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Academic Capitalism and Academic Culture: A Case Study

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Abstract
This case study investigated the impact of academic capitalism on academic culture by examining the perspectives of faculty members in an American academic department with significant industrial funding. The results of this study indicate that faculty members believe that the broad integrity of the academic culture remains unaffected in this department and they consider industrial sponsorship as a highly effective vehicle for enhancing the quality of education of students and pursuing their scientific interests. This study provides valuable insights to federal and institutional policies created to foster industry-academia partnerships and commercialization of academic research.
Keywords: higher education; organizational culture; privatization; technology transfer.

El capitalismo académico y la cultura académica: Un estudio de caso

Resumen
En este estudio de caso se investigó el impacto del capitalismo académico en la cultura académica mediante el examen de la perspectiva de los investigadores en un departamento universitario estadounidense con importante financiación de origen

industrial. Los resultados indican que los profesores investigadores creen que la integridad de la cultura académica no es afectada en este departamento y consideran al patrocinio industrial como un vehículo altamente efectivo para mejorar la calidad de la educación de sus estudiantes y la búsqueda de sus intereses científicos. Este estudio ofrece profundizaciones valiosas sobre las políticas federales e institucionales creadas para fomentar las asociaciones industria-academia y la comercialización de la investigación académica.
Palabras clave: educación superior, cultura organizacional; privatización; transferencia de tecnología.

The investment policies outlined in the *National Science Foundation (NSF) Strategic Plan* for the years 2003–2008 continue to emphasize research and development of technologies with commercial applications. This trend started in the 1980s when the U.S. government designed policies and laws to encourage the cooperation of industries with universities to bridge federal funding gaps for research and cope with global competitive markets (Campbell & Slaughter, 1999; Slaughter & Leslie, 1997; Slaughter and Rhoads, 2004). In the early 1980s, the National Science Foundation (NSF) established a program to enhance industry-academia interactions through the Industry/University Cooperative Research Centers (I/UCRCs) around industrially relevant research, education of scientists in new technologies, and transfer of university-developed research and technology to industry. Other examples include the creation of the Business-Higher Education Forum, the Government-University-Industry Research Roundtable, and the Advanced Technology Programs housed in the Department of Commerce (Slaughter & Rhoades, 1996). As a result of these initiatives, science and engineering fields became more entrepreneurial around new technologies developed in areas such as materials science, optics, cognitive science, and biomedical research (Gumport, 1999; Krimsky, 2003; Slaughter & Rhoades, 2004).

This pattern is a developing trend for universities throughout the world as the increasingly global environment has pushed shifts in governmental funding and policies, increased reliance on private and corporate funds, and administrative decision-making (Neave, 2001). One of the greatest concerns is that these policy changes are occurring rapidly with little attention paid to the effects of these shifts on academic culture, the relevance of academic work, the attractiveness of the academic profession, and the role of faculty in generating and disseminating knowledge (Duderstadt, 2001). Public universities are responding to these external forces by expanding revenues through market-like behaviors, a phenomenon called academic capitalism. Some of these market-oriented activities that are the subject of this study involve university partnerships with industry, commercialization of research through patents, and the formation of spin-off companies (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004).

This emerging trend described above has fueled concerns that academic capitalism might be harming traditional academic culture as faculty members engage in market-like behaviors such as partnering with companies and commercializing research (Gumport, 2002, 2005; Newman, Couturier, & Scurry, 2004). These concerns focus on the potential incongruence between market values and the values embedded in the various logic models that shape meaning and guide behavior of academic professionals, faculty who must increasingly respond to the complex demands of contemporary academic life. From an organizational culture perspective, the academic culture is driven by and manifested in multiple logic systems—including institutional, social, and industrial logic. The first two are found easily within a university. Institutional logic comprise the institutional

practices and symbolic constructions that shape organizations' cultures (Friedland & Alford, 1991). The social logic of universities is based on a range of social expectations such as mass education, citizenship, and knowledge preservation and advancement.

In contrast to this social logic, and increasingly introduced into the academic workplace through academic capitalism, industrial logic is the contribution to society via economic growth, the training of a skillful workforce, and research with commercial applications, all promoted and gauged through market forces. This coexistence of multiple logics in today's academic institutions is generating tensions over conflicting practices (Gumport, 2002; Mendoza & Berger, 2005). For example, academics are expected to foster and disseminate basic knowledge as part of their social mission (Merton, 1957). However, some of the direct implications of industry-university partnerships documented in the literature include overemphasis in applied research and secrecy of knowledge (Campbell & Slaughter, 1999; Gladieux & King, 2005; Slaughter, Campbell, Hollernan, & Morgan, 2002). Reward structures constitute another area where major differences between industrial and academic cultures exist (Mendoza & Berger, 2005; Slaughter & Leslie, 1997). The academic profession is driven by intrinsic motivation and rewards that have historically been based on the fascination with research, the enchantments of teaching, and discipline-oriented prestige rather than on material or monetary incentives (Clark, 1987). Given fundamental differences among these logic systems, faculty members participating in academic capitalism might move away from values such as altruism and public service as they move toward market values (Slaughter and Leslie, 1997). This study tests this claim with empirical evidence regarding the impact of academic capitalism on academic culture, examining the perspectives of faculty members in a department with significant industrial funding.

Theoretical Framework

Drawing from the works of Allaire and Firsirotu (1984), Becher (1984), and Clark (1970), Kuh and Whitt (1986) provide a framework for analyzing culture in higher education. This framework has four layers of analysis that portrays culture in institutions of higher education as a dynamic system shaped by the interplay of these cultural layers. The four layers in question are the external environment that surrounds a given higher education institution, the institution itself, subcultures within the institution, and individual actors. The external environment layer is characterized by the continually evolving nature of colleges and universities according to the interactions between conditions in the external environment and the needs and concerns of groups within the institution (Tierney, 1988). The institutional layer refers to the different cultures present across types of higher education institutions. Some elements involved in institutional culture include size and type as well as the institutional mission, leadership, and symbols used to communicate values (Kuh & Whitt, 1986). For example, at major universities research is highly valued while the highest value in liberal arts colleges is the interaction between faculty and students (Clark, 1987).

