The Commercialization of Academic Science: Conflict of Interest Policies and the Faculty Consultant

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Social scientists have studied the effects of faculty consulting on academic productivity—teaching, research, and service (1- 6)—and used productivity as a proxy for conflict of interest. Most recently, writers in both the disciplinary and popular literature have addressed conflict of interest and faculty consultants. However, little empirical research that investigates the connection between entrepreneurial behavior, consulting, and conflict of interest, exists. This study identifies four specific behaviors that could compromise scientific objectivity and thus, be classified as conflicts of interest: research agenda bias, prior review, withholding, and secrecy.

These conflict of interest behaviors are grounded in the norms and counternorms of science proposed by Merton and Mitroff (7-8). Four norms dominate the roles of scientific researchers: universalism, dissemination, disinterestedness, and organized skepticism.

Universalism suggests that science is open to all individuals regardless of their personal traits. The scientific method is used to pursue truth. Dissemination allows for research to become open to all challenges, subject to verification, and widely disseminated, the antithesis of prior review. Research advances knowledge and resides in the public domain. Results become communicated so that others may build upon previous work to move knowledge forward. The purpose of communication also allows for research to become open to all challenges, subject to verification, and widely disseminated (9).

The disinterested search for truth enables scientists to explore all information regardless of where it might lead. Science's reliance on verification and reliability reflect institutionalized controls to ensure that knowledge benefits humanity and allows the researchers to proceed objectively. Although knowledge advancement is the institutionalized role of scientists, some desire credit for their discoveries vis-à-vis election to the National Academy of Sciences or a trip to Stockholm (e.g., Nobel Prize). Conflicts then arise over the priority of discovery that further fuels secrecy. Furthermore, academic science is a competitive industry that encourages researchers to withhold results for personal aggrandizement either through enhanced reputation or financial gain. Entrepreneurial behavior is a perceived threat to the researchers' disinterestedness in the pursuit of knowledge for its own sake. Burton Clark views entrepreneurialism as "a characteristic of social systems...taking risks

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when initiating new business practices where the outcome is in doubt...(10)" The scientist maintains a vested interest in the research outcomes. When individual scientists establish research agendas based on profitability, science is not served. The payoff between basic research discoveries and economic profitability often requires time that neither society nor the marketplace are willing to grant academics. This creates the appearance that basic research projects compete with commercially viable proposals for funds.

Finally, Merton described organized skepticism as the "temporary suspension of judgment and the detached scrutiny of beliefs" that affords scientists with the opportunity to examine results using empirical or logical criteria (11).

The search for truth rests upon the foundations of basic research. When academic scientists pursue lines of inquiry regardless of their commercial viability, the public interest is served. However, shifting political forces place equal or even greater importance on commercially viable academic science that could stimulate economic growth expeditiously (12).

This study examines life sciences faculty who report earning additional income by consulting for non-profit organizations, industry, and government and their engagement in actual conflict of interest behaviors. This study limits the definition to consulting activities for financial remuneration, and examines individuals who select consulting as a major source of supplemental income from nonprofit organizations or government agencies, private enterprise, or both public and private. Furthermore, the study examines behaviors of those who consult exclusively with one company.

Methods

The data source used for this study is part of the Academic-Industry Research Relationships Study in Genetics and Other Life Sciences. The analyses here are based on data from the broader study's 1994-1995 national survey of 3,169 U.S. faculty in the life sciences. Fifty research-intensive institutions were selected based on the levels of National Institutes of Health funding for 1993. All medical-school departments and other academic life-science departments and graduate programs were identified using the 1994 *Peterson's Guide to Graduate Programs in Biological and Agricultural Sciences.* One medical clinical department, one non-medical clinical department, and two non-clinical departments were randomly selected from each institution. Both the Peterson's Guide and University Bulletins identified 4,000 faculty that included non-clinical, clinical, and researchers funded by the Human Genome Project (HGP). A stratified random sample of faculty, half of whom were clinical and half of whom were non-clinical, were selected from a list of faculty across the 200 departments. Special provisions were made to include the HGP researchers because of the broader study's interest in behaviors of genetics researchers. Ineligible faculty (those who were deceased, retired, or not located) were omitted from the sample, leaving a final sample size of 3,169 faculty.

Data Collection

The data collection process occurred from October 1994 through April 1995 by the Center for Survey Research at the University of Massachusetts. Each participant was mailed a survey packet, which included a cover letter, coded postcard, and questionnaire. The questionnaire and postcard were to be returned separately to protect respondent anonymity. Reminder/thank you postcards were mailed shortly after the initial mailing. Follow-up calls conducted from late November to mid-February to non-respondents generated an additional 190 cases for analysis. We received useable responses from 2,052 faculty, for a total response rate of 65 percent.

