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When Two Worlds Collide: An Examination of The Influence of Academic Entrepreneurship on Academic Roles and Motivations of University Faculty

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ABSTRACT OF THE DISSERTATION

When Two Worlds Collide: An Examination of the Influence of Academic Entrepreneurship on Academic Roles and Motivations of University Faculty

by

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Academic entrepreneurship refers to university faculty engagement in commercialization of research and innovative activities that are beyond their academic work in research, teaching, and service in their university. Academic entrepreneurship includes three types of entrepreneurial activities: academic patenting, technology licensing, and generations of university spin-off firms. The present investigation focuses on faculty entrepreneurs who are engaged in university spin-off firms (USOs) and examines how faculty entrepreneurs perceive their two roles—the entrepreneurial role and academic role—in the university and how they reconcile the tensions between these roles. Critical scholars have claimed that academic entrepreneurship has inherent conflicts with faculty's academic roles in research and teaching and could lead to an erosion of university missions in the education of students and service to the public

(Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004). However, empirical evidence suggests otherwise: Faculty participation in entrepreneurial activities benefits the missions of the university—by generating more research, more revenue, and more economic impact (e.g., Azouley et al., 2009). This scholarly debate motivates the present investigation to address how faculty entrepreneurs, if at all, change or alter their academic roles and priorities in the context of academic entrepreneurship. The investigation relies upon a qualitative research design with a dilemma analysis approach to interview. The primary data rely on 40 semi-structured interviews with faculty entrepreneurs in Bioengineering and Computer Science departments at University of California, Los Angeles, University of California, Irvine, and University of California, Riverside. Additional data were collected from Entrepreneurship Center directors and students who study with the faculty participants with regard to faculty engagement in entrepreneurial activities. The three universities were selected based on their entrepreneurial outputs: UCLA, UCI, and UCR are respectively at high, medium, and early stage of their entrepreneurial process. Findings indicate that faculty entrepreneurs adopt a hybrid logic of academic professionalism and entrepreneurship to connect their entrepreneurial engagement with their academic roles. By doing so, faculty participants developed an academic entrepreneurial identity—they possess both academic values and entrepreneurial norms and attribute a social mission to their entrepreneurial activities. To construct and develop an academic entrepreneurial identity, faculty entrepreneurs are obliged to *segregate* their audiences between academics and entrepreneurs, as well as their resources for their academic research and their entrepreneurial research. They also

delegate their work to either their students or business entrepreneurs to maintain their main academic identities. In faculty's balancing the two roles, the institutional environment and support of the university play critical roles. If the university mission aligns with the entrepreneurial goals of faculty, then faculty entrepreneurs are more likely to integrate their entrepreneurial activities into their teaching and instruction. In turn, the enhanced teaching and instruction can contribute to the educational goals of their university. However, if the university's mission does not align with the goals of faculty entrepreneurial activities, then faculty are most likely to find themselves caught in conflicts between their two roles, where they cannot achieve a balance, and, eventually, they have to give up either the entrepreneurial role or the academic role. Implications for policies and practices are discussed in the final chapter of the dissertation.

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Chapter I INTRODUCTION

Statement of the Research Problem

The U.S. public university was established upon both educational values and social functions to deliver higher education teaching and basic research, as well as other public services to the society (Etzkowitz, 2003; Laredo, 2007; Levin, Martin, & López-Damián, forthcoming). However, as the social and economic circumstances have changed, the public university are also under economic imperative to engage in revenue generation activities so that they can remain competitive in the higher education market (Berman, 2012; Brint, 2019). Academic entrepreneurship, a widely embraced revenue generation activity in the public research university, is referred to as the economic engagement of the university in the market through the patenting, licensing, and creations of spin-off firms that are based on faculty research. The economic promises held in these entrepreneurial activities are that research can generate economic spillovers, which contribute to the economic development of the community and enhance technological advancement in the nation. Academic entrepreneurship is perceived as a policy solution (Bush, 1954) by policymakers to resolve the funding issues of the public university, and thus has become institutionalized in both colleges and universities (Colyvas & Powell, 2007). However, despite the economic contribution of academic entrepreneurship, scholars have raised concerns that the promotion of entrepreneurial activities is incompatible with academic values and the educational missions of the university, which could lead to a decline in public trust in university research, as well as decline in a

university's commitment to education (Slaughter & Leslie, 1997; Slaughter et al., 2004). What is central to the decline in public trust are concerns that the advent of academic entrepreneurship might have shifted or diminished university commitment to their traditional missions of research, education, and service.

There is an assumption around academic entrepreneurship that faculty engagement in commercialization of research or university spinoffs can provide financial stability to the public universities, particularly when facing a declined public financial support (Pfeffer & Salancik, 1978; Colyvas & Powell, 2007). However, financial gains are concentrated only in a few universities (Brint, 2019). Indeed, most university entrepreneurial outputs cannot keep up with their investment inputs (AUTM, 2011). The total revenue generated from academic entrepreneurship covers only 1% of the university costs at most universities (Brint, 2019). Granted, there are some widely recognized university spin-off companies (e.g., Xerox, Genentech), but the majority of university spin-off firms do not last longer than 5 years (Rasmussen & Wright, 2015). Current studies have identified environmental and institutional variables that are associated with universities' entrepreneurial performance. Yet, these studies did not attempt to explain why in the same state and under the same institutional policies and practices some universities engage more faculty in entrepreneurial activities than others. Further research, then, is needed to examine and explain the institutional micro-processes of entrepreneurial engagement and individual level factors, such as socio-psychological processes of academic entrepreneurship and motivations of faculty entrepreneurs.

Furthermore, the misalignment between the expectations for and the actual returns of entrepreneurial activities also lead to questions on the compatibility of academic entrepreneurship in the university. Arguably, the reason that academic entrepreneurship does not develop at most universities is because there are conflicts that emanate from the implementation of entrepreneurial activities on university campuses (e.g., Kenney & Coe, 2004; Philpott, Dooley, Oreilly, & Lupton, 2011). Thus, academic entrepreneurship may not be "social optimal" for public universities (Kenney & Patton, 2009, p. 1408) because the behaviors of a university's pursuit of monetary profits from entrepreneurship contradict the traditional value of higher education and the disinterested role of academic science in the university (Blumenthal et al., 1998; Brint, 2019; Merton, 1954; Slaughter & Leslie, 1997). In addition, the prevalence of entrepreneurial activities on university campuses can be seen as a result of market logic in faculty research, where faculty may align their research agenda with market interests rather than the interests of science. Consequently, the shift in research agenda could lead to a decrease in production of basic science in university research and to support for research that has commercial potential (Etzkowitz, 1998, 2001; Murray & Stern, 2007; Slaughter et al., 2004). The stigma that surrounds the production of market-driven research has led to a heightened tension between faculty entrepreneurial motivations and academic values, and this tension places faculty at the center of the debates over academic entrepreneurship.

Despite the above scholars' concerns, the conflicts between academic values and entrepreneurial behaviors may not be totally irreconcilable. Since the 1980s, there are efforts from the federal level to promote research collaborations between university

faculty and industrial scientists so that the linkages between the university and industry can be enhanced and strengthened (Lam, 2011; Siegel et al., 2007). There have been specialized organizations established on campuses to facilitate technology transfer and knowledge sharing between the scientific and business communities (Berman, 2012; Thursby & Thursby, 2007). Innovative inventions are generated from the university-industry collaborations and contribute to the advancement of human society (Brint, 2019; Powell & Snellman, 2004). In this regard, despite the conflicts between entrepreneurial values and academic values, it is compelling for public universities to embrace academic entrepreneurship on campus in line with the federal agenda of innovation, which justify faculty engagement in entrepreneurial activities. However, it remains unknown how the conflicts emanated from academic entrepreneurships are resolved, if at all, at the individual level. The extant literature on academic entrepreneurship focuses predominantly on economic outputs of the entrepreneurial model (e.g., Bozeman, Fay, & Slade, 2013; Powers & McDougall, 2005; Siegel, Waldman & Link, 2003). Seldom does an empirical study address its outcomes related to education, such as teaching, mentoring students, and service. The extent to which academic values are diminished as a result of faculty engagement in academic entrepreneurship is under-investigated, which will cast further doubts on faculty entrepreneurs and their already stigmatized academic identities.