Different subcultures operate within higher education institutions, which in themselves correspond to the third layer of Kuh and Whitt's framework (1986). Administrators, faculty, and students are the three most predominant subcultures in higher education. In addition, there are subcultures within these groups: discipline-based subcultures among faculty, professional ones among administrative staff, and minority associations among students (Tierney, 1988). Another example is the existence of subcultures within disciplines formed around people with different views about the discipline, as might be the case between clusters of professors who are more entrepreneurial and who hold values different from their colleagues (Slaughter & Leslie, 1997). Conflicts and tensions between subcultures are common, as is the case between administrators and

faculty. Administrators tend to hold a managerial (Rice, 1986) or utilitarian (Etzioni, 1961) culture in opposition to faculty members' core values of discovery and dissemination of knowledge through autonomy and academic freedom (Peterson & Spencer, 1990). Finally, the fourth layer includes the role of individual actors as shapers of culture such as presidents, heads of departments, and individual faculty members. All agents participate in the construction of culture (Kuh & Whitt, 1986).

While the cultural framework proposed by Kuh and Whitt (1986) focuses on the cultural complexity of colleges and universities, Becher (1984) suggests that discipline-based subcultures are the primary source of faculty identity and expertise. Elements of disciplinary subcultures include a range of assumptions about what is to be known and how, the tasks to be performed, standards for effective performance, patterns of publication, professional interaction, and social and political status (Becher, 1984; Clark 1984). Some scholars assert that differences across disciplines have greater impact on faculty than do individual similarities among faculty members (Becher, 1989). Moreover, Bowen and Schuster (1986) found that differences among faculty members were related more to disciplines than to type of institution. In a similar vein, Clark (1987) illustrated the nature of the academic profession as a collection of academic tribes and territories with a widening array of disciplines and specialties. Nonetheless, departments are the main structure of higher education, and their culture is also a significant source of identity for faculty members (Becher, 1989). Finally, there is an overarching core culture of the academic profession based on concepts of academic freedom, individual autonomy, production and dissemination of knowledge, collegiality, collegial governance, service to society through the production of knowledge, and education of the young (Clark, 1980; Morril & Speed 1982, Ruscio, 1987). Given the multiple sources of influence and the complex nature of academic culture, this study uses a multi-layered approach for understanding academic culture as the basis for exploring how involvement in academic capitalism has impacted one academic department in an American research university.

Methods

This article reports on a case chosen for its ability to answer key questions about academic capitalism. Due to their revelatory nature, case studies that represent critical or unique cases are particularly useful to extend or challenge theories. More specifically, Denscombe (2002) notes,

> Social researchers can opt to focus on instances that are anything but representative or typical. Extreme instances may be selected deliberately because they have certain qualities that exaggerate the influence of a particular factor that is of interest to the researchers. (p. 147)

Guided by the approach described above and by other experts in the use of qualitative methodologies (e.g. Berg, 2004; Creswell, 1998; Denscombe, 2002; Yin, 1994), this study employs an embedded case study (Yin, 1994) as a strategy for studying a unique department that is heavily involved in academic capitalism and in which the faculty members themselves are the main source of empirical evidence. The primary focus is how industrial partnerships within a specific academic context influence the culture of an academic department.

The department selected for this study is a top-ranked materials science unit in a large Research I University that exhibits a series of unique circumstances, evidence of the impact of academic capitalism on academic culture. In particular, the department is considered one of the best centers in fundamental polymer science and the training of outstanding scholars, indicating high levels of academic achievement. In addition, the department is heavily involved in partnerships with industry and attracts significant funds from businesses. We selected this department because we

were intrigued by the department's apparent ability to be successful at embracing institutional logics that some describe as inherently contradictory.

This department has close collaborations with industry given the natural proximity of the field of polymer science to industrial applications. Industry-funded research in the department comprises approximately 30% of the total research sponsorship. According to several faculty in the department, this level of industrial sponsorship is significant compared to peer departments in the field, which according to these faculty bring in 5% or less funding from industry. In the 1970s, the National Science Foundation (NSF) sponsored the establishment of a center in the department to promote interdisciplinary collaborations. Today, this NSF-supported center integrates efforts of more than 20 faculty from departments in science and engineering and supports research collaborations and outreach programs with more than 10 other academic institutions across the country. In the early 1980s, another center was established to enhance industrial interactions as part of the Industry/University Cooperative Research Centers (I/UCRCs) program sponsored by the NSF. NSF created the I/UCRC program to foster partnerships between universities and industry around industrially relevant fundamental research, the education of scientists with an industrially oriented perspective, and the transfer of university-developed research and technology to industry. An I/UCRC often begins with a small grant to seed partnered approaches to emerging research areas for five years to a university professor, a faculty member expected to form a team to run a successful center with industrial funding. After the initial five years, the center is expected to be self-sufficient and supported primarily by industrial funds. The I/UCRC center in this department is one of the few centers of this kind that has survived beyond NSF's initial support. Today, the center has more than 40 industrial partners and four basic programs of interactions with industry with specific guidelines and regulations. It operates mainly as a consortium where multiple companies invest in an area of common interest, but it also channels sponsorships to individual faculty members around specific projects.

To explore the culture of this department, we used semi-structured face-to-face interviews approximately one hour long with 10 faculty members, individuals who represent the vast majority of the department; field observations during numerous visits to the site throughout an academic year; and collection of relevant documentation and artifacts. The interview protocol was designed based on the cultural knowledge around academic capitalism identified in previous studies (e.g. Mendoza, 2007a; Mendoza & Berger, 2005; Slaughter, Archerd, & Campbell, 2004). The interview protocol included questions about the central topics in the interaction of institutional logic, social logic, and industrial logic: how departments balance conducting basic research and educating their students alongside working with industrial sponsors; the benefits and downsides of industry-university collaborations; the advantages and disadvantages of industrial versus governmental grants; the impact of industry-university collaborations to students, basic research, publications, and academic freedom; the motivations of industry and faculty to engage in industry-university alliances; and the ways industry-academia collaborations can be improved. All interviews were recorded and transcribed. Data analysis was based on a constant comparative method to identify and contrast analytical constructs to generate theoretical explanations of the phenomenon in question. Categorical analysis was conducted based on open coding techniques and the guidelines set forth by Rossman and Rallis (2003) and Lincoln and Guba (1985) to ensure the trustworthiness, validity, and authenticity of the study. Throughout the study, the researchers constantly searched for rival explanations or evidence, established a chain of evidence, and created a case database. These procedures and the multiple sources of data provide sufficient warrant for our claims about this department.

Results

Three main themes dominate our results and thus the presentation in this section. First, we describe participants' general description of the department's research and funding. Second, we discuss how faculty protect their academic values as they partner with industrial sponsors of research. Finally, we take a closer look at the implications of industrial funding to key components of the academic culture. Shared meaning was found among faculty, and very few differences were found among participants. Therefore, unless explicitly stated, the results described represent the shared view of faculty interviewed.