For this substudy, the sample consists of the 1,032 non-clinical faculty respondents. Selection of the individuals was assured by including only faculty who do not conduct clinical trials on " drugs, devices, or diagnostic or therapeutic technologies." The non-clinical faculty was chosen because previous research conducted using the complete sample shows that these individuals are on the "front end" (entrepreneurial) of the commercialization process. Furthermore, the industry relationships between clinical faculty and corporations are structured around clinical trials rather than new discoveries (12).

Variables

Faculty gender, academic rank, average annual research budget, average level of entrepreneurial behavior, and average income earned above salary were used as independent variables in the

statistical analyses. The entrepreneurial behavior scale constructed consists of the following survey items: "Has the research that you do at your university resulted in....*(Check one for each item)*...patents applied for, a startup company." Individuals could check either yes (coded as "1") or no (coded "0"). The next question used for this scale was: "For the firm with which you currently have the greatest involvement, which of the roles listed below do you have? *(Check all that apply)*...equity holder, company owns or licenses a patent based on your research." If the respondent left the item blank, it was coded as "0" for no. A check mark was coded as "1" for yes. The reliability for the entrepreneurial behavior scale offered a standardized alpha of .69 (n = 1032).

Conflict of Interest measures

Research agenda bias. One conflict of interest measure concerns external influence on research topics: "To what extent has your selection of research topics been affected by...*(Check one for each item)* a) the likelihood of commercial application of the results." Participants were offered the following response options: Not at all (coded as "0"); very little (coded as "1"); to some extent (coded as "2"); or, to a great extent (coded as "3"). The results were collapsed into a dichotomous variable coded "1" for yes and "0" for no.

Prior review. Another conflict of interest measure considers the publication relationship between faculty and the sponsor. The following item measured prior review: "Have you personally conducted any research at your university, the results of which are the property of the sponsor and cannot be published without the sponsor's review or consent?" Yes was coded as "1" and no as "0".

Secrecy. This variable identifies the relationship between commercial science and publication of results. "Has your university research resulted in findings that were *never* published for proprietary reasons?" was the item used to measure secrecy. Yes was coded as "1" and no as "0".

Withholding. The final conflict of interest measure for this study considers the sharing relationships between academic researchers. This item asks individuals to report their denial of others' requests for research tools: "In the last 3 years, have any other university scientists requested any results or materials that you did not provide?" Yes was coded as "1" and no as "0".

Statistical analysis

Unless otherwise noted, statistical significance and the direction of reported relationships between consulting and conflict of interest behaviors were tested by multivariate linear and logistic regressions. The equations were adjusted for academic rank, gender, institutional control (public or private), academic program ranking, institutional location (metropolitan versus non-metropolitan), supplemental income amount, and levels of entrepreneurial behavior.

Results

Sixty percent (n =616) of this sample (n =1032) report that they have consulted with either public (35.2 percent) or private (24.5 percent) enterprises at least once. This contrasts with the 26 percent of the respondents who consult with either group as a major source of supplemental income. Table 1 shows the consultants' characteristics broken down by gender, academic rank, average research budget, average level of entrepreneurial behavior, and average income earned above salaries. Males account for 82 percent of the sample, thus it is not surprising to see them represented more than females in the consulting categories ($x^2 = 24.74$ $p < .001$). Full professors represent 54 percent of the total sample and are also consult more than assistant and associate professors ($x^2 = 16.88$ $p < .05$). However, the assistant professors that consult work more with private enterprise than the public sector. One possible explanation for this finding is that assistant professors may have established relationships with companies during their graduate training. The results further indicate that those who consult exclusively with one company tend to be male, full professors. Furthermore, private enterprise consulting faculty have larger research budgets than non-consultants, which supports a Louis et al. (13) earlier study that suggested that research budget reflects entrepreneurial behavior as it indicates a commitment to large-scale research. Private enterprise consultants also report more entrepreneurial behaviors. The analysis indicates the specific entrepreneurial activities of these individuals: 65 percent have applied for patents ($x^2 = 63.99$ $p < .01$); 20 percent have started new companies ($x^2 = 15.19$ $p < .01$); 23 percent hold equity in a company ($x^2 = 82.87$ $p < .001$); and 15

percent are involved with companies that own patents from their university research (x^2 = 31.94 p < .001).

