

# A Framework for Examining the Effects of Industrial Funding on Academic Freedom and the Integrity of the University

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Industrial funding of research in universities is not new. Philanthropic support of basic research and investment in the development of commercial products such as nylon have generally been regarded as beneficial to both society and industry. In these instances, the universities consider that they have served both well and with no loss in integrity. Other university-developed technologies, such as a number of chemical pesticides, have been viewed with mixed blessings.<sup>1</sup> Recent increased industrial support in biotechnology, microelectronics, and automation now raises additional concerns.

Industry currently spends \$250–\$300 million per year on research and development in universities.<sup>2</sup> Edward David, President of Exxon Research and Engineering, recommends tripling this figure over the next ten years because he regards it to be “economically and socially desirable,” and because “fine science and technique created in academia [are] not effectively coupled to the

nation’s commercial innovation system.”<sup>3</sup> David argues that such actions should be construed as research support “consistent with a commercial ‘mission,’” not as “industrial philanthropy,” but he then goes on to recommend that industry funding of more fundamental research, rather than of more applied, would reap commercial benefits in the long run.

If advice such as this were followed, industrial funding would increase from its present level of 4 percent of what the Federal government currently provides to about 15 percent.<sup>4</sup> These aggregate figures are sometimes cited to support the view that because industrial funding of research is such a small part of the universities’ total income, concern for excessive or serious influence is unwarranted. However, the relative distribution of industrial and government support varies from institution to institution. At MIT, for example, industry-funded research has more than tripled in the past five years, growing from \$6.7 million in the 1977–1978 academic year to \$20.3 million in 1981–1982, while total Federal support has grown at about 10 percent per year, from \$102 million in 1977–1978 to \$157 million in 1981–1982.<sup>5</sup>

The distribution of industrial support also varies across scientific disciplines. A New York University study of 465 industry-supported research programs indicates that 67 percent were in engineering and computer sciences and 14 percent were in biotechnology.<sup>6</sup> The National Science

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Foundation Division of Policy Research & Analysis is currently compiling a profile of industry involvement by field. As expected, the distribution of support is not spread evenly across fields. Thus, any inquiry into the effects of industrial funding on the university must necessarily go deeper than aggregate impressions reveal.

In *The Divided Academy*, Everett Carll Ladd, Jr., and Seymour Martin Lipset show that the disciplines most aligned with conservative political ideas and favorable to the private sector are engineering, medicine, and chemistry. The disciplines most removed from these views are the social sciences, physics, and mathematics.<sup>7</sup> Edward David, in citing this work, notes that this polarity is reflected sharply in the profile of industrial funding.<sup>8</sup> And, "unlike the commercialization of biotechnology," one journalist observes, the "growing corporate role [for developments in microelectronics] in engineering schools has so far been accompanied by little controversy or academic soul-searching."<sup>9</sup> He offers the explanation that "electrical engineers and computer scientists have long had close relationships with industry," a suggestion that parallels David's expectation that academics in engineering, medicine, and chemistry are kindly disposed towards industrial goals.

These facts and observations are beginning to raise concerns in both academic and industrial communities. Vigorous discussions about the university-industry relationship have taken place in each university contemplating new large contractual arrangements for private support of biotechnology. The national controversy around these concerns also stimulated the Office of Technology Assessment to undertake a serious examination of industrial-academic relationships in biotechnology at eight major universities; the final report from that study is due to be transmitted to the Congress in March. In the 1981 Annual Science & Technology Report to the Congress, the President's Office of Science and Technology Policy and the National Science Foundation give prominence to the issue of industry-university cooperation in genetic engineering.<sup>10</sup> Two major conferences involving university and industry also were held in the last nine months, one a closed conference at Pajaro Dunes, California,<sup>11</sup> in March 1982, and the other an open conference in Philadelphia<sup>12</sup> in December 1982.

