commercial value, to patent the discoveries, to then develop or seek partners to develop commercial potential, to negotiate licenses or equity positions, and to enforce patents.[21] All of these activities take resources. Indeed, the cost of trying to enforce patents alone can prove very expensive.[22]

While no comprehensive source of data on the costs that universities occur in trying to generate licensing income is currently available, summary information from the AUTM licensing survey permits us to make some back of the envelope calculations. During fiscal year 2000, the 142 U.S universities in the AUTM sample employed a total of 479.95 "licensing" full-time equivalent employees (FTEs) and 494.53 other FTEs in their technology transfer offices. They also incurred $117,927,842 in legal fees, of which third parties reimbursed only $53,685,716.[23] Hence these universities' net legal fees for technology transfer activities were roughly $64 million and they employed a total of about 975 employees. These employees include patent attorneys, other professionals and support staff. If we assume that the fully loaded costs of each employee (salaries, benefits, office space etc.) averaged $100,000 that year, the total expenses of technology transfer activities for these institutions were in the range of $161.5 million dollars, or an average of about $1.15 million per university.

Maintaining the assumption that the average fully loaded cost of each employee was $100,000; the AUTM survey responses allow us to compute an estimate of the net

[21] Thursby and Thursby (2000) describe this process in much more detail and provide estimates of licensing production functions.
[22] The University of Rochester has established an "eight figure" legal fund in its effort to obtain billions of dollars in royalties from the makers and marketers of the arthritis drug Celebrex (Blumenstyck 2002b).
[23] Association of University Technology Managers (2001), attachment D

licensing income (income after expenses) for 138 of the universities in the sample. The mean net licensing income in this sample was $6,554,200, but the median was only $343,952. By my calculations 51 of the 138 institutions actually lost income that year on their commercialization activities and the median net licensing income for the 87 that made money was $1,309,828. When one remembers that the licensing income received by universities is split between them and the faculty members whose patents have generated the income, it seems clear that commercialization of research has yet to provide most universities with large amounts of <u>net</u> income to support the universities' scientific research activities.

V. Concluding Remarks

Permit me to conclude with some speculations about the future of higher education as we move into the 21st century. First, it is clear that public higher education institutions will continue to look more and more like private institutions. Lack of state funding is forcing many to move towards higher tuition policies in an effort to maintain their quality. While most economists applaud high tuition policies for public higher education institutions, they have tended to do so under the assumption that states, or the institutions out of their own resources, would provide need-based financial aid to allow lower-income students to attend these institutions. However, state and federal funding of financial aid is moving more and more towards merit aid, not towards need based aid, and in the main public institutions are not generating large amounts of income that can be used for need based aid from their tuition increases –they are simply trying to make up for state appropriations cuts. So reduced access to our four-year public institutions for students from lower-income families is likely to occur and we are likely to see more and more lower-income students starting their college careers at cheaper (for them) public two-year institutions.

This trend will increase the importance of state policy makers more seriously thinking about their public higher education systems as a whole. Efforts will be needed to improve the transition of students from 2-year colleges into 4-year colleges and to develop a better understanding of which state policies facilitate such transitions. Efforts will be needed to help understand why within states some 2-year colleges are better at preparing their students who desire to transfer to 4-year institutions to successfully complete the 4-year colleges and why some 4-year colleges in a state do better jobs educating transfer students than other 4-year colleges. Chris Smith and I have done some preliminary work on this problem. [24]

The growing financial problems of public higher education institutions have pushed them to look more like private academic institutions in another way, namely increasing their reliance on private giving and endowment income to fund current operations. Giving from corporations, foundations and alumni rarely comes without strings and as their efforts to generate more giving increase, public higher education institutions will increasingly find that they have to be careful what they ask for. Put perhaps slightly differently, the growing interrelationship between universities and external constituents is likely to lead to whole sets of issues concerning how the goals of the universities mesh with the goals of the funders.

Science and engineering research will continue to grow in importance and costs. Some institutions have already realized that they do not have the resources that are

[24] Ehrenberg and Smith (2002)

needed to compete and have reduced their aspirations and financial commitments. For example, Clark and Catholic universities have both "voluntarily" dropped out of the Association of American Universities. Others, especially emerging public universities, such as the University Centers of the State University of New York, however, are actively involved in the arms race of spending for science and engineering research and in doing so have moved away from their traditional missions of providing quality undergraduate education. It is ironic that the turn of the 21st century sees the great private and public research universities reemphasizing the importance of undergraduate education, while some of the emerging publics, by financial necessity, are moving in the opposite direction.