Participants' Descriptions of the Department's Research and Sponsorship

Faculty unanimously agree that the main goal of the department is training polymer scientists, followed by the production of fundamental polymer science. One department member said,

> If you think of the polymer science and engineering department, what is it that we sell? There are really two things that we offer: first of all the scholarship that we perform be it fundamental or applied, but equally or probably more important are the scholars we train.

This academically-oriented goal among faculty indicates the presence of a strong traditional academic culture despite the department's active engagement in academic capitalism.

Professors believe that the department has a good combination of both applied and fundamental research as well as a balance across types of funding (private and public). As one faculty described it, "The strength of this department has been the fact that we can marry the fundamental with the applied." Faculty participants explained that their research is related to the fundamental physical and chemical principles of polymers, but usually their research has clear technological applications if several steps away from the actual manufacturing of a product in an industrial setting. Several faculty members alluded to the erosion of boundaries between applied and basic research are very blurred in the field due to the nature of their work. However, they stated that the department is focused on fundamental science compared to other departments in the field, which they described as more product oriented or more interested in the development of new technologies. Despite the fact that faculty in this department are mainly involved with fundamental research, they have also discovered materials that are worthy to patent for future applications.

These views support findings from previous studies that have shown that faculty members in science and engineering have a clear sense that the boundary between academia and industry has changed (Mendoza, 2007a; Slaughter et al., 2004). For many faculty members in these fields, the "wall" between industry and academia is no longer present. This shift has open the possibility to a host of opportunities, but it also provides surprises and potentially compromising situations with implications for the integrity of the academic profession (Slaughter et al., 2004).

One faculty member indicated that faculty in the department are successful at obtaining both federal and industrial grants. Nonetheless, those faculty members who have been in industry for a number of years before becoming academics see differences between themselves and faculty who have not been in industry for extended periods of time. These faculty members recognize that faculty who have been in industry tend to think more about practical applications, a habit that might facilitate their ability to attract industrial funds. In addition, some of these industry-experienced faculty indicated that faculty who have been in industry are better at dealing with people, sharing

equipment, and working collaboratively. In doing so, they said, they bring different perspectives to their teaching and advising by being able to talk about real past experiences in industry and understand the industrial world more accurately. These differences become clearer through students' positive teaching evaluations of those faculty who have been in industry.

Faculty believe that the department can afford to reject industrial funds at odds with their interests because of the reputation of its scientists and the large amount of overall funding it enjoys. These results suggest that there is sufficient funding available for these faculty members and that it is the responsibility of individual faculty members to shelter their students from industrial demands and provide students with training in basic science that lead to publications. One department member said,

> I think certainly, we're at a point to negotiate. We have the luxury of being able to say no, and we're not so absolutely destitute or desperate that we almost have to take anything to make it work. I think a lot of companies appreciate our being very frank.

Some faculty mentioned that there are other institutions that tend to serve industry and bend their mission more to please corporate sponsors. One professor mentioned that once a long-lasting collaboration has been established with a corporation, there might be cases where faculty will serve industry needs in very specific occasions. In these cases, an industrial sponsor usually provides support for a broader research program involving several students. Within that broader partnership, faculty in this department might agree to perform several measurements for the company. Faculty justify this activity by noting that these measures do not typically demand a lot of time and energy on the part of the students, who at the same time are learning how to conduct specific measurements with sophisticated instrumentation. Faculty insist that these types of short projects might be viewed as service to industry, but in reality they provide an educational experience for the students that is beneficial as long as it does not interfere with students' main dissertation research. Faculty members claim that they are well aware of and intentionally guard against the potential negative issues associated with such projects; for example one faculty member observed,

> Some of these company projects, if you're not careful, they can be really contract work. Maybe the university has an electron microscope and all they want is a technician to crank samples through those instruments and they can afford to give lots of money and it would be useful to train a student on those pieces of equipment in the short term. But that doesn't make science and it doesn't make a thesis, and so it's the job of the advisor to say, "OK, well, your thesis is going to be partly of running these samples, and while you may be entirely funded by doing this, we've got to find something that demonstrates your full capability as a researcher."

Department faculty believe they have the necessary autonomy to protect their shared values.

The department's I/UCRC center. Academic departments are affected in mixed ways by initiatives such as the I/UCRC centers; issues include potential conflicts over intellectual property, secrecy of knowledge, and exclusivity clauses against the formation of corporate-academia alliances. However, these organized research units (ORU) bring benefits such as encouragement of interdisciplinary research, exposure to current industrial research and needs, additional funds, and job opportunities for students (Anderson, 2001; Gumport, 2005; Slaughter& Rhoades, 2004). The faculty interviewed in this study strongly support initiatives such as the I/UCRC centers and believe that those concerns are manageable and minimal compared to the benefits that these initiatives bring to the department.

Several faculty talked about the uniqueness of the department's I/UCRC and the benefits it brings to the department, greatly enhancing the department's ability to obtain funds. According to many of the faculty, the success of this center begins with a full time director dedicated to collecting industrial funding and working on agreements attractive to both faculty and industry. The director handles all of the legal contracts, including timelines and identification of common objectives between potential sponsors and the department, organizes meetings with industry representatives, assists faculty in writing proposals that meet the demands and needs of industrial sponsors, and actively networks with potential sponsors. The following comment by a faculty member illustrates how the director of the center finds opportunities:

> Our director for the center looks at faculty and says, "What is this person going to be interested in? What companies should be supporting that? What companies are also interested in those things? There are a lot of companies out there, thousands of companies. Let's identify a few of them that are really going to be interested in his results. They should be supporting him."

Another advantage of the center is that it manages one-on-one research contracts that are normally handled through the university's office of grants and contracts. The arrangement is advantageous because the department's director can talk directly to industry sponsors about technical, administrative, and legal details, an arrangement that expedites the contract process. In addition, a small portion of the industrial funds channeled through the center are saved to create grants for junior faculty members in the department. Faculty mentioned that an important aspect of the center is that it provides a structure and consistency that allows the development of long lasting relationships with industry and long-term projects. Similarly, several studies have indicated that faculty members believe that the collaboration between government and industry through centers dedicated to fundamental research allows long-term projects, which is the preference of academics (Slaughter & Leslie, 1997; Slaughter et al., 2002; Slaughter & Rhoades, 2004).