A primary question, then, concerns the ability of university faculty to balance their increased intensities of entrepreneurial engagement and their academic responsibilities. It seems to be taken for granted by policymakers and university administrators that faculty are able to engage in multiple entrepreneurial activities

without compromising their academic work. However, as the level of faculty entrepreneurial engagement and the intensity of the corporate linkages increase, the difficulty for faculty members to maintain their academic entrepreneurship as well as their professional productivity also increases. It remains unknown how these entrepreneurial faculty balance their multiple roles as well as maintain their performances in both their entrepreneurial and academic activities.

Apart from faculty balancing strategies, another key question is to identify what motivates faculty to pursue entrepreneurial activities. Previous literature has claimed that faculty's interests in generating financial benefits for themselves as well as for their institutions are the main drivers of academic entrepreneurship. However, this claim might be too narrow to explain all types of and various extents of faculty engagement in entrepreneurship. Furthermore, if monetary rewards are main incentives for faculty, then how this monetary incentive influence their motivations to conduct research and teaching is vital to the construction of academic work in the university. Additionally, not all faculty members adopt entrepreneurial behaviors; some faculty are more entrepreneurially involved than their colleagues. In what ways these faculty entrepreneurs distinguish themselves from their non-entrepreneurial counterparts remains unknown. Arguably, faculty entrepreneurs have formed a new group within the academic community: faculty entrepreneurs are brought together from different disciplines because of their shared interests in entrepreneurship as well as their motivations, inspiration, and values for entrepreneurial activities. Empirical research to date has examined the productivity of entrepreneurial faculty members (e.g., Louis, Jones, Anderson,

Blumenthal, & Campbell, 2001), and assumes that these faculty are no different from their non-entrepreneurial counterparts in areas of research, teaching, and service responsibilities. Yet, empirical research has not examined the identities formed within the entrepreneurial community of faculty and the structure of academic work for faculty entrepreneurs.

Purpose and Significance of the Study

The purpose of the present investigation is three-fold: (1) to explain if and the ways in which faculty maintain a balance between their academic roles and entrepreneurial activities, (2) to identify faculty's perceived motivations for participation in academic entrepreneurship, and (3) to explain the influence of academic entrepreneurship on faculty understandings of their academic roles (i.e., research, teaching, and service). I focused my investigation of academic entrepreneurship on the public sector of higher education institutions and chose three public research universities that are characterized as the high, middle, and beginning stage of the entrepreneurial process. In this way, I sought to understand how the institutional environment, as well as the level of institutional support, influences the ways that faculty members perceived their entrepreneurial motivations and obtained balance between their roles in entrepreneurship and roles in the university. To obtain a comprehensive understanding of the influence of academic entrepreneurship on academic roles, I focused my investigation on faculty engagement in spin-off firms —a form of commercialization of research that is beyond the invention stage of research. Particularly, university spin-offs (USOs) have been perceived increasingly as important mechanisms for universities to transfer faculty

inventions to the marketplace. However, the effects of USOs on faculty roles in research, teaching, and service have not been addressed adequately in the literature. Therefore, I aimed to bridge this gap in the literature by investigating faculty experiences, motivations, and strategies of balance during their participation in USOs.

To many universities, the goal of USOs is to generate additional streams of revenue and commercial products so that the university can gain financial benefits from their faculty inventions as well as make contributions to the local and national economy. There are also expectations on USOs to maintain a research capacity in their conducting of more applicable and entrepreneurial research, which is different from the basic research generated at a traditional university lab, and thereby bolster technology innovation. These expectations on USOs are built upon the assumption that faculty are managed to maintain their productivity in research and teaching while they engage in USOs. The financial promise of academic entrepreneurship may have obscured the condition where some universities do not have the sufficient resources and supporting structures for their faculty members to participate in entrepreneurial activities. Therefore, by focusing on faculty motivations and engagement in USOs, I sought to uncover faculty perceptions regarding their perceived effects of USOs on their research, teaching, and service, and thereby shed light on the compatibility of USOs with the academic roles and commitments of university faculty.

The present investigation contributes to the literature in three ways. First, I address the motivational drivers that faculty entrepreneurs perceive as important to engage in USOs within the university. To challenge the assumptions that faculty are

driven mainly by financial returns of USOs, I demonstrate that the main driver for faculty to engage in USOs is not financial but social and scientific returns that participation in USOs can bring them. In spite of entrepreneurship literature that suggests that entrepreneurs are intrinsically driven, in the main, by their pursuits of independence and wealth, I find that faculty entrepreneurs are more likely to be driven by external imperatives from governments and adopt entrepreneurial strategies as a way to remedy the lack of governmental support and funding for research. In this way, the present investigation fills the gap in the literature on entrepreneurial motivation of faculty in their participation in USOs and sheds light on institutional policies and practices that facilitates USOs and entrepreneurial practices of a university's faculty members.

The present investigation is also among the first group of scholarly work to examine the identity of faculty empirically in the context of academic entrepreneurship. Although there is a growing body of literature that has examined the influence of academic entrepreneurship on higher education institutions at the macro level, such as the role of the university (Dasgupta & David, 1994; Etzkowitz, 1998, 2001) and the mechanisms of knowledge distribution (Murray & Stern, 2005), there is limited research that examines the micro-level effects of academic entrepreneurship on universities. Some exceptions, such as Owen-Smith and Powell (2001), perceive faculty as rational agents who make their decisions on invention disclosures based on their perceived costs and risks of engaging in technology transfer process. Although these studies enhance understandings of faculty decision making process in invention disclosures, they do not consider faculty engagement in the further development of technology that is beyond the

invention disclosure stage. The present investigation focuses on faculty engagement in university spin-offs and examines what motivates faculty to engage in the spin-offs, as well as how they rationalize and make sense of their involvement in spin-off companies. In this way, the present investigation follows the line of Powell and Owen-Smith's research and extends it to the investigation of faculty career choices in the further stages of academic entrepreneurship.

Finally, the present investigation expands the literature on institutional logics by examining the influence of new institutional logics on faculty sensemaking processes. The logic of entrepreneurship was discussed previously in business literature, but that literature is not entirely conclusive about how the logic of entrepreneurship develops in higher education and how the logic of entrepreneurship is interpreted by faculty members. Therefore, in the present investigation, I adopted four distinct institutional logics: the logic of the market, the logic of professionalism, the logic of science, and the logic of entrepreneurship. Through these logics, I examine faculty sensemaking of their entrepreneurial behaviors in their institutions. By doing so, the present investigation explains how faculty entrepreneurs interpret and make sense of their institutional expectations for entrepreneurship. By comparing faculty sensemaking and faculty's uses of logics in their entrepreneurial engagement, the present investigation links institutional environment with faculty sensemaking process to shed light on micro-foundations of academic entrepreneurship.

