

Managing Institutional Research Advancement: Implications from a University Faculty Time Allocation Study

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Abstract While much is known about faculty time allocation, we know very little about how traditional managerial factors influence faculty time allocation behaviors. We know even less about the possible downsides associated with relying on these traditional managerial factors. Using survey data from the National Science Foundation/Department of Energy Survey of Academic Researchers, our study predicts faculty time allocations to grant writing as a function of pressure from administrative superiors. We then examine how pressure from administrative superiors influences faculty job satisfaction and the likelihood to pursue uninteresting research grants. Our findings indicate that faculty time spent pursuing grants increases in response to pressure from administrative superiors but that this same pressure is associated also associated with increases in pursuit of uninteresting research grants as well as decreases in work satisfaction. Our study contributes to better understanding of the merits and limitations of traditional, hierarchical approaches to managing university faculty behavior.

Keywords Higher education research institutions · Research and development · Grantsmanship · Faculty time allocation

Introduction

Faculty members at research universities typically divide their time between research, teaching, and service (Colbeck 1998; Easterly and Pemberton 2008). Time allocated to these activities varies with institutional affiliation, tenure status, academic field, gender,

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and individual preference (Blau 1994; Link et al. 2008; Singell et al. 1996). While we know much about faculty time allocation, we know little about how time allocation behaviors and attitudes are influenced by traditional managerial factors (Middaugh 2001), despite the contribution such insight may offer higher education theory and practice. Indeed, the bulk of conventional managerial axioms are developed with generic organizations in mind (Rainey and Jung 2014). Yet, perspectives old (Blau 1973) and new (Jarvis 2013) assert that universities stand as a unique class of organization, characterized at least in part by reliance on faculty as a unique form of human capital whose primary commitments are to their field of inquiry and not to the organizations where they work. Such perspectives suggest that traditional managerial factors, especially those that rely on hierarchical administrative structures, will have limited utility in influencing the behavior of university faculty members. Accordingly, the study presented here examines how one traditional managerial strategy, administrative pressure (as perceived by the faculty member), influences faculty time allocations to select activities. Specifically, we examine how, even given the expectations for research university faculty (Clark 1987), increases in administrative pressure to pursue grants and contracts are associated with increases in faculty time allocated toward pursuing grants and contracts. We find a statistically significant positive effect of administrative pressure, indicating that in this case, the supervisor-subordinate relationship expected in generic organizational settings may also apply in the context of research university faculty (the subordinate) interactions with research university administrators (the supervisor).

We extend our study to consider possible downsides of perceived administrative pressure (hereinafter “administrative pressure”) on research university faculty productivity. Specifically, we examine how perceived pressure from administrative superiors to pursue grants and contracts affects job satisfaction and faculty autonomy, with the latter measured through increases in the likelihood that the faculty member pursues grants to conduct research he or she finds uninteresting. We find an increase in administrative pressure to pursue grants and contracts to be associated with decreases in job satisfaction and increases in the likelihood that a faculty member pursues grants as a result of that pressure, regardless of their interest in the topic.

Reflection on the merits and limitations of administrative pressure in universities in particular is important. Conventional managerial wisdom expects subordinates in a generic organizational setting to be responsive to their administrative superiors, but in the absence of extreme conditions, there is no reason to believe that such pressure should be associated with decreases in job satisfaction. In other words, subordinates in traditional work settings expect top-down pressure from their administrative superiors. It is not unreasonable for pressure from administrative superiors to play a role in steering subordinates towards performing at least some work they find less interesting and motivating (Deci 1971). In the case of research universities, there is an interesting dynamic where faculty members are expected to generate external funding (Ali et al. 2010; Thyer 2011), but they are traditionally shielded from pressures from university administrators with respect to the direction of their research (Ryan et al. 2012). Despite administrative pressure, faculty autonomy in the nature of their research, or the “perceived freedom to choose the subject matter of one’s research,” is valued, and thus motivates greater productivity (Trowler and Becher 2001, p. 136). Thus there is a dual motivation for faculty members, with competition between external pressures, such as administrative pressure, and intrinsic interest in their research (Lechuga and Lechuga 2012).

The Organizational and Environmental Context of Faculty Time Allocations to Grant Writing

Research advancement is a strategic domain that touches on nearly every level of research university administration, from presidents to provosts down to individual faculty members. There is strong interest in the time spent by faculty members at research universities pursuing extramural funding (Fairweather 2002). Universities are constantly challenged to improve research productivity and extramural funding activities of their faculty for economic reasons, particularly decreasing sources of state funding (Ali et al. 2010; Fairweather and Beach 2002). Additionally, there are strong expectations for universities to produce new knowledge through research and increase knowledge through teaching as their pivotal and unique form of social impact (Bentley and Kyvik 2012; Scott 2006). In this context, increased emphasis on grant pursuit is a priority for universities (Porter and Umbach 2001).

Grant writing time is a topic of some currency given recognition of competing priorities for faculty, such as increasing research productivity through faculty time spent pursuing grants on the one hand and maintaining a balanced allocation of time towards teaching on the other. For example, Daniel and Gallaher (1990) first considered barriers to and motivations for faculty grant pursuit in the late 1980s. Link and colleagues have explored the various characteristic and tendencies of research grant-active faculty (see for example Link et al. 2007). More recently, we have seen recognition that protected research time is considered too scarce for many faculty. We also note increased interest in comparative studies of the predictors and motivators of research time given the evolving global knowledge society and changing expectations for scientific discovery (Bentley and Kyvik 2013; Hardré et al. 2011).

Complicating our understanding of faculty grant writing time, the evolution of the American research university has occurred amidst concerns about threats to academic freedom, faculty autonomy, and insulation of faculty from institutional pressures to raise revenue (Austin 1990; Gumpert 2000). As research universities evolve, these competing priorities are becoming a growing threat to faculty autonomy. A sense of uncertainty about faculty time allocation and expectations looms large as university administrators struggle to effectively manage their elite human capital, encourage academic entrepreneurship, and otherwise advance the strategic goals of the organization (Allen et al. 2007; Bercovitz and Feldman 2008).

The sensitive nature of administrator efforts to control allocation of time spent by university faculty members on their various work activities, including grant writing, has been documented (Hull 2006; Paewai et al. 2007). However, given the state of the debate about the role of academia in the knowledge society as well as concerns about clarifying the specific roles of faculty within research universities, greater understanding of the role of university administrators in influencing faculty research behaviors, including grant writing, is called for. Perhaps more importantly, theoretical and practical contributions can be drawn from insights relative to how these same pressures influence important motivation-related forces such as faculty satisfaction with their desired research agenda. Furthering this understanding is the primary purpose of our study.