Given the success of the department in partnering with industry, faculty offered the following advice to programs interested in developing productive collaborations with industry: conduct a critical assessment of what the department could offer to industry, find a niche according to what the department has to offer, devote substantial resources and planning, mentor junior faculty, develop a center similar to the one the department hosts, hire a full time staff administrator dedicated to the center, encourage individual faculty to actively develop one-on-one relationships with industry, actively network in conferences and other meetings, and be loyal and honest about the department's values and protect the department from corporate interests. One faculty member explained:

> You have to be loyal to the academic goals …to the university. And, you have to make sure that those goals can overlap with industrial [goals]… there can't be any conflicts. So, you go in and accept those things that are in line with what you want to do and you have to be honest with industry up front, not just take money and promise them stuff that you can't deliver because your reputation will kill you.

This last piece of advice reveals the way faculty approach industry and shows the existence of a strong academic culture in the department.

Federal versus industrial funding. Several faculty consider government grants more stable, competitive, longer term, and more closely related to the more fundamental science than industrial grants. (The exceptions include grants from the U. S. Department of Defense.) Faculty recognize that federal funds are more prestigious because they are awarded through a rigorous peer review process and thus competitive. The higher value of federal grants in the department agrees with the

pillars of the academic culture related to the value of basic science and the peer review process. Moreover, one faculty member mentioned that national rankings are mainly based on federal grants rather than on industrial grants. However, senior faculty in this study recognized that industrial grants are valuable as well and that some industrial grants are as open-ended and competitive as federal grants (thus raising their prestige value). Another reason given by several faculty for the higher value of federal grants is related to the tenure review process. According to these faculty, to achieve tenure, a faculty member must have established a record of renewed federal grants as a measure of the quality of a faculty member's research. However, one faculty member mentioned that federal grants were starting to lose their value within tenure review because the renewal process is longer than a typical faculty member's probationary (tenure-track) period. In addition, another faculty mentioned that federal grants are being tailored towards large multidisciplinary projects involving several investigators, which diminishes the ability of individual junior faculty members to obtain federal grants. Overall, in agreement with what has been suggested by Slaughter et al. (2004), faculty believe that while it was prestigious in the past, federal funding is losing its value, and in part because federal grants have also become more difficult to obtain, faculty members have become more interested in funding from other sources.

According to the faculty in this study, industrial grants are also becoming more difficult to obtain. Several faculty mentioned that over the last 15 years, industry sponsorship in material sciences has been shrinking. These professors also report that industries once had unrestricted think tanks to support basic science. However, the internal research structure of companies has changed. Because company executives are more accountable and have to demonstrate global competitiveness, industry looks for research that is more product dependent and reliable for short-term results. Many of the scientists who worked in those think tanks migrated to academia as companies began cutting funds for those programs. Also, as one professor noted, many chemical and materials companies have moved overseas and no longer have central domestic research facilities.

Protecting the Core Values of the Academic Profession

Faculty interviewed for this study tended to define good research in line with traditional concepts of rigorous scientific research. None of the responses reflected industrial or business related values such as the idea that research should lead to useful applications competitive in the market or cost-efficient. On the contrary, faculty considered that good research should make an original contribution to knowledge or to a particular technological application, and good research has an impact on society or the scientific community. None of the faculty considered that good research should aim directly at the development or improvement of a specific application. In addition, some faculty members talked of the importance of scientific rigor and originality in any good research. Faculty believe that rigorous research is recognized through the peer review processes in the form of publications and by its capacity to attract funding. However, some faculty members mentioned that the best research is measured by its impact over time. Several interviewees also mentioned that in an academic setting, good research should lead to the proper education of students. Faculty believe that their department appropriately balances educating students, conducting research and working with industry. Some faculty members went further: they believe that these are not opposing forces that need to be balanced. In general, faculty are satisfied with industrial partnerships and have been able to successfully pursue both their scientific and educational objectives.

Protecting the education of students. All of the faculty interviewed for this project asserted that their main professional goal is to educate students through basic science and to conduct

fundamental research. Therefore, faculty carefully partner with industry assuring that such traditional academic goals are preserved. Some faculty mentioned having to turn down offers from industry in cases where those partnerships had the potential to interfere with academic goals. Similarly, faculty believe that if partnerships with industry are conducted properly, it is a mutually beneficial arrangement in which faculty obtain funds to support research and students, students engage in meaningful projects and learn about the industrial world, and industry gains access to new knowledge, expertise, and facilities. The key is to carefully plan and craft the agreements with industry in ways that students' education is not harmed. To accomplish this, faculty adapt industrial projects into a meaningful educational experience for students. One department member said,

> A lot of what we look at when industries come to us is, "Is there a synergy and does this fit with mine?" The company could come to me and say, "We have all this money and we want to get this done in three months," and I look at the question and the problem and say, "Is this something I'm interested in, is this an area that I have expertise, that I personally feel I can contribute to?" But then I have to sit back and say, "Do I have a student who can contribute to this program where it's either directly in line with their thesis investigation? Involves a slight deviation? Or is the student at the point where we can take a detour for three months?" It's all timing and situational dependent… I'm not going to do every- and anything just to get a few thousand dollars or tens of thousands of dollars or even one hundred thousand dollars if it's not going to be a really good fit because it's a waste of money from the industrial sponsor's perspectives, it's a waste of time and energy and effort on my behalf and the student's behalf.

Another said,

> There are a number of companies that call us up wanting help on something very specific and whether it is fire-fighting type of research where they need something in the next three months or six months and we're very upfront, I often point them to other places that could help them better. We're real honest; we don't do that kind of research here. Now, we pick programs that fit with educating students and post-docs… with getting their thesis and that's paramount here. I mean, you have to look at the students… we train students, that is what we do.

A third said,

> I'm not in the business of providing some company their next product; it's just not part of the game. You know, the game is to educate students, and if it's done properly, everyone wins.

As illustrated in these comments, faculty in this department strive to balance industrial funding with the education of graduate students. Most of the faculty interviewed said that the department's main product is their students, who should be trained through basic research; therefore, industrial money must be used for education in basic research.

Most of the faculty in this department assert that the use of students in industrial projects that compromise students' education and ability to publish is unethical and exploitative. They believe faculty should avoid putting students in projects that are too applied without an educational component unless the student is about to graduate and the experience will help him or her get a job. One professor said that helping students obtain professional positions is not only rewarding for faculty, but placement is also more important to the university and the department than patents or funds. To this department member, a good education results in satisfied alumni, which is essential for an academic institution to succeed:

> I have a post-doc who is applying to Harvard; I hope I can get him into Harvard… If I can get students and post-docs into these institutions, that's going to be far more important to this university than getting a patent or getting a bag of money… because these people go into these other institutions and are going to provide students to this university and students are what makes this university. What you want to be able to do is to get people into the institutions that provide feeders… if you increase the quality of students and grad students, everything else comes.