These two conferences, although stimulated by the controversies surrounding biotechnology, did address much broader issues. For example, a

statement issued by the conferees at the Pajaro Dunes meeting observes that:

These problems center on the preservation of the independence and integrity of the university and its faculty, both faced with unprecedented financial pressures and complex relationships. . . . The overriding concern of the participants was to explore effective ways to satisfy the university community and the public that research agreements and other arrangements with industry be so constructed as not to promote a secrecy that will harm the progress of science, impair the educational experience of students and post-doctoral fellows, diminish the role of the university as a credible and impartial resource, interfere with the choice by faculty members of the scientific questions they pursue, or divert the energies of faculty members and the resources of the university from its primary educational and research missions.<sup>13</sup>

A. Bartlett Giamatti, President of Yale University and a keynote speaker at the Philadelphia conference, notes in an article in *Science* that "the university exists to protect and foster an environment conducive to free inquiry, the advancement of knowledge, and the free exchange of ideas." He argues that arrangements for industrial support of research must preserve these basic functions.<sup>14</sup>

Beyond biotechnology, serious criticisms are also levied at industrial support of university research in both microelectronics and chemistry. David Noble, for example, has expressed concern about the possible undue influence of the chemical industry on universities and about the appropriateness of university assistance for developing industrial technology that threatens to displace labor.<sup>15</sup>

Writing in *Harper's* magazine, Wayne Biddle has pointed out two other critical issues. He first describes the examples of large contractual arrangements at MIT and Harvard, but then argues that "the real perversion of academic independence may occur through the collective impact of many smaller ties."<sup>16</sup> Furthermore, he observes, the question "is not whether academic freedom and the quality of education are being maintained, but whether the problems of society are being solved." The Pajaro Dunes and Philadelphia conferences defined the issues and controversies in a different way and gave relatively little attention to these points—but they are being addressed in other arenas. One of the most interesting discussions surrounds the American Civil Liberties

Union (ACLU) effort to draft a revision of its 1970 Policy 64 on the University and Contract research.<sup>17</sup> The ACLU is particularly sensitive to the dangers of skewing or distorting what it views as the universities' threefold mission of teaching, research, and public service.

Because the issues at stake in industry-university arrangements go beyond the separate controversies, this essay seeks (1) to categorize the kinds of research undertaken at academic institutions, (2) to examine the idea of the university as a place dedicated to free inquiry, as a repository of diverse interests and views, and as an institution that seeks to meet societal needs, and (3) to identify the values in need of preservation. The framework presented in this paper is offered to untangle the rhetoric of criticism and its rebuttal, rather than to settle the question of whether or not academic freedom is being compromised in a particular instance. That framework necessarily involves exploring the incentive structure that determines the scope, content, and dissemination of the results of scientific and technical research; assessing how the relevant incentives might be affected by industry funding; and examining how these constraints may affect academic freedom.

Two caveats should be noted at the outset. First, this essay does not flow from an "idealized" view of the university. The university is not, and perhaps never has been, a pristine institution. Academic inquiry within the university is clearly subject to a variety of constraints from within and without, and academic freedom is never a fully realized objective. Government funding certainly provides a major potential for skewing research and teaching, albeit possibly in very different ways. The key task here, then, is to examine the potential impact of industrial funding on this already imperfect structure. It is important to ask in what ways industrial funding of scientific and technical research moves us toward a more fully realized academic freedom, and in what ways it moves us away from this goal. Paul Gray, President of MIT, while not unmindful of the dangers, argues that industrial support helps offset the uncertainties of government support, lends temporal stability to research, and allows the university to be more relevant to society.<sup>18</sup> Other observers emphasize the possible risks.