We are motivated by a variety of perspectives on motivations and incentives for faculty engagement in research activities, including pursuing grants and contracts (Bauman 1982; Boyer 1997; Boyer and Cockriel 1998, 1999, 2001; Daniel and Gallaher 1990; Dooley 1995; Easterly and Pemberton 2008; Meyer and Evans 2003; Sterner 1999). This literature

primarily addresses faculty attitudes toward pursuing grants. It describes the relative saliency of these attitudes and is instructed by the work of Link and colleagues on trade-offs made by faculty when pursuing knowledge transfer efforts such as commercialization and technology transfer (Allen et al. 2007; Link and Siegel 2005; Link et al. 2007, 2008; Siegel et al. 2004). However, there is little literature so far to examine the connection between these attitudes and faculty motivations and specific behaviors (Lechuga and Lechuga 2012).

Accordingly, our study adds to the current literature by recognizing the relationship between the managerial strategies of university administrators and behaviors of faculty members. The focus on both individual and organizational influences in faculty time allocation is particularly relevant as university administrators respond to pressures such as the simultaneous decreasing levels of funding and increasing costs of running a university (Dooley 1995; Sterner 1999), the need to increase the research productivity of the university faculty and reputation of the institution (Dundar and Lewis 1998), and the political pressure resulting from perceptions that pursuing grants has become an inappropriately dominant force in the work of university faculty members (Fairweather and Beach 2002; Thyer 2011). In light of these pressures, it is anticipated that university administrators and policy makers may benefit from better understanding the impact their policies and pressures have on faculty behavior as well as attitudes. Given the complexity of the tripartite mission of the new American research university (Washburn 2011), faculty are certainly a unique form of human capital relative to their knowledge base and their expected societal contributions (Allen et al. 2007; Cole 2009). This calls for continued study of faculty from the human capital perspective.

A Review of University Faculty Time Allocation Literature

Middaugh (2001), among others, sets the premise for this study noting that faculty time allocation and ensuing pressures are poorly understood, regardless of the level of research at the college or university. This departs from the more traditional approach to faculty time allocation that addresses work-life balance. Link et al. (2008) note that the traditional economic approach to tradeoffs between work and leisure is well understood. However, tradeoffs between different types of faculty work activities have received little scholarly attention (Link and Siegel 2005).

Singell et al. (1996) determined that both institutional and individual characteristics influence faculty time allocation. Similarly, Fairweather (2002) addresses the myths surrounding faculty productivity in relation to career advancement, finding that young faculty members in particular seek clues about how to manage promotion and tenure pressures that include grant-writing. More recently, Bozeman and Boardman (2013) describe the rapidly changing expectations of researchers and their increasingly complex roles as faculty, especially in their evolving relationship with business and industry. Faculty face departmental pressures and expectations for participation in research institutes and centers as opportunities for funding from agencies such as the National Science Foundation.

Unlike other institutions, academia has a complex set of requirements for faculty, including expectations for knowledge transfer and positive societal impacts spanning to domains of teaching, research, and service (Houston et al. 2006). Research faculty members can find this confusing, and may look to administrative direction for cues on appropriate ways to manage their time. Equally confounding is that research funding is

becoming ever more competitive (Laudel 2006). Considering the Matthew Effect, which states that resources tend to go to those with status and prestige, and since grants tend to go to the most richly funded researchers, there is limited funding for others, especially young faculty (Crane 1965).

A study by Link et al. (2008) provides strong empirical evidence of rank and tenure effects on faculty time allocations. Their study examines the extent to which faculty with more seniority and established careers might allocate less time for undesirable, less fulfilling activities. They identify patterns in the ways faculty members at research universities allocate their time between a range of activities such as teaching, research and service. For example, they find that research faculty members exercise their preferences for ideal activities later in their career, i.e. after being tenured, when obligatory commitments diminish. Similarly they find that engagement in research activities decreases with seniority; full professors engage in more university service and associate professors tend to trade research for teaching.

A related study by Easterly and Pemberton (2008) notes that faculty advancement at United States higher education institutions is still generally granted on success in three traditional areas of the research university mission. Increasingly however, research activities are receiving disproportionately large attention. This observation, coupled with the findings of Link and his co workers (2005, 2007, 2008) concerning technology transfer and industry relationships, seem to suggest that faculty members are giving greater levels of consideration to motivations and incentives such as promotion and tenure when allocating their time to extramural funding and research in particular. Similarly, a study by Toutkoushian and Bellas (1999) suggests that promotion mechanisms tend to weigh heavily on research productivity. This is additional evidence to suggest that junior and untenured faculty members, in response to institutional pressures related to promotion, are likely to allocate more time to research and grant writing.

The literature over the past few decades touches on many aspects of faculty motivations for time allocation. Yet a vague area in the literature is the characterization of how *university administrators*, as opposed to *university policies*, impact faculty time allocations. The American Association of University Professors (AAUP) has longstanding views on the role of the professor within the organizational context of the university. In a 1994 statement, the AAUP reinforced their view that it is in the public's best interest that the faculty appointment be one of "dignity and independence:"

Teaching and research are the very purpose of an academic institution and the reason why the public values and supports it. This means that the faculty, who are responsible for carrying out those central tasks, would be viewed as having a special status within the institution. The Association has taken this view from its earliest days. Its first statement, the 1915 Declaration of Principles, declares that members of a faculty "are the appointees, but not in any proper sense the employees" of the trustees; they are partners with the trustees, and, as the 1915 Declaration states, the office of faculty member should be—indeed, it is in the public interest that the office of faculty member should be—"one both of dignity and of independence". (AAUP 1994, p. 47)

Despite this view of faculty autonomy, Porter and Umbach (2001) note that allocation of faculty time is an issue of particular and growing interest to university administrators. They suggest that administrators directly and indirectly affect the ways faculty members, both junior and senior, allocate their time. This is also the position taken by Meyer and Evans (2003) who argue that administrators' positive and negative reinforcement are

pervasive in academic management and in addition, faculty members are, more or less, slaves to the administration. In contrast, Toutkoushian and Bellas (1999) argue that a faculty member's personal preferences are the ultimate determinants of time allocation, sometimes to their own detriment. Accordingly, they note that women and minority faculty members tend to be promoted more slowly than others. This is at least in part, according to Toutkoushian and Bellas (1999), a result of women and minority tendencies to allocate time towards less promotable activities. They argue that university administrators should have a heavier hand (i.e. personalized incentives) in determining how women and minorities allocate their time. In the following section we further discuss specific aspects of the time allocation literature to date that influence our study.

