The Impact of Institutional and Peer Support on Faculty Research Productivity: A Comparative Analysis of Research Vs. Non-Research Institutions

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THE IMPACT OF INSTITUTIONAL AND PEER SUPPORT ON FACULTY RESEARCH PRODUCTIVITY: A COMPARATIVE ANALYSIS OF RESEARCH VS. NON-RESEARCH INSTITUTIONS

BY

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ABSTRACT

Across the landscape of American higher education, research has gradually established its dominant role in faculty work since the end of WWII—a paradigm shift yet to be fully studied and understood. Situated on their traditional locales on the spectrum stretching from pure teaching to heavy research, contemporary institutions all attempt to be involved in research activities. Research productivity, an essential contributor to the improvement of society and mankind, becomes the iconic indicator for institutional prestige, one of the vital resources any higher education institution requires for maintaining operation and facilitating development and growth. Responsively, an institutionalized recruitment and reward system unanimously sets the requirement for research productivity to allow faculty members to move through the academic pipeline. This study is aimed at identifying influential factors that may lead to higher research productivity at research and non-research institutions respectively by analyzing the data collected from the CAP (Changing Academic Profession) survey.

The logistic regression models have revealed four major findings. First, at research and non-research institutions, faculty collaboration with either domestic or international colleagues is essential for research productivity. Second, faculty collaboration with international colleagues is the best predictor of research productivity among all the factors included in the study (faculty professional characteristics, administration support research, peer support research). Third, faculty preferences in research lead to higher research productivity at research institutions, but not apparently at non-research institutions. Fourth, administration generally plays no role in improving
research productivity; nonetheless, it may play a marginal role at non-research institutions if peer collaboration is neither counted nor present.
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DEDICATION

To my parents

To my mentor and advisors, current and former

To my relatives

To my friends

who has supported me along the way
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CHAPTER I. INTRODUCTION

THE ORIGIN OF THE PROBLEM: RESEARCH PRODUCTIVITY

During the first half of the twentieth century, faculty life at most institutions consisted largely of a heavy teaching load, with little or no research activity (Middaugh, 2001). However, the situation has changed considerably since the end of World War II (Finkelstein, 1984). From the inception of World War II, leading research universities worked closely with the federal government on projects in applied research to support the war effort. Gradually, applied research began to diffuse across other doctoral granting universities due to the availability of government funding. This gave rise to formal graduate education at large numbers of American colleges and universities (Middaugh, 2001). Following World War II, graduate students whose training had emphasized research techniques, as opposed to teaching paradigms, moved into faculty positions across the nation (Middaugh, 2001). These faculty members concentrated on developing research programs in their fields of study. This research-oriented pattern was further reinforced by the cold war and space race in the 1960s and 1970s (Middaugh, 2001). The concern about faculty research productivity brought a paradigm shift in the academic profession in higher education settings. Ernest L. Boyer (1990) described the situation in his book *Scholarship Reconsidered: Priorities of the Professoriate*:

The problem was that the research mission, which was appropriate for some institutions, created a shadow over the entire higher learning enterprise, and the model of a “Berkeley” or an “Amherst” became a yardstick by which all institutions would be measured (p.12).
The rapid expansion of higher education system in the US after World War II has reshaped the landscape: Institutions begin to operate under ever increasing pressure to compete for resources which they used to take for granted. Research visibility enhances institutional stature among peers (Alpert, 1985). Research is no longer a sporadic and individual activity loosely organized by institutions. The quality and quantity of faculty research directly affects the institution. From a financial standpoint, faculty-acquired grants can bring in external funding for direct and indirect research costs (C. Bland, J., Weber-Main, Lund, & Finstad, 2005). Concomitant discoveries can yield new inventions and patents, generating additional revenue (C. Bland, J., et al., 2005). Not only does excellence of faculty research attract external funding for future initiatives, it also becomes a means whereby an institution can establish a reputation for outstanding faculty and demonstrate achievement and progress to the public (Meisinger, Purves, & Schmidtlein, Winter, 1975). Institutions need faculty members to be more productive in research for the sake of institutional reputation or prestige, which can give the institution an edge in the increasingly fierce competition for a shrinking applicant pool and endowment. Thus, institutions strive to gain prestige by either attracting well known faculty with strong research orientations or enticing their current employed faculty members into doing research in addition to originally assigned teaching loads. Research universities' (Carnegie Classification Research I and II) take the lead in this trend which in turn aligns with their spirits and missions.

Non-research institutions have found it necessary to follow this trend to maintain their competitive position, although their administrative leadership and teaching oriented faculty may be inadequately prepared to meet this demand. Research expectations are
now rising at teaching institutions (J. Fairweather, 1993). Research is no longer the prerogative of doctorate granting institutions and major universities; state colleges and liberal arts schools have begun to stress research, publications, and involvement in professional societies (Seldin, 1984). In addition, faculty in traditionally professional programs are encouraged to lean towards research-tracks. Nursing is an example of a professional program that has dramatically increased its research productivity in response to calls for change (C. Bland, J., et al., 2005). While research is no longer an optional choice for any institution, it is now a matter of survival and required faculty development. Therefore, institutions are seeking to understand how they can promote faculty research productivity. In other words, before institutions start to pour their limited resources, they need to answer this prioritized question: “In what way can they help faculty produce more research outputs?”

BACKGROUND

Study of Research Productivity

Numerous studies have sought to determine the factors that promote research activities and enhance faculty research productivity (Baird, 1986; Baldwin, September, 1985; Blackburn & Lawrence, 1995; C. Bland, J., et al., 2005; C. J. Bland, Center, Finstad, Risbey, & Staples, 2006; Creamer, 1998; Creswell, 1985; J. Fairweather, S., 2002; Finkelstein, 1982; Fox, 1992; Layzell, 1996; Meyer, 1998; Teodorescu, 2000; Tien & Blackburn, 1996; Wanner, Lewis, & Gregorio, 1981; Yuker, 1978). The findings of these studies, however, are primarily focused on research universities or heavily research-oriented institutions. Indeed, their pre-eminent finding is that the institutional goal, as
reflected in institutional type, is an important predictor of research productivity. Research productive departments have clear organizational goals that place a high priority on research (C. Bland, J., et al., 2005). Baird's (1986) study of 74 chemistry, history, and psychology departments found that those with clear, dominant, research-centered goals were most productive. Research institutions do possess a wide variety of natural advantages when paired with a research-driven mission with research-oriented faculty. On the other hand, non-research institutions, accounting for a much large percentage of the total higher education institutions, have a blurred vision of their institutional missions. Blackburn et al. (1978) found faculty productivity to be highest where educational emphasis was on graduate students, followed by progressively less productivity as the institution increased its focus on undergraduate students. Research productivity also decreased when a unit focused on applied graduate training rather than academic graduate training (C. Bland, J., et al., 2005). These observations, however inspiring, may not provide useful advice to the vast majority of non-research institutions as to how to enhance the research activity/productivity of their faculty and ultimately maintain their place in an increasingly competitive institutional landscape. First of all, the majority of non-research institutions are responsible for educating the bulk of the population and disseminating knowledge. They are in no position to forgo this basic institutional mission. Secondly, the stratification of research and non-research universities is now in place. While non-research institutions are unlikely to have the resources—human or financial—to compete as research intensive institutions, they can search for ways to promote faculty research activity on a more modest scale and compete for institutional reputation and prestige among their own peers. More specifically,
research universities will compete with research universities of the similar type; non-research universities will compete with non-research universities of the similar type. For instance, practically a top tier research university will not compete with a four-year liberal college situated at another tier of the hierarchy.

In a real world scenario, institutions of the same type usually compete for students with certain characteristics and quality. In this segmented market of prospective students, each type of institution will provide specific educational services to its targeted applicants. What they need most is to “stand out” among their peer institutions (here peer means the same type or similar type). If research capacity\(^1\) is the most important characteristic that enhances prestige, which in turn secures enrollment and revenue from tuition, what kind of support can non-research institutions provide to encourage research activities and promote research productivity of faculty? Are there any differences between research and non-research institutions? What can research universities do? What about non-research institutions? Do those rules to promote research productivity developed in vast literature on research universities also apply to non-research institutions?

Analogous to the concern at the institutional level to increase research production, individual faculty are also increasingly pressed to conduct research. They often feel constantly insecure in the academic employment system. It is the explicit rule that faculty research productivity is considered as the major criterion for awarding tenure.

Unarguably, faculty research lends an element of objectivity to the promotion and tenure

\(^1\) In practice, most smaller institutions use ranking system to show the public that they are among the “elite” institutions. They rarely advertise to the public that they achieve excellence in research in their enrollment campaign. However, research capability does help them move up the ranking, when they are rated by US News or other third party organizations.
processes when it can be codified and included on a vita so that peers can review it easily (Ladd, 1979). Publishing has replaced teaching as the principal faculty role in universities and has become an increasingly important criterion for promotion, tenure, and career success in 4-year college (Blackburn & Lawrence, 1995). In the meantime, with the elimination of age-based mandatory retirement required by federal law in the 1980s, institutions have systematically raised the standards for awarding tenure (Townsend & Rossier, 2007). Young faculty need to work all out to climb up the academic ladder to the tenure position. They need to know how they can be more productive in research, depending on what type of institution they serve and how can they possibly get supported to do research from the institutions where they work. Faculty working or planning to work at non-research institutions need even more career consultation in order to get better prepared for the challenge with which they are unequally faced compared with their peers in research institutions.

The Purpose of this Study

Therefore, the imperative to promote research productivity and an understanding of what factors contribute to it at the institutional and individual levels has become an increasing concern in American higher education. Traditional studies on research productive institutions or departments attempt to extract the factors conducive to research. It is known that the biggest assets an institution has are talented research faculty members, who are born and trained to be researchers in all respects. In other words, faculty or people per se are undoubtedly the major factor accounting for high research productivity, since they produce the publications from their intellectual activities of brainstorming and experimenting. However, not every institution can house this breed of faculty. Nor are
most non-research universities bequeathed with the adequate assets favorable for research activities. Generally speaking, non-research institutions, lacking research tradition and resources as they still are, need more data or studies particularly tailored to their indigenous situations. The purpose of this study is to identify the factors that support faculty research productivity in non-research institutions and determine the extent to which they are similar to, or different from, the factors that support research productivity in traditional research universities.

This dissertation begins the inquiry into how to improve research productivity by discussing the concept of environment. In other words, this study will develop a conceptual framework of environment affecting individual behaviors. The practical implication of choosing this conceptual framework is that environment is an exogenous variable that can be controlled or interfered with by the institution. Institutions may find the hope of enhancing faculty productivity by altering their environment. This environment framework naturally includes the faculty as the creator of the academic product: On the one hand, working in an organization, faculty immerse themselves in the contextual environment of both institution and department; On the other hand, working in a field, faculty also associate with other faculty in their professional networks. Intuitively, one would surmise that administration support and disciplinary networks of the faculty may have an impact on their research productivity. It is easy to conceive that an organization facilitating certain support may positively influence productivity. However, faculty productivity is intricately linked to a number of variables beyond the domain of administrative support and peer interaction. Even within the domain of institutional administration, it is sometimes difficult to distinguish between administration support and
institutional resources. For example, one can assume that the reward system, resource allocation patterns, academic atmosphere, faculty autonomy and free exchange of information are all closely related to research productivity. These aforementioned variables fall into the category of administration support, even if some of them are related to resources. In contrast, faculty ratings on technology for teaching, laboratories, research equipment and instruments, computer facilities, library facilities, secretarial support, and teaching/research assistant support are considered as institutional resources and are therefore not included in this study.

This study will employ a regression model (logistic regression) to test the impact of factors related to administrative support and peer interaction on faculty research productivity at both research and non-research institutions. The data source for this study is designated to be the Changing Academic Profession Survey [CAP], whose instruments can cover our research interests. Since the Carnegie Foundation deployed the international faculty survey in 1992, there are few authoritative and large scale surveys with data on administrative support and peer interactions, let alone more specific items on institutional and peer support related to research activities. The National Study of Postsecondary Faculty [NSOPF]: 2004 and HERI Faculty Survey conducted by National Center for Education Statistics (NCES) and UCLA respectively do not contain data on either such indicators, even if they do provide ample data on faculty research productivity. Fortunately, such data are made sufficiently available in 2007 International Changing Academic Profession Survey (referred as CAP in the later paragraphs).
RESEARCH QUESTIONS

Since institutional prestige is closely tied to research capacity, both research and non-research institutions need to enhance research productivity. Otherwise, they will gradually lose their place in academia. This will erode their prestige, and possibly result in the next Domino card—the loss of more students. However, previous studies on research productivity are primarily focused on research universities. With the changing competitive environment that brings more and more non-research institutions into the research promotion arena, the general questions (Q) are:

Q1: Does the degrees of administrative support (both tangible and attitudinal) have an impact on faculty research productivity at both research and non-research universities?

Q2: Does the degree of peer support and collaboration with peer have an impact on research productivity in both research and non-research universities?

Q3: Do institutional/administrative and peer support appear to have different impacts on research productivity in the different institutional settings of research and non-research universities?

These overarching questions can be further translated and concretized into the format of research hypothesis. The guiding research hypotheses (H) for this dissertation are:

H1: Since faculty per se are actually conducting research activities, their professional characteristics (i.e. academic disciplines, appointment types and preference
in research) will have an impact on research productivity. However, the magnitude of such impact will not match administration and peer support factors.

**H2:** In research institutions, faculty research activity is not closely related to administrative influence and support. Faculty possesses the advantage of acquiring resources such as grants and external funding, which correlates with research productivity. To put in another way, administrative support (e.g. whether they provide resources or merely attitudinal support research activities) has relatively low or no impact on research productivity. Faculty in research institutions will have higher level of autonomy and lower dependency on administration in a number of aspects.

**H3:** In contrast, faculty research activity is more closely related to administrative support in non-research institutions. Since in those institutions administration plays an important role in securing resources for faculty, in setting research oriented blueprints and in adjusting for faculty workload of balancing teaching and research, faculty interaction with administration will have relatively greater impact on research productivity. Whether administration supports research does make a difference across non-research institutions. Faculty with higher research productivity in non-research institutions will report more administrative support either tangibly or attitudinally and more active policies of initiative and guidance from administration.

**H4:** Research institutions usually employ a large number of research oriented faculty with comparably equivalent research capability. Therefore, they are most likely to have informal collaboration with colleague (i.e. other faculty or graduate students) within their institutions. Often there is no need to collaborate with other professors outside the
institution, particularly in ubiquitous small projects. In other words, although they conduct more research than their peers in non-research institutions, most of the research collaborations occur within the institution where they reside. Moreover, these faculty members are mostly trained in nationally distinguished academic programs. An empirical assumption of individual characteristics of this group of people is less "acquisitive" in term of resources that can be supplied by collaborators. They have the initiative to decide with whom they want to collaborate, if anyone at all, if they feel no need or perhaps no gain from collaboration with colleagues from a less prestigious institution. Therefore, the higher position up in the academic hierarchy, the fewer colleagues they may consider as appropriate candidates to collaborate. Instead, they have their individual channel and power to secure indispensable resources. In sum, faculty in research institutions tends to collaborate with others, especially outside their own institution, less frequently. In other words, collaboration with peers (either domestic or international) has relatively low or no impact on faculty productivity in research institutions. Nonetheless, the impact can vary across academic fields.

**H5:** In contrast, faculty in non-research institutions have to be more active and sometimes aggressive in identifying and making optimal use of collaborators both within the US and worldwide. The primary targets for them are collaborators with the resource infrastructure of research universities. Nonetheless, "elite" research faculty in research institutions who can benefit them is in high demand and in short supply. The odds are not in favor of the faculty in non-research institutions in at least two ways. On the one hand, it is difficult for these faculty members to find equivalent collaborators within their own institutions; on the other hand, they are "unfairly" driven by the pressure of maintaining
the same amount of research work. These push-pull effects of the environment make them more likely to explore the possibility of both domestic and international collaborations. This faculty predilection for collaboration can be easily reinforced, since faculty members in non-research universities in the majority are on the same boat. In other words, already highly accomplished and well-known researchers in those US research institutions are difficult to connect with and are in relatively small numbers. Most collaboration happens between faculty members in non-research universities, either with domestic or international collaborators. How they “pair up” with each other varies, depends on how much they need each other. To summarize, collaboration with peers has relative greater impact on research productivity in non-research institutions.

SIGNIFICANCE OF THE STUDY

Although it has been widely reported that environmental characteristics facilitate faculty productivity, the focuses of these existing studies are primarily set on intellectual peer activities rather than administrative context. In other words, they rarely address the question head-on: if the administration of an institution (preferably non-research in orientation) wants to support faculty research, what can they do to support it? Does the support work after all? Thus, the first highlight of this dissertation is to use administrative support data to explain the variance in research productivity. It is the quantitative study of administrative support information that rarely appears in other studies. The second highlight of this dissertation is to extend the studies conducted in the last three decades involving faculty collaboration with peers around the world and pay special attention to differentiating the impact of domestic and international collaboration. In other words, it is aimed at finding out if internationalization has an impact on research productivity, and
the strength of the impact. As more and more U.S. institutions seek out opportunities for collaboration with institutions all over the world, they may benefit from collaboration between their faculty and foreign colleagues and enhance their research productivity. This latent bonus descends upon the unsuspecting faculty, whose institutions are in the midst of the general “international collaboration initiatives” sprouting and flourishing across the America. These institutions’ primary goal of collaboration is to attract more international students and to bring new sources of revenue as the original agenda.

This study can bring potential contributions to policy and decision making in non-research institutions that are aspiring to increase their research profile. They need to cultivate certain favorable environment fostering better research productivity at both institutional and departmental levels. It is expected that administrative influence and peer support will not appear to be in same pattern in research and non-research institutions. Non-research institutions may be able to exploit several advantages that play minor roles in research universities to their full capabilities in order to compete in this less favorable environment (mostly with their peer institutions rather than large research universities).

To summarize, this dissertation will try to counter the equivocal arguments in the existing literature suggesting an egalitarian institutional goal conforming to that of the research universities regardless, as it turns out to be not applicable in the practice.

Faculty members can have constructive reflections on the administrative environment of the institution. Furthermore, the implication can be extended to those prospective professors who will begin their academic career path after graduation and will take this factor into consideration. They can think about what type of institution is
best for them according to their own judgment of the balance between teaching and research in this turbulent research-driven era.

A third party of people that bear faculty research productivity in mind are the external stakeholders that allocates resources or makes endowment to the institution. However, these stakeholders pay much of the attention to the cost analysis of overall faculty productivity. For example, as the demands on state revenues have increased, state legislators have begun to focus attention on increasing the productivity of faculty at state-supported universities as an alternative to increasing state spending (Layzell, 1996). Some legislators believe that significant cost savings would result if faculty, especially faculty at research universities, were required to do more teaching (Porter & Umbach, 2001). Moreover, a study done by the Maryland Higher Education System (1994) argued that the University of Maryland, College Park, could save $20 million annually if all full-time, tenured and tenure-track faculty were required to teach five courses per year. However, a mandated increase in faculty teaching could decrease institutional costs, but these savings might be offset by a concomitant loss in research revenues (Porter & Umbach, 2001). Faced with this paradoxical situation, what the institution may consider is to achieve a balance when it bargains with external stakeholders and faculty. The ideal strategy for an institution is to increase the efficiency of faculty workload while not introducing extra working hours. Therefore, if institution can somehow help maintain high efficiency of faculty research activity, the required amount and quality of teaching workload could be more assured. The institution can convince the external stakeholder of accountability to the budget, and avoid instigating dissentient voices among their faculty.
Finally, compared with existing literature, this study can provide “up-to-date” information for policy makers. Moreover, the research framework applies not only to the American higher education system, but also to other countries whose data is collected by this massive survey project. Administrators in those countries can also draw references from this study if they want to do their own studies on faculty research productivity.