A second caveat concerns the nature of the analysis presented in this paper. Concerns about industrial funding come under two headings: those which stem from obvious conflicts of interest with their origin in the stated differing objectives of

academe and industry, and those which are more subtle, less measurable, or even impossible to discern in the particular case. Examples of the first type are openness vs. secrecy in research, patent ownership, exclusive vs. non-exclusive licensing of patentable technology, or equity position in the sponsoring source, etc. These issues were extensively debated in both the major conferences mentioned above. The conferences ended in great optimism that these sticky problems could be solved in a spirit of cooperation. And they probably can. The other type of problem includes the less tangible issues such as the accusation that important activities in the university—e.g., the choice of research projects, the actual performance of the research, the directing and educating of students, and the expression of views critical of industry—will be skewed or distorted. Because success at reaching an accommodation on the first set of important concerns may lessen the necessary vigilance on the second set, I have chosen to concentrate on the latter. I am not dealing here with "hard" data, or with particularly easy or obvious examples. Accordingly, my essay involves certain assumptions about the underlying motivations of those who make decisions in academe about research and teaching and it is appropriate to acknowledge that different assumptions may well lead to different conclusions.

## Academic Freedom and the Nature of the University

Few people would argue with the assertion that, as a matter of principle, the university should foster academic freedom. Consensus on the proper *definition* of academic freedom may be more difficult to secure.

In its classical sense, "academic freedom" simply represented the freedom of scholars to pursue knowledge without constraint. While this is a useful starting point, it is insufficient to describe the complexity of the modern university. Universities have long accepted constraints on their pursuit of knowledge; academic research, writing, and teaching all bear the mark of outside influence. In theory this is perfectly appropriate. To respond to and serve the public need, the university must look beyond pure intellectual inquiry. A modern definition of academic freedom, then, must incorporate the natural interplay between the university and the society.

| "Basic" Research   | "Applied" Research   |
|--|--|
| Intellectual inquiry conducted within existing paradigms | Inquiry directed at assessing socio-economic or political consequences of science and technology.<br>(Technology Assessment) |
| Intellectual inquiry challenging existing paradigms      | Inquiry directed at commercial outcomes  |

Figure 1.

In the context of science and technology, "academic freedom" can be described as the freedom to pursue research which may be categorized into four types: intellectual inquiry conducted within existing paradigms; intellectual inquiry that challenges existing paradigms; inquiry directed primarily at the socioeconomic or political consequences of science and technology (i.e., technology assessment); and inquiry directed at producing foreseeable commercial value. In this essay, research is intended to include a variety of related activities from the education of students in the research efforts to the communication of the results. The first two of these types of research might be described as "basic" research; the latter two, as "applied" research.\* For the purposes of discussion, the four kinds of research may be graphically presented as shown in Figure 1.

The left side of the figure encompasses inquiries that grow out of healthy intellectual curiosity and represent the pursuit of knowledge for its own sake. As Thomas Kuhn notes in *The Structure of Scientific Revolutions*,<sup>19</sup> two kinds of academic endeavor may take place within this framework of inquiry: scholars whose pursuit of knowledge leads them to build upon existing paradigms, and others whose pursuit leads them to challenge directly these existing paradigms. Kuhn has emphasized the value assumptions underlying science and the natural resistance to change. Where there is true academic freedom, both paths of inquiry will flourish, and our fund of knowledge will grow as a result.

The right side of the figure describes the more direct relationship between the university and the society at large, exhibiting the university's efforts to serve the public interest. Some of these activities

are directed at assessing particular social or political outcomes, such as effects on health, the environment, employment, political power, and the distribution of economic resources. They include part of what is done as technology assessment or science policy research. In essence, it is research where the rate of return is measured in terms of social investment rather than pecuniary profit. Traditionally, the government funds much of this work, although industry itself is an important contributor. The second kind of "applied" academic endeavor is directed at a particular commercial outcome, and may be research designed to create a new product or technology, or to improve an old one. The act of classifying research into one of these categories becomes an important part of the debate. For example, whether research in biotechnology should be considered basic or applied has been clouded by the Supreme Court decision, *Diamond v. Chakrabarty* (447 U.S. 303), which allowed a developer to patent new life forms.