Exploring Motivations Influencing Engagement in Research

Empirical examination of individual faculty member motivations and disincentives for engaging in grant related activity date back at least 30 years. For example, Burgoon (1988) noted that the individual benefit for pursuing grants extend well past financial gain. According to Burgoon, pursuing a grant is a means to and a product of excellence in professional scholarship. Daniel and Gallaher (1990) use survey methods to identify reasons faculty members do not engage in research activities, especially pursuing grants. They are among the first of many to report that lack of time during a busy faculty member's day is a major barrier to grant writing. Much of the literature in this area builds on the work of Daniel and Gallaher (1990) and seems to be informed by the common observation that grant writing for faculty is intimidating, risky, and time consuming when there are competing expectations and priorities (Monahan 1993, 1995). But the early literature tended to be oriented more toward attitudes of faculty about grant writing and less about the motivators or incentives.

In the 1990's the literature quickly turned to discussion of grant writing motivations. For example, in a study by Dooley (1995) it was observed that the "increasing exigency to secure grant funding has created an increased urgency for faculty to examine grant writing as an activity necessary for professional advancement" (p. 10). Similarly, it was observed of faculty that, "the tender loving care you devote to your student is equaled in importance only by the attention you bring to conceiving and writing research proposals" (Schoenfeld and Magnan 1994, p. 299). This literature identifies the pursuit of grants as a necessity for professional development and career advancement for research faculty. The trend has continued since a more recent study by Easterly and Pemberton (2008) looked critically at faculty job announcements and noted that proposal writing is quite frequently a position requirement. Other studies also echoed Dooley's (1995) and Burgoon's (1988) observations that pursuing grants contributes to professional development (Kleinfelder et al. 2003).

Meyer and Evans (2003) added a layer of complexity to observations on motivation by parsing out differences between intrinsic and extrinsic motivations. Intrinsic motivations are those that relate to the personal career benefits facing faculty as a result of pursuing grants. These include professional development and, for example, the satisfaction of feeling as though one has contributed to knowledge advancement. For example, Boyer and Cockriel (2001) observe several intrinsic motivations such as professional reputation and promotion or tenure as major motivators behind grant writing. Alternatively, extrinsic motivations include pressures from university administrators to perform satisfactorily in research and pursuit of grants. Dundar and Lewis (1998) find that university administrators, concerned about reputation, have increased focus and pressure on faculty to perform in research and grant related activities. These studies are of greatest interest to us for this

research. We contend that grant writing is affected by a combination of intrinsic and extrinsic factors. Specifically, university administrator pressure as an extrinsic factor affects grant writing by research faculty when controlling for their faculty position or intrinsic motivations.

The Influence of University Administrators

Historically, studies of faculty productivity in research related activities have focused on characteristics of individual faculty members. However, Dundar and Lewis (1998) note that increasing attention has been placed on organizational factors that explain variation in faculty time allocation. Universities have a long history of enacting various changes to increase the volume and quality of grant related activity (Churchman and Hellweg 1981). For example, some university colleges appoint associate deans with special responsibilities over research (Dooley 1995). Seminars and other activities are also implemented to help faculty members increase grant writing abilities. It is easy to understand why university administrators may want to have a hand in enhancing faculty pursuit of external grants. Benefits of grant productivity include professional development of faculty members (Churchman and Hellweg 1981), enhancing financial resources for the university (Sterner 1999), and promoting the reputation of the university (Dundar and Lewis 1998).

Tools available to university administrators to achieve these goals include what Meyers and Evans (2003) refer to as sticks and carrots. For example, incentives include salary advancement and promotion for excellence in this area or loss of withdrawal of departmental resources and support for underperformance. While Meyers and Evans (2003) criticize such management approaches, the literature supports the idea that administrative approaches have a great influence on faculty research activities, specifically grantsmanship (Middaugh 2001).

Evolution and Contributions of the Current Study

In this study we offer some insight into the impact that administrative pressure has on grant writing time by faculty. In particular we aim to confirm that traditional hierarchical managerial pressures affect university faculty productivity and behavior. If so, do these pressures also burden faculty in ways that are especially concerning relative to the views on faculty as special forms of human capital? In some sense, we aim to take the foundational literature on faculty time allocation (e.g. Bentley and Kyvik 2013; Singell et al. 1996; Toutkoushian and Bellas 1999) further to test empirically selected specific mediators like administrative pressure.

A review of the extant literature shows the progression to current opportunities for new and expanded empirical work. The early literature concerning faculty motivation for grant writing addressed fairly narrowly defined populations of faculty, which set the foundation for models for faculty productivity as a whole. For example, Boyer and Cockriel's (2001) survey of university faculty, Dooley's (1995) study of faculty in the College of Education at Texas A&M, and Easterly and Pemberton's (2008) survey of female faculty members all contributed to identifying relevant independent and control variables. In other early literature the population was very broadly defined and not focused on our particular issue of interest, that being the funding and financial viability of research universities as they face growing societal expectations for contribution to new knowledge. Similarly Singell et al.

(1996) developed and tested an economic model of faculty time allocation based on faculty preferences, comparing four institutional types as categorized in a 1973 Carnegie Commission study. In addition to expanding the discussion to categories of research-focused universities, their study created a follow-on question where administrative pressures fit into the faculty time allocation model in institutions where research is a primary output. Case study methods, which may be limited for statistical generalizations (Yin 2009) were also valuable in setting the framework for this and other faculty time allocation studies. For example, previously mentioned studies by Fairweather and Beach (2002) and Daniel and Gallaher (1990) both rely on case study designs for their findings. We have also seen evolving literature on comparative faculty time allocation. Bentley and Kyvik (2012, 2013) look at individual faculty allocation in various countries, with a focus on international differences in distribution of organizational resources and the economic viability of research universities in particular.

Of the literature we have identified so far, three in particular inform the type of faculty time allocation relevant to our study using samples from multiple disciplines in multiple institutions (Link et al. 2008; Singell et al. 1996; Toutkoushian and Bellas 1999). One additional study has similarly addressed research productivity (Porter and Umbach 2001). The work of Boyer and Cockriel (1998) especially contributed to the methodological design of our study. Taken in total, the literature reinforces the need to better understand the factors that motivate and discourage university faculty pursuit of grants. Independent variables that have emerged that predict time to grant pursuit include: differential perspectives of tenured and untenured faculty; the role of scientific discipline; the impact of working in a research-extensive university; and demographics such as age, gender and race.