Introduction to the Literature

Academic Entrepreneurship and the Shifted Priorities in Higher Education

The advent of academic entrepreneurship in universities can be dated back to the 1970s (Berman, 2012; Rhoten & Powell, 2008). During that time, the rise in economic powers of Japan and West Germany influenced U.S. policymakers to think that the leading position of U. S. research was threatened, and that technological innovation in the U. S. had not caught up with that in other countries (e.g., Japan, Russia, and Germany) [Rhoten & Powell, 2008]. In order to enhance its global economic competitiveness, U. S. policymakers demanded more economic outcomes from scientific research and viewed technological innovation as vital as well as an engine to the national economic development (Berman, 2012; Mowery, Nelson, Sampat, & Ziedonis, 2015). Simultaneously, in line with the governmental emphasis on innovation, knowledge in biotechnology has been growing and developing quickly. Professor Cohen and Boyer from Stanford first patented their rDNA research, which lift the curtain of academic patenting in the university. As a result, the legal environment for patenting and licensing activities at the university has been loosened: The passage of the Bayh-Dole Act in 1980 has legitimized technology transfer activities at universities by turning the ownership of federally funded inventions from the government to the university (Aldridge & Audretsch, 2011; Mowery et al., 2015). As such, commercial activities are legitimized in the universities, which enables faculty and their institutions to profit off academic research. The issuance of the Small Business and Innovation Research (SBIR) grant in 1984 has also provided seed money and financial incentives for university faculty to

engage in spin-off firms. As a result of these policy initiatives, commercialization and entrepreneurial activities have become embraced widely by universities as an integrated activity in the U. S.

Apart from the governmental emphasis on economic outcomes, the development of knowledge in university labs has also drawn industrial attention (Berman, 2012; Colyvas & Powell, 2007; Mowery et al., 2015; Rasmussen, 2011). The biological research generated at universities has appealed to many pharmaceutical companies: With some development, biological research can be transferred from the university lab to the marketplace. These companies have begun to collaborate with university faculty and fund university research that has commercial potentials (Powell, Owen-Smith, & Colyvas, 2007; Stokes, 2011). This type of university-industry collaboration on technology transfer held the promise that university research could be transferable and applicable to the market, thereby placing technology transfer at universities in a prominent role in the economic development agenda of the U. S. The prominence of Silicon Valley, Route 128, and The Research Triangle serve salient examples of the technology transfer development of university research.

However, despite the developments in technology transfer to the private sector, the public sector was not acculturated to such a commercial culture (Dougherty et al., 2016; Rhoten & Powell, 2008). An unprecedented challenge for public universities is the erosion of state and federal funding in the 1980s. During that time, many states retreated their investment in higher education, which placed public universities at a disadvantage in their competition with the private university for faculty, students, and resources

(Owen-Smith, 2003; Powell et al., 2007; Ramírez, 2013; Rhoten & Powell, 2008). To secure financial support from state legislatures, public universities have had to demonstrate that they fulfill educational missions, such as granting higher education access to a diverse population of students as well as fulfilling economic demands of the local community and state governments. The economic pressure to perform, along with the public pressure to maintain student diversity, provided incentives for public universities to seek other sources of funding. In this regard, since the 1980s, academic entrepreneurship has become "venerated" (Colyvas & Powell, 2007, p. 219) among public universities to generate revenues and resources in order to maintain a competitive position in the higher education market.

Key Concepts

Previous literature on academic entrepreneurship tends to view faculty engagement in entrepreneurial activities as a homogenous and identical process. However, there are various entrepreneurial activities that require different levels of engagement and activities from faculty. Beneath the surface of the debate on academic entrepreneurship is a misconception that all entrepreneurial activities are identical and have same influence on academic roles. that Perkmann et al. (2013) conducted a systematic review of literature on academic scientist involvements with academic engagement and commercialization. They define academic engagement is a type of collaboration, which link university scientists to other organizations notably firms, while commercialization is a type of resource generation, with the objective to commercially exploit a patented invention, or a body of unpatented expertise. Under Perkmann et al.'s

definition, commercialization can be an outcome or follow-on activity of academic engagement. I define academic entrepreneurship is a type of commercialization, which includes founding of a firm, further development of licenses with commercial interests, and consulting to firms and companies. In this way, academic entrepreneurship is beyond academic engagement, such as invention stage of a patent, but focused on the commercial outcomes.

Academic, or faculty entrepreneurs are therefore defined as university faculty who participate in activities that are beyond the invention stage of research and have direct participation in business activities, such as creations of firms (Abreu & Grinevich, 2013; Mars & Rio-Aguilar, 2010). Powell and Sandholtz (2012) once described these faculty entrepreneurs as *amphibious entrepreneurs* who inhabit two or multiple roles simultaneously in both the world of academics and the world of business and are able to integrate contradictory principles into their professional identities to maintain their roles in both worlds. These faculty entrepreneurs are distinguished from those faculty who also did patenting and licensing because of their direct involvement in business activities. They are also different from business entrepreneurs because they maintain their positions with the university. Therefore, because I am only interested in faculty engagement in USOs, I focused my recruitment of participants from faculty entrepreneurs.

Academic Patenting refers to the disclosure of an invention and application of a patent on university research or technologies. Academic patenting is usually the first step of commercialization of research, where faculty inventions and university technologies can be recognized and commercialized to the marketplace.

Technology licensing refers to the licensing procedure of a university patent or technology to an external company or private-owned firms. Technology licensing is often the next step of academic patenting. When university research and technology are patented, companies or firms can identify these inventions through the university patenting pool. Once an agreement is reached between the university, faculty, and the company, a licensing contract will be drafted that grants the company authority to use the university technology. The contract can be exclusive—only the licensee company can use the university technology—or non-exclusive—the licensing of the university technology to one company does not prevent other companies from licensing the same technology.

University spin-off (USO) firms refer to the creation of patent- or technology-based firms. USOs are often led by faculty or students and are affiliated with the university. The USOs are created based on faculty patents and inventions.

The Literature on Academic Entrepreneurship

The past two decades have witnessed a significant shift in the disposition of universities towards academic entrepreneurship. There have been an increasing number of studies carried out to explain the phenomenon of academic entrepreneurship as well as the changes being wrought by it. There are studies that focus on the norms and behaviors emanated from academic entrepreneurship, such as Zucker and Darby's (1996) seminal work on the role of start-scientists in the commercialization of bioscience inventions, Colyvas' (2002) investigation of life scientist engagement in technology licensing, and Powell and Owen-Smith's (2001, 2003) observations of the changed attitudes and research norms of university faculty towards academic entrepreneurship, as well as

rationalization process that university life scientists employed to disclose their inventions. There are also studies attempted to theorize the micro-level process of academic entrepreneurship, such as Jain, George, and Maltarich's (2009) conceptualization of the role identity of U.S. scientists, Powell and Colyvas's (2010) theorization of the micro-foundation of academic entrepreneurship. Other researchers have taken a critical perspective that raises concerns on the negative effects of academic entrepreneurship on basic science, scientific norms, and educational values in the university (Dasgupta & David, 1994; Murray & Stern, 2005; Nelson, 2004; Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004). The scholars' views on academic entrepreneurship are bifurcated (Bozeman & Boardman, 2013) and fragmented in the influence of academic entrepreneurship in the university.

The literature review in this investigation is divided into three part, that is, (1) the role of universities in regional development and the anatomy of entrepreneurial university, (2) academic patenting and spin-offs and its influences on universities, and (3) entrepreneurial motivations and barriers of academic entrepreneurs. Part one provides a background of the emergence of academic entrepreneurship in higher education. This includes an analysis of the literature of different driving factors for higher education institutions to adopt entrepreneurial practices as well as the diverse mechanisms that universities employed that comprise the different dimensions of academic entrepreneurship. Part two discusses the fragmented views in the literature regarding the effects of academic entrepreneurship on research, teaching, and service. I separate academic entrepreneurship by the level of faculty engagement and examined each effect

on research and teaching. So far, literature has not recognized nor examined the effects of academic entrepreneurship on faculty service work, which posed a research gap in this cluster of the literature. Part three focuses on the micro-level effects of academic entrepreneurship on faculty role identities. This includes current research on faculty construction and modification of identities in the context of academic entrepreneurship, as well as a discussion of entrepreneurial traits that entrepreneurs are likely to possess and share. Although there is no research compared faculty entrepreneurs and business entrepreneurs with regard to their traits and propensities, or motivations, I provided some similarities and differences between these two identified in separated bodies of the literature as a foundation to build my arguments this investigation. The paragraphs below introduce the main arguments about the effects of academic entrepreneurship identified in the literature, while more details of the current research as well as gaps in the literature are presented in Chapter 2.