When faculty who consult exclusively with one company were compared with those who do not (including non-consultants), exclusive consultants report higher levels of entrepreneurial behavior, research budget, and amount earned above their institutional salaries. Table 2 shows the mean differences between these groups. Exclusive consulting offers greater financial rewards for the academic scientist, which should increase the potential for them to defy research behavioral norms for self-aggrandizement.

The analysis indicates the specific entrepreneurial activities of those who consult exclusively with one company: 72 percent have applied for patents (x^2 = 30.41 p < .001); 35 percent have started new companies (x^2 = 33.65 p < .001); 35 percent hold equity in a company (x^2 = 83.61 p < .001); and 30 percent are involved with companies that own patents from their university research (x^2 = 70.09 p < .001).

Conflict of interest variables. When consultants were asked to report on the conflict of interest variables used in this study, we found that of those who answered "yes", the majority were private enterprise consultants. Table 3 shows these results. Private enterprise and nonprofit/government consultants were most represented in research agenda bias (x^2 = 26.58 p < .001); prior review (x^2 = 37.15 p < .001); withholding (x^2 = 11.49 p < .01); and trade secrets that resulted from university research (x^2 = 10.61 p < .05). The results for secrecy were not statistically significant.

Logistic regression analyses. Entrepreneurial behavior level (0 to 4) is associated with private enterprise consulting when gender, academic rank, teaching, publication numbers, service,

	Characteristics							
	Gender		Rank			Research Budget	Entrepre-neurial Behavior	Income over Salary
Consulting:	**Male**	**Female**	**Assist.**	**Assoc.**	**Full**			
No Consulting	79%	21%	13%	24%	63%	239,752	.43	4,995[1]
Public Consulting	80%	20%	8%	29%	63%	355,494	.47[2]	3,880[3]
Private Consulting	96%	4%	17%	22%	61%	397,337[4]	1.14[5]	1,5201[6]

Table 1. Consultant characteristics (N=1032) reported in percentages and means. [1] Difference between non- and public consultants (p < .001) [2] Difference between public and private consultants (p < .001) [3] Difference between public and private consultants (p < .05) [4] Difference between public and private consultants (p < .001) [5] Difference between non- and private consultants (p < .001) [6] Difference between public and private consultants (p < .001)

	Research Budget	Entrepreneurial Behavior	Income over Salary
Consulting:			
Exclusive	365,568[1]	1.76[2]	22,170[3]
All Others in Sample	269,196	.48	5,595

Table 2. Mean differences between exclusive consultants and all others in the sample on research budget, entrepreneurial behavior, and amount earned over income. [1] (p < .05) [2] (p < .001) [3] (p < .001)

	Behaviors				
	Research Bias***	Prior Review***	Withholding**	Secrecy	Trade Secrets*
Consulting:					
No Consulting	23%	11%	9%	ns	6%
Public Consulting	24%	9%	8%	ns	7%
Private Consulting	43%	29%	18%	ns	12%

*Table 3. Consultant reports (N=1032) of conflict of interest behaviors. ***p < .001 ** p < .01 * p < .05*

research budget, and amount of supplemental income are held constant. The most meaningful variable in the equation is the private enterprise consultant status ($t = 9.32$, $p < .001$), followed by publication numbers ($t = 4.48$, $p < .001$). The strength indicates that private enterprise consultants appear more likely to engage in entrepreneurial activities than either public consultants or non-consultants. The full model, which explains 15 percent of the variance, suggests that faculty who consult with private industry and who have higher publication numbers are more likely to engage in entrepreneurial behaviors than others.

There is a modest correlation between supplemental income and private enterprise consulting ($r = .32$, $p < .001$), and exclusive consulting ($r = .32$, $p < .001$). Supplemental income amount was not regressed on consulting, however, because of these correlations. The model, which accounts for 15 percent of the variance, indicates that publication numbers, service levels, and total research budget from all sources is closely aligned with supplemental income amount. The most salient independent variable is service ($t = 5.86$, $p < .001$), followed by publications ($t = 3.73$, $p < .001$) and overall research budget ($t = 3.61$, $p < .001$).

Correlations show weak relationships between private industry consulting and research agenda bias ($r = .16$, $p < .001$), withholding ($r = .09$, $p < .01$), and prior review ($r = .18$, $p < .001$). Additionally, those who consult exclusively with one company are correlated with research agenda bias ($r = .08$, $p < .001$) and prior review ($r = .15$, $p < .001$).

Logistic regressions were conducted to test whether or not consulting with private enterprise affects research agenda bias, prior review, secrecy, and withholding. The models to test private enterprise consulting effects included the following control variables: faculty attributes, institutional characteristics, academic productivity measures, and entrepreneurial behavior levels.