Our study seeks to fill the gaps in the literature on prediction of faculty time allocation in part to further inform the debate on the role of traditional managerial incentives in the university faculty work environment. With growing expectations that they meet societal expectations of impact as well as an ability to adapt to changing financing and resource environments, the management of faculty, the core human resource of universities, clearly comes into question. New management strategies for faculty as elite human capital have reached a crossroad with traditional views of faculty autonomy as the source for the most efficient and effective societal impact, particularly at research universities. University faculty are typically thought to have great freedom from organizational or administrative influences with respect to the content of their intellectual pursuits, but extensive freedom of academic pursuit is debatable (Cole 2009; Gumpert 2000). That leads us to the current study.

Hypotheses

We anticipate that university administrators exert influence over faculty members in ways that advance the strategic priorities of the university. Accordingly, we posit that faculty members respond behaviorally to the expectations of their administrative superiors with respect to grant writing, and that they adjust their performance to comply with these expectations. If administrative pressure does affect faculty behavior, does this pressure also manifest itself in limiting faculty autonomy in typically protected areas such as a research agenda or interest in extramural funding? Do these same pressures affect faculty job

satisfaction, which could have human resource implications such as retention? With these premises, we offer the following hypotheses.

H₁ Increases in a faculty member's perception that administrative superiors expect him or her to pursue external grants or contracts is associated with increases in the amount of time allocated towards pursuing external grants or contracts.

H_{2a} Increases in a faculty member's perception that administrative superiors expect him or her to pursue external grants or contracts is associated with decreases in job satisfaction.

H_{2b} Increases in a faculty member's perception that administrative superiors expect him or her to pursue external grants or contracts is associated with increases in the likelihood that faculty pursue grants and contracts that are uninteresting to them.

Data and Methods

To test our hypotheses, we constructed a set of 4 multivariate regression models in two stages. Models 1 and 2 examined H₁ in stage one and Models 3 and 4 examined H_{2a} and H_{2b} in stage two. We used cross-sectional survey response data from the National Science Foundation/Department of Energy Survey of Academic Researchers (SAR).¹ The survey was administered to a random sample of non-administrative university faculty members at the 150 Carnegie Extensive Doctoral/Research Universities (formerly referred to as "Research 1" universities).² The survey was conducted in 2005 and the sample was stratified by academic discipline and gender. The target sample was 200 men and 200 women from each of the 12 National Science Foundation science and technology disciplines including biology, computer science, mathematics, physics, earth and atmospheric science, chemistry, agriculture, chemical engineering, civil engineering, electrical engineering, mechanical engineering, and materials engineering (Bozeman and Gaughan 2007). Sociologists were also sampled as a social science reference category.

SAR data are ideal for examining these hypotheses for multiple reasons. First, and most importantly, the Survey of Academic Researchers is one of the few studies to provide time allocation data across a large number of institutions and academic fields while also collecting information on important motivational factors. Second, there is some reason to believe that more recently collected data may include echoes of the Great Recession, including a nonstandard grants environment for university research (which, according to Sarewitz (2003), is otherwise characterized as more or less stable over time). For example, nearly \$16 billion in R&D funding has been allocated as part of the American Recovery and Reinvestment Act (ARRA) since 2009,³ largely for durable research instrumentation and other resources.

The overall response rate for faculty members at research universities is 38 %. The number of overall observations is 1448. Several classes of faculty were removed, as these

¹ SAR data was collected by a team of researchers in the School of Public Policy (SPP) at Georgia Institute of Technology. Prior to data collection, SPP researchers requested and were granted approval from the Institutional Review Board to conduct the survey research project according to their compliance with human subjects protection protocols in place.

² For more detail see <http://www.carnegiefoundation.org/newsroom/press-releases/carnegie-launches-knowledge-network-what-we-know-about-value-added>.

³ See <http://www.recovery.gov/arra/Transparency/fundingoverview/Pages/fundingbreakdown.aspx> for current ARRA allocation levels.

individuals represent atypical tenure or promotion characteristics that one might reasonably presume to threaten the validity of the findings. These included tenured assistant professors, untenured associate or full professors and full professors who received tenure the same year they started in their tenure track position. Our final number of observations is 1429.

Models 1 and 2 test H_1 , that increases in administrative pressure to pursue grants and contracts are associated with increases in the time allocated towards pursuing grants and contracts. The dependent variable, time, is measured as the average amount of time (Model 1) and percent of time (Model 2) spent per week pursuing grants or contracts. These are measured as responses to the following question: “For the most recent full academic term, please indicate the average number of hours per week devoted to writing or developing proposals for grants and contracts.” The mean number of hours reported is 5.02 (SD is 4.93). The minimum is 0 and the maximum is 35. Respondents were also asked to approximate their time spent researching, teaching and providing service. The mean of the sum of time spent on all activities is 53.73 h. The mean percent of time spent writing grants is approximately 9 %, or roughly 250 h over the course of a year. We adopted a Poisson estimation strategy because the dependent variable violates the assumption of normality for OLS prediction and has no negative values (Gardner et al. 1995; Dietz and Bozeman 2005).

We understand that individual faculty members have a number of important motivations that influence their behaviors relative to allocating time towards grant writing. Accordingly, we controlled for the extent to which the faculty member writes grants because he or she enjoys preparing proposals, needs to support graduate students, wants to buyout teaching time or wants to supplement their salary. All of these controls were instrumented as variables that are responses to survey items where faculty respondents were asked to agree or disagree with specific statements on a four point Likert scale with four indicating strong agreement and one indicating strong disagreement. To control for enjoyment of preparing proposals, we used respondents’ agreement with the statement, “generally, I enjoy proposal preparation.” To control for the need to support graduate students, we used respondents’ agreement with the statement, “a major motivation for my preparing proposals is to support graduate students.” To control for interests in buying out teaching time, we used respondents’ agreement with the statement, “I try to obtain grants or contracts to “buy out” from teaching.” Finally, to control for the need to supplement salary, we used respondents’ agreement with the statement, “I try to obtain grants or contracts for salary funding.” We used these controls to partial out the effect of administrative pressure on our time allocation predictions in stage one only. We did not include these in our likelihood estimations of job satisfaction and pursuit of uninteresting grants in stage two.

H_{2a} and H_{2b} state that increases in administrative pressure are associated with decreases in job satisfaction and increases in pursuit of uninteresting grants, respectively. To test these hypotheses we estimated the effects of administrative pressure in ordered probit predictions of self-reported measures of job satisfaction and agreement with the statement, “I sometimes pursue grants and contracts that are uninteresting to me.” Both measures, like the other Likert-scale questions outlined above, are responses on 4-point agreement scales ranging from strongly disagree (1) to strongly agree (4).