Department faculty believe that they safeguard their educational mission from the potential danger of industrial incentives' corrupting their academic principles.

Protecting free dissemination of knowledge and academic freedom. Every interviewee asserted that the primary driver of projects is personal scientific interest and curiosity coupled with expertise. However, due to the blurred boundaries between basic and applied research in this field, scientific problems are related directly or indirectly to applications. Some faculty feel attracted by the intellectual challenge involved in coming up with original solutions to existing problems or improvements of technologies, while other faculty are more driven than others toward what are the present needs of industry, although with a focus on the fundamental science behind those applications. Significantly, faculty report they are able to obtain enough funding to pursue their scientific interests fully; they do not believe that sponsors have played a role in directing their research. This ability to find enough funding to pursue their research interests is associated with faculty members' success at selling their ideas properly to either government or industrial sponsors. Two faculty members highlighted the importance of writing large grant proposals and actively seeking funds to pursue their interests freely, rejecting grants that might undermine their professional interests.

The department faculty interviewed for this study feel strongly about the importance of publishing for their careers as the most important measure of good scholarship. Also, some faculty members highlighted the paramount importance of freedom in research. Therefore, these faculty members carefully design contracts with industry to ensure satisfying degrees of freedom and publications. These faculty members in general are very satisfied with their academic freedom and ability to publish despite their involvement with industrial sponsorship. In some cases, industry funds come without restrictions in the form of gifts or block grants. According to one faculty member, in some cases, industry values greatly publications as an effective vehicle to learn the basic science behind their products. Also, faculty argue, some government grants can be more restrictive than industrial grants, especially grants from the Department of Defense. One faculty member pointed out that the only difference between government agencies and companies is that the initial conversations with potential industrial sponsors tend to be more defined with a clearer goal in mind than with grants from the government. Moreover, some faculty members feel that they have had more freedom with industrial grants than with NSF grants, which demand publications for renewals. Interestingly, one faculty member mentioned that the bigger the scope of an industrial grant, the more control a company might have over a research group. Therefore, he prefers to set up contracts with industry around very specific and clear deliveries and expectations as a way to control the scope of control of the company on his research. On the other hand, he compensates for that restriction by having government grants and industrial gifts to purse his research interests more freely and educate students properly.

The Consequences of Industrial Sponsorship

Investment of time and human resources. Several scholars have mentioned that faculty are spending considerable time in patenting and developing relationships with potential donors; in other words, market-like activities are absorbing faculty time that could be used for other purposes such as research or graduate education. Over time, faculty members spend significant time acquiring expertise in recognizing the commercial value of their science, locating commercial partners, and negotiating contracts (Clark, 1987; Gumport, 2005; Slaughter & Leslie, 1997). The faculty in this study recognized that healthy and productive collaborations with industry requires significant effort to develop. One department member noted the investment needed in networking inside individual companies:

> It takes a lot of legwork to go to these companies, and you are not always sure of whom the main contact person should be; who makes the decisions in the company… each company is very different so there is no set kind of strategy for getting industrial money.

Faculty also pointed out the networking role of presentations in this uncertain environment:

> Your point of contact may get reassigned, transferred to a new position, might even leave the company… you cannot rely on one person to maintain a relationship if it's going to be a long term relationship. So it's better to go once a year to the company, give a presentation, talk to hopefully 30 or 40 people every year where they get to know your face, once a year at least, and when one person gets reassigned, you know somebody else there.

On occasion, interviewees noted, there was a frustratingly low return on that investment in establishing relationships:

> A lot of times we spend you know, a year or two just in discussions with companies… I spend a lot of time talking to them and the dollar per hoop ratio is completely out of balance. You can often times spend six or eight months working on a company and maybe there'll be $20,000…. and a lot of it is just laying some future ground work in trying to build up a rapport, teaching them what you can do, having them develop some confidence… And many times they test you: "We'll give you a small project on a short time frame. Can you deliver?"

Impact on students. One opportunity cost of establishing relationships with industry is the time that could be spent with students. Findings from previous studies have raised concerns that time spent by faculty members engaging in academic capitalism might be taking professors away from their labs, students, and university service (Gumport, 2002; Kerr, 2002; Lee and Rhoads 2003; Milem, Berger & Dey, 2000; Slaughter & Leslie, 1997). Moreover, Gumport (2005) indicates that the training of graduate students has been tailored towards the needs of industrial sponsors, and that this tendency challenges the presumptions that faculty are interested in the disinterested pursuit of knowledge. However, faculty in this study strongly believe that industrial partnerships, a clear form of academic capitalism, enhances the quality of graduate education and does not undermine faculty desire and conduct of disinterested fundamental science. As noted earlier in the article, faculty defended the educational value of industry ties:

> I think that the industry funded program here is a huge opportunity for students; it's a wonderful, wonderful program. You know, 95% of what's going on there is very, very good from the projects they work on, to the contacts they make, to what it can be in the future, it's very, very good. And so the implications are mostly positive, mostly positive.

Another department member said,

> As an educator I think industry [is] a tremendous vehicle that can be used to show the students about life that you can't do inside the classroom.

The value of industrial involvement in the education of students inspired faculty to create an educational program in which students have an opportunity to learn about the industrial world in a structured fashion. Through this program, faculty invite outside speakers from industry to teach students about a variety of topics such as what industry thinks is important, patents, scaling up and manufacturing, safety issues, diversity in the work place, barriers for women's advancement, communication, and team research. In addition, some faculty mentioned that they intentionally structure opportunities to expose students to industry by arranging visits to companies with students, sending students to conduct research in industrial labs for a period or time, and encouraging companies to visit the department and meet students.

Faculty were convinced that the most positive effect of industrial sponsorship on students is the opportunity to learn about industrial enterprise through visits to companies, direct interactions with industry representatives, and work on industrial problems that might have a significant impact on society. One faculty member prefers industrial grants because students are usually attracted to a specific industrial need or problem. According to faculty, another positive experience is when students present their research to industrial representatives, an interaction that exposes students to different ways of communication with industry representatives as well as providing an opportunity for students to receive feedback on their research. Faculty believe that these are very powerful experiences that teach students about the industrial world including its culture, people, and research, experiences better than those available in any traditional academic setting. One professor alluded to the fact that usually alumni are very grateful about the quality of the education they obtained in the department and the opportunities they had to interact with industrial sponsors:

> The students who are working on a particular project are the ones that are actually doing the work. And when I have these meetings with these companies who come here to see their research, it's my students who present the results with me, so those students are the ones who are actually involved, so that gives them more opportunities to practice communication skills, presentation skills… learn how to organize a presentation or respond to a question in a succinct way or expand as necessary based on the type of questions.