Obviously, these four categories cannot be drawn with precision. Dividing lines will often fade, and overlap will certainly occur; the distinction between basic and applied research will not always be meaningful. Evaluation of the toxicity of a chemical, for example, could be inspired just as well by scientific curiosity as by a concern for social impact. The close association between the two categories of applied research also gives rise to definitional difficulty. Without question, assessing the political or socioeconomic consequences of science and technology will have a commercial effect, just as every commercial activity will have a corresponding social effect. These four categories are useful, however, in distinguishing the primary motivation behind the academic inquiry.

In this century, we have seen a shift from the left side of the figure to the right side. Driven by the changes in the nature of government and private funding, universities have concentrated more and more on the "applied" side of academic inquiry. More recently, increased industry funding of university research has begun a more intensive movement toward applied research with more immediate commercial return. It is the effect of this movement, then, that is receiving attention.

In large part, how one assesses this effect depends upon how one perceives the nature of the university in general. It may well be unrealistic to assume that the university could be, or should be, "impartial" or a repository of neutral competence. Biases find their way into academic work,

\* An additional type of research is that undertaken for military purposes. This important topic deserves extensive discussion, but is beyond the scope of this essay.

although the imprint of bias is not always obvious. Any academic inquiry, including scientific and technical research, involves a multitude of choices among competing interests, methodologies, and viewpoints. It is the extraordinary academician who can avoid his or her own personal beliefs in making those choices; most cannot. To look merely to the effect of industry funding on neutrality, then, is to miss its true impact on academic freedom. Further, science itself is not neutral. Harvey Brooks argues that "professional expertise may carry with it value premises with implications going well beyond the purely technical 'facts' in a given situation, and that consequently the political neutrality of expert analyses cannot be taken for granted."<sup>20</sup>

How, then, does one measure the health of academic freedom within the university? It appears much more instructive to look at the extent to which a university permits a meaningful diversity of viewpoints. True academic freedom—the freedom to pursue academic inquiry in all four categories—will necessarily generate a rich variety of opinions and approaches. Rather than fostering a neutral viewpoint, the university should properly foster a *multiplicity* of viewpoints, since it is through the interplay of opposing ideas that the quality of academic work—and thus its ultimate social value—is enhanced and refined. The right to dissent is not meaningfully encouraged, in fact may be endangered, in an institution unless there are visible signs that diversity is safe. Thus a multiplicity of research and courses must be securely based. This is ensured by the existence of the actual research and courses, not by mere expressions of openness.

To be meaningful, the multiplicity of ideas should exist on many levels—not only in a variety of academic or paradigmatic viewpoints, but a variety of social and political viewpoints as well. In the context of scientific and technical research, the university should encourage diversity of thought in both the evaluation of technological efficacy and the evaluation of the social impact of technology.

Academic facilities and talent, however, are scarce resources; their use for one purpose necessarily reduces the pool of talent and facilities available for other purposes. The opportunity cost of using resources to pursue a particular avenue of research, then, is that they are not available to pursue other routes. Whether industrial funding will quell or encourage a diversity of viewpoints may be determined by the incentives that control the nature and direction of academic research.

## Industry Funding and the Incentives to Undertake Research

Academicians are faced with an identifiable set of choices regarding any research they contemplate pursuing. The choices made will depend in large part on an identifiable set of incentives and constraints on academic behavior. It is important to understand how industrial funding can determine the research choices, and then for each project to decide whether funding is appropriate.

### *The Making of a Research Project*

In general, five fundamental decisions must be made during the course of a research project. The first, of course, is the choice of the general *category* of research to be pursued. Will an engineer, for example, focus on developing new technologies for automation or investigate the effects of automation on labor or work organization? A second related decision is the choice of the *specific* project. If one decides to develop a commercial technology, for example, a number of different kinds of technology can be pursued; will the research develop chemical pesticides or biological pest control methods?