All four models used controls for academic rank, gender, ethnicity, citizenship status, marital status, and children at home. Academic rank is modeled as two dummy variables, one for assistant professors and one for full professors. Link et al. (2008) find tenure and rank to be a significant predictor of time allocation using these same data. They note that tenured full professors spend less time teaching and researching but more time in service,

whereas tenured professors who have not been promoted to full-professor typically spend more time teaching and less time researching. Similarly Walden and Bryan (2010) note the differences in scholarly and grant writing and the role of tenure position on faculty productivity. Clearly, faculty time allocation has changed over time due to many variables (Milem et al. 2000). Accordingly we expect to find that tenure position affects grant writing time.

Gender is modeled as a dummy variable set to 1 if the faculty member is male. Prior research on faculty gender suggests that women would spend more time on grant activities than men (Boyer and Cockriel 1999; Gaughan and Ponomariov 2008). There are numerous possibilities for modeling race, ethnicity and citizenship. We followed the specification provided by Link et al. (2008) and offer a set of dummy variables as follows: a dummy variable set to 1 if the faculty member is Asian, another set to 1 if the faculty member is white and a final set to 1 if the faculty member is a US Citizen. Specification as such is largely motivated by the characteristics of the data. Over 83 % of respondents identified themselves as white. The next most common category was Asians, representing over 11 % of respondents. African American faculty members comprised just 20 responses and those who identified themselves as Hispanic represented only 43 responses. Based on the research of Toutkoushian and Bellas (1999) we can expect that research productivity will vary by gender, race and ethnicity. Male faculty are expected to have higher levels of research output than female faculty and non-whites, notwithstanding Asians, who on average have higher research outputs than whites. Marriage and family dynamics are thought to limit total time available to allocate towards work, and therefore influence the time allocated towards writing grants. Grant funding may offer supplemental earnings, thus motivating faculty members with dependent spouses and children to spend more time pursuing them. We suspect that patterns of time allocation differ by academic field.

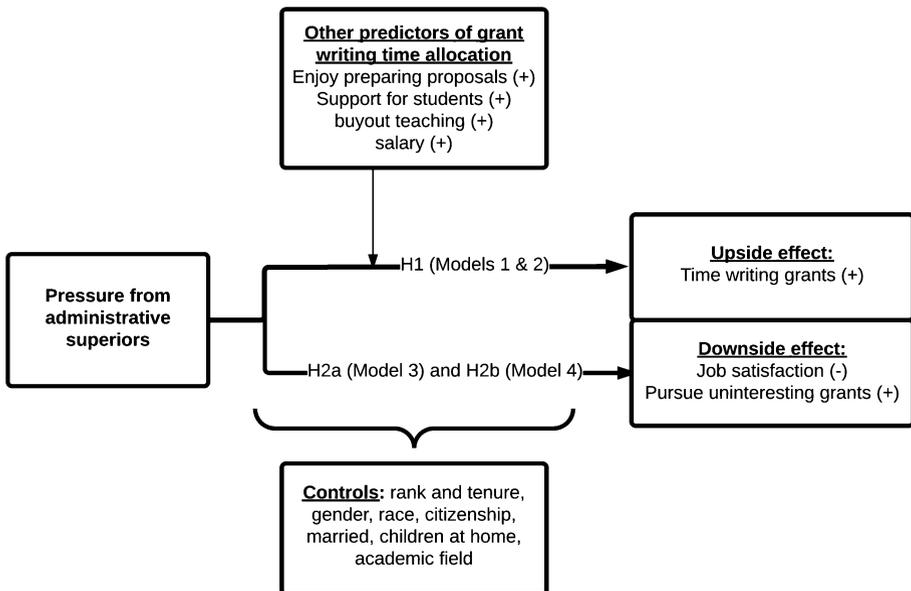


Fig. 1 Hypothesized merits and limitations of pressure from administrative superiors

Included here are dummy variables set to 1 for 12 academic fields including biology, computer science, mathematics, Earth and atmospheric sciences, chemistry, agriculture, sociology, chemical engineering, civil engineering, electrical engineering, mechanical

Table 1 Variable descriptions

Variable Name	Variable Description
Dependent	
Time writing grants in hours per week	Self-reported number of hours spent writing proposals for grants or contracts per week in the most recent academic year
Percent time writing grants	This is the percent of total time allocated towards writing grants
Independent	
Write due to pressure from administration	Four point Likert scale with 1 strongly disagree and 4 strongly agree
Write because enjoy preparing proposals	Four point Likert scale with 1 strongly disagree and 4 strongly agree
Write to support graduate students	Four point Likert scale with 1 strongly disagree and 4 strongly agree
Write to buyout teaching	Four point Likert scale with 1 strongly disagree and 4 strongly agree
Write to get salary increase	Four point Likert scale with 1 strongly disagree and 4 strongly agree
Control	
Associate professor	Dummy variable set to 1 if associate professor, 0 otherwise. Reference category is assistant professor when modeling as a fixed effect
Full professor	Dummy variable set to 1 if full professor, 0 otherwise. Reference category is assistant professor when modeling as a fixed effect
Male	Dummy variable set to 1 if male, 0 not male
Asian	Dummy variable set to 1 if Asian, 0 otherwise
Citizen	Dummy variable set to 1 if US Citizen, 0 otherwise
White	Dummy variable set to 1 if white, 0 otherwise
Married	Dummy variable set to 1 if married, 0 otherwise
Children at home	Dummy variable set to 1 if children live at home, 0 otherwise
Biology	Dummy variable set to 1 if academic field is biology, 0 otherwise
Computer science	Dummy variable set to 1 if academic field is computer science, 0 otherwise
Mathematics	Dummy variable set to 1 if academic field is mathematics, 0 otherwise
Earth & atmospheric science	Dummy variable set to 1 if academic field is earth and atmospheric sciences, 0 otherwise
Chemistry	Dummy variable set to 1 if academic field is chemistry, 0 otherwise
Agriculture	Dummy variable set to 1 if academic field is agriculture, 0 otherwise
Sociology	Dummy variable set to 1 if academic field is sociology, 0 otherwise
Chemical Engineering	Dummy variable set to 1 if academic field is chemical engineering, 0 otherwise
Civil engineering	Dummy variable set to 1 if academic field is civil engineering, 0 otherwise
Elec. engineering	Dummy variable set to 1 if academic field is electrical engineering, 0 otherwise
Mechanical engineering	Dummy variable set to 1 if academic field is mechanical engineering, 0 otherwise
Materials engineering	Dummy variable set to 1 if academic field is materials engineering, 0 otherwise

engineering, and materials engineering. The reference category for field effects is physics.