SUMMARY

In summary, the nature of this study will be quantitative. The data analysis will be descriptive along with some inferential statistical analysis of the survey items measuring administration and peer support on research only. However, in the literature review section, literature regarding a wide range of characteristics found to account for high research productivity is still reviewed, including institutional resources, reward system, academic politics, academic freedom, social support, etc. Efforts will be made to distinguish between general institutional wealth (e.g. laboratory support and library services), and administration support. Previous literature generally employs several constructs for faculty productivity. Administration supports and peer interactions are dispersed in those constructs. The literature review will be threaded by pulling out pieces of administrative support and faculty peer interaction and molding into the new paradigm, which will be tested with CAP survey result.

GLOSSARY

Institutional / administrative support: Administration support refers to some activities and attitudes of administrative personnel believed to be influential either directly or indirectly, with faculty research activities at an institution. It can also include
some environmental variables at institutional or departmental level essential to the faculty routine activities which include research. More specifically, administration support consists of variables depicting administrative support on research physically or attitudinally, and variables describing the administration interaction or communication with faculty (also called environmental variables) believed to affect faculty research activities.

**Administration interaction with faculty:** it refers specifically to the environmental variables. It is defined as within the domain of administrative support. Administration support and administration interaction with faculty will NOT be used interchangeably in this paper.

**Peer support:** Peer support refers to all types of collegial activities relevant to research activities. Peer support can be used interchangeably with peer interaction, since peer interaction conceptually cover the connotation of peer support in that it is believed to be fully involved with faculty research productivity.

**Collaboration /Co-authorship:** faculty collaboration is more general than co-authorship. Collaboration simply means that faculty work together, not necessarily leading to co-authorship. Co-authorship implies collaboration first which then leads to publishing together.
CHAPTER II. LITERATURE REVIEW

INTRODUCTION

In this chapter, previous literature involving in faculty research productivity will be reviewed. The goal of this chapter is to synthesize the literature basis and establish the framework of this study. The literature review has been presented in these steps: (a) Select three existing and canonical framework from massive literature sources with purpose of filtering out useful elements for further review; (b) Construct an analytical framework using selected elements based on the content arrangement of CAP survey; (c) Delve into the detail of literature sources to support a newly formed three-component literature framework that accounts for faculty research productivity: the framework with faculty professional characteristics, administrative support for research, and peer support for research.

THREE EXISTING FRAMEWORKS OF FACULTY PRODUCTIVITY

Faculty research productivity has been widely studied since the 1950s. The majority of the studies focus on research institutions and test a number of factors including demographics, individual professional characteristics and environmental influence (Blackburn & Lawrence, 1995; C. Bland, J., et al., 2005; C. J. Bland, et al., 2006). These factors were chosen from three existing frameworks published in influential education journals. In this dissertation, those factors associated with administrative support on faculty research activities and peer interactions shaping research outcomes will be selected, adapted, and restructured from the vast accumulation of literature sources. These factors linking with institutional administration and peer support are
collectively described as *environment*. The literature review will attempt to regroup and re-organize these overarching concepts of "environment" into a framework of administration and peer support for research in the faculty working and professional environment (mega-environment).

1st Existing Framework: (Blackburn & Lawrence, 1995)

Blackburn & Lawrence (1995) propose a comprehensive framework for analyzing the factors that impact on faculty productivity, both research and teaching productivity, by reviewing copious studies done in the past decades. Within their grand framework, they propose two components: environmental response and social knowledge. The environmental response construct includes the different types of formal feedback that faculty receive about their role performance (Blackburn & Lawrence, 1995). More specifically, they define the response between faculty and administrators as the "one-way request from faculty and the feedback from the administrators" (p.25). In the CAP survey, the faculty-administration interaction is clearly surveyed as "supportive attitude of administrative staff towards research". The other component, social knowledge, is an overarching construct containing two sub-level constructs. The professional network linking peers is defined as the intellectual climate, situated in the category of social support, which itself is a sub-category of social knowledge. Their model is described in figure:
Blackburn and Lawrence (1995) investigate the mechanism of social knowledge motivating and accounting for faculty behaviors. According to their framework, the influence from the immediate environment that faculty members are immersed is designated as their perceptions of the environment, a part of what they call social knowledge. In other words, social knowledge refers to faculty’s perceptions of various aspects of the work environment (Blackburn & Lawrence, 1995). In their model, positive group climate, and communication and networks are listed as the environmental components contributing to productivity. What is more, they suggest that faculty form beliefs from experiences with colleagues, administrators, committee decisions, faculty
meetings, institutional rules and norms, and professional associations (Blackburn & Lawrence, 1995).

Next, these perceptions of the environment motivate their behaviors (Blackburn & Lawrence, 1995). Some environmental responses motivate faculty to revise their environmental perceptions and to modify their behaviors. A professor's decision to act in some ways and not in others is influenced by comments—especially feedback received from colleagues, but also that from students and administrators (Blackburn & Lawrence, 1995). They characterize this faculty behavior as social responses.

In summary, Blackburn and Lawrence (1995) believe that faculty behaviors are more correlated with the behaviors of their colleagues (other faculty members of the same or similar discipline) than with the behaviors of administrators, although the influence of the latter does count.

2nd Existing Framework: (C. J. Bland, et al., 2006)

Bland et al (2006) summarize the literature that identifies a defined set of facilitating characteristics in relation to high levels of productivity sustainable over time. There are three domains in which these characteristics fall: the individual faculty member, the structure or environment in which the faculty members find themselves, and the leadership of the organization. In their framework, concepts of communication are dispersed across these three domains. Faculty governance interaction is defined as "keeping missions and goals visible to all scholars", "assertive participative style of leadership and governance", and "initiating structures and environment features facilitating productivity" in the "leadership" construct, and "positive group climate",
"communication networks" and in the "environment" construct. In contrast, peer interaction is defined as "academically socialized" in the "individual faculty" construct and "positive group climate" and "communication networks" again in the "environment" construct (C. J. Bland, et al., 2006). This model blurs the boundary between individual and environment and attempts to mix two types of associations (faculty-administration, faculty-peer) into a "mega-environment". For example, in this model, "academically socialized" in the "individual faculty" construct obviously refers to faculty communication with peers. However, "positive group climate" and "communication networks" simply blends these two types of interactions, both with administration and with peers. Despite difficulties, this study is designed to distinguish between administration and peers influence in order to control for them in policy recommendations.
In their book The Research Productive Department: Strategies from Departments that Excel, Bland et al. (2005) established an overarching and literature-base framework for understanding how to maximize research productivity. This framework asserts that research productivity rests on three foundations: (a) the characteristics of the individual researcher, (b) the characteristics of his/her home institution, (c) the characteristics of the institution’s leadership (C. Bland, J., et al., 2005). These foundations also fall into three general domains respectively: (a) faculty member, (b) department, college, or university, (c) department head/chair, dean, and so forth. These three domains are “pillars of productivity” acting together as an interdependent whole to support the overall structure of the research enterprise (C. Bland, J., et al., 2005).

Bland and her colleagues reviewed literature on individual characteristics that facilitate research to include eight major factors: (a) socialization to academic values and norms, (b) a strong motivation to create new knowledge, (c) competence in their content area, (d) well-developed research skills, (e) engagement in simultaneous projects, (f) committed involvement in both institutional and discipline-specific activities (i.e., orientation), (g) a balance between institutional commitment and individual autonomy, (h) scholarly work habits (Blackburn, et al., 1978; C. J. Bland & Bergquist, 1997; C. J. Bland & Schmitz, 1986; Pelz & Andrews, 1966; Taylor et al., 2001; Tschanen-Moran, Firestone, Hoy, & Johnson, 2000; Wheeler & Creswell, 1985).
Secondly, they reviewed the work on the institutional features that facilitate research productivity: (a) targeted recruitment and selection of driven faculty researchers, (b) clear goals that serve a coordinating function and heavily emphasize research, (c) a strong academic culture, (d) a positive group climate, (e) mentoring for junior faculty, (f) frequent communication between faculty and their professional networks, (g) sufficient and accessible resources, (h) substantial, uninterrupted time for research, (i) a critical mass of faculty who have been together for a while and who bring different perspectives to the mix, (j) adequate and fair salaries and other rewards, (k) professional development opportunities for all faculty, (l) a decentralized organization (Blackburn, 1979; C. J. Bland, Hitchcock, Anderson, & Stritter, 1987; C. J. Bland, Seaquist, Pacala, Center, & Finstad, 2002; Dundar & Lewis, 1998; Long & McGinnis, 1981; McGee & Ford, 1987; Perkoff, 1986; Perry, Clifton, Menec, Struthers, & Menges, 2000; Teodorescu, 2000).

Thirdly, Bland and their colleagues reviewed leadership features that facilitate research productivity. Effective leaders: (a) are highly regarded as a scholar; serves as a sponsor, mentor and peer model for other group members, (b) possesses a “research orientation” have internalized the group’s research centered mission; (c) capably fulfill all critical leadership roles (e.g., manager of people and resources, fundraiser, group advocate, keeper of the vision); (d) keep the group’s mission and shared goals visible to all members; (e) use an assertive, participative style of leadership that holds frequent meetings with clear objectives, creates formal mechanisms and sets expectations for all members to contribute to decision-making, make high-quality information readily available to the group, and vest ownership of projects with members and value their ideas; (f) successfully initiates structures for attending to the many individual and institutional

To sum up, Bland et al (2005) have conveyed two key messages in their book on research-productive organizations:

A diverse set of individual, environmental, and leadership characteristics contributes to the research productivity of an organization. An Individual’s success in research depends on their knowledge, skills and motivation, but also hinges on the depth and breadth of support provided by their home institutions. This support can take the form of resources (personnel, funding), protected work time, culture-building activities, coordinating goals, leadership styles, and a host of other environmental factors—most of which are leveraged by department heads/chairs and other academic leaders (C. Bland, J., et al., 2005).

Most importantly, these many individual, environmental, and leadership characteristics operate as an interdependent whole. They are broad-reaching, mutually reinforcing, and synergistic. In other words, the highest levels of research productivity are achieved when all characteristics are present and when there is a successful interplay between them (C. Bland, J., et al., 2005).

DEFINITION AND MEASUREMENT OF RESEARCH PRODUCTIVITY

Definition
Before addressing measurement of faculty productivity, one must bear in mind of the fact that there are many problems involved in this type of measurement (Yuker, 1978). Moreover, the definition of research productivity has been traditionally used interchangeably with the definition of faculty productivity (Meyer, 1998). This dissertation, as stated clearly in Chapter I, is focused only on faculty research productivity.

Other literature sources add clarification of the definition of research productivity. Fox (1992) indicates that research productivity and publication productivity are not strictly equivalent in that publication is an indicator of research with time lags between the two. In other words, publication is the outcome of research observed, while research is not directly observable (Fox, 1992).

Measurement

Quantitative measurements have been used to assess faculty research productivity. The three most commonly used indicators are publication counts, citation counts, and peer and colleague ratings (Folger, Astin, & Bayer, 1970). The literature suggests that these three measurements are inter-correlated (Creswell, 1985). Studies have established a positive correlation in the range of $r=0.50$ to $r=0.75$ between publication counts and citation (Cole & Zuckerman, 1984). Visibility with peer correlates positively with publishing-productivity rates (ranging from $r=0.37$ to $r=0.56$) and with citation counts (ranging from $r=0.45$ to $r=0.63$) (Cole, 1979). These higher correlations provide the legitimacy of reducing these "multidimensional" measurements of research productivity into a one dimensional measurement, publication counts (Porter & Umbach, 2001).
Publication counts include papers presented at professional meetings, journal articles, monographs, chapters in books, and books written alone or in collaboration (Creswell, 1985). These items are all well represented in the CAP survey. Two common methods are used to analyze publication counts data. Traditionally, faculty scholarly performance has been assessed by “straight counts” of publications (Lindsey, 1980). An alternative method of using the data is “weighted counts” (Creswell, 1985).

The variables that measure the number of refereed publications not only describe measurable outputs from faculty activity but also reveal information about the quality of those activities (Porter & Umbach, 2001). However, selecting weights that are applicable across disciplines and types of institutions are impractical and can be misleading (J. Fairweather, S., 2002). Fairweather (2002) uses simple counts of eligible publications as the measure of research productivity.

Literature sources also suggest that both straight counts and weighted counts have limitations in accuracy. Obviously for “straight counts”, when researchers count publications, they may give equal credit to poorly conceived papers appearing in badly edited journals and to well-written papers in high-quality journals (Smith & Fiedler, 1971). Counts from disciplines with many publication outlets will be non-comparable with those from disciplines with few outlets. In a study of faculty research productivity defined as publications, Konrad and Pfeffer (1990) find that the relationship between publication and pay is stronger in disciplines with strong norms emphasizing research and those with scientific paradigms. In other words, those faculty members in sciences and technology disciplines or in fields with rigidly defined systems are situated in a better position to publish. Professors in applied sciences, or humanities may be at a
disadvantage if they are evaluated by the number of publications. Fulton and Trow (1974) reported that the percent of faculty not currently engaged in any research ranged from a low of 5 percent in biology to a high of 31 percent in the fine arts. Moreover, contributions of co-authors may be regarded the same as the contribution of a single author. Shorter articles may be given the same value as longer articles. Finally, publication counts may give more weight to the “operator” who produces quantity than the scholar who produces quality (Bayer & Folger, 1966; Smith & Fiedler, 1971).

The critiques are also prevalent for “weighted counts”. Braxton and Bayer (1986) caution that disciplines may vary in the weight ascribed to different types of publications. Glenn and Villemez (1970) suggest that a weighting scheme should be based on values assigned only within specific academic fields or disciplines. The problem becomes even more complicated when faculty in disparate disciplines emphasize different forms of publications. In soft or low-consensus disciplines such as sociology, psychology, and political science, scholarly books and monographs are often weighted more than edited books, and edited books receive equivalent weight to articles published in high-quality journals (Biglan, 1973; J. Braxton, M. & Hargens, 1996). In hard or high-consensus disciplines such as biology, chemistry and physics, journal articles might receive more weight than books (Colbeck, 2002).

Middaugh (2001) proposed that it is important to measure the outputs over a fixed period; the creation of intellectual capital requires time. Most institution agree that it is appropriate and generous to allow a faculty member 36 months to produce a piece of work (Middaugh, 2001).
In summary, there is not yet a single best rule for measuring research productivity. Despite various suggestions in literature, the research design has to take the actual distribution of data into consideration and ensure that the data analysis has maximally equalized publication counts in all kinds of situations.

ADMINISTRATIVE SUPPORT IN THE ACADEMIC ENVIRONMENT

Administrative support for research is one of the institutional features that appear to characterize research productive departments. Organizational theorists have reported relevant findings on the general managerial side of maintaining organizational vitality. A critical part of a healthy organization is clear, effective communication, which requires active participation, demands openness on the part of individuals at all levels, and requires that everyone has an opportunity to be heard, to discuss the issues and to have a role in decision before they are finalized (Sorensen, Furst-Bowe, & Moen, 2005). This is labeled as trust communication when information is openly and truthfully shared, when mistakes can be admitted, and when there is open and constructive dialog (Reina & Reina, 1999). The approaches of communication used in an institution include facilitated group discussions to hear from faculty, specific forums, meeting with individual departments and employee surveys (Sorensen, et al., 2005).

The interaction between faculty member and administrative personnel can be construed as a basic component of “academic politics”. Two layers of such interaction can also be further understood as one with senior management and the other with the ordinary administrative staff. On the one hand, the decision-making paradigm can have an impact on the allocation of time, resources and rewards for faculty members
On the other hand, interaction with ordinary administrative staff forms the departmental environment favoring certain faculty activities (C. Bland, J., et al., 2005). Productivity is tied to the organizational environment of work: the signals, priorities, human and material resources that provide the ways and means of research (Fox, 1992).

**Administrative Support To Create Research Incentives: Physical And Intangible**

A more concrete and practical perspective to explain administrative support is to track allocation and flow of resources. The tasks of the research-productive faculty member require resources in the form of time, space, equipment, supplies, and facilities (C. Bland, J., et al., 2005). Productive research environments have administrators and faculty who are highly committed to research and who allocate resources accordingly (C. Bland, J., et al., 2005).

Department heads and chairs can help faculty maintain their professional networks by financially supporting travel, nominating faculty for research honors and awards, and arranging faculty office or laboratory space so as to facilitate local collaborations (C. Bland, J., et al., 2005). In other words, they must act in the pragmatic role of manager; in charge of budget, salary, space, and personnel (C. Bland, J., et al., 2005). Moreover, their responsibility also consists of championing their department’s success at the level of the larger institution (college, university) and lobbying for resources that will keep their departments thriving (C. Bland, J., et al., 2005).

Blackburn and Lawrence (1995) argue that faculty aspiration can be dampened when they see that necessary resources are hard to come by and senior faculty believe
such effort has no value. Moreover, money and specialized technology is critical
(Blackburn & Lawrence, 1995). Bland et al. (2005) found that the research expectations
for faculty are clearly defined in policy statements such as tenure requirements.

Baldwin and Krotseng (1985) state that some intangible incentives can also have a
powerful influence on professors’ performances. Approval, praise, and other forms of
meaningful attention from departmental and institutional administrators may be among an
organization’s most powerful forms of reinforcement (Peters & Waterman, 1982).

Administration Support to Guide and Facilitate Research

Yet another lens through which to examine the problem is to establish the link
between the inefficiencies in institutional demands placed on the faculty and the
consequences for their research commitment and productivity. Studies on faculty stress,
suggest that its origin may lie in institution administration either setting excessive
demands or incongruent demand on faculty (Fahrer, 1978). On the one hand, the structure
of the academic career and the ladder of tenure system poise as one of the incentives for
novice professor to increase research activity (to publish). On the other hand, teaching
and other excessive or incongruent demands are the chief culprit for research oriented
faculty at either research institutions or teaching institutions.

Bland at el. (2005) described a scenario of interaction with administration and
change of institutional focus in their qualitative study at University of Minnesota:

General College has moved in the last 10 years from a less research-productive
unit to one of the leading research units in developmental education... First, there
was an externally imposed structural change by the university [Commitment to
focus] that led to a much more narrow range of appropriate activity for the college and that emphasized research. Then six years ago, the administration wanted to close the college. All the markers of measures they used to ask whether we're doing our job were improving, but we really needed to focus down even more tightly. We were told, "Do this." And when the alternative to "doing this" was being put out of business, people took that seriously (p. 49).