Job and networking opportunities for students were also mentioned by several faculty as some of the positive aspects of industrial funding:

> It makes it easier for students to get a job, to share with prospective employers "I've worked on this application" or "I've worked on research toward this application." A lot of prospective employers can identify with that a little easier than they can with fundamental research and hire directly rather than tying in the fundamental research. Too, I think there is a difference in terms of culture between academia and industry in terms of what research takes place or how research takes place so the student can be exposed both to the advisor as well as a collaborator in industry to see what science in industry is like… to give them an idea.

When faculty were asked about the negative effects of industrial funding, they refer to possibilities that might harm students, but they asserted that normally there are no such issues in their program. Some faculty mentioned that there is the possibility that sponsors might withhold students' publications on rare occasions. One professor said that he has seen few instances in which students were unable to talk about their industry-sponsored research in job interviews; however, this professor stated that these conflicts could always be managed. Other professors

mentioned that industrial funding has the potential to be restricted and constrained to meet specific demands. However, if a student is working in this kind of project, it is usually a small portion of his or her research. Another faculty member said that sometimes industry has hard deadlines and demand quick results that may jeopardize the quality of the science; but again, according to this professor, students are involved in other projects with sufficient basic science that fulfill the educational mission of the department.

Impact on research. According to faculty in this study, there are also positive aspects of industrial sponsorship related to research—the opportunity to learn about new materials and technologies being developed as well as information that might be part of trade secrets. Other benefits of industrial sponsorship reported include faculty members' being connected to industrial research as well as to their needs and issues as sources of new research projects:

> Many of the positive aspects are just the exposure to new ideas and new materials… that are covered under patents… all the sort of knowledge and information that has been accumulated that is sort of hidden behind the veil of trade secrets. I think the other big positive is the fact that you get a feel for what modern industry is looking for and you can better prepare your students to go out and be competitive.

One faculty member argued for a positive interaction between basic and applied research:

> It keeps the department honest, because you have to do research that actually is going to move the frontier of polymer science forward. So even though you still may be doing stuff that is blue sky and exploratory using government funds or whatever, you're still able to push the boundaries of what is being applied and used out in the real world by having those industrial contacts.

Other benefits mentioned by faculty include the fact that industrial grants offer more flexibility in terms of travel money for conferences. Also, according to one professor, industry researchers tend to be very critical of the research being sponsored, and are willing to cut off funding if they are not satisfied, what this faculty member thought was a form of beneficial accountability nonexistent in federal research support:

> With a company you have to be 99% sure you can deliver what you say… they will hold you accountable. In a government proposal, unfortunately, there's no accountability… an outside committee reviews the quality of the proposals that might sound like they are feasible at the time, but whether the PI actually executes what they say they are going to do is not evaluated by that same committee three years later… it's up to the program manager to assess that, but they don't have that expertise or that level of interest in every single project that they're funding.

Faculty argued that disadvantages of industrial sponsorship are minimal compared to the benefits that these partnerships bring to the department, their academic careers, and students. In any case, the most commonly mentioned disadvantage of industrial funding was that it is subject to economic and market constraints, a fact that might force companies to cut funding suddenly. In those cases, faculty believe it is the job of the faculty member involved to continue funding students from other sources. Some faculty members expressed their frustration with industry's unwillingness to provide grants for at least three years, an uncertainty that makes it difficult to accommodate these grants with the curriculum of students. Faculty felt that this uncertainty was an obstacle to sponsoring students—the Ph.D. program requires at least five years of study. As one department member explained,

> To get that second year of funding up front is very difficult so you are always on a six month or one year kind of renewal basis, which makes it difficult to forecast

> for planning the growth of the group… whereas a government grant comes in for 3-5 years usually.

One faculty member pointed out the frustrations in a more vivid way:

> The biggest negative side is that you're a foster child. What I mean by that is, when companies go through cost-cutting, the best way to save costs are through the academic kinds of funding that are doing once a year. And so you have to be mature and have enough different programs going so that when one disappears, you have another one that is up and coming that can support your student and put together a thesis that has good sound science and a good focus… So that's the biggest challenge, the time frame.

Finally, two faculty members mentioned that one barrier to industrial funding is corporate competition. Sometimes, a faculty member might be working on areas of interest to more than one company. As industry strives to keep their research confidential, a faculty member might face restrictions imposed by their industrial sponsors.

Intellectual property. According to Slaughter et al. (2004), the three areas where the greatest disputes emerge between academia and industry are publishing versus patenting, secrecy versus access, and contested ownership over intellectual property. Findings from other studies demonstrate that faculty members consider publishing more valuable than patenting despite the pressure by university administrators to generate streams of revenues from commercialization of research (e.g. Campbell & Slaughter, 1999; Gladieux & King, 2005; Mendoza & Berger, 2005; Slaughter et al., 2004). One of the reasons for faculty members' reluctance to patent is the perception that any individual profit is unlikely to generate significant royalties (Slaughter et al., 2004). Moreover, younger professors cannot afford long delays in publishing their research. In the work by Slaughter et al. (2004), some professors thought industry was blocking the free flow of knowledge, including new discoveries. Sometimes the stakes are high when faculty members have developed long term and elaborate relationships with industry, forcing faculty members to maintain industrial secrets. However, professors in this study (in material sciences) believe it is possible to publish and patent simultaneously, especially among established faculty with long-term programs. In some cases, professors address intellectual-property concerns by removing confidential data from theses and publications. These professors are convinced this practice does not compromise the integrity of the science because the portion removed from publications is either very small or too applied to a specific product. This result suggests that despite industrial contracts and universities' policies to control faculty members' research, faculty are able to manipulate situations to protect their integrity as researchers. In great part this is possible because faculty members are experts, and their sponsors or employers do not know enough to regulate faculty in such a detailed fashion (Slaughter & Rhoades, 2004).