Figure 1 shows our logic model including hypotheses, controls and their corresponding models. Table 1 that follows provides descriptions of all variables, Table 2 shows time allocation differences across key faculty demographic and field groups, and Table 3 provides summary statistics.

Results

Table 4 below presents the results of the Poisson estimations of the regression controlled effect of administrative pressure on a faculty member's time allocation towards grant writing.

Since the results of the Poisson estimation are not easily interpreted, we also provide the incident rate ratios (IRR) for each coefficient. According to Model 1, a single point increase in perceived pressure from administrative superiors is associated with a 1.19 h

Table 2 Grant writing time by gender, rank and academic field

	Mean hours				
	Per week	SD	% Time	SD	N
All Respondents	5.02	4.93	9.10	8.42	1429
Gender					
Men	4.59	4.67	8.32	7.80	696
Women	5.42	5.13	9.86	8.91	733
Rank					
Untenured (assistant prof)	6.26	5.30	11.30	9.03	369
Tenured	4.58	4.71	8.33	8.07	1060
Associate	4.79	4.84	8.57	7.71	376
Full	4.47	4.64	8.21	8.26	684
Academic fields					
Biology	5.88	5.78	11.04	10.89	106
Computer science	4.32	3.82	8.13	7.37	116
Mathematics	2.13	2.61	3.95	4.64	84
Physics	3.81	3.88	7.80	8.75	120
Earth/atmospheric science	4.32	4.09	7.45	6.27	129
Chemistry	7.56	6.52	12.45	9.49	118
Agriculture	5.32	5.52	10.81	9.66	104
Sociology	2.66	3.83	4.80	6.50	120
Chemical engineering	6.14	5.09	10.82	8.27	100
Civil engineering	5.98	5.43	10.68	8.75	140
Elec. engineering	5.62	4.37	9.96	7.48	95
Mechanical engineering	5.34	4.35	9.59	7.32	122
Materials engineering	5.95	4.47	10.66	7.60	75

Table 3 Summary statistics

Variable	Mean	SD	Min	Max
Dependent variables				
Time writing grants (h)	5.02	4.93	0	35
Percent of time writing grants	9.10	8.42	0	76
Independent variables				
Pressure from administration	3.89	0.39	1	4
I enjoy preparing proposals	2.55	0.88	1	4
Support graduate students	3.47	0.77	1	4
Write to buyout teaching	1.74	0.94	1	4
Write to get salary	2.78	1.03	1	4
Control variables				
Assistant professor	0.26	0.44	0	1
Associate professor	0.26	0.44	0	1
Full professor	0.48	0.50	0	1
Male	0.49	0.50	0	1
Asian	0.10	0.31	0	1
Citizen	0.87	0.34	0	1
White	0.83	0.37	0	1
Married	0.86	0.35	0	1
Children at home	0.47	0.50	0	1
Research center affiliate	0.39	0.49	0	1
Biology	0.07	0.26	0	1
Computer science	0.08	0.27	0	1
Mathematics	0.06	0.24	0	1
Physics	0.08	0.28	0	1
Earth & atmospheric science	0.09	0.29	0	1
Chemistry	0.08	0.28	0	1
Agriculture	0.07	0.26	0	1
Sociology	0.08	0.28	0	1
Chemical engineering	0.07	0.26	0	1
Civil engineering	0.10	0.30	0	1
Elec. engineering	0.07	0.25	0	1
Mechanical engineering	0.09	0.28	0	1
Materials engineering	0.05	0.22	0	1

N = 1429

increase in time allocated towards writing grants per week, on average and holding all else equal. This is statistically significant at the 0.01 level. When considering grant writing in terms of percent time (Model 2), the effect of pressure from administration is a 12.6 percent increase in time allocated towards grant writing, on average holding all else equal. This effect is significant at the 0.01 level. Three of the four motivation controls are also statistically significant at the 0.01 level. A one-point increase in enjoyment in preparing proposals is associated with a 1.12 h increase in time allocated towards writing grants per week, on average holding all else equal. A one-point increase in support for graduate students is associated with a 1.20 h increase and time allocated towards grant writing, on average holding all else equal. Finally, a one-point increase in writing for more salary is

Table 4 Poisson model of pressure from administration superiors on faculty time per week writing grants

	Estimated coef. (grant writing hours)	Std. error	IRR	Estimated coef. (% time)	Std. error	IRR
Independent variable						
Pressure from administration	0.170**	(0.047)	1.19	0.228**	(0.036)	1.26
Grant writing motivation controls						
I enjoy preparing proposals	0.117**	(0.014)	1.12	0.094**	(0.011)	1.10
Support graduate students	0.182**	(0.020)	1.20	0.145**	(0.015)	1.16
Write to buyout teaching	0.005	(0.014)	1.00	0.020	(0.010)	1.02
Write to get salary	0.055**	(0.013)	1.10	0.057**	(0.009)	1.06
Other controls						
Associate professor	−0.227**	(0.032)	0.80	−0.245**	(0.024)	0.78
Full professor	−0.238**	(0.030)	0.79	−0.228**	(0.022)	0.80
Male	−0.100**	(0.025)	0.90	−0.115**	(0.019)	0.90
Asian	0.213**	(0.054)	1.23	0.174**	(0.041)	1.20
Citizen	−0.002	(0.036)	1.00	−0.008	(0.027)	1.00
White	−0.017	(0.047)	1.00	0.008	(0.035)	1.00
Married	−0.138**	(0.035)	0.90	−0.085**	(0.026)	0.92
Children at home	0.116**	(0.026)	1.12	0.114**	(0.019)	1.12
Biology	0.411**	(0.062)	1.51	0.327**	(0.044)	1.39
Computer science	0.047	(0.065)	1.05	−0.034	(0.047)	0.97
Mathematics	−0.340**	(0.089)	0.72	−0.460**	(0.065)	0.63
Earth & atm. science	0.052	(0.064)	1.05	−0.099*	(0.046)	0.90
Chemistry	0.629**	(0.058)	1.88	0.431**	(0.042)	1.54
Agriculture	0.423**	(0.064)	1.53	0.418**	(0.045)	1.52
Sociology	−0.163*	(0.078)	0.85	−0.296**	(0.057)	0.74
Chemical engineering	0.359**	(0.063)	1.43	0.234**	(0.045)	1.27
Civil engineering	0.260**	(0.060)	1.30	0.155**	(0.043)	1.17
Elec. engineering	0.238**	(0.065)	1.27	0.112*	(0.047)	1.12
Mechanical engineering	0.207**	(0.062)	1.23	0.098*	(0.045)	1.10
Materials engineering	0.355**	(0.068)	1.42	0.234**	(0.049)	1.26
Constant	−0.138	(0.206)	0.87	0.455**	(0.155)	1.58
Observations	1442			1442		
Likelihood ratio Chi squared (25)	1089.41***			1704.83***		
Pseudo R-squared	0.1059			0.1128		

* $p < 0.05$ ** $p < 0.01$

associated with a 1.10 h increase in time allocated towards grant writing per week, on average holding all else equal. Writing to buyout teaching is not statistically significant in these models.