Evidence from industrial, governmental, and agency (rather than academic) settings suggest that productivity is higher where scientists are free to select, initiate, and terminate their own research (Pelz & Andrews, 1976). However, Pineau and Levy-Leboyer (1983) found that performance is generally low when either there is no coordination or, conversely, when there is an effort to completely control the direction of academics' work.

One obvious reason to communicate with administrative staff is to get support for grant development and management. In most academic departments, the acquisition of external research funds is both a prerequisite for and an important indicator of faculty research productivity (C. Bland, J., et al., 2005). Well-trained support staff can greatly facilitate many of the essential pre- and post-award tasks that would otherwise take up critical faculty time (C. Bland, J., et al., 2005). Sometimes, department heads or chairs share many tasks that well-trained grant staff can perform. Moreover, while in some departments, these tasks are distributed among administrative assistants or accounting personnel, other departments may have a single, highly skilled staff member capable of handling all these areas (C. Bland, J., et al., 2005). Another type of highly valued personnel with respect to grant development is finance and accounting staffs. These
people are crucial to faculty being able to prepare a rough budget for their proposals and have the edges smoothed out (C. Bland, J., et al., 2005). A third and critical human resource in highly research-productive departments is talented, well-trained, administrative staff, who are responsible for hybrid tasks such as typing or word-processing, phone triage, writing correspondence, setting up meeting and so forth. (C. Bland, J., et al., 2005). A fourth type of administrative staff that can be helpful to faculty is a non-faculty coordinator in undergraduate or graduate education (C. Bland, J., et al., 2005). This person can help with student academic advising, which will otherwise divert faculty from their time they use in research.

**PEER SUPPORT IN THE ACADEMIC ENVIRONMENT**

Peer support to facilitate research has well-established literature support to which we have already alluded in the three existing frameworks. Blackburn and Lawrence (1995) advance the idea that higher colleague commitment contributes to higher research productivity. Allison and Long (1990) report that scientists who move to universities whose departmental national rating is appreciably higher than that of the institution they left increased their productivity by 25 percent. In contrast, scientists who move to lower-rated departments showed a substantial decrease in both their average number of publications and the average number of citations to their publications (J. M. Braxton, 1983). One reason for such variation in research productivity can be variation in the exchange of information and collaboration between high commitment and high-level colleagues. Collegial exchange on research problems and discoveries stimulates involvement by testing ideas, activating interests and reinforcing the work (Fox, 1992).
In a study of 84 randomly selected research projects at 15 universities (one in Canada and 14 in the US), Birnbaum (1983) found that productivity was higher in projects that reported low turnover, good leader-member relations, and open discussion of disagreements. Bland et al. (2005) propose that good communication is also a key feature of a positive group climate, which is crucial to high research productivity. Bland et al. (2005) described a list of strategies to encourage socialization and information sharing among faculty in their qualitative study at University of Minnesota:

General College brings in new faculty recruits two weeks before the semester begins to allow them to learn about the campus, each other, and the research interests of other faculty. Veterinary Pathobiology provides small but frequent opportunities for faculty to gather to recognize an achievement, a holiday, and faculty or graduate student transition. Marketing and Logistics Management has a weekly seminar for the presentation of faculty work. The Law School provides summer orientations and courses on teaching for new faculty. They also host a Thursday lunch series where faculty research is presented and discussed. These have a consistent attendance of about half the school, as well as faculty across the university interested in law or public policy. Many departments hold retreats and traditional social events…(p. 60)

Another construct that affects faculty communication is intellectual climate. It refers to the atmosphere in which faculty work, the stimulation they receive from immediate colleagues on their campus, scholars who visit to present colloquia and lectures, researchers they know professionally, graduate students, professional association meetings and committees (Blackburn & Lawrence, 1995). A lively and
stimulating atmosphere can inspire faculty to bring their ideas, even half-baked ones, to the discussion and receive a considered response (Blackburn & Lawrence, 1995). There are many studies over the last three decades and across the disciplines supporting the relationship between intellectual climate and publication output. In a regression analysis of data from 437 scientists and engineers, Bozeman and Lee (2003) found that the number of collaborators was the strongest predictor of research productivity, measured by both fractional and normal publication count. Blau (1974) found that most effective determinant for production is a few direct associates in the ongoing research project and a wider set of colleagues who know the relevant theory.

Fox (1992) found that compared with BA and MA granting departments, faculty in PhD granting departments are more likely to speak with colleagues about research, to report a primacy of work (compared to leisure or other facets of life), and to cite the importance for themselves of obtaining (or maintaining) national recognition. In another sense, collegiality is important because scientific work, more so than that of other fields, relates to, builds upon, and extends existing knowledge (Garvey, 1979). The communication takes place both formally and informally. It can provide room for speculation, retraction and immediate feedback on failure as well as success (Fox, 1992).

Thus, collaboration is also closely related to collegiality and productivity (Fox, 1992). Fox (1992) finds a high correlation (0.79) between the total number of articles published in refereed journals and the number published in collaboration. Gordon (1980) reports that co-authored papers are more likely to be accepted by journals than single-authored papers in scientific fields. Presser’s (1980) analysis of papers submitted to a major social psychology journal show that co-authorship helps avoid very bad ones with
outright errors, even if it may do little to produce superior papers. Finkelstein (1982) finds that most prolific scholars are those who are in touch with a wide variety of professionals beyond their own campuses (Finkelstein, 1982). Nudelman and Landers (1972) suggest that the total recognition given by the scientific community to every one of the authors of a multiple-authored paper is larger on average than the recognition given to the author of a single-authored paper.

Although the act of writing is a solitary activity for most people, maintaining a research and publication agenda is a highly social process (Brodkey, 1987). Collegial exchange is not just a social aspect of work performance but a critical element of it, and exclusion from such networks “limits the possibility, not simply to be part of a social circle, but to do research, to publish, to be cited” (Fox, 1991).

The network through which faculty interacts with peers even comes into existence as early as in graduate school. Austin and McDaniels (2006) further point out that the knowledge, skills, and professional networks that students acquire in graduate school shape their capacities as early career faculty to contribute to their disciplines.

Moreover, some evidence suggests the existence of “stratification” or “invisible college” that influences the publication of scientists trained at or working in influential institutions (McNamee & Willis, 1994). Publication is a central social process of science because it is through publication that research findings and results are communicated and exchanged, and unpublished work is also important to the development and communication of knowledge (Fox, 1992).
Peer interaction has other derivative effects that partly explain the gender difference in research productivity (Astin, 1991). "Overwhelming evidence" is found from dozens of studies in the 1970s that men out-publish women (Finkelstein, 1984). The productivity gap between men and women widens because women are less recognized, particularly in the form of citations, for their work (Ward & Grant, 1996). Cognitive or scientific authority refers to who is recognized as being an expert in a field and accepted as a reliable source of information and advice. Men are more likely than women to be awarded cognitive or scientific authority (Fox, 1991). Nonetheless, some evidence suggests that male-female disparities in the proportion who publish are narrowing (Schuster & Finkelstein, 2006).

FACULTY PROFESSIONAL CHARACTERISTICS

Numerous studies outline the characteristics of successful researchers. Some of the characteristics have already been discussed previously and are briefly reiterated here.

There are approximately five areas with regard to faculty professional characteristics to explain variation in research productivity: human capital, personal tastes, career status, teaching workload, and demographics (Porter & Umbach, 2001).

Human capital describes the non-physical attributes of an individual that affect career aspirations and mobility (Porter & Umbach, 2001). The most common attributes defined in human capital theory are individual’s knowledge, skills, values, education, and training (Becker, 1993). Faculty members with greater research skills and training are expected to produce more research (Porter & Umbach, 2001). Faculty members improve research quality and strengthen professional characteristics after they develop their
research interests and receive research training from their graduate programs. Some
scholars attempt to measure faculty skills and training by looking at whether they hold a
research assistantship or PhD degree (Porter & Umbach, 2001). Other scholars use
graduate department characteristics as the representation of faculty quality characteristics.
Buchmueller et al. (1999) found that graduate department characteristics where a faculty
obtained their PhD, such as departmental ranking and mean faculty publications, are
correlated with greater productivity. Faculty members who worked as research assistants
in graduate school or obtained a post-doctoral fellowship also tend to be more productive

Personal orientation and tastes are also reported to have an impact on faculty
research productivity (Neumann, 1996; Noser, Manakyan, & Tanner, 1996; Porter &
Umbach, 2001). For instance, Noser et al (1996) found that highly productive faculty
were much more likely to cite “conduct research” as a motivation for remaining in
academia than “teach/work with students,” and that this relationship was reversed for less
productive faculty. Faculty that prefer to teach rather than do research publish less; while
those faculty that prefer to do research publish more (Porter & Umbach, 2001). Some
studies found a negative relationship between teaching and research productivity,
although the strength of the relationship varies (Fox, 1992; Noser, et al., 1996).

Appointment type has also been found to have an impact on research productivity.
Some scholars measure appointment type by professional rank and use this classification
in the analysis. The professional rank refers to instructor/lecturer, assistant professor,
associate professor, or full professor. Research has shown that faculty with higher rank
are more productive (Bellas & Toutkoushian, 1999; Dundar & Lewis, 1998; Noser, et al.,
1996; Tien & Blackburn, 1996). Other scholars use tenure or non-tenure track as faculty rank (C. J. Bland, et al., 2006; Tien & Blackburn, 1996) and found that tenure-track faculty has demonstrated higher level of research productivity. However, these findings are not free from criticism. For example, Guyer and Fidell (1973), Over (1982), and Wanner et al. (1981) show that rank has no influence on faculty research productivity when other relevant variables are taken into consideration. The conclusion can be very different based on variations in study samples, differences in statistical methods and measures of faculty research productivity (Tien & Blackburn, 1996).

At last, some studies have included demographic variables controlled in the model. The demographic variables included are age (sometimes years of professional age rather than actual age), gender, ethnicity, and number of children (Bellas & Toutkoushian, 1999; Buchmueller, et al., 1999; Noser, et al., 1996; Wanner, et al., 1981). However, demographic variables used in those studies either show unstable results or represent variations caused by other factors (Astin, 1991; Finkelstein, 1984).

**SUMMARY OF THE LITERATURE REVIEW**

Three existing frameworks of faculty productivity have been reviewed and then some factors are pulled from these framework for the construction of the new framework for this study in Chapter III. Despite efforts to separate factors from each other and to group them under the three aforementioned components described above, there is oftentimes an overlap between two factors, or a factor bestriding over two constructs. Generally speaking, faculty professional characteristics do have an impact on research
productivity. Nonetheless, it is difficult to separate the performance of individual scientists (or scholars) from their social and organizational context (Fox, 1991).

A number of studies also show that institutional features (characteristics of the workplace environment) tend to have the greatest impact on faculty productivity (S. M. Clark & Lewis, 1985; Teodorescu, 2000). The literature review focused on administrative support does yield some positive results but not overwhelming evidence. First, research and non-research institutions vary in their administrative structure so that they have to be studied separately. In their study not separating research and non-research institutions, Pellino, Boberg, Blackburn, and O’Connell (1981) described that place of employment is the single best predictor of faculty scholarly productivity:

Faculty who come to productive surroundings produces more there than they did before they arrived and more than they will later if they move to a less productive environment. Resources, support, challenge, communication with producers on other campuses, all correlate with a professor’s productivity (p. 7).

The place of employment can mean research and non-research institutions to a large extent. Secondly, administration can provide resources support or even emotional support that is conducive to research activities. Obviously, one cannot make a strong conclusion that administrative effort will lead to quantum leap in research productivity because research productivity and results are not directly the consequences of such support. It is the faculty per se that do the research, not the governance. In plain words, a not sufficiently talented and trained faculty team cannot simply become a Nobel Prize Laureates no matter how much the institution invests in the research. That is why there
are few any studies in areas of administrative support indicating a direct relationship or linkage to research productivity.

In contrast, with regard to faculty peer interaction, there is abundant literature directly linking faculty peer collaboration and research productivity. Faculty collaboration directly affects the knowledge flow in research. Since the relationship is well established, the data analysis will only serve to verify the literature under different circumstances.

Disruptive evidence, although fragmentary, can also be found to link "comfortable environment" to "less productive" faculty. For instance, Fox (1992) finds that faculty in higher (Particularly PhD) compared to lower degree granting departments are significantly more likely to characterize their departments in ways that include tense rather than comfortable: as cold, unjust, intolerant, unfriendly, unhelpful, competitive and even as irresponsible. By closer scrutiny, one can separate this unfriendliness within the department from that within the broader academic circle and professional network. Some faculty may find it difficult to collaborate with people in their own department who share conflicting interests of reward and promotion. But they feel at ease to collaborate with colleagues outside their own workplace and find no threat to their own "sphere of interests".
CHAPTER III. METHODOLOGY

INTRODUCTION

The chapter will include three major sections. In the first section, a theoretical framework will be proposed based on the research questions and literature review. The framework leads to the selection of independent and dependent variables that will be used in the data analysis. The second section will introduce the data source—the CAP survey data—for this study. In the third section, a thorough explanation of research design will be presented. The research design section will include the list of all the variables, the methodologies and the rationale of using these methodologies. Briefly speaking, the purpose of this chapter is to provide research methods matching the theoretical framework to test five general research hypotheses: (a) Faculty professional characteristics have an impact on research productivity and therefore are needed to be controlled; (b) At research institutions administration support doesn’t have impact on research productivity; (c) At non-research institution, administration support has impact on research productivity; (d) At research institutions, faculty usually do not collaborate with peers at other institutions either domestically and internationally, ergo research productivity does not vary, whether faculty collaborate or not; (e) At non-research institutions, faculty are keen to collaborate with peers, therefore faculty who report higher productivity in research collaborate more with their domestic or international colleagues. The statistical procedure used for data analysis will be logistic regression.

THEORETICAL FRAMEWORK
The general framework of this dissertation draws on three existing frameworks (Blackburn & Lawrence, 1995; C. Bland, J., et al., 2005; C. J. Bland, et al., 2006) that describe how the environment encourages and supports faculty research productivity. The environment refers to the mega-environment encompassing two constructs: faculty-administration relationships and peer professional network. The first construct, faculty’s institutional administrative relationships, refers to the administrative support in material and attitude provided by administrative leadership and staffs for the faculty in the local environment of the institution. The second construct, faculty collaboration with either domestic or international colleagues, is an aspect of environment that can be controlled or changed, sometimes from the institutional level. In Bland et al (2006) model, faculty’s activity that occurs in the environment is subjected to the environment, and sometimes exerts pressure on the environment, which finally becomes hospitable to research productivity. In other words, the mission of this study is again clarified: if the evidence of impact of any environmental variable manageable from the institutional level is found, we are in the position to identify the policy recommendation regarding institutional practice with more confidence. In this study, administrative support and peer collaboration are collectively termed the faculty mega-environment. Categorically, this environment is the media where faculty works with two types of social networks: administrators and peers.
Faculty's relationship with administration is a multi-dimensional construct that can affect a wide range of faculty variables, such as faculty research productivity, job satisfaction, and commitment, as suggested by the literature (C. Bland, J., et al., 2005; C. J. Bland, et al., 2006). The multi-dimensional construct includes (a) faculty relationship with leading administrators (oftentimes some faculty members in administrative positions such as chairs and deans) and (b) with ordinary administrative staffs. People in administrative positions shape common knowledge on a variety of environmental variables that have bearings on faculty research productivity. The deficiency in survey tools makes it relatively difficult to capture the quantitative measures of administrative support. What we can capture is the information gathered indirectly from question posed from different angles. In the CAP survey, faculty need to
give their self-evaluations of their interests and efficacy (their preferences in research or
teaching) and their perceptions of the environment of their department or institution
(most administration variables). Thus, faculty provides attitudinal information about
administration more or less mixed with their personal attitudes and values. In contrast,
the measurement of peer support or interaction is relatively straightforward. Faculty can
be asked questions about if they have collaborators and the location of those collaborators.
At least there is no personal bias involvement in the measurement. The constructs and
measurements will be discussed in detail after the introduction of CAP survey.

DATA SOURCE: THE CAP SURVEY

The CAP survey inherits and extends the first International Survey of the
Academic Profession in 14 countries in 1992 or 1993 led by Ernest Boyer and Philip
Altbach at the Carnegie Foundation for the Advancement of Teaching. Since this first
Carnegie international survey was analyzed, the landscape of higher education across the
globe has changed. Fifteen years later in 2007, Prof. Martin Finkelstein at Seton Hall
University and Prof. William Cummings at George Washington University, together with
other colleagues world-wide from a group of 19 countries\(^2\), organized a follow-up survey
entitled “The Changing Academic Profession”.

The CAP survey consists of three major themes: internationalization,
managerialism, and relevance. Internationalization refers to the increasing cross-border
collaboration between faculty, academic activities (research and teaching), and

\(^2\) The participating countries are: Argentina, Australia, Brazil, Canada, China, Finland, Germany,
Italy, Japan, Malaysia, Mexico, Netherlands, Norway, Portugal, Romania, South Africa, South
Korea, United Kingdom, United States, and Venezuela.
permeability of national boundaries. Managerialism refers to changes in the governance that have increased roles of administrators and government entities at the expense of faculty. Relevance, broadly conceived, refers to increasing pressures globally for higher education to visibly support economic competitiveness and social progress (Finkelstein & Cummings, 2008). Two of the three themes align with the purposes of this study. First of all, management and administration have changed in the institutions in the transformation of historical and social background. The adoption of the language and values of business—downsizing, the growing use of temporary employees, privatization and commercialization—has impacted higher education (Zusman, 1999). Perhaps it is important from the data analysis to find out: How does administrative initiative (partially inseverable from commercial perspectives of motivating employees) affect faculty productivity now? Secondly, internationalization has also overlapped with peer collaboration. The emergence of free trade, the internet, the globalized, knowledge-based, and corporate economy (Slaughter & Rhoades, 2004) has broadened the channels and enriched the aspects of faculty collaboration. What impact does faculty collaboration with peers (more international colleagues than before) have on faculty research productivity? Traditional studies, despite their confirmation on peer collaboration enhancing research productivity, suffice neither in the historical background nor the modern tool (internet) to describe the magnitude and the trend of this phenomenon. In other words, this study in faculty collaboration can provide up-to-date information to describe this phenomenon in this fast changing world.

As a highly decentralized system, American higher education has a large employment of some 655,000 faculty on full-time appointment at nearly 4,000
corporately independent institutions. On the one hand, these institutions vary by size and
degree level, that is, from large universities offering doctoral level programs to small
colleges focusing on undergraduate baccalaureate level. On the other hand, these
institutions can be divided by the level of control: publicly or privately funded. Based on
these two characteristics of institutions in American higher education landscape, the
sampling procedure of the CAP survey identifies a total of 80 institutions across these
four strata. Faculty list from these institutions were acquired. Then the research team
determined the proportion of full-time faculty in the population of each stratum of the
institutions. After that, the team randomly selected faculty within each stratum of
institution in the sample approximately equal to the pre-determined proportion of full-
time faculty in the population. The results of this sampling procedure yielded a total of
5,772 faculty members at eighty 4-year colleges and universities across the United States.