Finally, the evolution of the public higher education institutions will, to a large extent, be determined by the financial incentives that their state budget allocation process provide. The majority of states have some form of formula funding and/or performance funding as part of their resource allocation process.[25] For example, in New York State, the SUNY schools now get financial rewards for generating external research funding and for expanding their enrollments relative to the rest of the system. They also get larger rewards for enrolling upper class students and graduate students than from enrolling lower level undergraduates. This resource allocation model surely does not encourage the development of high quality lower-level undergraduate education. Rather it encourages, the use of adjuncts and teacher assistants to teach lower level courses. Developing funding allocation models that do not provide incentives for participants to try to "game the system" is very difficult and thus strong academic leadership at the center of state

[25] MGT of America (2001)

systems appears to be a valuable, but often ignored, commodity in the planning for the evolution of public higher education.

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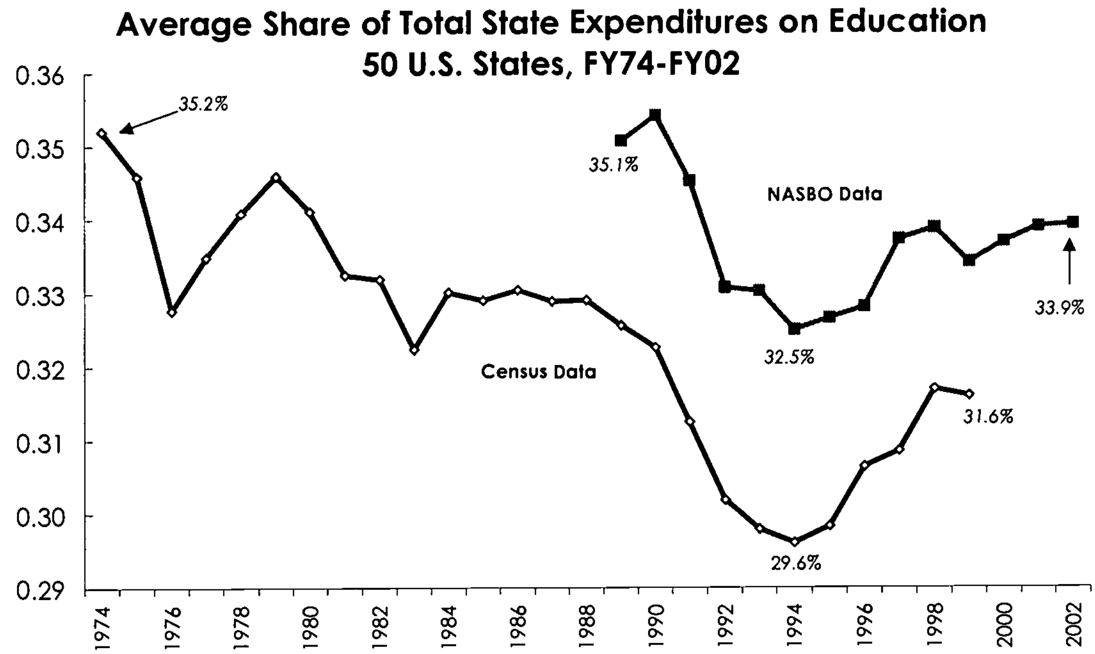
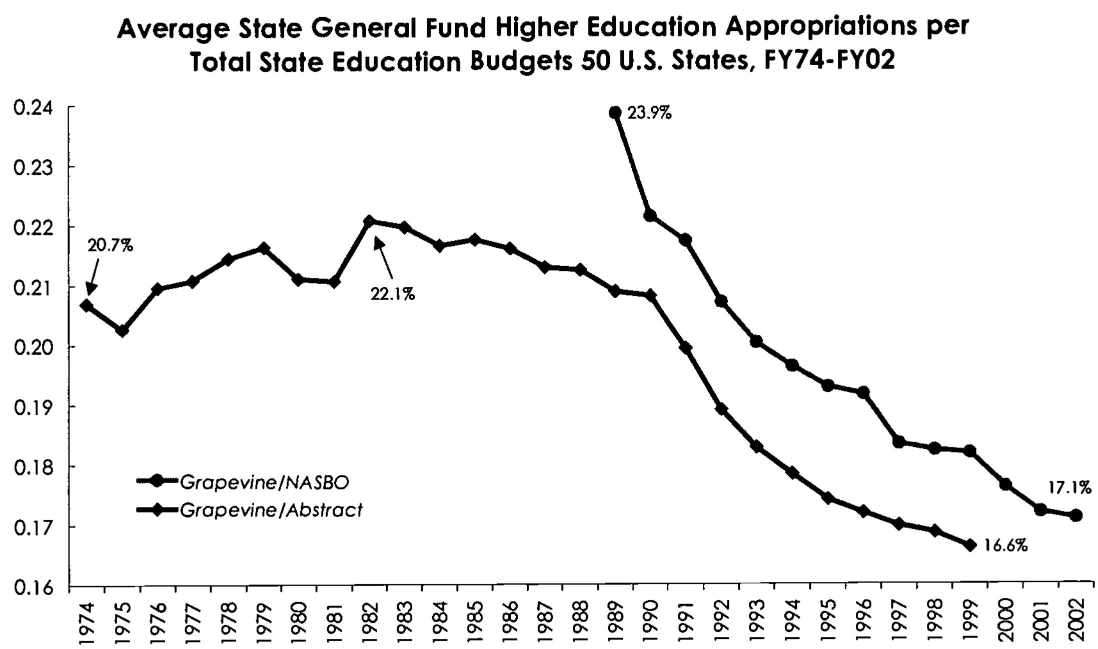
Figure 1