First of all, there has been a historical negative connotation surrounding commercial behaviors in the university. A number of influential observers, such as Nelson (1990), Slaughter and Leslie (1997), Bok (2003), have criticized the commercial behaviors of university faculty and argue that faculty should remain monetary-disinterested in research and commercialization of research could jeopardize the scientific norms of open science as well as the integrity of academic research. Blumenthal et al. (1998) and Louis et al. (2001) further pointed to an increased secrecy surrounded commercialized research and argued that the race to patent knowledge have prevent scientists from sharing their scientific results with the scientific community. This could

limit access for scientists to construct well-rounded theories building from each other's work, which over time could lead to a hinderance of knowledge advancement. (Murray & Stern, 2007). Furthermore, Slaughter and Leslie (1997) have described faculty engagement in the market and quasi-market place as capitalist behaviors, which could possibly lead to faculty buying out their teaching hours, a diminution in faculty-student interactions, and more part-time lecturers hired to teach (see also, Campbell & Slaughter, 1999; Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004). In this regard, academic entrepreneurship is seen to have a deleterious effect on the generation and dissemination of knowledge in the university, which harms the academic role of the university (Cowan, 2005; Feller, 1990; Nelson, 2004).

In contrast, other scholars have suggested that the advent of academic entrepreneurship in the university might not be all negative. Instead, they argued that academic entrepreneurship is in fact beneficial to faculty research and financial stability of the university, as well as the national economy and society at large (Azoulay et al., 2009; Colyvas, 2002; Shane, 2004; Wright, 2014). To begin with, scholars have argued that academic innovation, the application and use of knowledge in order to benefit the society, has always been inherent to the university mission (Brint, 2018; Vallas & Kleinman, 2008). The relation between the university and the society has long been established, and the university engagement in the local community has been widely acknowledged as a fundamental function of the public university. As such, academic entrepreneurial activities are seen as beneficial to the local community by attracting investors and generating employment opportunities that contribute to the local economy.

In this way, academic entrepreneurship can perpetuate an entrepreneurial ecosystem in its local community and thereby can generate social benefits (Autio, Kenney, Mustar, Siegel, & Wright, 2014; Siegel & Wright, 2015). In addition, Colyvas et al. (2002) found that technology licensing attracts industrial investment on university research and thereby contributes to enhancing the research capacity of universities. Siegel and Wright (2015) echo this argument by demonstrating that faculty can make their research more relevant to the market by engaging in academic entrepreneurship. Furthermore, Bozeman and Boardman (2005) argued that the establishments of research centers provide various opportunities for the university as well as its local community to grow economically and sustainability. As such, these scholars conclude that there is a virtuous circle emanated between academic entrepreneurship and university social and educational functions.

However, in addition to the above arguments, there is a third argument that focuses on the importance of context as well as the implementation of academic entrepreneurship practices that mediate the effects of academic entrepreneurship. They argue that if the university environment is not compatible with the logic of academic entrepreneurship, the virtuous cycle could easily turn vicious. These scholars have pointed out that although academic entrepreneurship is well embraced by universities, not all the university are successful in generating economic impact through academic entrepreneurship (Brint, 2019). In fact, the majority of entrepreneurial outputs in the higher education is concentrated in a few elite institutions, such as Stanford, or MIT; most universities' entrepreneurial outputs could not keep up with their entrepreneurial investments. For these elite institutions, academic entrepreneurship brings them more

funding and research opportunities and attracts more entrepreneurial researchers and scientists (Powell & Owen-Smith, 2001), and in turn contributes to their elite statuses. However, for others, the adoption of entrepreneurial models from the elite institutions may not fit their institution environment and thereby leads to irreconcilable conflicts between entrepreneurial activities and academic roles. In addition, scholars also found that academic entrepreneurship is enacted upon a combination of factors, such as the economic status of the local community, business opportunities in the region, as well as the institutional culture and support, such as the research capacity and the support from the technology transfer office (Abreu & Grinevich, 2013; Siegel & Phan, 2005). Therefore, the examination of academic entrepreneurship effects on universities should not be examined alone without putting it into contexts. Arguably, its influence is largely dependent upon the combability between the entrepreneurial values and the university culture.

There are a few empirical studies that examined the influence of academic entrepreneurship on research production in the university. Mowery et al. (2016) examined the effect of Bayh-Dole Act 1980 on the university research agenda and found that the increased patenting and licensing activities at universities after the Bayh-Dole Act did not skew the university research agenda to the applied side; research conducted at the university is essentially basic science. Thursby and Thursby (2010) as well as Thompson, Ziedonis, and Mowery (2018) further found that licenses on scientific research are actually associated with an increase, with some delay, in the number of citations to the related publications. Their findings indicate a positive effect of patenting

on the knowledge distribution. In line with their findings, Brain Wright analyzed 12,515 inventions and related licenses at nine University of California. He found that industry-funded inventions were associated with more citations on average than federally sponsored inventions (Drivas, Lei, & Wright, 2017). Although there is an assumption that corporation are likely to restrict access to the broader audience, Wright found that industrial funding functions similar to federal funding and has not skewed science towards inventions. In this regard, it seems that the empirical evidence has pointed to a rather non-significant, or sometimes positive, than negative effect of patenting and licensing on knowledge generation and distribution at universities. However, these studies are all quantitative that may neglect nuanced changes in faculty perceptions and cognitive behaviors. These changes may be subtle, but accumulatively, could lead to a tipping point in the university, where both the research role and academic work are fundamentally changed. For example, these quantitative studies did not address individual faculty's' performances with regard to research, teaching, and service. Neither did they examine the influence of academic entrepreneurship on university teaching and faculty approaches in mentoring and instructions. In conclusion, there is a gap in the literature on the micro-effect of academic entrepreneurship on faculty work. Specifically, very little is known about the cognitive and motivational-drivers of faculty entrepreneurs in the university and the strategies they employed to maintain their dual involvements in the world of academics and the world of entrepreneurs.

Theoretical Orientation

In order to examine the underlying sense making processes of faculty entrepreneurs, I employed the concepts from institutional theory, specifically, institutional logics (Thornton & Ocasio, 2008), as well as a framework of identity theory (Burke & Stets, 2009) to guide my approaches to interviews as well as to guide data analysis. Institutional theory is used to explain the institutional context and the support for academic entrepreneurship. Specifically, I deployed different institutional logics in the university to examine the underlying mechanisms of academic entrepreneurship on faculty perceptions and self-understandings of their roles. Identity theory is used to explain faculty perceived imperatives to engage in entrepreneurship as well as their sensemaking and modification process of their understandings of research, teaching, and service in the university. By doing so, I answered the research questions of the extent and the ways that faculty perceive academic entrepreneurship have influenced their academic roles.