The survey process consists of two parts: online-survey, followed by a paper-
based survey by regular mail. The content of these two types of the survey is identical.
The paper-based survey was designed to address respondent concerns, such as providing
confidential information on-line. The online survey was hosted by the Research Divisions
of SPSS Corporation (the statistical Package for the Social Sciences) which the U.S. team
had contracted with. The online survey is programmed based on the conventional
integration of webpage and relational database technology so that the respondents should
answer some questions on the screen before they proceed to the next page. Moreover, the
validation techniques of programming were employed to ensure valid inputs of the
respondents. Some respondent resistance to these techniques may depress response rate
(about 30 -45 minutes to complete the entire survey although it was possible to save
responses and complete in multiple sittings). However, these measures keep the integrity, congruity, and validity of the data, and reduce missing values. The survey was emailed to all 5,772 faculty on October 3, 2007. There were also five reminders sent out electronically between October 15 and December 7, 2007.

Of these emails containing the hyperlink to the uniquely identified survey page and database record sent to each faculty, 707 emails bounced back primarily due to the "spamming" function of the university email systems. The rest of the 5065 emails actually made their way into faculty email inboxes. Of all faculty that took the online survey, 1,048 respondents completed their survey. The response rate for online survey is 20.7%. In addition, approximately 50 additional respondents answered up to 80% of the survey. These incomplete but useful records were also included in the analysis. With these additional 50 respondents, the online survey has an effective response rate of 21.7%. Although this response rate, if judged by the standards of paper survey, is quite low, literature suggests (Kaplowitz, Hadlock, & Levine, 2004) online survey in the US appears to be considerably lower than paper surveys. Online survey tends to have a response rate ranging from 10% to 30% (Hamilton, 2009). In an compensatory effort to increase the response rate and the effectiveness of the survey, a paper version of the survey was mailed to approximately 1,000 non-respondent faculty (of those who either didn’t get the email “spammed” by the email system or chose to ignore the online survey). Three hundred forty-two additional completed paper surveys were mailed back. Another attempt of sending postcards to non-respondents was also implemented to increase response rate. Finally, the survey yields a total of 1440 respondents from both online and paper survey, a response rate of 24.9%. 
RESEARCH DESIGN

Base on the information extracted from literature sources in relation to a number of factors, the study design is formed to ensure the robustness of the study. First of all, institutional type and academic field form the two major axes that differentiate the American academic profession (B. Clark, 1987). Institutional type and academic field have to be considered as control variables not only for the research questions of this dissertation, but also for the technical reasons to explain the variance. Faculty in research universities perform different and more complex roles from the faculty at other 4-year institutions or at other 2-year colleges (Finkelstein, Walker, & Chen, 2009). In terms of academic field, faculty in the natural sciences engage in fundamentally different kinds of work activities and share different norms for teaching and research activity than faculty in the humanities and social sciences (Finkelstein, et al., 2009). Moreover, the shaping force of institution type and academic field may interact with each other. Therefore, according to research questions addressing the different needs for research and non-research universities, literature reviews and technical requirement to control variables, two variables (institutional type and academic field) and their interactions (if needed) should be considered as independent variables to be controlled. Secondly, individual characteristics also play a vital role in faculty academic work and careers. Therefore, two more variables, faculty professional orientation (Finkelstein, et al., 2009) and faculty appointment type (C. J. Bland, et al., 2006) should also be controlled as independent variables. In sum, four variables (institutional type, academic field, professional orientation and appointment type along with interactions (in theory) between institutional type and academic field should be controlled in the regression model.
DATA ANALYSIS

Grounded in the research questions and literature review, this dissertation conceptualized a three stage model for understanding the effect of administrative and peer support on faculty research productivity. This study will employ logistic regression to undertake separate analyses of the determinants of productivity in research and non-research institutional settings. There are two separate logistic regression analyses for research and non-research institution separately with the dependent variable faculty research productivity. Each set of logistic regression analyses take a three-stage model: three groups of independent variables entering the regression equation three times with each time one more group incrementally. The model starts from the first group of controlled variables—academic field, faculty professional orientation and faculty appointment type, to administrative support variables, and finally to peer support variables.

Table 1 shows three groups of independent variables that will be entered in the logistic regression models sequentially. The table also shows the dependent variable, which will be explained in detail later.

Table 1

Independent Variables and Dependent Variable

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appointment Type</td>
<td>(1) Administration provides incentives for research</td>
</tr>
<tr>
<td>Research or teaching orientation</td>
<td>Percentage of the funding from the institution</td>
</tr>
<tr>
<td>Academic Discipline: 2-categories</td>
<td></td>
</tr>
</tbody>
</table>
Considering the research quality when making personnel decisions
  Staff's Supportive attitude towards research activities
(2) Administration guides research
  Central administration set internal research priorities
  Senior administrative staff evaluate research
  Institution emphasizes inter or multi-disciplinary research


<table>
<thead>
<tr>
<th>Group</th>
<th>Dependent Variable</th>
<th>Variables entered</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Collaborate with colleagues in research</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaborate with persons at other institutions in the US</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaborate with international colleagues</td>
<td></td>
</tr>
<tr>
<td>(2) Co-author with colleagues</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Co-authored with colleagues located in the US</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Co-authored with colleagues located in other (foreign) countries</td>
<td></td>
</tr>
<tr>
<td>(3) Colleagues evaluate research</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research evaluated by peers in your department or unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research evaluated by members of other departments or units</td>
<td></td>
</tr>
</tbody>
</table>

Dependent Variable\(^3\): Faculty research productivity
  1 = productive
  0 = not productive

The hierarchical structure of the logistic regression for both research and non-
research institutions is displayed in Table 2. The inferential statistics consists of two sets
of logistic regression analyses for research and non-research institutions separately. Each
set contains three logistic regression analyses.\(^i\)

Table 2

Overview of Logistic Regression Models

<table>
<thead>
<tr>
<th>Analyses (research and non-research respectively)</th>
<th>Variables entered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(^{st}) logistic regression model</td>
<td>Faculty professional profile</td>
</tr>
<tr>
<td>2(^{nd}) logistic regression model</td>
<td>Faculty professional profile, administrative support</td>
</tr>
</tbody>
</table>

\(^3\) In fact, the logistic regression models the logit of probability \(\text{logit}(p_i)\) as dependent variable in the
equation, see endnote ii for more information. The dependent variable discussed throughout this study is a
only verbal description as intuitively acceptable concept.
| 3rd logistic regression model | Faculty professional profile, administrative support, peer support |

The conceptual plan of logistic regressions are displayed in Figure 4.
Figure 4: Detailed conceptual framework for logistic regression analysis
There are two main causes for the adoption of a sequential/block entry of independent variables in the logistic regression. First, it is important to know the relative influence by three groups of variables in relation to each other. For instance, suppose that the professional characteristics are statistically significant when they are entered into the model by themselves, but they become not significant after other groups are entered into the model. Under this circumstance, if they are entered at one time rather than sequentially by blocks, this gradual loss of predicting power is hidden from observation. Secondly, the comparison of research and non-research universities with regard to the emergence of different statistically-significant predictors in three stages of the models will also be ignored. The absence of such information will inadvertently impede the accuracy of this study.

The next two sub-sections are devoted to the comprehensive explanation of technical rationales of using these independent variables and transforming the originally continuous variable into a dichotomous dependent variable. The rationale will address two major technical questions: (a) What should be the best variable for measuring faculty research productivity? (b) Why choose logistic regression over conventional regression technique? (c) Do the variables meet the requirement of these two technical questions need to be solved to ensure the robustness of the data analysis. Independent and dependent variables will be analyzed in detail to provide solution to these two technical questions.

**Independent Variables**
Based on the literature review, three groups of variables are used to model faculty research productivity. According to the conceptual framework (see Table 1), faculty research productivity is a function of faculty professional characteristics, administrative support for research, and peer support for research.

Faculty professional characteristics have impact on research productivity. Faculty professional characteristics are represented by three dummy-coded variables. The first variable included is appointment type: tenure, tenure-track, and other contracts. On the one hand, tenure or tenure-track appointment is based on the merit system of publication ranking and itself affect faculty research productivity. On the other hand, faculty in tenure or tenure-track positions will have more access to the resources need for research. The second variable brought in is teaching or research orientation. It is dummy-coded to represent faculty preference: teaching or leaning towards teaching versus research or leaning towards research. The third variable included in faculty professional characteristics is academic discipline, which is divided into two categories: (a) Natural Science, and Engineering, Life, Agriculture, and Medical Sciences, and (b) Humanities, Social Sciences, Education, Business, and other.

One of the focus of this study and also a component of “mega-environment” is administrative support (research). As an amorphous construct, administrative support for research is then divided into two more concrete and more measurable sub-constructs: (a) administration provides incentives for research, and (b) administration guides research priorities. The purpose of the data analysis is hereby articulated: to find whether these types of administrative support for research actually increase research productivity. First, three variables are included under the construct administration provides incentive for
research. The first variable measures the percentage of funding from this institution. The second variable included is consider research quality when making personnel decisions. The third variable is about the supportive attitude of administrative staff towards research. To sum up, the variables under administration provide incentives for research either measures the monetary/material support or the psychological influence that encourages faculty to conduct research activities. Secondly, another three variables are brought in under the construct administration guides research. The first variable of this kind is central administration set internal research priorities. The second variable included is senior administrative staff evaluate research. The third variable included is institution emphasizes inter or multi-disciplinary research. In summary, this sub-group of variables are about whether the administration guides research in some direction or is concerned about research activities.

Another focus of this dissertation is peer support research, which is also a component of mega-environment. Similar to the administration support for research construct, it is also divided into three sub-constructs. The first sub-construct is about whether faculty collaborate with colleagues in research. The associated variables are collaborate with persons at other institutions in the US and collaborate with international colleagues. The second sub-construct is related to co-authorship with colleagues, measured by the variable co-authored with colleagues located in the U.S. and the variable co-authored with colleagues located in other countries. The third sub-construct is named Colleagues evaluate research, measured by the variable research evaluated by peers in your department or unit and the variable research evaluated by members of other department or units.
It should be noted that all these independent variables are also checked for co-linearity problems (see VIF values in APPENDIX C). No evidence of multi-collinearity is found among these independent variable so that they can be all included in the logistic regression analysis.

**Dependent Variable: Measurement of Research Productivity**

The CAP survey requires the respondents to enumerate ten types of research activity and production. Faculty report what they have done in the last 3-year interval. The items are listed in the Table 3:

*Table 3*

*Research Products Reported by Faculty in CAP Survey*

<table>
<thead>
<tr>
<th>Question No.</th>
<th>In the last 3 years, you have...</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>D4-1</td>
<td>Scholarly books you authored or co-authored</td>
<td></td>
</tr>
<tr>
<td>D4-2</td>
<td>Scholarly books you edited or co-edited</td>
<td></td>
</tr>
<tr>
<td>D4-3</td>
<td>Articles or chapters published in an academic book or journal</td>
<td></td>
</tr>
<tr>
<td>D4-4</td>
<td>Research report/monograph written for a funded project</td>
<td></td>
</tr>
<tr>
<td>D4-5</td>
<td>Paper presented at a scholarly conference</td>
<td>Scale</td>
</tr>
<tr>
<td>D4-6</td>
<td>Professional article written for a newspaper or magazine</td>
<td></td>
</tr>
<tr>
<td>D4-7</td>
<td>Patent secured on a process or invention</td>
<td></td>
</tr>
<tr>
<td>D4-8</td>
<td>Computer program written for public use</td>
<td></td>
</tr>
<tr>
<td>D4-9</td>
<td>Artistic work performed or exhibit</td>
<td></td>
</tr>
<tr>
<td>D4-10</td>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Previous research oftentimes employed the approach of combining various types of research outputs into a single measure or index as the dependent variable (Bellas &
Theoretical and operational advantages and disadvantages of using such combined outputs has already been discussed in Chapter II. Here the detailed literature sources are reviewed in preparation for data analysis. The rationale of choosing what type of academic output is based on the impartiality of measuring the efforts faculty make in such type of output. Therefore, the nebulous concept of combining all kinds of outputs appears to be disadvantageous to some faculty who have really high quality publications. Some academic works require more time and efforts to produce than others do, and the amount of effort within a category can vary (Porter & Umbach, 2001). For example, an article published in a refereed journal is embedded with more efforts and time faculty has spent on than its counterparts in a non-refereed journal. In addition to this problem, another drawback to the criterion of adding a variety of academic outputs regardless of their types is that concrete policy recommendations can be difficult to make, because the substantive impact of a change in a independent variable is not always clear (Porter & Umbach, 2001). In other words, first of all, institution cannot have a unified standard to measure and boost research productivity; secondly, the results of data analysis will become less stable. Thus, it is important to set up a criterion upon these academic output. Upon this standard, a selection criterion emerges. In their study based on the survey data of 1993 National Study of Postsecondary Faculty (NSOPF), Porter and Umbach (2001) use the total number of articles published in refereed professional or trade journals, creative work published juried media and chapters in edited volumes combined into a single measure of refereed publications. In this study, the same rationale (Porter & Umbach, 2001) is
adopted to form a single dependent variable of research productivity. This productivity variable of combined outputs refereed in nature includes (Table 4):

Table 4

Refereed Publications or Other Academic Outputs

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Content</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>D4-1</td>
<td>Scholarly books you authored or co-authored</td>
<td></td>
</tr>
<tr>
<td>D4-2</td>
<td>Scholarly books you edited or co-edited</td>
<td></td>
</tr>
<tr>
<td>D4-3</td>
<td>Articles or chapters published in an academic book or journal</td>
<td></td>
</tr>
<tr>
<td>TRPC</td>
<td>Total Refereed Publication Counts (TRPC) = D4-1 + D4-2 + D4-3</td>
<td>scale</td>
</tr>
</tbody>
</table>

Choose the appropriate refereed publication or combinations

The aforementioned literature basis above has justified the rationale of choosing the sum of these three refereed publications. However, in this empirical analysis, there is yet another important procedure for verifying this variable “Total Refereed Publication Counts” in order to make the data analysis a stronger one. The question raised here is: What kind of refereed publication or sum of refereed publication should be used? There could be three options in this case. In the Table 5, a distribution of three groups of refereed publication in the sample for research and non-research institutions is listed. The distribution of three groups doesn’t vary much from each other. Regardless of what group of refereed publications is selected, the results of data analysis should be stable (see Table 3). Under this condition, “Plan B” in Table 5 best matches the practices of literature sources. Therefore, “Plan B” has been chosen to represent faculty research output.
It is natural to conceive a conventional linear regression analysis that includes the variable of the sum of these refereed publications as its dependent variable. However, a new problem arises when the preliminary screening of these variables of the number of publications indicates a highly skewed data distribution that can threaten the basic assumption of conventional multiple regression analysis. The sum of these three refereed academic outputs also demonstrates a high degree of skewness (see APPENDIX A). The dependent variable in a regression analysis should meet the assumption of normality or normal distribution of error term (see APPENDIX B) in the classical linear regression model (CLRM) (Gujarati, 2004). The fact is that many faculty members have zero publication counts in some variables (some variables have more than 50% of zero counts). Data transformation (e.g. logarithm or square root) does not reduce the skewness to the desirable level. Therefore, conventional regression cannot be applied with this highly skewed distribution of dependent variable: the sum of three refereed publications.

Logistic Regression: How to determine the cut point?

The solution to this problem is to convert the distribution of the dependent variable (refereed academic works) into a dichotomous variable with two categories of “Productive” and “Not productive” and to adopt logistic regression model instead of conventional linear regression model. It may appear to be tantalizing to use the median as the cut point for the criterion of productive or not productive. Nonetheless, this taxonomy can jeopardize the validity of the study in that the benchmarks of productivity differ

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4 Please see page 108-110.

5 Logarithm transformation cannot be directly used to the data, since zero is not defined in the domain of logarithm function.
considerably between research and non-research institutions. For example, if the median (the median is 2, see APPENDIX D) of both research and non-research institutions is used as the cut point, only 35.3% of the non-research institutions are eligible for being regarded to be productive; in contrast, 61.5% of the research institutions are regarded as
Table 5

Cumulative Percentages of Publication Distribution for Three Different Standards

<table>
<thead>
<tr>
<th>Publication counts</th>
<th>PLAN A</th>
<th>PLAN B</th>
<th>PLAN C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Books authored or co-authored</td>
<td>Books authored or co-authored</td>
<td>Articles or chapters published in journals ONLY</td>
</tr>
<tr>
<td></td>
<td>Books edited or co-edited</td>
<td>Books edited or co-edited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Articles or chapters published in journals</td>
<td>Articles or chapters published in journals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Patent secured on a process or invention</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Artistic work performed or exhibited</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>0</td>
<td>18.6%</td>
<td>93</td>
<td>19.2%</td>
</tr>
<tr>
<td>1</td>
<td>29.1%</td>
<td>52</td>
<td>53.9%</td>
</tr>
<tr>
<td>2</td>
<td>47.1%</td>
<td>44</td>
<td>73.7%</td>
</tr>
<tr>
<td>3</td>
<td>53.9%</td>
<td>34</td>
<td>80.1%</td>
</tr>
<tr>
<td>4</td>
<td>60.5%</td>
<td>33</td>
<td>85.5%</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The reason to combine "patent secured on a process or invention", and "artistic work performed or exhibited" is not to disadvantage certain types of faculty, such as research scientists who is mainly engaged in developing new machinery or professor of art whose work is mainly painting.
productive (see Table 5) In this case, non-research institutions are disadvantaged and research institutions seems to get by easily. Also backed up by literature review, the requirement of this dissertation favors a separate analysis of research and non-research institutions. In the real world, research and non-research institutions are faced with different challenges which are believed to be solved by different approaches. A separate analysis of research and non-research institutions can make the explanation more straightforward and the statistically significant predictors for two types of institutions crystal clear.

Thus, a dual standard is proposed to research institutions and non-research institutions separately. As discussed above, the adoption of this dual standard can ensure the fairness when research and non-research institutions are analyzed separately.

For research institutions, the cut-off point of the dependent variable is set to be 2. In other words, faculty in research institutions who have more than two publications in the last 3 years are regarded as productive. In contrast, the cut-off point is set to be zero for non-research institutions. In other words, faculty in non-research institutions only need to have at least one refereed publications to be considered as productive. The frequency tables (see Table 5) show that this dual standard appears to be fair for both types of institutions. In research institutions, 38.5% of the faculty has more than two refereed publications in the past three years. In non-research institutions, 38.8% of the faculty has at least one refereed publications in the past three years (see APPENDIX D). It can be seen that non-research institutions on average fall far behind the research institutions. This dichotomous variable will serve as the dependent variable in the logistic regression model, whose role is bulk of the data analysis. By setting the cut point in this
way, we are able to divide faculty in either research and non-research institutions into two groups: approximately 38% of the faculty are classified as “Not Productive” compared to approximately 62% of the faculty as “Productive”. Two separate logistic regression analyses ensure that faculty in research institutions compare with themselves within research institutions, and faculty in non-research institutions compare only with themselves within non-research institutions. In both research and non-research institutions, faculty labeled as “Not Productive” occupy the lower 38% percentile of their own group sample size, but based on different cut points.