The first regression shows that the level of entrepreneurial behavior ($x^2 = 74.05$, $p < .001$) of the faculty member as well as academic program ranking and metropolitan location affects whether or not they allow commercial potential or funding opportunities to determine their research agenda. This finding suggests that faculty in highly ranked programs in metropolitan areas are less likely to allow external factors such as commercial viability and funding to affect their research topics. However, as levels of entrepreneurial behavior increase, the odds that they define research topics according to non-research-related dynamics increase by a factor of 1.65.

The second regression tests the relationship between consulting and prior review. The results indicate that private enterprise consulting has a negative effect on prior review, while supplemental income amount and level of entrepreneurial behavior has a positive effect ($x^2 = 68.16$, $p < .001$). The probability that private enterprise consultants will publish results only after sponsor's review decreases by a factor of .50. However, the likelihood of prior review increases by a factor of 1.59 for rising entrepreneurial behavior levels and 1.24 for supplemental income amount. Essentially, a private enterprise consultant is less likely to conduct research not published without the sponsor's consent. But, increased entrepreneurial behavior and supplemental income do affect prior review.

Private enterprise consulting does not appear to affect withholding research tools from other scientists who request them in either tested model. Faculty in private institutions are less likely to withhold (by a factor of .59), while supplemental income increases the likelihood of withholding (by a factor of 1.26). When entrepreneurial behavior level is added, the negative effect of institutional control remains constant, while the supplemental income effect is slightly lessened ($x^2 = 34.90$, $p < .001$). Levels of entrepreneurial behavior increase the chance that one will withhold from others by a factor of 1.37. The results indicate that faculty in private institutions are less likely to withhold from other scientists even when controlling for levels of supplemental income and entrepreneurial behavior.

Finally, academic program ranking decreases the likelihood that a scientists' university research results in trade secrets by a factor of .56 while level of entrepreneurial activity increases it by a factor of 2.67 ($x^2 = 58.30$, $p < .001$). This model accounts for 21 percent of the variability for this variable.

The models generated to explain why some scientists conduct research that is never published for proprietary reasons were not statistically significant. Thus, issues related to secrecy as defined in this study were not

examined in this analysis.

Analyses on the effects of exclusive consulting on the conflict of interest variables showed results that are similar to the private enterprise consultant for research agenda bias (no effect), prior review (negative association), and withholding (no effect). These important findings suggest that even the faculty member who consults exclusively with one company is unlikely to violate the research norms of the academic enterprise.

Discussion

The results do not indicate that conflicts of interest occur with any significant frequency; to the contrary, the results show that academic scientists are able to balance their institutionalized scholarly roles with commercial science. Faculty remain embedded in their own social organizations which in the case of the consultant includes the university, the discipline, and the government, organization, or company with whom one consults. Rowan and Miskel argue that these social organizations generate the norms that direct individual behavior (15). Although conventional wisdom suggests that when the faculty consultant serves multiple masters, academic roles and norms are sacrificed for self-interest, the results imply that the consultant maintains an allegiance to the norms of teaching, research, and service. Given these criteria, the faculty in this study can be perceived as actors within the institution of academic science, rather than simply as a set of actors who operate within a single organizational entity. This argument is founded on the capacity of faculty members to interact in a variety of situations that appear to have competing interests and values while they perfect their craft. If academic science is the institution, the institutionalized roles and norms embedded in the scientific method become the criteria consultant-scholars use to make decisions in their relationships with commercial scientists.

University faculty have a societal contract that affords researchers with academic autonomy in exchange for a commitment to improve social welfare through teaching, research, and service (16). The question that drives university conflict of interest policies is whether or not faculty fulfill these institutionalized roles without serving their own self-interest. If they fail to fulfill their duties or pursue their own self-interest in the course of their academic activities, critics would argue that they are involved in a conflict of interest. However, the conflicts that academic scientists face are complex and do not allow for a simple explanation.

Despite the lack of a positive relationship between private enterprise consulting and the conflict of interest variables tested in this study, the need to protect universities, disciplines, and the public from academic renegades remains. Current methods such as disclosure to both academic journals and universities provide an important mechanism to alleviate conflict of interest. However, these policies should be grounded in conflict of interest behaviors, rather than potentials, and enforced by individuals in the academic community. Emanuel and Stein reported that one out of three authors of journal articles held financial stakes in reported research outcomes and failed to disclose such in their publications (17). If self-regulation of the academic enterprise should continue without external interference, enforced disclosure becomes an important tool to prevent conflicts of interest from bleeding into research activities.