Models 1 and 2 show that associate and full professors on average spend less time writing grants than their assistant professor counterparts. Male faculty members spend less time writing grants than their female counterparts and married faculty spend less time writing grants than unmarried faculty. Asian faculty and those who have children at home spend more time and greater proportions of their time writing grants than their counterparts who do not have children at home. This is an unexpected finding since the literature shows that men and women research faculty usually devote the same overall time to their employment each week (Misra et al. 2012).

There are strong statistically significant differences between academic fields. Biology, chemistry, agriculture, and all engineering fields spend statistically significantly greater

Table 5 Marginal effects of administrative pressure on satisfaction and pursuit of grants

Independent variable	Job satisfaction (Model 3)	Robust SE	Pursuing uninteresting grants (Model 4)	Robust SE
Pressure from administration	−0.143***	(0.038)	0.127***	(0.021)
Control variables				
Associate professor	−0.027	(0.042)	−0.008	(0.017)
Full professor	0.137***	(0.038)	−0.037**	(0.016)
Male	0.043*	(0.024)	−0.010	(0.010)
Asian	0.013	(0.069)	0.017	(0.026)
Citizen	−0.085*	(0.046)	0.001	(0.018)
White	−0.001	(0.058)	0.025	(0.022)
Married	0.124**	(0.050)	0.018	(0.022)
Children at home	−0.051*	(0.030)	0.019	(0.013)
Academic fields				
Biology	0.059	(0.073)	−0.006	(0.032)
Computer science	−0.079	(0.074)	0.074**	(0.032)
Mathematics	−0.048	(0.071)	0.003	(0.033)
Earth & atmos. science	0.140**	(0.070)	0.020	(0.032)
Chemistry	−0.001	(0.068)	−0.003	(0.032)
Agriculture	0.052	(0.069)	0.084***	(0.031)
Sociology	−0.011	(0.074)	0.033	(0.032)
Chemical engineering	0.070	(0.071)	0.070**	(0.031)
Civil engineering	−0.075	(0.067)	0.123***	(0.034)
Elec. engineering	−0.100	(0.072)	0.085**	(0.034)
Mechanical engineering	−0.093	(0.073)	0.102***	(0.030)
Materials engineering	0.011	(0.076)	0.077**	(0.031)

Marginal effects of probability of “strongly agree”

N for Model 5 = 1421

N for Model 6 = 1423

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

amounts of time and proportions of their time on grant writing than their counterparts in physics. Sociologists and mathematicians spend statistically significantly fewer hours writing grants than faculty in physics. There are no statistically significant findings relative to computer science and earth and atmospheric sciences.

Our first hypothesis is that increases in a faculty member's perception that administrative superiors expect him or her to pursue external grants or contracts is associated with increases in the amount of time allocated towards pursuing external grants or contracts (H_1). Our findings support this hypothesis. While the effect is small, it is neither statistically or economically trivial. A one-point increase in our measure of pressure from administration is associated with a 1.19 h per week increase in time allocated towards grant writing. As such, a shift from "strongly disagree" to "strongly agree" is associated with a 4.76 h per week increase in time allocated towards writing. If the faculty member works 50 weeks per year this translates to a difference of 238 h annually.

Table 5 presents the results from Models 3 and 4, which test H_{2a} and H_{2b} , that increases in administrative pressure are associated with decreases in job satisfaction and increases in pursuit of uninteresting grants, respectively. To test these hypotheses we estimate these effects of administrative pressure in ordered probit predictions of self-reported measures of job satisfaction and agreement with the question, "I sometimes pursue grants and contracts that are uninteresting to me." Both questions are responses on 4-point agreement Likert scales ranging from strongly disagree (1) to strongly agree (4). Because ordered probit coefficients are not directly interpretable, Table 5 provides estimates of the marginal effects of the probability of a respondent strongly agreeing with the respective statements. Accordingly, we find that when holding all else equal every one-point increase in a respondent's sense that administrative superiors expect them to pursue grants and contracts is associated with a 14.3 % reduction in the likelihood that they report to strongly agree with the statement, "I am satisfied with my job" (Model 4) and a 12.7 % increase in the likelihood that they agree with the statement, "I sometimes pursue grants and contracts that are uninteresting to me" (Model 4). Both effects are statistically significant at the 0.01 level. The results in Models 3 and 4 support hypotheses H_{2a} and H_{2b} .

Discussion

We find statistically significant evidence to support all three of our hypotheses. Increases in administrative pressure to pursue grants and contracts are associated with increases in time allocated toward granting writing, decreases in job satisfaction and increases in the likelihood of pursuing uninteresting grants and contracts.

A number of additional findings are worth discussion despite not pertaining directly to our hypotheses. To begin, Models 1 and 2 find that faculty members with children at home spend more time writing grants and contracts than their colleagues without children at home. A number of studies have considered the relationship between family dynamics and faculty work behaviors including productivity (Toutkoushian and Bellas 1999; Fox 2005) and job satisfaction (Bozeman and Gaughan 2011). Fox (2005) finds that women with pre-school aged children are especially productive relative to women faculty without children or with children in K-12 schools. Fox finds that even when controlling for life-stages, women with children at home are more productive than their counterparts. A partial explanation that pertains to the present study is the notion of disciplined allocation of time, which Fox (2005, p. 143) uses in noting that women with pre-school children allocate less

time to departmental service and advising undergraduates (tasks that generally inhibit research productivity) and spend more time advising graduate students (tasks that can help research productivity). Accordingly, it may be the case that faculty with children at home experience greater overall time pressure and naturally select into time allocation habits that enhance research productivity, including writing grants.

