Increased Cost of University-Based Research

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Abstract. The components of university-based research are people (faculty and supporting staff), instrumentation, facilities, materials, and the maintenance of an environment in which research flourishes. The costs of some of these components are rising rapidly due to the accelerated pace of science, the need for new and renovated research facilities, increased regulations and health and safety standards, and increased salary costs. The costs described are direct and indirect, both growing at nearly the same rate since 1984.

NEED FOR UNIVERSITY-BASED RESEARCH

The very success of past university-based research — and the resulting benefits — have accelerated the pace, complexity, and sophistication of current research efforts. A significant component of the U.S. Gross National Product (GNP) can be traced to relatively recent discoveries. Our competitive position in the world economy, our strength in defense, and our prospects for improved health, to cite just a few examples, can be traced to past investments in university research.

The return on such investments is impressive. The social rate of return on academic research was recently estimated at 28 percent.[1] Various analysts have reported that technological innovation accounts for 44 to 77 percent of increased productivity.[2]

Our nation's future requires accelerated investments in research. Japan and West Germany now spend larger percentages of GNP on research and development (R&D) than the United States. If only nondefense

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R&D is considered, they have exceeded the United States for nearly two decades. U.S. investment in nondefense R&D as a percentage of GNP has declined for at least two years.[3]

ACCELERATED PACE OF SCIENCE

Major advances in science can still result from individual genius and from pencil-and-paper studies. Theorists work much as their predecessors did, but they solve exceedingly more complex problems, whose solutions require more complex techniques, more creative research, and purer materials and ever-more-sensitive instruments to experimentally confirm.

Per-unit expenditures for scientific research are going up due, in substantial part, to the higher costs of more sophisticated instruments and the facilities needed to house them. If one were to examine recent breakthroughs in science, one would see that the tools of science are inevitably new instruments and facilities — typically more complex and more expensive than ones used earlier. "Indeed, a good part of the excitement of science in the past year comes out of new instrumentation. The scanning tunneling microscope for visualizing atoms; the increasing set of 'impossible experiments' that can be done on supercomputers; techniques such as capillary electrophoresis that can follow chemical changes in single neurons; or an incredible set of new tools for deciphering DNA structure. Soviet scientists tell their leaders that without industry that can manufacture state-of-the-art equipment, they can never catch up to the West. Young Chinese scientists are reluctant to return home because their training will be almost useless without well-equipped laboratories."[4]

Throughout the 1980s, U.S. academic institutions invested heavily in R&D instruments. Results of a survey of academic research equipment in selected fields showed that approximately 40 percent of all instrument systems in research use in 1985–86 had been acquired in the previous three years, and about 25 percent of instrument systems in use in 1982–83 had been retired from research by 1985–86. The median age of the national stock of scientific instruments (both in use and not in use) in 1982–83 and 1985–86 was five years. However, the median age of state-of-the-art instruments was two years, indicating the rapid pace of technological change in research instrumentation.[5]

ACADEMIC RESEARCH BUILDINGS, FACILITIES, AND INSTRUMENTS

The country's research universities also experienced large increases in investment in academic research buildings, facilities, and instrumentation during the 1980s. Recent surveys indicate that after an extended period of decreased federal support, nonfederal investment is now being made to upgrade and replace obsolete facilities and instruments. In addition to the $12.1 billion that universities spent for separately budgeted research activities in 1987, $1.8 billion was disbursed for capital investment in science and engineering facilities and fixed equipment for research and instruction. Nonfederal sources provided most of the funds for capital expenditures — as much as 92 percent in 1987 as compared with 81 percent in 1980 and 71 percent in 1970.[6] There is strong consensus that much greater investments must be made in the 1990s to modernize facilities. To the extent these investments are made, they will result in higher use charges in indirect cost rates.

Construction costs of academic science and engineering facilities were expected to reach $3.4 billion in 1988 and 1989. New construction projects are increasingly expensive — in 1986 and 1987, for example, the cost of new academic research space in current dollars was $206 per square foot, compared to $287 per square foot in 1988 and 1989.[7] Costs are estimated to rise an additional 35 percent for 1990–91 projects, to $311 per square foot.[8] Factors contributing to the markedly increased costs of facilities construction include the need for accommodating new instrumentation, better environmental conditions (e.g., clean rooms), containment facilities, more stringent standards for animal care, toxic waste disposal, and biohazard controls.