There are yet another two reasons to choose the 38.8% cut point for both institutional types: (a) 38.8% is the lowest bar that can be found. This lowest bar makes the finding more easily acceptable in practice. Because for non-research institutions, we only need to know what are the best predictors for people who simply publish rather than have no research outputs at all. Administrators or practitioners are more interested to know what make faculty publish anything than to know how many they can publish. This actually makes the study even stronger. (b) It is safer to control the difference in academic fields the same as that in institutional types because (also see Table 6):

1. Observe the interaction between academic discipline and other variables in the regression model. A rigorous scientific as it is, this method will used when there is no other equally rigorous methods available.

2. Use academic discipline as another selection criterion to further divide the sample into four groups: research and STEM fields, Research and non-STEM fields, non-research and STEM fields, and non-research and non-STEM fields. In this case, we will need four sets of regression analysis all together. The advantage of this method is
straightforwardness in explanation and less constraint in the prerequisite of the statistical conditions. Moreover, the study can be easily dispersed among administrators and duplicated by the people in governance who don’t have very advanced level of training in statistics. It suffices the daily research practice of social science for purpose of policy recommendation. The disadvantage of this methods is that it is considered to be less scientifically rigorous as the Plan A (Chen & DesJardins, 2008; Jaccard, 2001). The reason for not using this method is to avoiding losing statistical power with shrinking sample size.

3. Find out the distribution in the cross-tabs of institutional types and academic discipline to see if the variation in academic can be reduced as much as possible. This method is the substitute for Plan B above. From the cross-tab of institutional type and academic discipline, it can be seen that there is not a big difference in four groups (research and STEM fields, Research and non-STEM fields, non-research and STEM fields, and non-research and non-STEM fields), if the selection standard (more than 2 publication for research institutions and more than 0 publications for non-research institutions) is imposed. In other words, the selection standard have an additional advantage of minimizing the variances of publication distribution in four groups. Therefore, we expect that academic discipline (although included in all regression models later) will not be a statistically significant predictor in any of the regression analysis later, thus avoiding adding extra statistical models that introduce interaction terms for explaining the results. However, if we set other bars (e.g. 54.5% for both research and non-research institutions), we will technically and inadvertently introduce bigger variances explained by academic discipline. As shown in Table 6, 38.5% cut point
introduces a smaller variation in the cross-table of institutional types and academic
disciplines than 54.7%.

Table 6

Cut Points for the Dependent Variable Refereed Publication, Institutional Type by Discipline

<table>
<thead>
<tr>
<th></th>
<th>Research</th>
<th></th>
<th>Non-research</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STEM</td>
<td>Non-STEM</td>
<td>STEM</td>
<td>Non-STEM</td>
</tr>
<tr>
<td>38.5% Cut Point (used)</td>
<td>Not productive</td>
<td>34.0%</td>
<td>41.9%</td>
<td>41.0%</td>
</tr>
<tr>
<td></td>
<td>Productive</td>
<td>66.0%</td>
<td>58.1%</td>
<td>59.0%</td>
</tr>
<tr>
<td>54.7% Cut Point (not used)</td>
<td>Not productive</td>
<td>47.9%</td>
<td>60.5%</td>
<td>59.5%</td>
</tr>
<tr>
<td></td>
<td>Productive</td>
<td>52.1</td>
<td>39.5%</td>
<td>40.5%</td>
</tr>
</tbody>
</table>

In the next chapter, further descriptive analysis will be given to the independent
variables appears to be significant in the logistic regression models. Additional
descriptive statistics will be shown for some other variables beyond the regression
models if necessary.

SUMMARY

In this chapter, a theoretical framework of "environment" impacting research is
proposed on the basis of literature review. The environment is further decomposed into
the components of administration and peer support, which can be measured hierarchically
by the CAP survey instrument. Therefore, survey items match the conceptual framework
for a textbook regression analysis. The rationale of selecting independent variables, choosing logistic regression over the conventional multiple regression and creating a new dichotomous dependent variable is thoroughly explained to maintain the robustness of the study. The logistic regression analysis will take three groups of variables—faculty professional characteristics, administration support research and peer support research—one more at a time incrementally. There will be two separate sets of three logistic regressions for both research and non-research institutions. The results will be presented in Chapter IV.
CHAPTER IV. RESULTS

INTRODUCTION

This chapter presents the results of the data analysis, which will be further divided into three major sections: descriptive statistics that reveal sample characteristics, inferential statistics that undergird the entire study—logistic regression analyses, and other graphic data representations focusing on specific predictors that are statistically significant in the final model. In these sections, the data analysis is designed to the answer of the research questions identified in Chapter I.

Concretely speaking, each logistic regression analysis actually verifies the conceptual framework in three sets (levels) of models. The first model in each set of logistic regression analyses (for either research or non-research institutions) consists of three variables. To be more specific, the first model includes or specifies three variables collectively called faculty professional characteristics. The second model in each set of logistic regression analyses contains administrative support variables in addition to the variables included in the first model. The administration variables are grouped under the general construct Administration Supports Research. This construct further consists of two sub-groups of constructs: (a) Administration provides incentives for research; (b) Administration guides research. Each of these sub-level constructs is measured and supported by multiple survey items. In the final step of each set of regression analyses, the third model contains additional peer support variables besides two sets of variables earlier added into the second model. Similar to administration variables, peer support variables are hierarchically grouped under the general construct called Peer Support.
Research, which is conceptually divided into three sub-level constructs: (a) Collaborate with colleagues in research, (b) co-author with colleagues and (c) colleagues evaluate research. To sum up, for both research and non-research institutions, there are three logistic regression equations adding variables from one to three groups of incrementally.

In short, two sets of three logistic regression analyses are presented.

DESCRIPTIVE STATISTICS: SAMPLE CHARACTERISTICS

The sample (stratified sampling) included 486 faculty from research institutions and 664 faculty from non-research institutions. In Chapter III, it has been demonstrated that the selection of cut-off point for productive and not-productive depends on institutional types and academic disciplines—a cut point can ensure the fairness of the benchmark across institutional types and academic disciplines. Then other two variables of faculty professional characteristics are also needed to be controlled in the analysis. The first descriptive data (see Table 7) show the basic distribution of faculty by institutional types.

Table 7

Faculty Professional Characteristics: by Institutional Types

<table>
<thead>
<tr>
<th></th>
<th>Research</th>
<th></th>
<th>Non-research</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Academic Disciplines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-STEM</td>
<td>248</td>
<td>51.0%</td>
<td>459</td>
<td>69.1%</td>
</tr>
<tr>
<td>STEM</td>
<td>238</td>
<td>49.0%</td>
<td>205</td>
<td>30.9%</td>
</tr>
<tr>
<td>Total</td>
<td>486</td>
<td>49.0%</td>
<td>664</td>
<td>30.9%</td>
</tr>
</tbody>
</table>

7 see Research Design Section, Chapter III
First, Table 7 shows the percentage of faculty in STEM\textsuperscript{8} and non-STEM fields in research and non-research institutions. While the actual number of faculty from STEM fields was similar in research (238) and non-research institutions (205), the proportion of faculty in STEM field at research institutions (49.0\%) is much greater than at non-research institutions (30.9\%). Thus, there are smaller proportion of non-STEM field faculty at research institutions (51.0\%) than at non-research institutions (69.1\%). The total number of faculty is 1150.

Second, Table 7 also shows the distribution of faculty by type of appointment in research and non-research institutions. Of the sampled faculty working in research institutions, 60.8\% (303) are tenured compared to 54.9\% (356) at non-research institutions. Eighteen percent (N=90) of the research university faculty are tenure-track compared to 23.5\% (152) of the faculty at non-research institutions. At research institutions, 21.1\% (105) of the faculty work on term contracts without tenure-

\textsuperscript{8} The acronym STEM stands for science, technology, engineering, and mathematics. The STEM fields refer to those academic and professional disciplines that fall under the umbrella areas represented by the acronym.
eligibility—about the same as the proportion of faculty (21.6%) at non-research institutions.

Finally, Table 7 shows the distribution of faculty preferences between research and teaching in research and non-research institutions. At research institutions, 62.2% (310) of the faculty report themselves as research-oriented and 37.8% (N=188) report themselves as teaching oriented. At non-research institutions, the situation is almost reversed: only 30.1% (N=207) of the faculty are research-oriented and 69.9% (480) are teaching-oriented. This table mirrors the fact that research institutions attract research-oriented faculty to work there.

Table 8

Faculty Refereed Publication (books authored or co-authored, books edited or co-edited, article published) by Institutional Types and Academic Discipline

<table>
<thead>
<tr>
<th>Institutional type</th>
<th>Academic discipline</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>STEM</td>
<td>238</td>
<td>7.79</td>
<td>10.642</td>
</tr>
<tr>
<td></td>
<td>Non-STEM</td>
<td>248</td>
<td>4.73</td>
<td>5.207</td>
</tr>
<tr>
<td>Non-research</td>
<td>STEM</td>
<td>205</td>
<td>3.67</td>
<td>9.464</td>
</tr>
<tr>
<td></td>
<td>Non-STEM</td>
<td>459</td>
<td>2.62</td>
<td>3.762</td>
</tr>
</tbody>
</table>

Table 8 displays some important descriptive statistics for the dependent variable Refereed Publications, which consists of the sum of books authored/co-authored, book
edited or co-edited, and articles published in refereed journals. The descriptive statistics are plotted by institutional types and by academic disciplines. Insofar as the distribution is highly skewed, the median and a measure of skewness are also displayed. In terms of faculty working in STEM fields, at research institutions, refereed publications of faculty working in STEM fields have a mean of 7.79, a standard deviation of 10.642, a median of 5 and skewness of 3.604. In contrast, faculty refereed publications in STEM fields at non-research institutions have a mean of 3.67, a standard deviation of 9.464, a median of 1 and a skewness of 6.042. Furthermore, in terms of non-STEM field faculty, at research institutions, refereed publications for faculty in non-STEM fields have a mean of 4.73, a standard deviation of 5.207, a median of 3.00 and a skewness of 1.884. In comparison, at non-research institutions, refereed publications for faculty in non-STEM fields have a mean of 2.62, a standard deviation of 3.762, a median of 1.00 and a skewness of 3.148. It can be seen from the data that faculty in research institutions on average publish more than those in non-research institutions (as indicated by mean and median). As for the absolute number of publications, STEM-field faculty at research institutions on average publish much more than others. Furthermore, faculty in STEM fields tend to vary highly in research productivity, as indicated by higher standard deviation and skewness for STEM field faculty in both research and non-research institutions. This high dispersion of data indicates that some faculty in STEM fields publish much more than most faculty do. STEM-field faculty at research institutions vary the greatest in publication numbers (SD=10.462). A few STEM-field faculty at non-research institutions publish much more.

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9 The complete distribution of each kind of publication is presented in the APPENDIX D for further references.
than the group mean, but most of them are not so widely dispersed (Skewness=6.042, SD=3.604).

It should be remembered that this research design has provided for equalizing the productive/not productive across the institution types and disciplines (see Chapter III). The skewness will not be a threat to the validity of the data analysis thanks to this design pattern.

In summary, descriptive statistics provides some basic information on faculty distribution in the sample. Among faculty members in the sample, 486 of them work at research institutions and 664 of them work at non-research institutions. These faculty are divided by institutional types in the first place. Then, three cross-tabulations are presented by further dividing into academic fields, appointment types, and research preferences individually. The data basically reflect the distribution of faculty characteristics in American higher education settings. Finally, central tendency (mean, median) and variability (SD and skewness) of dependent variable (faculty refereed publications) are also displayed. These sample information of dependent variable once again justifies the reason of using this research design for logistic regression taking research productivity as a dichotomous variable.

LOGISTIC REGRESSION RESULTS

The logistic regression analyses were structured in a sequence of three models from the first one that includes Group 1 variables only to the third one that includes Group 1, Group 2 and Group 3 variables altogether. Data at each level of the logistic regression will be interpreted afterwards with caution. Since research and non-research
institutions are analyzed separately, there are two sets of logistic regression analyses (three regression models in each set) for research and non-research institutions individually.

The results of the logistic regression analyses for research institutions are in Table 9.

Table 9

logistic Regression Models Results: Research Universities ONLY

<table>
<thead>
<tr>
<th>Research University</th>
<th>1st Model: Faculty professional characteristics</th>
<th>2nd Model: First model variables + the following variables &quot;Administration Support Research&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1.A11 Appointment Types</td>
<td>.497 <strong>.000</strong>* 1.645</td>
<td>.338 *<em>.038</em> 1.402</td>
</tr>
<tr>
<td>L1.B2 Research or teaching orientation</td>
<td>1.811 <strong>.000</strong>* 6.118</td>
<td>1.489 <strong>.000</strong>* 4.434</td>
</tr>
<tr>
<td>L1.DISCP2 Academic discipline</td>
<td>.226 .287 1.254</td>
<td>.251 .361 1.285</td>
</tr>
<tr>
<td>L2.1.D7.01 Percentage of funding from your own institution</td>
<td>-.059 .732 .943</td>
<td></td>
</tr>
<tr>
<td>L2.1.E4.08 Supportive attitude of administrative staff towards research activities</td>
<td>.544 .051 1.722</td>
<td></td>
</tr>
<tr>
<td>L2.1.E6.04 Considering research quality when making personnel decisions</td>
<td>.021 .939 1.022</td>
<td></td>
</tr>
<tr>
<td>L2.2.D6.05 My institution emphasizes inter or multi-</td>
<td>.050 .856 1.051</td>
<td></td>
</tr>
<tr>
<td></td>
<td>disciplinary research</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>L2.2.E1.09</td>
<td>Central administration set internal research priorities</td>
<td>.093</td>
</tr>
<tr>
<td>L2.2.E3.03</td>
<td>Research evaluated by senior administrative staff</td>
<td>-.115</td>
</tr>
</tbody>
</table>

3rd Model >> All the variables above + the following variables “Peer Support Research”

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>L1.A11</td>
<td>Appointment Types</td>
<td>.300</td>
<td>.164</td>
</tr>
<tr>
<td>L1.B2</td>
<td>Research or teaching orientation</td>
<td>1.270</td>
<td>.000***</td>
</tr>
<tr>
<td>L1.DISC2</td>
<td>Academic discipline</td>
<td>.215</td>
<td>.576</td>
</tr>
<tr>
<td>L2.1.D7.01</td>
<td>Percentage of funding from your own institution</td>
<td>.113</td>
<td>.631</td>
</tr>
<tr>
<td>L2.1.E4.08</td>
<td>Supportive attitude of administrative staff towards research activities</td>
<td>.471</td>
<td>.197</td>
</tr>
<tr>
<td>L2.1.E6.04</td>
<td>Considering research quality when making personnel decisions</td>
<td>.005</td>
<td>.989</td>
</tr>
<tr>
<td>L2.2.D6.05</td>
<td>My institution emphasizes inter or multi-disciplinary research</td>
<td>-.034</td>
<td>.927</td>
</tr>
<tr>
<td>L2.2.E1.09</td>
<td>Central administration set internal research priorities</td>
<td>.295</td>
<td>.506</td>
</tr>
<tr>
<td>L2.2.E3.03</td>
<td>Research evaluated by senior administrative staff</td>
<td>.109</td>
<td>.775</td>
</tr>
<tr>
<td>L3.1.D1.3</td>
<td>Collaborate with persons at other institutions in the US</td>
<td>.616</td>
<td>.100</td>
</tr>
<tr>
<td>L3.1.D1.4</td>
<td>Collaborate with international colleagues</td>
<td>.710</td>
<td>.060</td>
</tr>
<tr>
<td>L3.2.D5.02</td>
<td>Co-authored with colleagues located in the US</td>
<td>.867</td>
<td>.011*</td>
</tr>
<tr>
<td>L3.2.D5.03</td>
<td>Co-authored with colleagues located in other (foreign) countries</td>
<td>1.463</td>
<td>.002**</td>
</tr>
<tr>
<td>L3.3.E3.01</td>
<td>Research evaluated by peers in your department or unit</td>
<td>.123</td>
<td>.737</td>
</tr>
<tr>
<td>L3.3.E3.02</td>
<td>Research evaluated by members of other departments or units</td>
<td>-.453</td>
<td>.280</td>
</tr>
</tbody>
</table>

NOTES: (i) Chi-square values for models: Model 1: 108.881, df=3, p<=.000; Model 2:
For research institutions, the first model focusing on faculty professional characteristics shows that *Appointment type* and *Research or teaching orientation* are strong predictors of faculty research productivity in research institutions. The results are congruent with previous literature (C. J. Bland, et al., 2006). Most importantly, faculty themselves have to be intrinsically motivated to conduct research (Blackburn & Lawrence, 1995). The odds ratio of “Research or teaching orientation” \([\text{Exp}(B)=6.130]\) indicates that the odds of research-oriented faculty being placed in the *productive* group are 6.118 times of that of teaching-oriented faculty. In other words, faculty members in research institutions who are more research oriented tend to be 6.118 times more likely to be classified as research productive than those who are less research oriented. A less influential yet statistically significant variable is *Appointment Types*. The odds ratio \([\text{Exp}(B)=1.645]\) indicates the odds of tenured faculty being classified as *research productive* are 1.645 times that of tenure-track (not yet tenured) faculty, and the odds of tenure-track (not yet tenured) faculty being classified as *research productive* are 1.645 times that of other contract. In other words, faculty in tenure-able positions are 1.645 times more likely to be placed in the *productive* group than those in tenure-track (not yet tenured), and who subsequently are also 1.645 times more likely to be *productive* than faculty in other contract. Academic discipline appears to be not statistically significant.\(^{10}\)

To summarize, if only three factors of faculty professional characteristics are considered,

\(^{10}\) As discussed in Chapter 3, 38.5% cut point in outcome variable “faculty research productivity” have already minimized the variance in across the disciplines.
faculty preference in research and their appointment type can be used as two predictors of
research productivity.

In testing the second model wherein the additional variables of Administration
support on research are entered into the logistic regression, two variables of faculty
professional characteristics still remain statistically significant, although the odds ratio
for both of them slightly declines to 4.5 and 1.4, respectively. None of the administration
variables is statistically significant in the second model. In other words, administration
variables virtually play no part in explaining the faculty productivity—the dependent
variable.

Again, the odds of research-oriented faculty being research productive are 4.516
times that of teaching-oriented. In other words, faculty who report themselves to be
research oriented are 4.516 times more likely to be in the productive group than those
report to be teaching oriented; Tenured and tenure-track faculty are more likely to be
productive than non-tenure track faculty. So far, these results suggest that faculty in
research institutions are relatively impervious to administration initiatives, which are
intended to support research activities (certainly in comparison to the individual
professional characteristics they bring to the job).