We have no hypotheses relative to academic fields but understand that they play an important role in determining time allocation, as mentioned in our justification for including them as statistical controls. We note that all five engineering fields are associated with large, statistically significant effects on time allocations towards grant writing. This finding is consistent with our expectations given the role of sponsored research in determining tenure in these fields. Similarly compliant with our presuppositions are the findings that faculty in sociology and mathematics spend less time pursuing grants than their colleagues in physics. Moving to our predictions of satisfaction, we find that, except in the case of earth and atmospheric sciences, there are no statistically significant field effects on job satisfaction. This is particularly interesting in light of the growth of interdisciplinary research, research fields, academic departments and university research centers.⁴ One can reasonably assume that growth of interdisciplinary research could either enhance or threaten job satisfaction. For example, such research could expand the network of university-based collaborators and thus increase productivity and satisfaction, or it could increase the frequency and type of cross-field comparisons of research quality and relative compensation thereby decreasing satisfaction. As a consequence of these factors, we identify the relationships between academic fields, faculty research and job satisfaction as important domains for continued research, building upon, among others, the work of recent examinations of international aspects of satisfaction (Bentley et al. 2013), the role of financial incentives (Mustapha, 2013), and the multidimensional nature of faculty job satisfaction (Bozeman and Gaughan 2011).

While our findings support the claims that pressure from administrative superiors has both merits and limitations when it comes to managing university faculty, we are careful to note several important limitations. In the first place, our measure of administrative pressure pertains to just one domain of university faculty work—grant writing—for one type of university—the American research university. While grant writing at research universities is important, this fails to accommodate the possibility that important teaching and service related pressures may exist at these universities and are certain to exist at teaching focused institutions. A related limitation of our measure of administrative pressure is that it is based on perceptions and not on systematized management strategy. This is important since the pressure to write grants and contracts can come directly from department heads or less directly from tenure and promotion committees. In addition to the possibility for variance in the directness of pressure, we can also expect variance in the form of the pressure. For example, a written performance evaluation provided by a department chair with specific reference to grant writing expectations represents one embodiment of pressure, while an informal conversation between a faculty member and a department tenure committee represents another, even though both may occur to the same faculty member in the same department with the same expectations for grant writing.

We are also cognizant that faculty job satisfaction is known to be multidimensional (Bozeman and Gaughan 2011; Hagedorn 2000; Mamiseishvili and Rosser 2011) but it is not measured here in such a manner. While our predictions of the role of administrative

⁴ For a complimentary discussion pertaining to satisfaction and research center affiliation see Bozeman and Gaughan (2011).

pressure in predicting general job satisfaction are robust, we know that there are other factors that play an important role in predicting satisfaction including, but not only, life and career stage. Unfortunately, the lack of panel data here fails to afford the opportunity to examine many issues pertaining to life and career stage such as tenure and tenure casualties. Finally, we are careful to note that since our survey sample frames target faculty in the sciences and engineering, we are limited in our capacity to extend our findings meaningfully to faculty in the arts and sciences.

Conclusion

While pressure from administrative superiors to pursue grants and contracts may be an effective mechanism for increasing time allocations towards grant writing, it may also be associated with some negative workplace attitudes and behaviors, including, as noted here, decreases in satisfaction and increases in pursuit of uninteresting grants and contracts. It is telling that while controlling for academic field effects and personal attributes, this one factor—administrative pressure to pursue grants and contracts—remains a strong predictor of decreases in overall job satisfaction.

The observation that pressure from administrators has a strong positive effect on pursuit of uninteresting grants stirs mixed feelings. On the one hand, it is interesting to observe the strong effects academic administrators have on compelling faculty members' time allocation toward uninteresting activities. But university faculty cultures, especially for faculty in research universities, rely heavily on ideals of academic freedom. Such ideals are, in turn, rooted in notions of free inquiry and autonomy of the faculty member from pressures of the institution. While the prospects of operating under such autonomy are understandable from sociological perspectives including those of the professions and elite knowledge workers, they are also illustrative of the challenges universities face as they seek to advance their research agendas.

While it is true that for research faculty the pursuit of uninteresting grants is not something to embrace as routine, it may be worth tolerating since satisfaction with work as a research faculty member is likely multi-dimensional and is likely affected by other issues not related to grant activities. Indeed, unlike decreases in satisfaction, there could be an upside to pursuing uninteresting grants. In the first place, it may be the case that individuals who are engaged in the pursuit of uninteresting grants are also engaged in the pursuit of interesting grants. In such a case, it is reasonable to believe that the additional pressure from administrative superiors to pursue grants results in over-pursuit of grants. Under these circumstances, uninteresting grants may account for only a portion of the supplemental efforts of the faculty member. In some sense, this is to suggest that those who are pursuing uninteresting grants are likely pursuing as many interesting grants as are available to them. This high-volume dynamic may come about through faculty mentorship or collaboration patterns. Both are generally positive activities that could very well be associated with increases in the likelihood of pursuing uninteresting grants. A second potential upside here is the hypothesis that grants viewed as uninteresting now may become interesting later. Interest in the grant topic may increase naturally with the evolution of the faculty member's research agenda. Alternatively, it may very well be the case that merely receiving funding for the research peaks interest.

In conclusion, that faculty members at research universities have drivers that predict allocation of their time to teaching, research and service is expected; that is what research

university faculty do to enjoy better salaries than faculty in liberal arts universities (Caplow and McGee 1958). How time is allocated to these activities is more difficult to specify and varies with a number of factors including tenure status, academic field, gender and personal preference (e.g. Link et al. 2008; Singell et al. 1996). Looking at managerial pressures and constraints on faculty autonomy is relatively new to this discourse. Within this context, the topic of grant writing specifically is important from a practical perspective as universities face dramatic decreases and changes to their traditional modes of finance. From a theoretical perspective, with faculty serving as elite human capital, managerial issues and pressures on faculty become a higher priority for additional investigation.

Our results suggest that administrative pressure to pursue grants, even in uninteresting areas, results in additional time allocation to that effort in the short term but could lead to the negative consequences of faculty job dissatisfaction. Our findings suggest one of two things. First, if faculty autonomy, in research universities in particular, is of great social value, then more should be done to protect their personal research agendas (Perorazio 2009). Second, and alternatively, if university research is of greater social value and it is optimized through administrative pressures and channels, then we must recognize that research university faculty are different, with multidimensional interests, and that they are satisfied on many levels, such as work in uninteresting areas. Our findings support the importance of an expanded research agenda to investigate the implications of managerial pressures on faculty time allocation, and in particular the possible policy interventions that can facilitate the faculty role in institutional funding generation without creating more than the usual dissatisfaction of individual scientists who are directed other ways than their personal research interests.

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