The results of this study offer some important implications for how academic policies should be conceived. First, policy development and implementation should rest upon data. Empirical data provides a foundation for the formulation of effective and enforceable policy. The policies developed in this arena span the boundaries between the disciplines, funding agencies, academic institutions, and private sector companies. Rather than establish guidelines in isolation of one another, policies could become aligned across these boundaries to establish both consistency and clarity. Ultimately, compliance becomes evaluated at both the department and disciplinary levels. Consistency and clarity across boundaries will permit faculty to make informed choices.

Second, policymakers should develop clear guidelines within their institutional and agency sectors. Policies that guide rather than constrain faculty behavior could aid faculty understanding of specific behaviors that constitute conflict of interest. Furthermore, clearly articulated guidelines should identify the consequences of individual action so faculty will understand the ramifications of their behavior.

Finally, academic institutions could identify consulting as a component of the faculty reward structures. Boyer and Lewis suggested that consulting could become a means for faculty to

involve themselves in both community and institutional service (1). Consulting activity could become an element of faculty development programs that stimulate faculty vitality and, ultimately, productivity.

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Bibliography

1. Boyer CM, Lewis DR. Maintaining Faculty Vitality Through Outside Professional Consulting. In SM Clark, DR Lewis (editors). Faculty Vitality and Institutional Productivity: Critical Perspectives for Higher Education. 1985.
2. Fairweather JS. Faculty Work and Public Trust: Restoring the Value of Teaching and Public Service in American Academic Life. Needham Heights (MA): Allyn and Bacon Publishers; 1996.
3. Patton CV, Marver JD. Paid Consulting by American Academics. Educational Record 1979: 175-184.
4. Rebne D. Faculty Consulting and Scientific Knowledge: A Traditional University - Industry Linkage. Educational Administration Quarterly 1989; 25(4): 338-357.
5. Teague GV. Faculty Consulting: Do Universities Have "Control"? Research in Higher Education 1982; 17(2): 179-186.
6. Marsh HE, Dillon KE. Academic Productivity and Faculty Supplemental Income. Journal of Higher Education 1980; 51(5): 546-555.
7. Merton RK. The Sociology of Science: Theoretical and Empirical Investigations. Chicago: University of Chicago Press; 1973.
8. Mitroff II. Norms and Counternorms in a Select Group of the Apollo Moon Scientists: A Case Study of the Ambivalence of Scientists. American Sociological Review 1974; 39(4): 579-595.
9. Louis KS, Anderson MS. The Changing Context of Science and University-Industry Relations. In H Etzkowitz, A Webster, P Healey (editors). Capitalizing Knowledge: New Intersections of Industry and Academia. Albany (NY): State University of New York Press; 1998.
10. Clark BR. Creating Entrepreneurial Universities: Organizational Pathways of Transformation. United Kingdom: Pergamon; 1998: 4.
11. Merton, RK. op cit. 1973: 277.
12. Etzkowitz H, Webster A. Entrepreneurial Science: The Second Academic Revolution. In H Etzkowitz, A Webster, P Healey (editors). Capitalizing Knowledge: New Intersections of Industry and Academia. Albany (NY): State University of New York Press; 1998.
13. Louis, KS, Jones, LM, & Anderson, MS. Bought and Sold: Academic Ideas in the Marketplace. Paper presented at the meeting of the Association for the Study of Higher Education, Miami, FL. (1998, November 6).
14. Louis, KS, Blumenthal, D, Gluck, ME, & Stoto, MA. Entrepreneurs in Academe: An Exploration of Behaviors Among Life Scientists. Administrative Science Quarterly, 1989; 34, 110-131.
15. Rowan B, Miskel CG. "Institutional Theory and the Study of Educational Organizations". In J Murphy, KS Louis (editors). Handbook of Research on Educational Administration, Second Edition. San Francisco (CA): Jossey-Bass Publishing; 1999.
16. Slaughter S, Leslie LL. Academic Capitalism: Politics, Policies, and the Entrepreneurial University. Baltimore (MD): The Johns Hopkins University Press; 1997.
17. Emanuel EJ, Steiner D. Institutional Conflict of Interest. N Engl J Med 1995; 332 (4): 262-267.
18. Boyer CM, Lewis DR. Maintaining Faculty Vitality Through Outside Professional Consulting. In SM Clark, DR Lewis (editors). Faculty Vitality and Institutional Productivity: Critical Perspectives for Higher Education. 1985.