NEW REGULATION AND INCREASED HEALTH AND SAFETY STANDARDS

Academic research is often encumbered by the secondary or tertiary influence of regulations and policies intended to do something else. This encumbrance is manifested in delay, restraint, and costly compliance. In most instances universities are not quarreling with the need for regulation, rather with the seemingly unnecessary clerical and administrative requirements imposed as a means to demonstrate compliance. Enumerated below are recent examples of new regulations or policies which create additional administrative burdens, hence additional costs.

Misconduct in Science (1989)
Drugfree Workplace (1989)
Drugfree Workforce (1989)
Care of Animals in Research (1989)
Debarment and Suspension (1989)
Anti-Kickback Act (1988)
Nondelinquency of Federal Debt (1989)
Notice of Cost Sharing (1989)
Certification of Accuracy of Indirect Costs (1988)
U.S. Office of Management and Budget Circular A-133 — New Auditing Rules (1990)
Clean Water Standards (1988/90)
Right-to-Know Laws (1988/90)
Medical and Infectious Waste Disposal and Tracking (1988/90)
Low-Level Radioactive Waste Disposal (1988/90)
Clean Air Standards (1988/90)
Procurement Integrity (1990)
Anti-Lobbying Rules (1990)
Hazardous Waste Disposal (1988/90)

All the regulations enumerated here are products of the past three years. All of these regulations necessitate: increased staff; increased supplies and expense for recordkeeping, monitoring, testing and disposal; and, in many instances, the renovation of facilities to meet new standards. "Each new federal program carries with it substantial monitoring requirements that often lead to the establishment of new internal bureaucracies whose principal function is to create more work for others. Health and safety regulations are a prime example. Most research universities have had to increase their staff of health and safety inspectors fivefold or more. These inspectors then find problems that others must be hired to fix."[9]

Almost all of these costs fall into the category of indirect costs because they cannot be directly attributed to a particular project or activity that occurs within the university. Primarily, these federal regulations support activities within the university's organizational structure. They may be the result of specific federal statutes, or they may be administratively generated based on broad agency powers. In either event, although subject to interpretation by each university, they must be satisfied.

SALARY AND RELATED COSTS

The challenge is to attract and retain the "best and brightest" persons in research careers. As the gap between university salaries and salaries in other sectors widened, the perception among many talented young people was that university careers were not economically attractive.

From 1960–61 to 1970–71, a "golden age," faculty salaries increased 23 percent in real dollars. But, other sectors had comparable and even greater increases. From 1970–71 to 1983–84, faculty salaries declined almost 19 percent in real dollars. Salaries in manufacturing, government, and comparable private sectors, while relatively flat during this period, showed no such decline. From 1960–61 to 1983–84, earnings in real dollars showed no improvement for faculty salaries. For the same period, government salaries were up 27 percent, manufacturing salaries were up 21 percent, and salaries of private sector employees in jobs equivalent to GS grades 11 to 15 were up 20 percent. Disposable personal income was up 53 percent.[10]

Clearly, universities could no longer ignore market forces. Competition for academic researchers became keen. Between 1984 and 1988, salaries of faculty members involved in research increased at a rate greater than the Consumer Price Index or the Biomedical Research and Development Price Index. The Public Health Service Inspector General reported that salary increases for faculty working in research and instruction were greater than increases for faculty devoted primarily to instruction and that salary increases associated with retention of faculty were greater than normal merit increases. The inspector general also reported that federal research support became a resource partner in university efforts to attract and retain first-rate researchers.[11]