Compared with the second model, the third model incrementally absorbs peer
support variables. As a result, two of peer-support variables emerge to be statistically
significant: co-author with colleagues located in the US and co-author with colleagues in

11 In the 2nd model for research institutions, the administrative item “Supportive attitude of administrative
staff towards research activities” is marginally statistically significant (p=0.051). There are other occasions
when marginal significance occurs. Please refer to endnote iii.
other foreign countries. The odds of faculty who report co-authorship with domestic colleagues to be research productive are 2.38 times that of faculty who report no co-authorship. In other words, the odds ratio for the variable co-authored with colleagues located in the U.S. suggests that those faculty who report to have written publications with domestic collaborators are 2.38 times more likely to be research productive than those who have never co-authored. Similarly, the results for the variable co-authored with colleagues in other foreign countries indicate that the odds for faculty who have written publications with international colleagues to be research productive are 4.319 times more likely to be productive than those who have never co-authored with international collaborators. In addition to these two newly emerging predictors, the variable research or teaching orientation remains statistically significant [Exp(B)=3.562].

The results of the third model shows that when all the variables from three clusters are brought into the equation and their relative impact is taken into account, only three predictors come out to be statistically significant. In conclusion, for research institutions, faculty professional characteristics and peer support are the factors that impact research productivity. The variable co-authored with colleagues in other countries appears to be the strongest predictor of all. In sum, faculty in research institutions who are productive are generally characterized by the profile of strong personal preference in research, co-authorship with collaborators either in the US or worldwide. Appointment type that is only statistically significant in the first two model losses its power in the last model once the variables of peer support are introduced.

In contrast, the results of the logistic regression analysis for non-research institutions is displayed in Table 10.
Table 10

Logistic Regression Models Results: Non-research Universities ONLY

<table>
<thead>
<tr>
<th>Model</th>
<th>Faculty professional characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Appointment Types</td>
<td>.332</td>
</tr>
<tr>
<td></td>
<td>Research or teaching orientation</td>
<td>1.537</td>
</tr>
<tr>
<td></td>
<td>Academic discipline</td>
<td>-.180</td>
</tr>
<tr>
<td>2nd</td>
<td>Appointment Types</td>
<td>.056</td>
</tr>
<tr>
<td></td>
<td>Research or teaching orientation</td>
<td>1.208</td>
</tr>
<tr>
<td></td>
<td>Academic discipline</td>
<td>-.156</td>
</tr>
<tr>
<td></td>
<td>Percentage of funding from your own institution</td>
<td>.151</td>
</tr>
<tr>
<td></td>
<td>Supportive attitude of administrative staff towards research activities</td>
<td>-.644</td>
</tr>
<tr>
<td></td>
<td>Considering research quality when making personnel decisions</td>
<td>.876</td>
</tr>
<tr>
<td></td>
<td>My institution emphasizes inter or multidisciplinary research</td>
<td>-.184</td>
</tr>
<tr>
<td></td>
<td>Central administration set internal research priorities</td>
<td>-.350</td>
</tr>
<tr>
<td></td>
<td>Research evaluated by senior administrative staff</td>
<td>-.042</td>
</tr>
<tr>
<td>3rd</td>
<td>Appointment Types</td>
<td>.361</td>
</tr>
<tr>
<td></td>
<td>Research or teaching orientation</td>
<td>.502</td>
</tr>
<tr>
<td></td>
<td>Academic discipline</td>
<td>-.528</td>
</tr>
<tr>
<td>L2.1.D7.01</td>
<td>Percentage of funding from your own institution</td>
<td>.054</td>
</tr>
<tr>
<td>L2.1.E4.08</td>
<td>Supportive attitude of administrative staff towards research activities</td>
<td>-.816</td>
</tr>
<tr>
<td>L2.1.E6.04</td>
<td>Considering research quality when making personnel decisions</td>
<td>.912</td>
</tr>
<tr>
<td>L2.2.D6.05</td>
<td>My institution emphasizes inter or multi-disciplinary research</td>
<td>-.302</td>
</tr>
<tr>
<td>L2.2.E1.09</td>
<td>Central administration set internal research priorities</td>
<td>-.301</td>
</tr>
<tr>
<td>L2.2.E3.03</td>
<td>Research evaluated by senior administrative staff</td>
<td>-.244</td>
</tr>
<tr>
<td>L3.1.D1.3</td>
<td>Collaborate with persons at other institutions in the US</td>
<td>.612</td>
</tr>
<tr>
<td>L3.1.D1.4</td>
<td>Collaborate with international colleagues</td>
<td>1.688</td>
</tr>
<tr>
<td>L3.2.D5.02</td>
<td>Co-authored with colleagues located in the US</td>
<td>1.413</td>
</tr>
<tr>
<td>L3.2.D5.03</td>
<td>Co-authored with colleagues located in other (foreign) countries</td>
<td>1.780</td>
</tr>
<tr>
<td>L3.3.E3.01</td>
<td>Research evaluated by peers in your department or unit</td>
<td>.284</td>
</tr>
<tr>
<td>L3.3.E3.02</td>
<td>Research evaluated by members of other departments or units</td>
<td>-.066</td>
</tr>
</tbody>
</table>

NOTES: (i) Chi-square values for models: Model 1: 70.747, df=3, p<=.000; Model 2: 36.582, df=9, p<=.000; Model 3: 48.288, df=15, p<=.000

(ii)**predictor is statistically significant based on Wald Test at .00 probability level; * predictor is significant at the .05 probability level

For non-research institutions, the first logistic regression model shares similar patterns to the research counterparts. Discipline still doesn’t emerge as a statistically
significant predictor of faculty research productivity\textsuperscript{12}. Similar to research institutions, faculty preference in research or teaching still stands out as the strongest predictor in the first model among faculty professional characteristics. The odds of research-oriented faculty being placed in the \textit{productive} group are 4.65 times of that of teaching-oriented faculty. In other words, in non-research institutions, when their professional characteristics are only included, faculty who report a preference for research are 4.65 times [odds ratio is 4.65] more likely to be classified in the \textit{research productive} category than faculty who consider themselves to be teaching oriented.

Next, faculty with different appointment types also vary in the likelihood of being classified to be in the research-productive groups. The odds ratio [\(\text{Exp}(B)=1.394\)] indicates the odds of tenured faculty being classified as \textit{research productive} are 1.394 times that of tenure-track (not yet tenured) faculty, and the odds of tenure-track (not yet tenured) faculty being classified as \textit{research productive} are 1.394 times that of other contract. To be more specific, tenured faculty are 1.394 times [\(\text{Exp}(B)=1.394\)] more likely to be research productive than tenure-track (not yet tenured faculty in non-research institutions; tenure-track (but not yet tenured) faculty tend to be 1.394 times [\(\text{Exp}(B)=1.394\)] more likely to be research productive than faculty in other contracts.

In comparison with research institutions, the results of the second model for non-research institutions show that two variables related to administrative support are statistically significant. First, for non-research institutions, the variable \textit{consider research quality when making personnel decisions} emerges as one statistically significant

\textsuperscript{12} Here again as discussed in Chapter 3, 38.5\% cut point in outcome variable “faculty research productivity” have already minimized the variance in across the disciplines.
predictors of whether a faculty member belongs or does not belong in the research productive group. According to the results, the odds of faculty working in an institution where research quality is related to decision-making process being productive is 2.401 times that of faculty working in an institution without the same aforementioned regulation. In other words, faculty working in those non-research institutions which consider research quality in personnel decisions are more than twice as likely to be research productive [odds ratio = 2.401]. The variable supportive attitude of administrative staff towards research, on the other hand, shows a negative relationship with research productivity. The odds of faculty reporting a supportive attitude of administrative staff being productive are only 52.5% that of faculty reporting no supportive attitude. The faculty who report a supportive attitude of administrative staff towards research in their institutions tend to be approximately ½ [Exp(B)=0.525] as likely to be in the research productive group. Besides these two administration variable, research or teaching orientation still serves as the strongest predictor of faculty research productivity so far. Tenured faculty in non-research institutions are 3.345 times more likely to become research productive than tenure-track faculty, who subsequently tend to be 3.345 times more likely to be in research-productive group than faculty of other contract types.

Finally comes the results for the third model offer non-research institutions. The third model concurrently testing three groups of predictor variables (faculty professional profile, administrative and peer support for research) indicates that two statistically significant predictors emerge while the originally statistically significant variables in the first and second model for non-research institutions no longer attain statistical significance. These two predictors, variable collaborate with international colleagues and
co-author with colleagues located in the U.S. even supersede the impact of the intrinsic variable [faculty] research or teaching orientation that appears to be statistically significant in the first and second models.

First, for faculty working at non-research institutions, those who co-authored with colleagues in the US are 4.106 times [odds ratio: \(\exp(B)=4.106\)] likely to be research productive. Because the cut point for research productive and not productive in non-research institutions is set to be zero, it means that those faculty who co-authored with domestic colleagues are almost four times likely to have at least one publication than those who do not co-author with other people in the US. Second, the odds are more favorable for faculty who collaborates with international colleagues. Faculty collaboration with international peers tends to be the strongest predictor for non-research institutions. Those faculty who collaborate internationally are approximately 5.3 times [\(\exp(B)=5.300\)] more likely to be research productive than those who don’t have that channel of collaboration, if other variables are controlled.

Therefore, for non-research institutions, only two variables from the construct peer support research appear to have impact on faculty research productivity. The effect of personal professional characteristics and administration support, although once statistically significant in the first and second models, is attenuated in the third model when peer support factors are introduced.

**CLOSE-UP ON THE VARIABLES IN THE FINAL MODEL (MODEL 3)**

In this section, variables statistically-significant in the final models will be examined in depth. Although the inferential statistics for them (i.e. the impact of
individual research orientation, peer collaboration domestically or international ) have already been formally displayed, a graphic exhibition of these statistically-significant variable (descriptive in nature) will be helpful in further interpretation and discussion. In this section, the cross-tabs\textsuperscript{13} of dependent variable in the logistic regression (productive / not productive) and statistically significant independent variables from the final models will be constructed.

**Research or teaching orientation**

The final model of research institutions show that research orientation is the second strongest indicator of research productivity. A closer look at the cross-tabs of research / teaching orientation and productivity (see Table 11) reveals more about this fact. At research institutions, 77.7\% (241) of the research oriented faculty actually have more than two publications in the last 3 years. For teaching oriented faculty, that figure is only 35.1\% (66).

*Table 11*

**Productive or Not: by Research or Teaching Orientation, Research Institutions ONLY**

<table>
<thead>
<tr>
<th></th>
<th>Teaching oriented</th>
<th>Research-oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Not productive &lt;=0</td>
<td>122</td>
<td>64.9%</td>
</tr>
<tr>
<td>Productive &gt;2</td>
<td>66</td>
<td>35.1%</td>
</tr>
<tr>
<td>Total</td>
<td>188</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{13} Please see the bar charts of cross-tabulations in Appendix E
Faculty Peer Collaboration

For both research and non-research institutions, the final models suggest that faculty peer collaboration is the most important factor for predicting research productivity, although the situation slightly varies across two types of universities.

The variable *co-authored with colleagues located in the U.S.* is statistically significant for both research and non-research institutions in the third model. As shown in Table 12, at research institutions, among faculty who reported to co-authored with colleagues in the US, 77.1% fall into the *productive* group, those who have more than two refereed publications in the last 3 years; only 22.9% fail to meet the "productive" standard.

*Table 12*

*Co-authored with colleagues located in the US: Research institutions ONLY*

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th></th>
<th>Yes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Not productive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;=2</td>
<td>60</td>
<td>52.2%</td>
<td>71</td>
<td>22.9%</td>
</tr>
<tr>
<td>Productive &gt;2</td>
<td>55</td>
<td>47.8%</td>
<td>239</td>
<td>77.1%</td>
</tr>
<tr>
<td></td>
<td>115</td>
<td></td>
<td>310</td>
<td></td>
</tr>
</tbody>
</table>

Similar pattern also fits non-research institutions. Of all faculty working at non-research institutions, who have co-authored with other colleagues located in the US, 87.5% of them are in the *productive* group, who have at least one refereed publication in the last three years; Only 12.5% of them are not productive—have not published anything (Table 13). In contrast, at non-research institutions, among faculty who have not co-
authored with U.S. colleagues, 59.4% of them are productive in the last 3 years and 40.6% of them are not.

Table 13

Co-authored with Colleagues Located in the U.S.: Non-Research Institutions

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not productive &lt;=0</td>
<td>78</td>
<td>38</td>
</tr>
<tr>
<td>40.6%</td>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>Productive &gt;0</td>
<td>114</td>
<td>266</td>
</tr>
<tr>
<td>59.4%</td>
<td></td>
<td>87.5%</td>
</tr>
<tr>
<td>Total</td>
<td>192</td>
<td>304</td>
</tr>
</tbody>
</table>

In the Table 14 regarding international collaboration with below, 90.4% of the faculty at research institutions reporting to have co-authored with international colleagues are research productive—have more than two refereed publications in the last 3 years; Only 9.6% of them have not achieved this requirement and thus are considered not productive in research. In contrast, only 62.7% of the faculty who do not have experiences of co-authorship with international colleagues have more than two refereed publications (categorized as research productive), and the other 37.3% of them have failed to meet the “productive standard”.

Table 14

Co-authored with Colleagues Located in Foreign Countries: Research Institutions

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not productive &lt;=2</td>
<td>101</td>
<td>11</td>
</tr>
<tr>
<td>37.3%</td>
<td></td>
<td>9.6%</td>
</tr>
<tr>
<td>Productive &gt;2</td>
<td>170</td>
<td>104</td>
</tr>
<tr>
<td>62.7%</td>
<td></td>
<td>90.4%</td>
</tr>
<tr>
<td>Total</td>
<td>271</td>
<td>115</td>
</tr>
</tbody>
</table>
Table 15 below shows international collaboration at non-research institutions. On one end of the spectrum in this cross-tabulation, of all faculty who do not report any types of collaboration, 33.0% have no publications. In contrast, of all faculty who collaborate internationally, only 13.7% have no publications. On the other end of the spectrum, of all faculty who do not report any types of collaboration, 67.0% of them have at least one publications in the last three years while they are research active; among the faculty who reports international collaboration: 86.3% have more than two publication in the last 3 years.

Table 15

Collaborate with International Colleagues: Non-research Institutions

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th></th>
<th>Yes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Not productive</td>
<td>128</td>
<td>33.0%</td>
<td>17</td>
<td>13.7%</td>
</tr>
<tr>
<td>Productive &gt;0</td>
<td>260</td>
<td>67.0%</td>
<td>107</td>
<td>86.3%</td>
</tr>
<tr>
<td></td>
<td>388</td>
<td></td>
<td>224</td>
<td></td>
</tr>
</tbody>
</table>

**SUMMARY**

In sum, this chapter has achieved the goal of testing research hypotheses through analyzing survey data. First, the cross-tabulations of faculty professional profile (variables to be controlled) by institutional type show the basic distributions of faculty sampled in the survey. Second, three separate logistic regression models conforming to the conceptual framework are conducted as the main body of data analyses. Finally, the cross-tabulations of dependent variable (productive or not) by those statistically
significant variables are listed to offer a close look of the results derived from logistic regression analysis.

Moreover, there are several variables appear to be marginal significant (0.05 < p < 0.06) on different occasions. These variables will not be considered as official results of statistical significant levels and thus not mentioned here. The discussion of these marginal significant variables are found in the endnote section.
CHAPTER V. DISCUSSION

INTRODUCTION

This chapter consists of four sections. The first section Findings will include a summary and further explanation of the results of the data analysis presented in the previous chapter. The second section Discussions will draw some comparative conclusions for research and non-research institutions. The research questions raised in Chapter I will be also discussed extensively in this section. In the third section Limitations, the problems of the research design and data analysis will be further discussed and then alternative methodologies for future research will be proposed. In the fourth section, it is the policy recommendations that will be discussed. The fifth section closes this study by bringing some historical and panoramic perspectives in the higher education landscape to bear on the impact of faculty collaboration.

FINDINGS

In this section, further analyses of statistically significant predictive models for research productivity at both research and non-research institutions will be discussed in terms of the categories of predictors examined. The interpretation will be mostly confined to what was found in the data analyses and will be scrupulously extended to what is not obviously suggested by the results per se only when necessary.

Personal Professional Characteristics

First of all, faculty preferences or predisposition are the preconditions for high research productivity. This statement is especially the case in the research institutions.
The connotation of faculty preferences is two-fold. First, faculty have to be self-motivated to be research oriented. On the other hand, more importantly, faculty have to be trained to have the skills to conduct research. In reality, faculty with high talent, exceptional research capacity, and strong motivation to do research usually congregate in large research institutions. In contrast, faculty with relatively lower capacity and motivation for research tend to seek employment at non-research or teaching-oriented institutions. Even if they self-report themselves to be research oriented in the survey, their research capability and potential may not be sufficiently strong to yield high-quality (refereed publications) research outcomes that characterize their counterparts at research institutions. Fundamentally, research institutions surpass non-research institutions in the faculty they possess, who have innate motivation and nurtured research capacity.

Working in the proximity of research-inclined peers, faculty at research institutions may need to be more focused on their research so that they can stand out. Therefore, a teaching professor at a research institution may not easily match their research-prolific colleague who spends most of their time in research activities. This underscores the fact that research or non-research preference persists as a predictor across all three models for research institutions.

In contrast, faculty at non-research institutions are in a different situation. First, their willingness to conduct research may not translate into a successful research outcome (refereed publications), since they have to compete with their better supported counterparts in research universities when they try to publish in the refereed publications. Second, most non-research institutions set their institutional mission to be teaching and thus become less dependent on the revenue generated by faculty research. Their revenue
dependencies lead them to focus attention on student retention and to meet the growing
demands from students (e.g., smaller class size, more student-advising time). Moreover,
unlike their counterparts working at research institutions, they generally do not have
sufficient research or teaching assistant support. Consequently, faculty at non-research
institutions will inevitably be subject to heavy teaching loads. Even though they want to
spend more time in conducting research, the nature of their job (actually different from
that of faculty at research institutions) may sap their motivation to focus on research.
Thus, in reality faculty with research preferences at non-research institutions may make
smaller research contributions than they actually want. This partially explains why
research orientation does not remain a statistically significant predictor after peer support
variables are introduced, despite their presence in the previous two models. To be more
specific, when more factors (in this case, peer support for research) are taken into
consideration, faculty at non-research institutions who claim to be research oriented
actually show no difference in research outcomes compared with those who claim to be
teaching oriented.

Appointment types also appear to account for research productivity in either
research or non-research institutions, but only in basic models including faculty
professional characteristics. Appointment types reveal much information about faculty
research. First of all, most institutions, whether research or non-research, tend to use the
number of publication to be the prioritized requirement for tenure-track employment or
promotion. Faculty who are tenured or tenure-eligible generally have higher research
capabilities. Secondly, tenured or tenure-track faculty can have more research-related?
resources at their disposal. These academic resources (notably, laboratories, research
funding, and research support staff) can help them produce more research work. Thirdly, tenure or tenure-track faculty may gain the advantage of more exposure to professional networks and information. If so, the variable appointment type may be a proxy for other factors later introduced into equation. As it happens, the impact of appointment type will be eclipsed by other variables entered later into the models. At research institutions, appointment type doesn’t remain statistically significant after peer support variables enter into the equation. For non-research institutions it emerges as statistically significant only in the first model.