When a new activity occurs at an institution, it often generates conflicts with the existing activities, and such conflicts can lead to a condition of uncertainty in daily institutional operations (Meyer & Rowan, 2008). Institutional theory suggests that once the new activity becomes institutionalized into the organization, the tensions on the conflicts are resolved (Meyer & Rowan, 2008). This adaptive process of the integration of a new activity is referred to as institutionalization, where a new activity gradually become integrated into the existing rituals of the institution. Universities are isomorphic institutions with little differentiation: once an activity becomes institutionalized at the

prestigious, leading institutions, other institutions will follow (DiMaggio & Powell, 1983). By adopting strategies and activities from the leading institutions, other institutions gain legitimacy and maintain or move up their institutional statuses. In this regard, when academic entrepreneurship was embraced and integrated in the elite institution, such as Stanford and MIT, other universities followed, and eventually, academic entrepreneurship is institutionalized in the higher education sector.

The institutionalization of academic entrepreneurship is also reflected in the individuals' behaviors, attributions of meanings, and identities in the institution (Powell & Colyvas, 2010). When faculty came to work at the university, they brought their educational backgrounds as well as professional values to the institution, but they nonetheless adopted the institutional values and conformed to the institutional norms. The continuity and changes in the institutional practices and routines shape faculty behaviors and perceptions of their work environment and roles. individual interests and aspirations by framing the possibilities for individual actions and these interests and aspirations influence whether or not individual behaviors result in persistence or change. The micro-foundation of institutionalization underlines individual engagements in the routines of regular operations and explains how meanings become attached to institutional routines. These micro-level rituals and negotiations aggregate over time and may replace macro-level coherence (Powell & Colyvas, 2010). In this process, individuals convert circumstances into action through the reciprocal interpretation of "who they are and how they understand their environment" (Powell & Colyvas, 2010, p. 282). Individual identity

is therefore embedded in this sense making process to inform and constrain actions (Weick & Sutcliffe, 2011).

Institutional Logics

Institutionalization explains why institutions can act alike and behave in similar ways, while institutional logic provides why particular behaviors are accepted but others are not. Institutional logic justifies what is considered legitimate in a particular institutional setting and is reflected in organizational and individual behaviors (Thornton et al., 2012). Scott (2001) refers to institutional logic as the "belief systems and related practices" of an organizational field (p. 139). Friedland and Alford (1991) posited it as a guide for organizing principles and providing actors the vocabularies of motive and a sense of self (i.e., identity). Building on these two definitions, Thornton and Ocasio (2008) defined institutional logics as "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules" (p. 101) that guide institutional policies, rules, and members' behaviors.

Institutional logics are sustained in and reproduced by the "cultural assumptions of the institution" (Thornton & Ocasio, 2008, p. 105). In higher education, the institutional logics of the university are embedded and reflected in the interests, identities, values, and perceptions of its faculty and other organizational members within the institution (Powell & Colyvas, 2010). In turn, institutional logics also provide guidance for faculty and other organizational members to evaluate and align their behavior with institutional expectations and environments.

For example, if faculty entrepreneurial behaviors are aligned with the institutional logics of the university, their entrepreneurial behaviors gain legitimacy and will lead them to an increase in institutional resources and institutional influence, as well as solidify their autonomy. However, if their entrepreneurial behaviors are not aligned with the logics of the institution, faculty will either act to negotiate with their institutions or abandon their behaviors in order to maintain their institutional membership (Giddens, 1984; Thornton & Ocasio, 1999). In this way, institutional logic is more than a motivator of actions: institutional logic justifies action.

As the world of science has come into contact with commerce, the identity associated with a university scientist may have expanded to include entrepreneurship (Colyvas, 2007; Etzkowitz, 1998; Merton, 1954; Owen-Smith & Powell, 2001). As more university faculty participate in such activities, commercial involvement has transitioned from unfamiliar and unusual to plausible and appropriate and finally to a core component of a scientific career (Colyvas & Powell, 2007). Identity theory is adopted in this investigation to frame the ways that faculty negotiate with the institutional forces and make sense of their entrepreneurial behaviors.

When universities shift their research agenda to align with the logics of entrepreneurship, individual faculty thus emulate their roles as entrepreneurs, consultants, and equity holders to generate resources and revenues (Powell & Colyvas, 2010). Individual faculty's language and vocabulary therefore shift to align with the world of business that entrepreneurs use to engage in dialogue and achieve mutual understanding. If a university consistently uses the language of business to explain its commercial activities, it enacts a

business protocol, which is different from academic protocol, in faculty language and the sense making process. However, because of the differences in professional fields, faculty interpretations are different. For example, the field of agriculture is closer to fundamental science while computer science is much closer to the field of business. Hence, when entrepreneurial activities are institutionalized at the college or school or departmental level, engineering faculty and agricultural faculty are likely to have different reactions to the entrepreneurial logics. Therefore, the variation in faculty responses reflect the tensions in disciplines and values disparity emanated from faculty identity.

Institutional Logics and Faculty Identity

Faculty perceptions or self-conceptions are rooted in their roles, backgrounds, and positionality within the social structure (Levin et al., 2020). Hence, faculty identity is shaped by their institutional environments, such as institutional rituals, institutional missions, and policy systems, as well as social contexts through which social expectations are enforced on individual faculty (Clark, 1987; Levin et al., 2020). Identity theory explains how individuals' perceptions and values are shaped by their social, cultural, and economic structures, and, in turn, influence their behaviors under different circumstances (Burke & Stets, 2009). While institutional theory suggests that the logics of the university are thus reflected in faculty behaviors, sensemaking processes, and how faculty justify their activities in the university (Powell & Colyvas, 2010), identity theory indicates that individuals also bring their own values and past experiences to the institution. In this regard, identity theory explains the interaction between the individual identity and the logic of their institutions. Individual identity is derived from individuals'

participation in multiple discourses within the institution and shifts and evolves continually. Levin et al. (2020) suggest that faculty possess an inner "personal self" that is in addition to their outer "organizational-self" (p. 6) where their personal histories and backgrounds determine the extent to which they adopt their institutional logics and how well they internalize their institutional logics and expectations into their personal value systems.

Research Questions

This investigation seeks to answer three main research questions.

1. Why do faculty engage in university spin-off firms while they maintain their academic positions at their university?
2. In what ways do faculty perceive that their participation in academic entrepreneurship shapes their understandings of their academic roles (i.e., research, teaching, and service)?
3. How is a balance between faculty's entrepreneurial roles and the academic roles obtained?

Research Methodology and Methods

The overall investigation employed a qualitative methodology with a dilemma analysis approach to interview (Creswell & Creswell, 2017). This methodology, as well as a dilemma analysis approach, is particularly useful for the exploration of individuals' experiences and perceptions under a contingent phenomenon. In the process of qualitative inquiries, I paid attention to participants' descriptions of their work environment as well as their understandings of their institutional expectations of their professional roles. In

this way, the nuances in participants' sensemaking process of academic entrepreneurship are addressed, derived from their justification of their experiences and their strategies to maintain their dual roles in both academic and entrepreneurial activities.