Faculty argued that generally there are no intellectual property issues (IP) with industrial sponsors because agreements are in place beforehand, and companies usually agree to these provisions. Such agreements are in line with the University's IP policy and generally provide industrial sponsors with a waiting period of three months in which sponsors can file a patent before publication. According to faculty, the waiting period of three months does not represent a significant delay because publication timelines are usually longer:

> I could simultaneously be writing a very prestigious publication, drafting a patent disclosure, take that patent disclosure and file that in a very short time frame, a week, and then, you know, 30 minutes after I knew the patent application had been filed in the U.S. Patent Office … [then] I'd submit it to the journal.

Several professors mentioned that industries are not interested in funding research that might lead to patents or too close to their products to avoid issues around IP:

> Industry generally doesn't want me to be involved in research that is related to the next product and the reason is, quite clearly, intellectual property… Because if I discover something, then the intellectual property remains at the university or there has to be some special accommodations made between the university and industry.

Finally, one professor noted that he has had difficulty managing restrictions on information when he has worked for competitors simultaneously.

More prominent in intellectual property than a conflict with industry sponsors was a conflict with the institutional logic of patenting. Several faculty members expressed frustrations that the University sees faculty's research as a money maker, which in the minds of faculty is unrealistic; in their view, profitable research tends to stay within industries, and faculty are not interested in making money. Faculty find more (and more reliable) value in conducting basic science, publishing, and educating students:

> Universities still don't know what they're doing. They look at it as a money making venture and you know, it doesn't really work that way that well… My main reason for being here is that I wanted to teach and I wanted to do the kind of research that I wanted to do… and I enjoy working with students… so when the university all of a sudden looks at you as a money-making entity, they want to make money off of patents, and they put all sorts of constraints on you… that's difficult. The thing is that the rules have changed a lot since many of us first came here and what I've seen over the years is that the university in some way is trying to become more and more like industry…

Several other professors argued that the university's administration should understand that educating students, conducting basic research, and publishing is the core mission of the university, a mission that should not be jeopardized to generate revenues through patents and partnerships with industry.

Discussion

Previous empirical studies have shown that faculty members in science and engineering believe collaboration between government, industry, and academia bring benefits to academia such as providing faculty with opportunities to do research, contracts to fund students, networking for future funding, equipment gains, recruitment opportunities of faculty and staff from clients, service contributed by project personnel, spillover to research and teaching, and employment opportunities for students (e.g. Blumenthal, Causino, Campbell, & Seashore Louis, 1996; Campbell & Slaughter, 1999; Mendoza, 2007a; Slaughter & Leslie, 1997; Slaughter et al., 2002; Slaughter & Rhoades, 2004). Although the results of this case study also highlight most of these benefits, the rich descriptions provided by the participants illustrate the interplay of factors involved in partnerships between industry and academia that illuminate additional insights and questions for future research as well as policy implications.

Powell and Owen-Smith (2002) portray the post-modern life scientist in research universities as an entrepreneur:

> The traditional view of the university researcher as a dedicated and disinterested, though passionate, searcher for truth is being replaced in the life sciences by a new model of the scientist-entrepreneur who balances university responsibilities and corporate activities in the development of new compounds and devices designed to both improve human health and generate revenues for the investigator, the university, and investors. (p 108)

The emergence of this new type of faculty members demonstrates the effect of what Kuh and Whitt (1986) call the environmental layer of their cultural framework. The neo-liberalist culture in our society of the last decades is the environmental layer that is pushing faculty members to turn to academic capitalism to maintain research resources and maximize prestige. Resource dependency theory offers a more detailed explanation of how this environmental layer affects the actions of individual faculty members (Slaughter and Leslie, 1997). Dependency theory is based on the premise that internal behaviors of organizational members are understood through the actions of external agents. In the case of higher education, the external agents are manifested in federal policies aimed to cope with global economic competition such as industry-academic collaborations forcing higher education to compete for the new sources of funds targeted to specific areas of R&D in applied fields. Since most faculty members teach and many perform public service but fewer win competitive research funds from government or industry, research is the activity that differentiates universities, where elite departments are defined in terms of excellence in scholarship and originality in research (Becher, 1989). Thus, research funds bring material gain and prestige to universities and push them to engage in academic capitalism. Departments in research intensive universities such as the one in this case study are particularly influenced by the environmental culture based on neo-liberalist ideologies due to the high value placed on research in this type of institution.

The second layer of the framework refers to institutional cultures. The department we studied belongs to a large top ranked research university. These universities are "citadels of the academic culture" (Kuh & Hu, 2001, p. 2) based on concepts such as academic freedom, production and dissemination of knowledge, and education of the young. The results of this study clearly demonstrate a culture among participants that strives to preserve these fundamental values despite their engagement with industry and entrepreneurial opportunities. In opposition to what has been suggested in previous research (Gumport, 2005; Slaughter and Leslie, 1997), the core academic culture in this department is not being consciously disrupted or altered in any significant way by academic capitalism. Moreover, the fact that very few differences where found among faculty members demonstrates that the department has a very strong homogeneous academic culture—even with the additional influences of industrial sponsors as external agents.

The results of this study clearly also suggest that significant clashes are occurring between faculty and administrators around intellectual property issues. These differences are explained by the tensions that usually occur among different subcultures in the third layer of Kuh and Whitt's framework. In this case, university administrators hold managerial values that are in sharp opposition to the academic culture of faculty. This study also discovered subcultures among faculty who have worked in industry and faculty who have followed traditional academic paths—although there were surprisingly few differences between these groups. Finally, the results of this study support the fourth layer of Kuh and Whitt's framework, in which individuality plays a significant role in shaping the culture of a given unit. On several occasions, faculty made clear that it was up to individuals how to respond and protect their academic interests as they became involved in partnerships with industry. However, this study found that individual differences were small when compared to a strong and cohesive academic culture in the department. The departmental academic culture in this case seems to be even stronger than the discipline-based cultures given that faculty believe other departments in the field respond differently to academic capitalism.

One of the most significant findings of this study is the high value that faculty place on education. This finding is particularly important given concerns raised in previous literature about the diminishing time and effort spent by faculty in the education of students due to academic capitalism (e.g., Gumport, 2002; Lee & Rhoads, 2003; Slaughter & Leslie, 1997). Although faculty in this study recognize that they spend considerable energy developing industry-academia relationships,

they emphatically state that the education of students is one of the most important goals of their careers and the department. The results of this study suggest that faculty intentionally use industrial funding to enhance the quality of the education of their students and actively protect students from sponsors' demands, to the point of rejecting funding if it jeopardizes the education of their students. Moreover, faculty strongly believe that industrial funding brings significant benefits to the education of students. Also, faculty in this study believe that industry's main reason for funding research in the department is to support the training of a skillful workforce in basic science and provide the opportunity to know students comprehensively throughout the years in the program, to help recruit those students who best fit their needs. Therefore, according to faculty in this department, sponsorship benefits both industry and academia because the interests of industry do not necessarily conflict with faculty interests. These results support the findings of Mendoza's (2007a) case study on the positive effects of industry-academia collaboration on the socialization and education of graduate students.