Administration Support Research

For research institutions, the logistic regression results show that none of the administration variables is statistically significant. In other words, the data suggest that administration support for research can rarely effectively promote research productivity in research universities. However, in non-research institutions, the situation is somewhat different. After administration variables enter into the equation (2nd model), there emerge two statistically significant predictors, which shed light on the ecology in some non-research institutions.

First of all, for non-research institutions, data suggests that when faculty rating on supportive attitude by administrative staff towards research activities changes from no to yes, faculty themselves are actually less likely (50% less chance) to be in the research-productive group. This negative relationship is at first counter-intuitive and has to be explained with caution. It would be incorrect to conclude that the supportive attitude of administrative staff has a negative impact on research productivity. Closer scrutiny of the
results yields a more logical explanation: It is highly likely that faculty who give positive rating tend to be those in less research oriented or in research-barren institutions. In such institutions, administrative staff may have higher levels of supportive attitude to make some changes, that is, to become more research productive. However, their supportive attitude is of no avail to their faculty who, out of many reasons, still do not publish. Therefore, this ostensibly statistically significant variable actually tells an empirical real-world tale: supportive attitude is basically of limited use in building a research-productive environment. Even though administrative staff at some non-research institutions tend to be emotionally supportive as reflected by positive faculty ratings in the survey, their attitude—in and of itself—will have little impact on their faculty research productivity.

However, for non-research institutions, the variable consider research quality when making personnel decisions is statistically significant in the second model with professional characteristics and administration support variables. It is reasonable to conclude that non-research institutions can create some monetary incentives to encourage research activities. Oftentimes monetary reward is essential to sparkle the creativity and maintain publication efforts of the researchers (Williams, Dunnington, & Folse, 2003). What this suggests is that while general expressions of administrative support may have limited effectiveness, those administrative efforts specifically targeted on shaping the reward system may be more successful in producing research outcome sat non-research institutions.

Peer Support Research
The findings of the data analysis in the third model show that peer support makes the biggest contribution to research productivity, regardless of institutional type. For research institutions, there is a direct positive relationship between co-authorship variables and research productivity. For non-research institutions, faculty who report either having collaborated with international colleagues or having co-authored with colleagues located in the U.S. tend to be more likely to be research productive. One can draw a strongly unequivocal conclusion that peer support facilitates the flow of knowledge, provides inspiration for faculty creativity, and thus lead to higher research productivity.

Some nuances of peer support variables need to be explained in greater detail. As defined in the glossary in Chapter I, collaboration is a more general concept than co-authorship. Collaboration simply means that faculty work together and doesn’t imply any joint product thereafter. In contrast, co-authorship is a more specific variable referring to the consequences of certain collaboration.

There are two dimensions that define the peer support construct: (a) collaboration and co-authorship axis, (b) domestic and international axis. In a more practical sense, the technical difference between collaboration and co-authorship is not considered to be important. The point is that in both research and non-research institutions faculty who collaborate with their colleagues in the US and worldwide appear to have a much higher chance to become research productive, regardless of whether measured by collaboration or by co-authorship variables. The real focus lies in the second axis: domestic and international. For research institutions, it is the variable co-author with colleagues in other countries (international) that becomes the best predictor among all variables in the
last model. Likewise, for non-research institutions, it is the variable *collaborate with international colleagues* that finally emerges as the best predictor of all variables in the last model. It can be concluded that international collaboration is most important factor that has impact on faculty productivity.

However, for research and non-research institutions, the variable *collaborate with persons at other institutions in the U.S.* appears to be not statistically significant. This non-significant factor may be attributable to the fact that faculty at all kinds of institutions generally collaborate with colleagues at their own institutions rather than with colleagues at other institutions. But this interpretation should be made with caution, since the data available in this study cannot appropriately test that possibility through this statistical analyses alone. In other words, the research hypothesis stating that faculty at research institutions tend to find collaborators within their own institution while faculty at non-research institutions cannot be tested by the results of this study. It is also impossible to disentangle two variables complete from each other: *collaborate with persons at other institutions in the US* and *co-authorship with colleagues located in the US*. Nor can the statistic analysis provide strong evidence to prove that the data align completely with their verbatim meaning. The only conclusion that can be safely drawn is that either variable means collaboration with colleagues in the U.S., yet rendering its itself insufficient in providing more detailed information about their scopes—whether this collaboration is only with people within their institutions or outside their institutions, as suggested by the verbatim meaning.

**DISCUSSIONS**
A preliminary conclusion drawn from the final models is that there is not a big difference between research and non-research institutions from the data results: their patterns appear to be similar. Nonetheless, the slight differences represented by data can refer to very different phenomena in the real world which need more explanation.

The last faculty professional profile variable, discipline, turns out not to have an impact on the research productivity. The results for academic disciplines must be explained with caution. It is because under the circumstance that the benchmark for research productivity is set to be relatively low the faculty from different disciplines do not vary too much in research productivity. Faculty in research institutions need to have more than two refereed publication in the past 3 years. Faculty in non-research institutions only need to publish one. Previous literature suggests that well-structured fields, such as science and technology, make faculty easier to publish, compared with social sciences and humanities (Konrad & Pfeffer, June, 1990). This will become true if the benchmark of research productivity is adjusted upwards slightly. The higher the number of refereed publication is set, the higher the proportion of faculty in STEM field in the highly-productive group. Another factor is collapsing (limiting) the coding categories for academic fields that has the effect of compressing variance. Both factors—the selection of a lower than desirable threshold value and dichotomization are re-enforcing the likelihood of non-significant findings.

To sum up, of all three variables depicting faculty professional profile, the preferences to research—the intrinsic power to know—overrides the appointment type and discipline. Thus, the first research hypothesis is adequately tested and partially confirmed. In research universities, faculty preference in research does have an impact on
research productivity. In non-research universities, faculty preference in research appears to be not as important as peer support and collaboration.

Next comes to the discussion of some administration support variables. First of all, what the literature in Chapter II suggests is that the impact of the administration on research productivity is ambiguous. Perhaps the best interpretation of the literature regarding administration is: administration can alter the resource allocation or environment factors that directly related to or cause high research productivity. If the administration variable has no correlation with those resources or environmental factors, its functionality may lead to other benefits favorable for faculty or the institutions, but not for enhancing research productivity. For instance, faculty satisfaction may be highly correlated with administration support and services, specifically, secretarial and office support, library services and availability of materials, and teaching and graduate assistants (Johnsrud & Rossier, 2002; Kerlin & Dunlap, 1993; Matier, 1990).

The findings reported here suggest that administrative support has no independent effect at research institutions, but a fairly circumscribed, albeit significant effect, at non-research institutions. Some attention, therefore, should be paid to reward systems that encourage research activities at non-research institutions. With fewer institutional resources than research institutions, non-research institutions need more emphasis in administrative system on earmarked reward of research. Faculty’s self-efficacy can also be thwarted by insufficient research resources and perhaps even more by meager income (at some non-research institutions). The second possible explanation is that faculty who is research productive can climb more rapidly up to administrative position to enjoy a variety of benefits, one of which is to secure more resources for research, if research
quality is considered as the key to personnel decisions. This variable reveals that faculty
at non-research institutions to some extent relies on the institutional initiative either to
secure some research-bound resources or to be rewarded for their research.

To sum up, the second and third research hypotheses are confirmed. At research
institutions where the reward system for research and research-centered culture is already
in place, administrative support does not have an impact on research productivity. In
other words, any policy aimed at changing administration practice will not likely
contribute an added effect given the de facto research culture in research institutions. In
contrast, at non-research institutions, the administrative initiative to add incentive to
research activity is effective but only to a limited extent. Administrative support appears
to be not as important when compared with peer support. However, because many non-
research institutions are still uncertain about what culture they want to have, and the
reward for research system has not yet been fully in place, some administrative incentives
for research activities does have limited effectiveness.

Finally, for peer collaboration variables, the findings show both the similarities
shared by research and non-research institutions and differences between them. The
biggest similarity lies in the third model for both types of institutions—research and non-
research: Collaboration with colleagues within the border of the US and overseas is the
critical factor for high research productivity. Research and non-research institutions do
not differ in pattern. Most importantly, collaboration with international colleagues
appears to be the best predictor of research productivity. There are still some small, yet
discernable differences between research and non-research institutions revealed by the
peer support variables. First of all, the relative weights for peer support variables provide
some clues. At research institutions, co-authorship with international colleagues appears to be the most important predictor for research productivity, as indicated by its odd ratio (4.319). However, if peer support and faculty professional characteristics are considered as a whole, it can be concluded that faculty collaboration and preference in research (odd ratio = 3.562) are both very important at research institutions. In contrast, at non-research institutions, the weights of peer support have overwhelmed any of professional characteristics and administrative support. If we consider the framework as a whole, peer support has fundamentally determined faculty research productivity at non-research institutions.

To summarize this discussion section:

1. In both research and non-research institutions, research-productive faculty tend to be engaged in collaboration with both domestic and international peers. Faculty who report international collaboration tend to be most likely to be research productive.

2. A holistic observation of three models together can reveal that administration appears to have different roles in research and non-research institutions due to the differences of faculty composition. But administration generally plays a negligible role compared with peer support in both types of institutions.

LIMITATIONS

This section will re-introduce the major limitations of the study. Alternative approaches/strategies to offset these limitations will be also proposed for future studies.

Measurement of Research Productivity
First of all, the measurement of research productivity poses some problems that are yet to be explored. The single dependent variable measuring faculty research productivity poses additional problems. Faculty work is extremely complex and cannot be explained using single measures for research productivity (Porter & Umbach, 2001). Porter and Umbach (2001) also included the total external grant dollar in a academic year when faculty was a principal or co-principal investigator alongside with refereed publication counts as the indicators of research productivity. However, they even criticize the limitation by using the variable of total external grant dollars: the ability to raise grant money and the ability to publish require different set of skills; variables that have a large impact on grant dollars earned do not necessarily have a similar impact on publications (Porter & Umbach, 2001).

The methods of reporting research productivity by adding the number of refereed academic works can be somewhat unwarranted, since it does not count for different weights among those refereed publications. In some disciplines, published journal articles are considered more important than edited books. In some disciplines, a patent with cutting edge technology can be a profoundly influential invention in the field. A more scientific approach in addition to assigning weighting index is to use a more detailed classification standard on discipline rather than to use a dichotomous classification: (a) Humanities, social sciences, education, business, and (b) Natural sciences, engineering, life, agriculture and medical sciences. There are two main reasons for not adopting this more detailed classification. One reason lies in the difficulty of finding a weighting index that can be used effectively in combination of more specific classification of disciplines; A second reason is the lack of sufficient/appropriate sample size for certain discipline.
For instance, not many faculty in education field report data on the survey. It makes hardly any difference if faculty in educational field is grouped with faculty in humanities.

Never has a systematic description of relative weights of publications in different disciplines been discussed in the literature. Perhaps there is no need to determine those weights precisely. However, there is some necessity to list some basic principles for quantifying research publications in general disciplinary categories.

Although the dichotomous dependent variable does circumvent the problem of skewed distribution, which causes non-normality in the error terms of conventional regression models, the simple break between productive and not productive demands scrutiny. Two alternative methods can be considered. The first method is to use a multi-nominal dependent variable in this logistic regression. In this case, perhaps a three-category criterion can be applied to the dependent variable: 0 publication as Not productive, 1-3 publication as productive, greater than 3 as very productive. The results of this multi-nominal logistic regression will provide more detailed information about faculty research productivity at more finely differentiated levels.

Another alternative method to consider is a multi-level model. A single multi-level model can control institutional types at different levels and shows the impact of independent variables for these levels (in this case, the levels can be institutional types, research versus Non-research). This hierarchical nature of data measuring faculty productivity also applies to academic discipline. Faculty members within an academic discipline more closely resemble one another than faculty in other discipline (Porter & Umbach, 2001). Only recently have higher education researchers begun to recognize the
need to analyze data taking into account the nested structures of institutions of higher education (Ethington, 1997). Multilevel modeling techniques allow researchers to handle appropriately the complex organizational effects of colleges and universities and provide the tools necessary to arrive at more accurate results (Porter & Umbach, 2001).

Finally, Poisson regression (or log-linear model) may also be considered to model the publication counts. One of the key requirements to use log-linear model is to verify the distribution of the categorical dependent variable to be Poisson distribution (P. E. Pfeffer & Schum, 1973), not binomial or multinomial. In spite of sparse literature in the application of this model in the educational research (it is widely used in econometrics), this model is worthwhile explored in this study when the measurement of faculty research productivity is count publications.

**Institutional Types**

Because in this study institutions are dichotomized into research and non-research types, it is imperative to raise the query of the possible limitations this imposes on the analysis.

American higher education operates within a highly stratified system, and the Carnegie classification depicts the hierarchical structure almost perfectly (Blackburn & Lawrence, 1995). Research and doctoral-granting universities differ from one another in amount of federal support received for research and developments. Res-I professors have a pervasive influence on faculty norms everywhere (Blackburn & Lawrence, 1995). Although faculty in non-research universities (Carnegie classification) behave quite differently from faculty in research universities (Res-I’s and Res-II’s), non-research
institutions themselves also differ in size and in their dedication to research activities. For example, most of the doctoral-granting institutions commit to graduation education and thus give a high priority to research; most of the comprehensive universities and colleges offer master-level graduate education, and professional degrees; Liberal arts institutions, nonetheless, are preoccupied with baccalaureate education. Therefore, comprehensive and liberal arts institutions are partially due to this institutional mission not quite like doctor-granting institutions in terms of research activities.

The CAP survey uses the institutional classification system of the Carnegie Foundation for the Advancement of Teaching (1987). Research I and II institutions are grouped together into a single category named “research institutions”. Other institutions including doctoral granting, Comprehensive I and II, liberal arts I and II collapse into a category named “non-research” institution with two-year colleges excluded from the analysis. The focus on the differences between generic divisions of institutional types instead of differences between subdivisions appears to be a limitation of this study insofar as it artificially limits the variance in an important independent variable that has been demonstrated by the literature to be a key determinant of faculty research productivity.

Supportive Attitude of Administration Towards Research

The different patterns occurring in the results of administration attitudinal support on research at research and non-research institutions cannot be thoroughly understood without further investigation in future studies. The results show a positive relationship, albeit non-significant, between faculty rating on supportive attitude of administration
towards research and research productivity at research institutions, but a negative statistically significant relationship at non-research institutions. This difference in the directions of the relationships need to be better studied through qualitative methods of research—interviews with faculty members at both types of universities, or more focused survey on administration-faculty interactions. Another possibility is that the results may change when other variables have been included, such as demographic variables.

Gender and Other Demographic Variables

The selection of variables included in the data analysis deserves further attention. In the previous literature, demographic variables, primarily gender and ethnicity, are included as controlled variables. For instance, Bellas and Toutkoushian (1999) found that women faculty spent significantly more time teaching than men and less time in research. They also found that Asian faculty spent a higher percentage of time in research than White faculty. The impression that males are more productive than females in academe is primarily empirical, and the evidence of gender differences in research productivity is mixed (Perry, et al., 2000). Moreover, in more recent studies, gender differences in faculty research productivity are unfounded (Blackburn, Beiber, Lawrence, & Trautvetter, 1991; Blackburn, Lawrence, Beiber, & Trautvetter, 1991; P. E. Pfeffer & Schum, 1973). As more female faculty enter into the academic profession, the gap between male and female faculty in a number of respects has diminished. Gender can also be a proxy of appointment status, because male faculty tend to occupy the higher level of academic profession (tenured) while female faculty tend to work in junior positions. Ethnicity, on the other hand, is more complex to tackle. Ethnicity may be a proxy of socioeconomic
status, culture and value differences, and childhood upbringings. All in all, gender and other demographic variables may need to be considered in future studies.

Interactions

The research design of using traditional methods (examining research and non-research institutions separately) and setting the cut point for research and non-research institutions has avoid testing the interactions between institutional types and academic disciplines. This traditional approach assumes that if academic discipline coefficient is statistically significant in one group but non-significant in another, it can be concluded that academic discipline (STEM/non-STEM in this study) has impact on one type of institution but not on another type of institutions. However, to make the aforementioned inference necessary, a formal statistical test of the differences between the coefficients for different groups is needed (Chen & DesJardins, 2008; Jaccard, 2001). In other words, the more formal method is to introduce an interaction of institutional type and academic discipline and to include all independent variables in a single regression model. Had the academic discipline become statistically significant in the traditional method, the interaction test is undoubtedly indispensible. It turns out that the academic discipline is not statistically significant, ergo the traditional method still holds its validity. However, future studies should do a pilot analysis and include interaction effects to formally test the difference between the coefficients for different groups.

IMPLICATION FOR POLICY RECOMMENDATION

This study has provided a data-driven understanding of how administration and peer support in particular affect research productivity. Based on the findings, there are
several implications for developing or designing practices to increase research productivity on either institutional level or departmental level. As always, separate discussions for research and non-research institutions will be held to ensure comparability.

**How Do Institutions Deal With Research Preferences?**

For research institutions, it is imperative to build a national or worldwide reputation in research so that more talented and successful faculty can be attracted. It all starts from the recruitment process—that is, to identify and hire existing or potential productive faculty. These talented and seasoned researchers are attracted by prestigious departments and the same species of colleagues, with whom they can share knowledge and work together. Thus, for policymakers at each institution, they need to have a clue of why their peer institutions may have achieved higher level of research productivity. In other words, they need to understand what they can do to cultivate a culture that inspires and sustains excellent research activities.

Institutions need to have a well-developed hiring system to screen and interview the candidates. There are some principles on which the hiring system can be modeled. First, institutions should have articulated criteria for recruiting research-productive candidates. Especially for research institutions, it is best to hire potential faculty with a strong motivation and clear goals for doing research or solving special problems in their own discipline (C. Bland, J., et al., 2005). The bar of research should be set high. Evidence of previous experiences in research is vital in the recruitment process. In practice, some programs approach the prospective candidates at national meetings and
then arrange a further on-campus interview. One noteworthy advantage of this procedure is that senior faculty can observe how candidates actually demonstrate their ability interactively with audiences, most of whom are experts in the discipline. Moreover, when candidates are interviewed onsite, the department can share the departmental culture and research expectation with them. Espousal of the department culture leads to faculty collegiality and collaboration within the department (C. Bland, J., et al., 2005).

In terms of recruiting the best candidates, research and non-research institutions should use their strengths respectively. Research institutions can use their reputations in the field to attract able and motivated scholars. Non-research institutions, however, can offer unique and attractive start-up packages for the newly-hired faculty to encourage them to do research. In fact, in non-research institutions, a stimulus package for research is best paired with an explicitly articulated departmental policy of supporting research, such as tenure requirements. Department should also let the candidates know clearly of their research expectations. At research institutions, research goals are usually already in place. For non-research institutions, departments can follow the goals and interests of their most productive faculty. Finally, it should be noted that oftentimes money spent in research doesn’t guarantee the outcome and the quality of the research. Therefore, for non-research institutions, the department should be aware of goals their prospective faculty are likely to achieve.