After the project has been chosen, one must then determine the manner and *methodology* of research. If the research will examine toxicity, for instance, should there be short-term or long-term animal assays? Will the researchers look at *in vitro* mutagenicity, or explore structure–activity relationships? Once the chosen research methodology has been implemented, a method of *evaluation* will be employed to measure the results. If the project is the development of a new technology, will the potential social impact be measured? If so, will a cost–benefit analysis be used, and will that analysis measure adequately the effects on human health and safety?

Finally, a decision will be made regarding the *dissemination* of research results, involving a determination of not only who will be told, but also how they will be told, and how much. For instance, if it appears that a new technology will have dangerous or undesirable side effects, will this fact be made known to those who will use or be affected by the technology?

In an ideal world, each of these decisions would be made after careful analysis of the academic and social merit of all of the available options. Within the modern university, however, a number of other factors enter and, in fact, often do tip

the balance toward one option or another. What are the incentives that motivate university researchers? Without attempting to compile an exhaustive list, I can identify five major factors:

(a) *Genuine Interest*. All other things being equal, it can be assumed that an academician would prefer to pursue those projects in which she or he is most interested. The key factors here are personal bias, viewpoint, and curiosity.

(b) *Availability of Funding*. The pursuit of research usually requires financial support. Faced with a choice among competing projects, the researcher will often be constrained to choose the one for which there is adequate funding.

(c) *Desire for Future Funding*. A related constraint is the academician's need to maintain a flow of funding for future projects. A researcher will feel an incentive to choose among research alternatives on the basis of whether they will enhance or ensure the availability of future funding.

(d) *Formal Status within the University*. Institutional success within the university is commonly measured by ability to rise in formal prominence within the institution. Thus, to the extent that tenure status, teaching arrangements, or departmental status will be influenced by the nature and direction of an individual's research, he or she may see an obvious incentive to make research decisions that could maximize formal status within the university.

(e) *Academic Reputation*. A related and final constraint is the desire to be in good "academic" standing with one's peers, not only at home, but also in the wider national and international academic community. Research direction, methodology, and results clearly influence how work is viewed by a researcher's contemporaries.

Industry funding can affect each of these major research incentives.

### *The Control of Incentives Through Commercial Funding*

AT&T has made a major investment . . . in very high grade economic talent over the past decade. It is not entirely accidental that this group of economists has produced a formidable new theory of multiproduct natural monopoly that may serve as a powerful argument in favor of barriers to entry and the exclusion of competitors in AT&T markets. The only other apparent beneficiary of

the normative implication of this theory is the postal service.<sup>21</sup>

This statement comes, not from an outspoken critic of industry's role in the university, but from Bruce Owen and Richard Braeutigam, two university professors, sympathetic to industry, who have written what they term a "how-to" manual for corporate business. They have seized upon a critical point: that industry can, in their words, "coopt the [academic] experts" and control the direction and content of academic research. Their suggestion of how this should be done is all the more disturbing for its dispassionate tone:

This is most effectively done by identifying the leading experts in each relevant field and hiring them as consultants or advisors, or giving them research grants and the like. This activity requires a modicum of finesse; it must not be too blatant, for the experts themselves must not recognize that they have lost their objectivity and freedom of action.<sup>22</sup>

The mechanisms of control are rarely this clearly articulated; nor, one would hope, are the commercial motivations so callous. It must be recognized, though, that industry funding justifiably tends to move the incentives for research in the direction that would profit its shareholders.

### *The Mechanics of Influence*

The potential for redirection of university research can be seen from even a rudimentary examination of the effect of commercial funding on the incentives outlined above. The key to such an analysis is an understanding of the interrelationship among the incentives. One incentive feeds and enhances the other, and vice versa, until the overall effect is substantial. Predictably, the cycle begins with the first extension of a funding offer to the university. Imagine a bright young university biologist, interested in developing new *in vitro* tests for mutagenicity because of the possible social benefits. He finds, however, that adequate funding for this project is not easily obtained. When his department chairman advises him that the university has entered into a multimillion dollar contract with a corporate funder to produce patentable work in genetic engineering and he is invited to join the research team, he finds it difficult to decline.