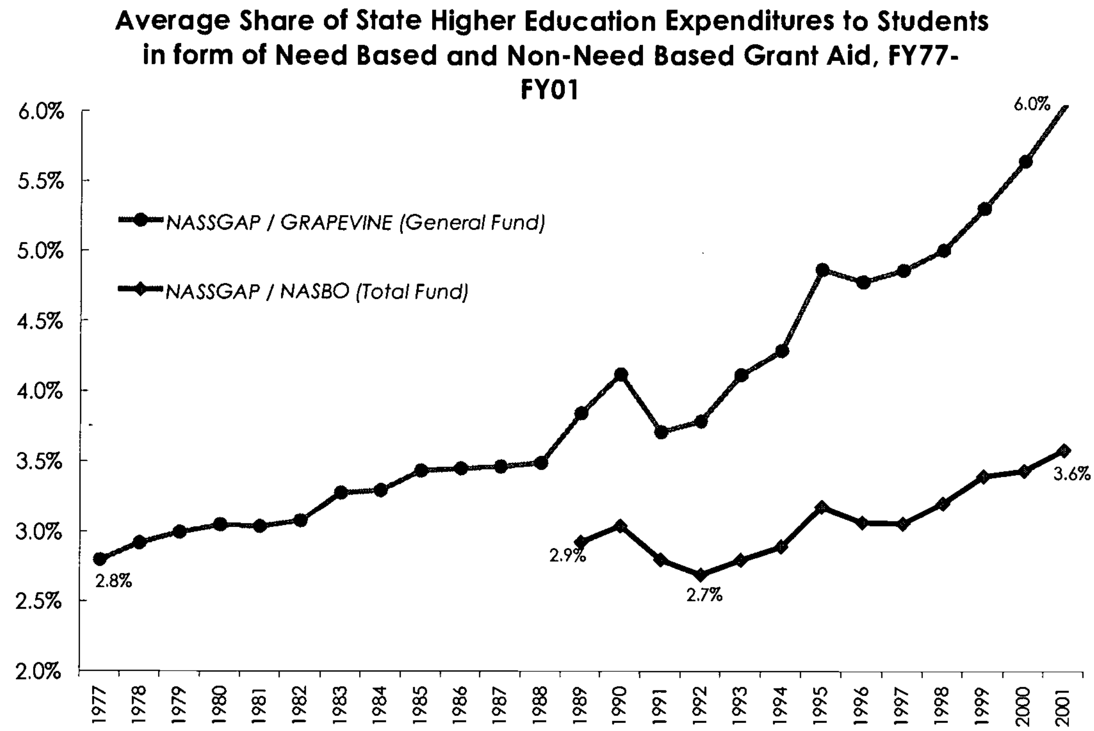
Sources: US Census via Statistical Abstract of the US and National Association of State Budget Officers. Annual State Expenditure Reports. Years represent end of fiscal year.