**How Do Institutions Set Reward System?**

Although some studies (B. Clark, 1986; J. Pfeffer, 1981; Reskin, 1985) demonstrate that high producers remain high producers over the course of their career,
while initially low producers remain below average, the employing department's productivity pattern, however, can alter the pattern somewhat: high-output departments raise the level of lower producers, and vice versa (Blackburn & Lawrence, 1995). This is also partially corroborated by the data for non-research institutions in this study.

Perhaps the most significant reward for faculty at any institution is the awarding of tenure. However, faculty members are more likely to do research when they are intrinsically motivated or intrinsically rewarded (Bailey, 1994). Rieger (1990) also found that high-producing faculty were individuals who believed they were well respected as researchers and scholars—that is, their efficacy is strong. Therefore, administrators must be aware that the introduction of extrinsic rewards for research, such as salary incentives, can diminish the strength of incentives that are intrinsic to the activity itself and so can lead faculty to conduct research solely for the financial gains (Blackburn & Lawrence, 1995). In other words, the monetary reward for research, particularly at non-research institutions, has to be kept to reinforce faculty morale, but should not be considered as the only policy for encouraging research and should be used frequently in combination with supporting intrinsic motivation.

How do Institutions Facilitate Faculty Collaboration?

The most important findings of this study are related to faculty collaboration, which can be encouraged by institutional practices and thus deserves closer examination. Given the fact that successful researchers themselves usually have extensive networks of colleagues with whom they regularly communicate, institutions can use their own professional network effectively to track eligible candidates in the recruitment process.
This means that the more experienced and successful the candidate is, the more connection he or she has with other people who are visible to the field. In practice, the current faculty can contact members from their professional network through whom they can find candidates matching the recruitment description. As a matter of fact, using the network is therefore a very efficient way of recruiting the potential research-productive candidates.

The benefit from faculty collaboration is reciprocal for both department and for faculty. Since the faculty collaboration with colleagues is very important, institutions can actually help in many ways to facilitate all forms of collaboration. First and foremost, institutions can immediately take initiatives within their own domain of influence—within the department. Usually department assigns a mentor—usually a senior faculty or the department chair—to help the newly recruited faculty. There are a number of areas where senior faculty can be encouraged to mentor the new faculty (C. Bland, J., et al., 2005): First, senior faculty can help them get familiarized with the characteristics of the department. Second, experienced faculty can help new faculty build their professional networks at conferences. Third, although the high-ranking faculty cannot write grant proposals for the new entrant professors, they can teach those new faculty the knowledge and skills of grant-writing. Here what institutions can do is to pair successful grant-getting senior faculty with new hired faculty so that the senior faculty can mentor them in this way. Fourth, tenured faculty can help new comers to attain the key requirements of research productivity necessary for promotion and tenure. Therefore, it is the responsibility, though not always, for the department to strengthen the relationship between new faculty and their mentors. Department should select mentors who
themselves are excellent researchers. Institutions can even arrange a more qualified person outside the department to be the mentor, who in particular has a strong interests in the research area of the new faculty, especially for those disciplines requiring a broad thinking (e.g. political sciences). There is actually a bonus in encouraging interdisciplinary collaboration between faculty members. Sometimes new faculty can find a mentor from a different department more easily to divulge their true emotion and feelings (C. Bland, J., et al., 2005). Thus, this mentor outside the department may help the new faculty make progress quickly.

The next step institutions can easily control is the communication and culture within the department. Departments can bring faculty members together via retreats, events or research workshops. Moreover, department may use these opportunities to reiterate the department mission and culture. If the department is successful in setting certain seasoned research-oriented faculty as the culture norm, this norm will influence younger faculty in the future. Institutions may pay some attention to the faculty who don’t work with others well. The department chair can help inform faculty of what research other faculty are now engaged in. Seminars and workshops are ideal occasions. However, oftentimes faculty feel more comfortable with informal conversations. Department should know the preferences of the faculty before they make any arrangement. Institution should encourage faculty members to give each other feedback or critiques during informal local peer reviews. Seasoned faculty members should be encouraged to share their experiences in serving as editors or heads of a professional committee, if they have been. New faculty also need to help each other to make progress.
To further foster collaboration between faculty within the institutions either within or between disciplines, the institutions may take the initiative to form faculty groups or arrange the faculty offices proximate to each other. Furthermore, institutions can set up research institutes, centers or other facilities that draw faculty with similar research interests from several disciplines. It is also beneficial to establish strong linkages between departments that can spur interdisciplinary inquiries. Therefore, institutions need to promote an overall culture of collaboration by creating research centers, providing grants for stimulating collaborative research, and emphasizing collaborative opportunities during recruitment.

As for the wider professional network that research-prolific faculty always have, institutions can also exert some influence on it by providing assistance for their faculty. More specifically, they should help faculty link up with their professional network. To achieve this, institutions can fund faculty to attend professional conferences (including symposia and special presentations). Administrators can also participate in the conferences, if they themselves are active scholars. Most institutions also regularly invite visiting professors or scholars to stay on campus. Hosting visiting scholars can in fact serve dual purposes. On the one hand, faculty can obviously use this opportunity to extend their professional network. On the other hand, the department can also consult with the visiting scholars about the candidates they may suggest. To improve faculty connection with their professional networks, the institution should maintain access to the Internet and other necessary technology services.

Finally, it is worthwhile for the institutions to seek partnerships with other institutions, especially with those located in other countries. Given the superiority
America has achieved in sciences and technology, institutions in other countries are willing to establish connections with American universities and colleges. This partnership is actually mutually-beneficial for both parties. For the areas of humanities and social sciences, American faculty can learn from their colleagues, oftentimes from other perspectives they have never given thought to before. A lot of faculty have research interests related to other cultures and societies, so they essentially have to collaborate or co-author with colleagues in other countries. For the fields of sciences and technology, research resources, such as research facilities, are often located in other places. Faculty from developing countries usually travel to developed countries (America is one of their destinations) to conduct research at top-notch research facilities. Research-only temporary appointments are heavily staffed in the United States by international researchers holding temporary visa permits (Altbach, Reisberg, & Rumbley, 2009). American faculty are also frequently involved in the research activities that are aimed at solving indigenous problems in another country. All these activities generate research and knowledge. What institutions can do is to help faculty establish those partnerships internationally, to help them find information about potential international collaborators and to enhance faculty’s awareness of multi-cultural ethos and values. To work together efficiently, American faculty need to know more about the culture of their international collaborators.

EPILOGUE

The past 60 years after World War II have witnessed rapid change of the faculty role. Faculty research activities have evolved from essentially sporadically-organized intellectual adventures at some elite research universities to widely recognized
requirements as the prioritized function of faculty across all types of institutions. It is widely known that technological revolution and social transformation posterior to World War II have shaped the landscape of higher education. Likewise, in the first decade of the 21st century, the knowledge explosion and globalization after the advent of Internet have brought up a new waves of impact on all aspects of higher education. In the mid-20th century, it was primarily the aftermath of American government efforts to win the technology race that lead to the diffusion of research trained faculty into non-research institutions and also the realities of a buyer's market for faculty. These faculty members carried knowledge and research ethos with them. The diffusion of research-oriented faculty epitomized the panoramic view of transformation of higher education. Today, it is more complicated than a few factors that cause or accompany the transition of the faculty role.

Why is studying faculty research productivity so important? Because the phenomenon of faculty pushing themselves to be research productive is no longer an insular realm for researchers and policymakers who are interested in studying faculty per se. This phenomenon has far exceeded the context of faculty or institution, and become interconnected with a wide range of issues in education or even in the society. Understanding how administrative support and peer interaction can impact on research can help offer a glimpse into the future of institutional organization and academic lives.

Under the backdrop of globalization, there is a rapid expansion in the scale and scope of internationalization activity in the higher education sector worldwide. For most American institutions, especially non-research types in the private sector, the imperative for internationalization comes not mainly from the side of encouraging faculty activities
worldwide, but primarily from the side of increasing revenue by attracting more international students. On the demand side, a global labor market, the needs of a knowledge economy, and the desire to learn from the world’s best have all encouraged students and governments to seek greater opportunities for international study and international partnerships (Ennew & Yang, 2009). On the supply side, declining mobility costs, developments in ICT (Information and Communication Technologies), trade liberalization and increased private sector investment have lead to an increase in the availability of opportunities for international engagement (Knight, 2004). This traditional student-centered collaboration between institutions has rapidly fanned out into other forms of collaboration in teaching and research, including franchising, distance and online learning, international campuses, research partnerships and networks, and international research programs (Ennew & Yang, 2009). More specifically related to the mobility of scholars and the rising prominence of collaborative research, Altbach et al. (2009) describe:

The burgeoning number of international agreements between tertiary institutions often includes long- and short-term faculty exchange components. International scholarship and fellowship programs, along with other collaborative projects, move countless numbers of scholars around the globe each year to conduct research abroad, while professional and scholarly meetings and conferences keep many academics on the move abroad. In some cases, academic superstars have been actively recruited from one country to another in an attempt to shore up prestige and academic output in the receiving institutions…(p. 51)
Institutions should fully recognize the trend of globalization and consider international collaboration in their strategic planning. The Internet has made the collaboration of researchers from different countries ever easier and has helped the results of research disseminate across the globe faster. The age of globalization has also seen a rapid expansion of the English language as the international lingua franca in the academic world. Scholars from non-English speaking countries generally receive English language education early in their school systems. The language barrier that used to obstruct communication between scholars worldwide is gradually waning. Moreover, with the rapid development of information technology and Internet, the communication between faculty in two nations becomes more convenient and effective. Technology can help researchers around the world synchronize their research activities and keep them updated with the latest development. The finding of this study has also verified the promising opportunities engendered by international collaboration for both research and non-research institutions to be productive in research. Internationalization—policy taken at the institutional level—presents many new and exciting opportunities for cooperation in research and insertion of innovation. At this time of globalization via Internet shaping research activities, institutions need to adapt themselves to this paradigm shift and re-plan their institutional development—with a important component of faculty career—accordingly.
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APPENDIX A: SKEWNESS OF CONTINUOUS DEPENDENT VARIABLE

SPSS RESULTS: RAW COUNTS OF PUBLICATIONS
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<th>Plan C</th>
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<td>Books authored or co-authored</td>
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<td>Articles or chapters published in journals</td>
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<td>Patent secured on a process or invention</td>
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**Histogram**

Plan A

![Histogram for Plan A](image1)

Plan B

![Histogram for Plan B](image2)

Plan C

![Histogram for Plan C](image3)

**Normal P-P Plot**

Plan A

![Normal P-P Plot for Plan A](image4)

Plan B

![Normal P-P Plot for Plan B](image5)

Plan C

![Normal P-P Plot for Plan C](image6)
APPENDIX B: RESIDUAL ANALYSIS
(conventional linear regression for Plan A, Plan B and Plan C)

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<td>Books edited or co-edited</td>
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<td>Artistic work performed or exhibited</td>
<td></td>
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</tr>
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Histogram

Normal P-P Plot

Dependent Variable: Refereed Publication (books authored+books edited+articles published+patent+artistic work)

Dependent Variable: Articles or chapters published in an academic book or journal
Conventional linear regression for Plan B ONLY

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**Histogram:**

- Dependent Variable: Refereed Publications (books authored + books edited + articles published)
APPENDIX C: COLLINEARITY STATISTICS
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<th>Model (Research institutions)</th>
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<th>Sig.</th>
<th>Collinearity Statistics</th>
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<td>Model (Non-research institutions)</td>
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a. Dependent Variable: PublicationNR
APPENDIX D: FACULTY REFERRED PUBLICATION BY INSTITUTIONAL TYPE AND DISCIPLINE
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<td>2.860</td>
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<tr>
<td><strong>Scholarly books you edited or co-edited</strong></td>
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<tr>
<td>Research</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>STEM</td>
<td>238</td>
<td>.17</td>
<td>.517</td>
<td>0</td>
<td>3.546</td>
</tr>
<tr>
<td>Non-STEM</td>
<td>248</td>
<td>.40</td>
<td>1.573</td>
<td>0</td>
<td>9.133</td>
</tr>
<tr>
<td>Non-research</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM</td>
<td>205</td>
<td>.14</td>
<td>.509</td>
<td>0</td>
<td>4.723</td>
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<tr>
<td>Non-STEM</td>
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<td>.16</td>
<td>.549</td>
<td>0</td>
<td>4.919</td>
</tr>
<tr>
<td><strong>Articles or chapters published in an academic book or journal</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM</td>
<td>238</td>
<td>7.42</td>
<td>10.399</td>
<td>5.00</td>
<td>3.658</td>
</tr>
<tr>
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<td>4.01</td>
<td>4.544</td>
<td>3.00</td>
<td>1.866</td>
</tr>
<tr>
<td>Non-research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM</td>
<td>205</td>
<td>3.43</td>
<td>9.222</td>
<td>1.00</td>
<td>6.287</td>
</tr>
<tr>
<td>Non-STEM</td>
<td>459</td>
<td>2.25</td>
<td>3.566</td>
<td>1.00</td>
<td>3.667</td>
</tr>
<tr>
<td><strong>Refereed Publication (Three above combined)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM</td>
<td>238</td>
<td>7.79</td>
<td>10.642</td>
<td>5.00</td>
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</tr>
<tr>
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<td>Non-research</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>STEM</td>
<td>205</td>
<td>3.67</td>
<td>9.464</td>
<td>1.00</td>
<td>6.042</td>
</tr>
<tr>
<td>Non-STEM</td>
<td>459</td>
<td>2.62</td>
<td>3.762</td>
<td>1.00</td>
<td>3.148</td>
</tr>
</tbody>
</table>
APPENDIX E: BAR CHARTS FOR CROSS-TABULATIONS
(a) Faculty Professional Characteristics by Institutional Types (Same as in Table 1)

### Academic disciplines by institutional types

<table>
<thead>
<tr>
<th></th>
<th>Research</th>
<th>Non-research</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEM Fields</td>
<td>49.0%</td>
<td>30.9%</td>
</tr>
<tr>
<td>Non-STEM</td>
<td>51.0%</td>
<td>69.1%</td>
</tr>
</tbody>
</table>

### Appointment Types by institutional types

<table>
<thead>
<tr>
<th></th>
<th>Research</th>
<th>Non-research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Contract</td>
<td>21.1%</td>
<td>21.6%</td>
</tr>
<tr>
<td>Tenure-track</td>
<td>18.1%</td>
<td>23.5%</td>
</tr>
<tr>
<td>Tenured</td>
<td>60.8%</td>
<td>54.9%</td>
</tr>
</tbody>
</table>
Research or teaching orientation by institutional types

<table>
<thead>
<tr>
<th>Research oriented</th>
<th>Non-research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching oriented</td>
<td>37.8%</td>
</tr>
<tr>
<td>Research oriented</td>
<td>62.2%</td>
</tr>
</tbody>
</table>

(b) Statistically-significant variables by dependent variable (productive or not) (same as in Table 5-7)
Co-authored with colleagues located in the US

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not productive: &lt;=2</td>
<td>52.2%</td>
<td>22.9%</td>
</tr>
<tr>
<td>Productive: &gt;2</td>
<td>47.8%</td>
<td>77.1%</td>
</tr>
</tbody>
</table>

Co-authored with colleagues located in the US: Non-research institutions

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not productive: =0</td>
<td>40.6%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Productive: &gt;0</td>
<td>59.4%</td>
<td>87.5%</td>
</tr>
</tbody>
</table>

Co-authored with colleagues located in foreign countries

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not productive: &lt;=2</td>
<td>37.3%</td>
<td>9.6%</td>
</tr>
<tr>
<td>Productive: &gt;2</td>
<td>62.7%</td>
<td>90.4%</td>
</tr>
</tbody>
</table>
Collaborate with international colleagues

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not productive: =0</td>
<td>33.0%</td>
<td>13.7%</td>
</tr>
<tr>
<td>Productive: &gt;0</td>
<td>67.0%</td>
<td>86.3%</td>
</tr>
</tbody>
</table>
The system used in this study is based on traditional Carnegie Institutional Classification specifications of Year 1987 edition. In the newly-designed Carnegie classification system, the traditional categories—Research I & II, doctoral I & II, are re-arranged into two categories in 2000 edition and three categories in the most recent 2010 edition. The table below demonstrates the differences between three editions:

<table>
<thead>
<tr>
<th></th>
<th>Research</th>
<th>Non-research</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Research I (research public)</td>
<td>Doctoral I (doctoral public)</td>
</tr>
<tr>
<td>1987</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td>Extensive</td>
</tr>
<tr>
<td>2010</td>
<td>Doctoral /Research Universities</td>
<td>RU/H: Research Universities (very high research activity)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RU/H: Research Universities (very high research activity)</td>
</tr>
</tbody>
</table>


The logistic regression model can also be described in the equation form:

1st model:

$$ \ln \left( \frac{p_i}{1 - p_i} \right) = \beta_0 + \beta_1^{T} c_i + \varepsilon_i $$

2nd model:

$$ \ln \left( \frac{p_i}{1 - p_i} \right) = \beta_0 + \beta_1^{T} c_i + \beta_2^{T} a_i + \varepsilon_i $$

3rd model:
\[ \ln \left( \frac{p_i}{1 - p_i} \right) = \beta_0 + \beta_i^T c_i + \beta_2^T a_i + \beta_3^T p_i + \varepsilon_i \]

where:

\[ \text{logit} (p_i) = \ln \left( \frac{p_i}{1 - p_i} \right) \]

\[ \beta_0 = \text{intercept} \]

\[ c_i = \text{vector containing three variables in Group One (faculty professional characteristics)} \]

\[ \beta_i = \text{coefficient vector for variable vector } c_i \]

\[ a_i = \text{vector containing six variables in Group Two (administration support research)} \]

\[ \beta_2 = \text{coefficient vector for variable vector } a_i \]

\[ p_i = \text{vector containing six variables in Group Three (peer support research)} \]

\[ \beta_3 = \text{coefficient vector for variable vector } p_i \]

\[ p_i = \text{the probability of being in the "research productive" group for the } i\text{th observation} \]

\[ \varepsilon_i = \text{error term} \]

There are two occasions when variables almost reach the level of significance but are officially not regarded as significant:

1. For research institutions, in the 2nd model, the variable "supportive attitude towards research activity by administrative staff" has the p value of 0.051. This variable, though not significant, can verify that research institutions bear different institutional environment from non-research institutions. The odds ratio is greater than 1 \([\exp(B)=1.722]\) for research institutions in the 2nd model, while the odds ratio is less than 1 \([\exp(B)=0.525, p=0.02]\) for non-research institutions. If this variable included in the 2nd model at research institutions were significant, it would formally add stronger evidence to the data interpretation which has already suggested that administration in both types of institutions works with very different environment.
(2) For non-research institutions, in the 3rd model, the variable "considering research quality while making personnel decisions" has the p value of 0.059, also non-significant. If this variable here in the 3rd model became statistically significant, this result would somehow strengthen the conclusion that administration can play a marginal role at non-research institutions. However, the formal results that cautiously state the much less conspicuous influence by administration variables compared with peer-support variables at non-research institutions will not be fundamentally altered.

In summary, even if those two marginal significant variables becomes statistically significant, it will strengthen the conclusions drawn from the formal results instead of weakening them.