The research design is comprised of research settings, data sources, and approaches to data inquiries, as well as procedures of data collection (Creswell & Creswell, 2017). Research sites of the University of California (UC) were selected for three reasons. First, UC is the largest public university in the U. S. and includes 10 campuses located in different parts of California. UC also holds the largest pool of patents and licenses among all the university systems in the U. S. Therefore, the active participation of UC universities in patenting and licensing activities provides a sample pool to recruit faculty entrepreneurs for the present investigation. Second, although UC is engaged actively in patenting and licensing, the extent of entrepreneurial engagement as well as entrepreneurial performance varies by campus. According the University of California economic impact report (2017), UC Los Angeles (UCLA), UC San Francisco (UCSF), and UC San Diego (UCSD) generate more economic impact[1] than the other UC campuses, which generate incomes (in thousands) of, respectively, $35,336, $24,386, and $18,662 from their patenting and licensing activities. In comparison, UC Riverside (UCR) generated (in thousands) close to $5,916, UC Irvine (UCI) $5,692, and UC Santa Cruz $296. Specifically, there were 20 startup companies created at UCLA, 11 created at UCI, and 2 created at UCR. Hence, the various entrepreneurial outputs reflect a

[1] In the report, economic impact is measured by the total revenue generated from licensing, the number of patent applications, and current number of patents, and the number of spin-off firms as well as its contributions to the employment (https://www.ucop.edu/innovation-alliances-services/_files/ott/genresources/documents/IE_Rpt_FY2017_FINAL.pdf)

difference in the level of entrepreneurial engagement within the UC, which makes the UC an appropriate site to examine and explore the relations between institutional environment and faculty perceptions of their primary roles within the university. Despite different entrepreneurial engagements at each campus, all UC universities are governed by the same institutional policies and rules regarding academic entrepreneurship. The differences in the institutional environments for academic entrepreneurship is likely to lie in the implementation stage of the policies. Therefore, by comparisons and contrast of faculty perceptions in different entrepreneurial contexts, the present investigation can shed light on mediating factors that influence the compatibility, or not, between academic entrepreneurship and academic functions in the public university. As a result, I selected UCLA, UCI, and UCR, universities that represent, respectively, high, medium, and beginning stage of academic entrepreneurship, as the sites to carry out the investigation and to recruit faculty participants.

Data collection comprised three stages (see Fig 1.1). The first stage included the conduct of fieldwork, which involved interviews with Directors from the Entrepreneurship Centers and review of institutional documents related to academic entrepreneurship at the three campuses. By doing so, I sought to understand the culture of academic entrepreneurship at each participating campus. The second stage included the pilot study, which I aimed to generate interview protocols and then modify these with a pilot interview with a USC faculty entrepreneur. After finalizing the interview protocol, I recruited and conducted interviews with faculty participants from the three UC universities.

With the goal to identify key institutional strategies related to academic entrepreneurship, I examined entrepreneurial strategies and innovation displayed on the University of California Office of President (UCOP) webpage. From there, I went on to each participating university's websites that addressed academic entrepreneurship and identified programs and offices that were related to their campus practices. I then immersed myself in the documents to gain understandings of each participating campus culture related to entrepreneurship. In order to triangulate the interview data as well as gain a more accurate understanding of the entrepreneurial practices, I reached out to Directors at each Entrepreneurship Center at the participating UC universities and conducted one-on-one interviews with the Directors. The first stage of the data collection was carried out to contextualize faculty interviews under their respective institutional contexts.

The second stage of data collection was the pilot study with faculty entrepreneurs from a different institution. Although these data are not included in the final analysis, they are used to modify and add interview questions to the final interview protocol in order to cover different aspects of faculty entrepreneurs' experiences, as well to capture a more accurate account of faculty entrepreneurs' understandings of their roles and their sensemaking of their behaviors.

The final stage of data collection was semi-structured interviews with faculty entrepreneurs from the three campuses. I confined my recruitment of faculty participants to the School of Engineering to minimize disciplinary differences in faculty perceptions. In addition, to obtain an equal number of faculty participants from each participating

campus that has a matching faculty profile, I focused my recruitment within departments of Bioengineering and Computer Science. This was because the two departments generated the most spin-offs firms within the UC, even at the beginning entrepreneurial university, UCR. This gave me not only a matching profile of faculty participants across the three campuses but also a larger pool from which to select faculty participants. In this way, the final list of faculty entrepreneurs was created based on both faculty involvement in university spin-offs, and faculty's research in Bioengineering or Computer Science.

Recruitment emails were sent to every individual on the final list, and then sent a second time to those who did not respond. Forty faculty responded and participated in the interviews (see Table 3.1). All interviews were semi-structured in nature, and these interviews were used to capture faculty perceptions regarding their entrepreneurial engagement. As well, I was able to be reflexive during the interviews and to probe interviewees' responses for the meanings and experiences derived from faculty participants. Each interview was approximately 1 hour in duration and was recorded with the participants' consent. One exception to this practice occurred with a participant from UC Riverside. Because the participant did not want to be recorded, I took notes during the interview. These notes were used to enhance my understanding of academic entrepreneurship but were not included in the findings of this investigation. All 40 interviews were conducted from March to June in 2019, and 40 interviews were transcribed and coded in the data analysis.

Data Analysis

The interview data were coded and analyzed using an inductive approach to thematic analysis (Braun & Clarke, 2012; Van Vugt, 1997). Thematic analysis links ideas and components derived from the qualitative data in a meaningful way to present a coherent argument. It is particularly useful to group themes embedded in the perceptions and views of individuals (Ata, 2016; Boyatzis, 1999; Lee, Lim, & Kim, 2017). In conjunction with the thematic analysis, an inductive approach allows the researcher to derive themes and meanings through the participants' own perceptions and addresses the existing patterns identified from the current literature. For example, scholarly literature suggests that there are three main institutional logics that exist in higher education institutions that guide faculty behaviors and perceptions, working together or separately (Brint, 2019; Gumport, 2000; Greenwood et al., 2011; Levin, Martin, Lopez Damian, & Hoggatt, 2018). By drawing upon these institutional logics, I sought to make sense of and interpret faculty's rationalizations of their behaviors and justifications for their motivations. Additionally, components of entrepreneurial identity are used to examine how faculty entrepreneurs construct an identity in the environment where they interact with and engage in both the business world and the academic world.

Analytical Frameworks

The logic of academic professionalism (Brint, 2019; Levin et al., 2020) and the logic of entrepreneurship and innovation (Brint, 2019; Etzkowitz, 1998, 2003) were employed as my analytical framework to capture faculty entrepreneurs' uses of logics in their sensemaking processes of faculty professional roles and entrepreneurial

involvements. As presented in the theory section, multiple institutional logics exist in the university that guide institutional and individual behaviors (Bastedo, 2009). The logic of academic professionalism is used by scholars to describe academic work and structure in higher education (Brint, 2019; Gumport, 2000; Greenwood et al., 2011). The logic of entrepreneurship and innovation is used in the context of academic entrepreneurship to capture the trend of university involvement in commercial activities as well as the university roles in the economic development. These two logics are employed to identify which logics that faculty participants use to justify their entrepreneurial behaviors and activities.

Because I was also interested in faculty motivations to participate in entrepreneurial activities while they maintained their positions with the university, I borrowed components from the entrepreneurial identity literature to detect the constructional process of faculty entrepreneurs in their formation of an entrepreneurial self as well in expressing their entrepreneurial motivations (Ollias et al., 2015). Storytelling and socialization abilities are identified as critical to convey an entrepreneurial self to others. Therefore, in the analysis, I paid particularly attention to faculty narratives of their entrepreneurial experiences and their social groups to examine and explain their construction of entrepreneurial identity within an academic setting.

The analytical framework aids in the explanation of the data for the development of findings on faculty entrepreneurial involvement. The qualitative data were analyzed through NVivo, a qualitative software program that helps manage and analyze large amounts of qualitative data and supports the coding process. All interviews were

imported into and stored in NVivo, and this enabled the identification of patterns across and within institutions and disciplines.