Faculty in this study report that despite their significant involvement with industrial sponsors, they are able to maintain their academic freedom, conduct basic research, and publish in peer-reviewed journals. This result contradicts previous assertions about potential overemphasis on applied research, restrictions in research, and secrecy of knowledge as faculty engage in academic capitalism (e.g., Powell & Owen-Smith, 2002; Gumport, 2005; Slaughter et al., 2004). Nonetheless, recent studies have also indicated that these constraints are not necessarily the case and that faculty are able to publish, follow their scientific interests, and comply with sponsors' demands simultaneously (Mendoza, 2007a; Slaughter et al., 2004). Faculty in this study explain that this is possible because research sponsored by industry is several steps away from direct applications. In addition, given that the development of any technology must relay on basic science, there are always possibilities to conduct fundamental research and publish in applied projects.

This study contributes to our knowledge regarding the impact of academic capitalism on the academic profession by documenting a case in which the broad integrity of the academic culture of faculty members in a department remains purely Mertonian, even with significant industrial funding (Merton, 1957). Moreover, these faculty members consider industrial sponsorship a highly effective vehicle for enhancing the quality of education of students and pursuing their scientific interests. However, the results of these studies are highly context-dependent and may not transfer to other academic settings. Therefore, the implications of industrial partnerships to the academic culture await additional empirical research across different types of institutions and disciplines.

Despite the overall positive findings, this study suggests some areas of concern requiring careful investigation. One of these areas is the perception among faculty indicating that general support for basic research is becoming less favorable as both industry and federal funding for basic science continues to decrease (Mowery, 1998). This raises important questions about the fate of fundamental discoveries in basic research. Several faculty indicated that there are other institutions within their field less committed to fundamental science either by choice or necessity. In some cases, faculty mentioned that departments or individual faculty members might end up bending their core academic values to please industrial sponsors. This study suggests this department is in a position to negotiate with industrial sponsors to protect their interests as a result of their privileged position as a top-ranked department with outstanding scientists able to attract significant funding both from industry and government. This position of privilege combined with a strong Mertonian culture explains the department's ability to maintain its core values in light of academic capitalism. Future research should investigate other departments in less privileged positions and with less cohesive cultures to determine to what degree academic capitalism forces encourage these institutions to compromise their academic values.

Implications for Policy

This case study has several implications for both institutional and social policy. On the one hand, an area of tension clearly voiced in this study relates to faculty members' negative perceptions of the University's intellectual-property policy, which they characterize as the greatest obstacle to partnering with industrial sponsors. As suggested in other recent studies, faculty complained about the pressure they experience by university administrators to patent their research though faculty are not interested in pure monetary incentives (Mendoza & Berger, 2005; Slaughter et al., 2004). Moreover, faculty in this study believe it is not cost-effective for universities to adopt these policies. Institutions should reexamine their policies for ways to create support for faculty who negotiate industrial contracts. In particular, campus leaders may want to look at ways their intellectual property policies are structured to ensure they maximize material benefits from licensing and encourage collaborations with industry. In addition, these policies could enhance benefits by offering faculty adequate institutional support that enables them to maximize autonomy when negotiating external contracts, particularly with industrial partners (Mendoza & Berger, 2005). Campus leaders may also want to offer workshops that teach newer faculty members how to negotiate such contracts. These types of workshops could also be offered through disciplinary associations. More experienced faculty members could be encouraged to collaborate with and mentor newer colleagues to balance their work strategically in light of current market pressures and the particular position of their academic department within the larger competitive organizational field.

Findings from this study provide valuable insights into federal policies related to the distribution of research funding and the shaping of programs aimed to stimulate collaborations between industry and academia by presenting additional evidence about the impact of these policies and funding distribution on the traditional norms and values of the academic profession and on the training of doctoral students. In particular, this study provides empirical evidence in support of federal programs such as the Industry/University Cooperative Research Centers (I/UCRCs). However, the benefits of this type of federal programs can be maximized if other types of organizations are included to create networks of knowledge. For example, the Canadian Networks of Centers of Excellence (NCE) are a web of social, economic, legal and administrative relationships among different types of institutions such as companies, universities, hospitals, schools, nonprofit organizations and federal agencies around critical issues of scientific, technological, cultural, social national importance. The Canadian government directs funding primarily to the administration of these networks and infrastructure to host conferences, workshops, professional training, and publications. Mendoza (2007b) argues that the Canadian networks offer a wider variety of benefits and opportunities for participants than the American I/UCRC program, and policymakers might want to consider this model for future R&D national investments (Mendoza, 2007b).

The results of this study also suggest potential negative effects that can result from uneven distributions of federal funding across academic institutions. In short, this study suggests that if federal grants are concentrated in a few institutions, those departments in fields relevant to industry with less federal funding might be compromising their core values to service industrial sponsors in exchange for funds. The government and its various funding agencies could evaluate the types of grants they offer and the availability to different types of departments and institutions. Faculty members emphasized a strong preference for unrestricted grants to help them generate more cohesive and strategic research agendas that enable them to do better basic and applied research and properly train students. Therefore, increased funding for federal research would provide better opportunities for more faculty members to have their work supported in ways that do not require them to make short-term decisions to pursue more restrictive and less prestigious grants and

contracts that are also lower in monetary support. Greater federal funding would also enable faculty members to be in stronger negotiating positions of industrial contracts which would better protect the ability of faculty members to drive their own research agendas and have more control over intellectual property.

Federal funding agencies should also consider ways to better support faculty members in less prestigious departments by continuing to expand initiatives such as the NSF EPSCOR program. This type of policy emphasis could strengthen the quality of research being conducted at a wider range of institutions, thereby increasing knowledge generated across the entire academy. The federal government may also want to broaden the impact of programs that fund cross-campus initiatives to better spread the wealth and to limit the effects of accumulative advantage. These recommendations come recognizing that the quality of research should still be the primary determinant for federal funding. However, the best ideas for future research may be limited by the quality of facilities in some departments and this issue should be examined closely as priorities for federal funding are considered in future funding cycles.

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