Two important factors are at work here. On the one hand, of course, the academician has gone to where the money is. As a result, the direction of his research will be that desired by the commercial funder. He also has done that which pleases his department chairman. Spurred on by new-found academic activity, he may become less and less interested in returning to his original *in vitro* mutagenesis project. At some point, he may pursue bioengineering research, not out of obligation, but out of genuine interest. And then, even though this researcher is pursuing the research he wants to undertake, there may be a loss in academic freedom of the university, because his original research ideas are no longer being pursued there. Diversity is lessened.

Other examples are also instructive. Take the case of a toxicologist who has reason to believe that two chemicals could be significant human carcinogens, but who has the resources to pursue a study of only one. If she knows that chemical A is manufactured by a company that is about to give a large technology/development grant to her university, and that chemical B is not, will her choice be unaffected by that fact? Is it not fair to say that fear of upsetting a potential funder may provide an incentive to investigate B rather than A?

Or take the case of a university epidemiologist hired by a manufacturer to investigate occupational cancer at its factories. Suppose that the manufacturer has supported technological research at the university and that both sides feel that a good working relationship has developed between them. What incentives play upon the epidemiologist's choice of study design and evaluation methodology? If the manufacturer also is seeking to avoid the imposition of a stringent OSHA regulation, then the manufacturer's preferences in the outcome of the research are clear. The epidemiologist will be aware of that fact, and of the benefit to his position at the university of pleasing a major funding source. If he has done work on a number of industry contracts, he may also have developed something of an industrial viewpoint. These factors may affect the way he approaches the project or presents the results.

This is not to say that he is likely to falsify his results. Blatant falsification remains a rare occurrence. There may, however, be some incentive to choose a study design that is less likely to reveal a positive correlation between worker exposure and disease. If, for example, he follows

the health status of workers for only a few years after exposure, he may not detect diseases, such as cancer, with long latency periods. Or, even if his data indicate a possible correlation between disease and exposure, he may choose a relatively insensitive method of statistical analysis to evaluate those data, and thus reach an inconclusive result. If the results are inconclusive, then bias may be introduced in the manner in which they are presented to the public. And it is here that differences in perspective become important. A report may indicate that the data are insufficient to determine whether or not the industrial exposure causes cancer, or it may indicate that the data contain no evidence of increased cancer mortality for the particular exposure. Obviously, the manufacturer in question would prefer the latter description of the research results. Experience indicates that incentives move in this direction. On the other hand, a toxicologist in the same university may be asked by a firm to determine, prior to its being marketed and a large capital investment made, whether a new chemical is carcinogenic. Here, all the incentives work in the direction of discovering carcinogenicity, if it exists. The firm wants to avoid a later discovery of toxicity.

These examples demonstrate the importance of examining the effects of industrial funding on a case-by-case basis. It would be just as inappropriate to conclude that, simply because a firm has commercial interest in the outcome of research, the research will necessarily compromise academic freedom, as it would be to presume the opposite.

## Conclusion

Universities are not repositories of neutral competence. The choice of research is influenced by a variety of factors including intellectual curiosity, personal values, financial reward, academic peer-group pressure, and political preferences. The preservation of the university as a place dedicated to "free inquiry" must entail not only the safeguarding of individual academic freedom wherever possible, but also the encouragement of variety in research directed toward a diversity of goals. True "balance" is impossible to define. Vigilance in examining whether the profile of university research retains a diversity of interests and views is essential. As industry responds to changing social and market demands, industry and society, as well as the university, would benefit from this diversity.

## NOTES

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