Structure of the Dissertation

This following chapters are organized based on a qualitative research design (Creswell & Creswell, 2017). In Chapter Two, I discuss the literature that addresses the imperatives and influences of academic entrepreneurship on research universities. This review serves as the foundation to develop findings for this investigation. By listing the opposing scholars' views on the advent of academic entrepreneurship in the university, I demonstrate a scholarly divide as well as a gap in the literature concerning to the micro-processes of faculty entrepreneurial engagement. After addressing the different scholarly perspectives regarding academic entrepreneurship, I provide empirical studies that examine the compatibility between and among academic entrepreneurship and research productivity, knowledge distribution, and teaching activities in the university. I discuss their findings and results. In doing so, I provide a summary of different empirical results on the effects of academic entrepreneurship on faculty research and teaching roles. In Chapter Three, I explain my methodology and methods. The chapter is guided by a qualitative methodological approach and is followed by descriptions of the research settings, data collection, and data analysis strategies. Research settings include description of the rationale for selection of the participating universities as well as the respective campus environments for academic entrepreneurship. Data collection is comprised of data sources and data collection methods and procedures. Data sources are provided first to justify the approach to respond to research questions. The data collection

procedure is iterative, and this approach allows me to collect rich data that are useful to answer the research questions. In Chapter Four, I present my findings based upon evidence from faculty perspectives on the effects of academic entrepreneurship on their professional lives. The findings are organized around the research questions, that is the influence of USOs on faculty motivation and roles in research, teaching, and services. At the end of Chapter Four, I provide strategies that faculty employed towards obtaining a balance at work. In Chapter Five, I provide the conclusions of the investigate and suggestions for future research.

Chapter II LITERATURE REVIEW

Introduction

This chapter provides a discussion of literature on faculty engagement in academic entrepreneurship, as well as the theoretical foundation and framework of the present investigation. Three clusters of literature are examined in the chapter: (1) the development of the entrepreneurial university, (2) academic patenting and spin-offs and their influences on universities, and (3) entrepreneurial motivations and barriers of academic entrepreneurs (Skute, 2019). The explanation of three clusters of the literature offer a foundation on which I base the background, theoretical framework, and the purpose of the present investigation. The literature discussed in this chapter is derived from peer-reviewed journal articles and scholarly books in fields such as Education, Sociology, Psychology, and Public Policy. I made an effort to consult literature outside the field of Education so that a diverse scholarly perspective is presented and discussed on the issues of academic entrepreneurship. In doing so, I aimed not only to provide an explanation of scholarly literature but also to identify the weakness as well as gaps in the literature.

I conclude that academic entrepreneurship is a multifaceted phenomenon which should not be examined in separation from either the context of the institution or individuals' interpretation of the institutional environment. Previous research examined

the influence of academic patenting and licensing on the rate, quality, and distribution of academic research, but it does not include the discussion of the influence of university spin-offs. Nor did this literature attempt to address academic entrepreneurship's influence on teaching and service roles of university faculty. This gap in the literature led the present investigation to collect in-depth data on the influence of academic entrepreneurship on the scientific norms as well as teaching strategies and perceptions of students and services of university faculty.

I employed institutional theory (Thornton & Ocasio, 2008) and identity theory (Burke & Stets, 2009) as my theoretical frameworks for the present investigation. Institutional theory serves as a theoretical foundation to explain the institutionalization process of academic entrepreneurship in the universities. Identity theory is used to capture individuals' perceptions and self-understandings and explain the sensemaking process that individuals make to justify their behaviors as well as influencing their intentions. Specifically, I drawn upon the logics of the institutions as well as the understandings of individuals to build my argument on the roles of institutional environment in mediating the effects of academic entrepreneurship on academic work. In sum, the goal of the chapter is to unpack the multifaceted phenomenon of academic entrepreneurship and translate it into different institutional settings of the university. By providing different scholarly perspectives regarding the influence of academic entrepreneurship, I point to more qualitative studies to examine the implementation of academic entrepreneurship effects on individual faculty.

This chapter is organized as follows. I first discuss the literature regarding the changing background of higher education as well as the development of entrepreneurial universities. Then, I focus the discussion on the compatibility between academic entrepreneurship and academic roles (i.e., research, teaching, and service). Specifically, I distinguish academic patenting from university spin-offs and discuss each's effects on academic work separately. Next, I introduce institutional theory (DiMaggio & Powell, 1987; Powell & Colyvas, 2010) as well as institutional logics (Thornton & Ocasio, 2008) to tie the different streams of university practices together and to capture individuals' sensemaking processes in entrepreneurship. In line with institutional theory, identity theory (Burke & Stets, 2009; Lok, 2010) is employed to explain individuals' interpretation of the environment in relation to their entrepreneurial behaviors. In this way, I address the interrelation between individual level and institutional level changes and provide a guideline for the design of the investigation.

The Literature on Academic Entrepreneurship

The recent systematic reviews of the academic entrepreneurship literature, such as the work of Grimaldi et al. (2011), Perkmann et al. (2013), and Skute (2019), suggest that there are three clusters of topics that are discussed frequently by academic entrepreneurship and education scholars. The three clusters are: (1) the role of universities in regional development and the anatomy of entrepreneurial university, (2) academic patenting and spin-offs and their influences on universities, and (3) entrepreneurial motivations and barriers of academic entrepreneurs. The three clusters cover different dimensions of academic entrepreneurship that range from its macro-level

effects in society to micro-level influences on individuals. As Perkmann et al. (2013) indicate, academic entrepreneurship is a multifaceted phenomenon, which signals a differential effect of each entrepreneurial activity on academic work in the university. Therefore, in order to provide a comprehensive review of the background for the studies on academic entrepreneurship, I discuss all three clusters of the literature and the interrelations among the entrepreneurial activities and focus the review on the micro-level effects on individuals.

The Development of the Entrepreneurial University

The first cluster of the literature focuses on the evolving role of universities in society and the emergence of "the third mission"[2] in the university (Galan-Muros et al., 2017). This body of literature traces the history of academic entrepreneurship to the 1980s and provides explanations of how an economic mission as well as an entrepreneurial model of the university is infused and expanded in the higher education sector. As well, scholars have identified different forms of academic entrepreneurship and various entrepreneurial activities at the university. As a result, universities are no longer viewed as ivory towers isolated from the society but increasingly recognized as an economic engine for regional development, a catalyst for technological innovation, and an instrument for societal development through the exploitation of entrepreneurial opportunities of university research (Bienkowska et al., 2015; Bramwell & Wolfe, 2008; Guerrero & Urbano, 2012).

[2] "The third mission" is a term that created by scholars such as Laredo (2007) who refers specifically to the economic development mission of the university. Thus, I adopted the term here to refer to university engagement in academic entrepreneurship.

The Public University and "the Endless Frontier." The third mission argument arises from a notion that university research can generate economic spillovers that can contribute to the economy as well as to the national innovation system (Gibbs, Haskins, & Robertson, 2012; McClure, 2016; Mowery & Rosenberg, 1993; Mowery et al., 2004). This notion emerged in the era of World War II (WWII), where U. S. policymakers began to recognize the power of science in the development of technology. Vannevar Bush (Bush, 1954), in his report, *Science: The Endless Frontier*, demonstrates a linear process between academic science[3] and technological advancement. Academic science is seen to contribute to U. S. military strength as well as to the innovation system of the nation (Stokes, 2011). The rises of Japan and West Germany in the 1970s have demonstrated how technology development and innovation can contribute to the national economy (Berman, 2012). During that period of time, U.S. policymakers began to address that they must develop indigenous scientific research in order to maintain a leading role of U.S. in science and technology, as well as a competitive edge in the political economy. An "innovation frame" was formed towards the end of 1970s with an endeavor to stimulate domestic economy through innovative technologies, where any political barriers that hinder scientific developments should be superseded (Berman, 2012, p. 34). The heightened focus on innovation has given rise to a prosperity of research development and scientific activities in the U.S., where universities are at the center of the attentions of the federal efforts. Increased federal funding was poured into the university to support the development of R&D activities as well as the diffusion of applied technologies.

[3] Academic science refers to the science and research conducted at the university.

Commercial behaviors and activities at universities were encouraged and validated by federal policies. As a result, by the end of the 1970s, university research entered the commercial realm of science, following the innovation frame. Federal funding became an important as well as the major purchaser of university research, with an innovation agenda to improve human health through patents and commercialization of science. As such, a fourth mission, economic development through academic innovation, was infused into the university, along with its roles in research, teaching, and service.