Figure 2



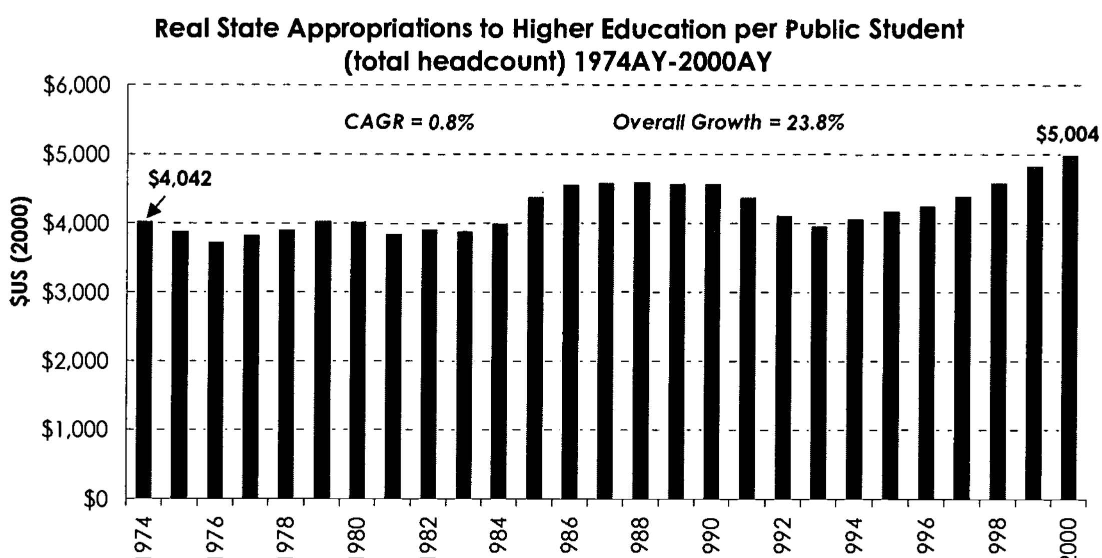
Sources: State Appropriation Data (numerator) from GRAPEVINE. State Budget Data from Census via Statistical Abstract of the US (Abstract) and National Association of State Budget Officers (NASBO)

Figure 3



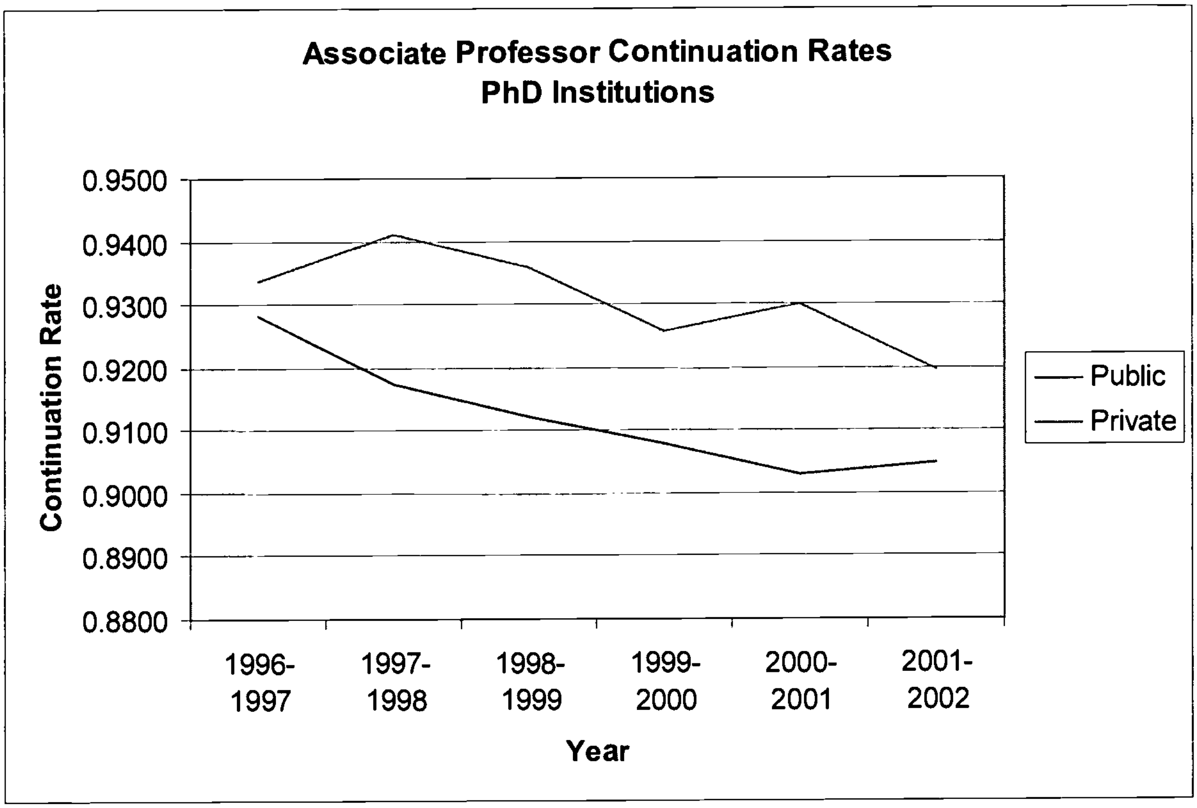
Sources: Grant Aid Data from NASSGAP, State Appropriation Data from GRAPEVINE and NASBO.