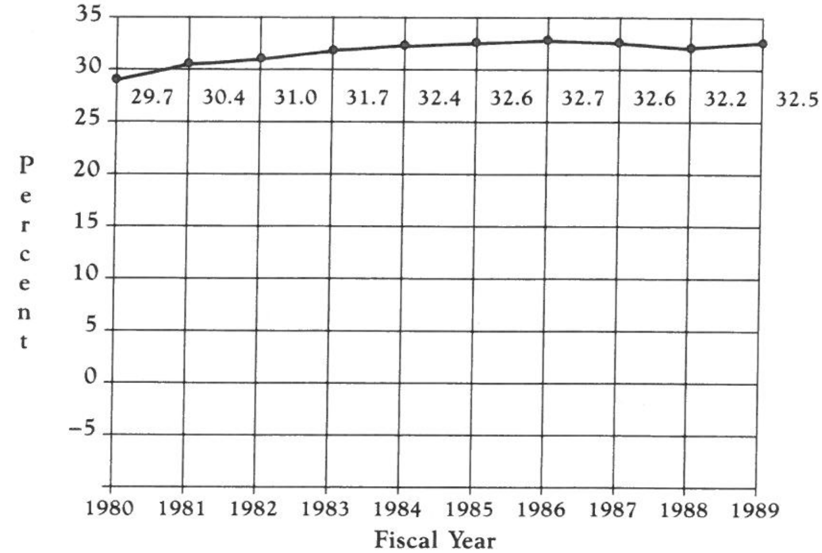
A NOTE ON INDIRECT COSTS

The increased costs described in this paper are both direct and indirect. Are indirect costs rising faster than direct costs? To answer this question, one can rely on data provided by the National Institutes of Health (NIH). The NIH data are significant because NIH funds about half of the academic science conducted in the United States.

Figure 1 displays indirect costs as a percentage of total costs for traditional research grants. The trend line rises from the base year 1980 until 1984. Thereafter, the trend line is almost level, not varying more than a few tenths of a percent between 1984 and 1989. Figure 2 displays the percent change in indirect and direct costs since 1984. Notice that the change in has been nearly the same since 1984, indicating that direct and indirect costs have been growing at nearly the same rate.[12]

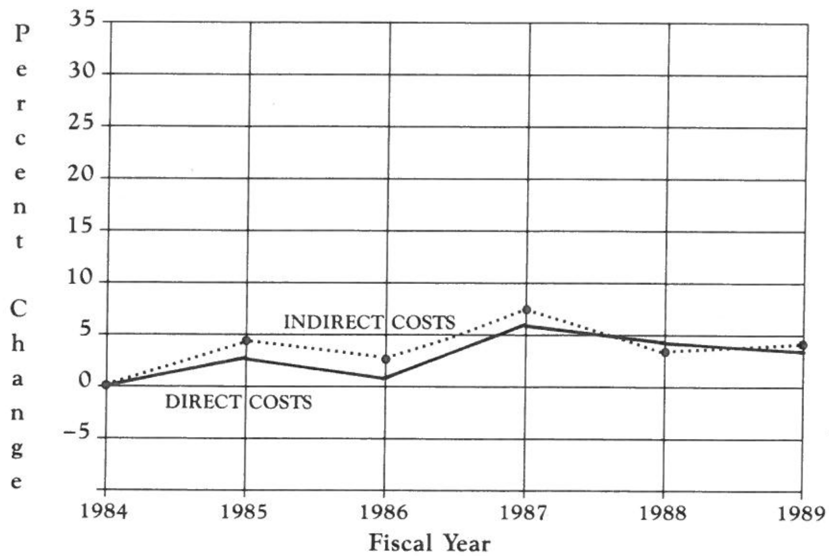
What conclusions can one draw from the preceding? The authors believe that any effort to control the costs of university-based research must address both direct and indirect costs. Tinkering with only one element of this equation will merely shift costs, not control them. The cost of science is going up "because the cost of quality rises rapidly as research problems become more difficult and the infrastructure needed to support inquiry grows more sophisticated and expensive."[13] Education is needed — within both the federal government and the university community — on the total costs of research, how these costs are incurred, how they are distributed between direct and indirect categories, and the effects of changes in funding on the financial health of universities.[14]

Figure 1
Indirect Costs as a Percentage of Total Costs for Traditional Research Grants



Source Data: NIH Extramural Trends FY 1980–89.

Figure 2
Direct Costs and Indirect Costs: Percent Change since 1984



Source Data: NIH Extramural Trends in FY 1980–89.

SUMMARY

Some special factors have been responsible for recent and anticipated increased costs of university-based research: the availability of more powerful instrumentation, the replacement of obsolete facilities after years of neglect, the costs of new regulations, and the required increases in salaries that had been allowed to fall behind salaries in other sectors. The costs described are direct and indirect, both growing at nearly the same rate since 1984. Investment in university-based research, however, gives promise of greater dividends to society.

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