Figure 4



Sources: US Department of Education & Illinois State's GRAPEVINE System

Figure 5



Associate Professor Continuation Rates
PhD Institutions
0.9500
0.9400
0.9300
0.9200
0.9100
0.9000
0.8900
0.8800
Continuation Rate
1996-1997
1997-1998
1998-1999
1999-2000
2000-2001
2001-2002
Year
Public
Private

Figure 6

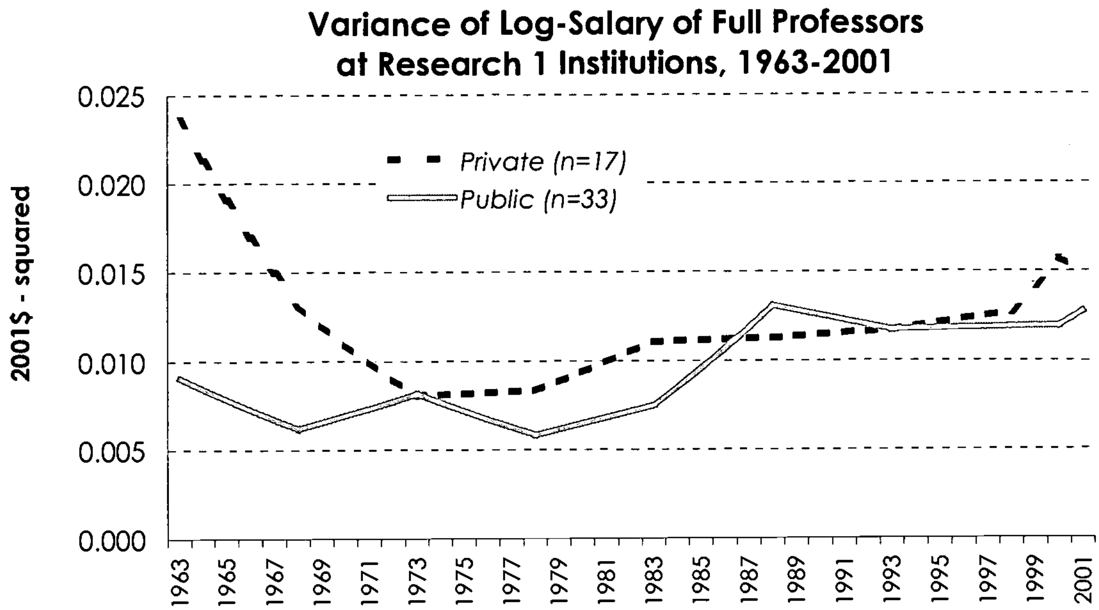


Figure 7

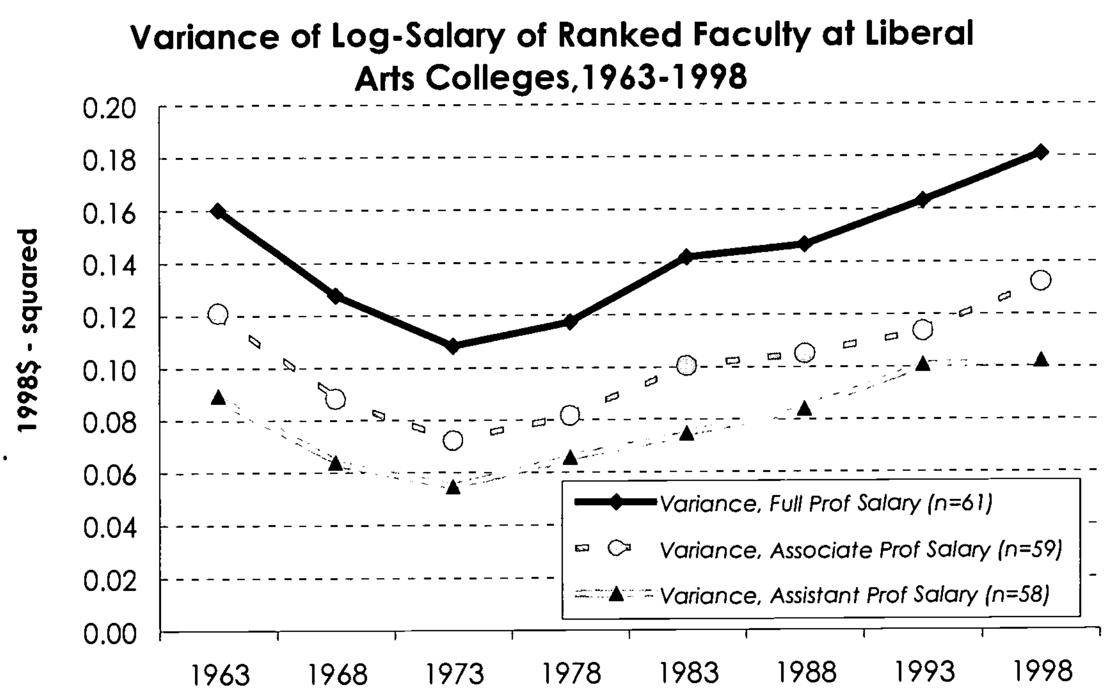


Table 1

Average Mean Start-Up Costs for Departments Reporting in the Category*

(Number of Departments Reporting)

		R1 Private	Other Private	R1 Public	Other Public
AA	PHY	353,905(3)	77,750(8)	311,842(15)	140,958(24)
AA	BIO	371,857(7)	179,056(18)	306,750(24)	180,710(31)
AA	CHEM	475,294(17)	202,352(17)	466,560(28)	211,020(50)
AA	ENG	337,000(11)	140,014(14)	192,840(30)	118,906(35)
HA	PHY	563,444(9)	254,071(14)	481,176(41)	248,777(47)
HA	BIO	437,917 (12)	208,886(22)	430,270(37)	217,082(49)
HA	CHEM	580,000(17)	259,348(23)	584,250(40)	284,269(60)
HA	ENG	416,875(16)	209,57(21)	259,494(50)	146,831(43)
AP	PHY	596,875(4)	80,000(1)	748,274(15)	324,375(16)
AP	BIO	750,000(3)	475,000(9)	573,438(16)	369,545(22)
AP	CHEM	991,667(12)	612,857(7)	833,571(21)	568,462(26)
AP	ENG	1,500,000(6)	226,667(9)	391,528(30)	202,038(19)
HP	PHY	1,000,000(4)	418,333(3)	1,110,577(24)	455,882(17)
HP	BIO	1,575,000(5)	555,500(10)	856,250(16)	709,444(27)
HP	CHEM	1,172,222(9)	575,000(8)	1,187,115(26)	648,913(23)
HP	ENG	1,807,143(7)	452,000(10)	472,086(34)	254,597(23)

* Tabulation of responses to the Cornell Higher Education Research Institute *Survey of Start-Up Costs and Laboratory Space Allocation Rules* that was mailed to 3 to 5 chairs of selected biological science, physical science and engineering departments at each research and doctoral university during the summer of 2002

Where

AA average start-up costs for new assistant professors
HA high-end start-up costs for new assistant professors
AP average start-up costs for senior faculty
HP high end start-up costs for senior faculty

PHY physics and astronomy
BIO biology
CHEM chemistry
ENG engineering

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