In particular, for public universities, whose establishment lies in the land-grant[4] history, the innovation agenda has been vital to the university's missions for two reasons. First, although university faculty were fond of curiosity-driven research, the rationale for federal funding had changed (Geiger & Sa, 2008). The innovation agenda portrayed commercialization of university research as a social good as well as financial potentials that neither the public university nor faculty could deny or "resist" (Geiger, 2019, p. 271). Second, the public sector, especially in the 1980s, experienced considerable changes in its financial structure, where state appropriations for higher education declined dramatically (Slaughter & Leslie, 1997; Toutkoushian & Hillman, 2012). Commercialization of scientific research was an additional source of funding that universities can rely on and do not need to pay back to the government or collect tuition from students. The changed funding structure as well as the pressure to produce

[4] Rhoten and Powell (2008) note that the roots of the public research university lie in the land grant tradition, with the founding of the University of Georgia, North Carolina, Vermont, South Carolina, and Virginia. The passage of the Smith-Lever Act (1914) enabled the land grant universities to engage in research and disseminate such research for public use and service.

innovative research fostered a new model of university in the public sector—the entrepreneurial university (Clark, 1998; Etzkowitz, 1998).

Emergence of the Entrepreneurial University. A subtheme in the first cluster concerns the emergence of the entrepreneurial university in the public sector, alongside the privatization and corporatization of higher education (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004). Despite the increased emphasis on scientific innovation, public funding for higher education institutions decreased instead in the 1980s (Slaughter & Leslie, 1997). The disinvestment of state governments on public universities has led to an increased college tuition for students and families as well as the adoption of business strategies in the university that emphasizes performance and productivity. More importantly, in order to sustain its daily operation and campus activities in the face of declined funding, universities turned to the private sector and seek funding from private foundations, firms and corporates, and industries (Clark, 1998; Etzkowitz, 1998, 2003). Universities have been active in seeking grant and contract research opportunities and engaged in fund-raising activities. The fund-raising behaviors of the university, as well as the survival mode of the institution in times of financial uncertainty, have nonetheless given rise to the notion of the entrepreneurial university. As Clark (1998) and Etzkowitz (1998) argued, an entrepreneurial model of the university was formed with the goal to adapt to external changes, strengthen management controls, to generate revenues for the university, and to become self-sufficient.

The model of the entrepreneurial university did not disappear even when state appropriations for higher education rose in the 1990s. Instead, the intention to develop

into the entrepreneurial university model continued to grow for higher education institutions throughout the late 1990s (Etzkowitz, 1998, 2003). Although public universities were no longer in the survival mode, they needed to demonstrate their unique contributions to the state in order to obtain a moderate level of state funding. The rise of the private sector in higher education has also intensified competition among universities for funding and resources. Public universities had to become more entrepreneurial in their ways of generating revenue to support their campus activities. Scholars have pointed out that there was an entrepreneurial turn in the 1980s for higher education institutions, where universities became increasingly business-like and engaged in market and market-like behaviors to strive for prestige and productivity in the higher education market (Slaughter et al., 2004). The increased business-like behaviors led to generations of new organizations and new offices on campus to facilitate knowledge transfer in the entrepreneurial process (Slaughter et al., 2004). For example, in 1980, there were approximately 20 universities with technology transfer offices (TTO); in 1990, the number increased to 200, and by 2000, almost every major research university had one (Colyvas et al., 2002).

The establishment of TTOs represents an entrepreneurial effort of the university to develop its entrepreneurial competencies to build connections with industries (Siegel & Phan, 2005). More importantly, the TTOs signifies the emergence of an entrepreneurial model in public universities, where academic entrepreneurship is seen as a valuable and vital mechanism for universities to generate revenues and have economic outcomes for the state (Guerrero & Urbano, 2012; Galan-Muros et al., 2017; Secundo et

al., 2017). Academic entrepreneurship as a mechanism for economic outcomes, however, varies in its effects and influences on each individual university. Thus, academic entrepreneurship cannot be simply understood as a single practice; instead, it carries a variety of activities and has context-dependent meanings.

Academic Patenting, Technology Licensing, and University Spin-Offs. There are three main mechanisms for inventions and technologies generated at the university to transfer into the market, and these three mechanisms are respectively, academic patenting, technology licensing, and university spin-offs. These three mechanisms are essential for colleges and universities to link their entrepreneurial goals with their institutional contexts and the surrounding environments.

Academic patenting refers to the patenting process of inventions or technologies generated within the university, where faculty and scientists, as well as TTO officers, collaborate and make joint efforts in the application process (Baldini, 2006; Mowery et al., 2001). The outcome of academic patenting is usually a patent, either patented inventions, or patented research tools, or products. The discovery of recombinant DNA gave birth to the industry of biotechnology and thus led to the passage of Bayh-Dole Act in 1980 (Berman, 2012). The Bayh-Dole Act 1980 permitted universities to patent the output of federal-funded science and research, and, argued by many scholars, represented a ramification point for science worldwide. Although academic patenting activities had been increasing in the university 12 years before the Act (Mowery et al., 2001), the Act has streamlined the patenting process and formalized patenting policies and practices. Before the Act, individual agencies differed in their policies concerning to the patenting

process and ownership of the research developed by university faculty, but the Act gave university faculty the ability to own their inventions and promote their inventions to the private sector. A series of policies were implemented to facilitate the academic patenting process. Technology Transfer Offices were established in the university, legitimated by the Stevenson-Wydler Technology Innovation Act of 1980, to push the commercialization goals of universities. As a result, academic patenting was embraced by universities and integrated into university practices.

Technology licensing is the next step of academic patenting (Colyvas et al., 2002). The patenting process guarantees protection only for the university IPs but does not generate additional income for the university. Hence, technology licensing is carried out by the university TTO officer, or sometimes faculty, to license the patent to companies and firms, or other interested parties, in exchange for royalty fees (Colyvas et al., 2002; Thursby, Jensen, & Thursby, 2001). Faculty and the university often negotiate with the potential licensing company and share the profits of the patents. The licensing of the Cohen-Boyer patents yielded over $250 million dollars and represents one of the most successful university technology licenses (Feldman, Colaianni, & Liu, 2007). Different from academic patenting, technology licensing requires identification of potential licensee companies, and dependent upon the university's linkages with the industries, the identification process can vary. In some cases, university patents were never licensed to companies. In this regard, although the Bayh-Dole Act enables the university to generate revenue from their faculty inventions, many university patents face the risk of *languishing* in academic archives, and, therefore, TTO officers need to seek faculty

involvement in the identification process of potential companies and use faculty linkages with the industries to license the patents (Thursby & Thursby, 2010).

University spin-offs (USOs) are different from both academic patenting and technology licensing. It does not require a patent or a license to create a USO, although many USOs do so to further the development of the patent (Rasmussen, 2011). Sometimes, USOs are created because faculty inventors do not want to license their patents to other companies; they started companies themselves and licensed their own patents from the university. Hence, some USOs are created absent patents, and faculty founders own the full profits generated from their companies, while in others, since faculty license their own inventions from the university, they share the profits with their universities. However, what distinguishes creations of USOs from academic patenting and technology licensing is that the roles and involvement of faculty are different. USOs require business skills of faculty and sometimes their participation in marketing and management, while, in academic patenting and technology licensing, faculty's roles lie mainly in their role as scientists and inventors. For example, when Cohen and Boyer patented rDNA in 1980, they did not plan to commercialize it until one businessperson came to them with commercialization ideas (Berman, 2012). Cohen, at the time, was not interested in starting a company; he maintained his role in the university and conducted basic research. Boyer, however, decided to join the businessperson and turned the patent into a business. Genentech, founded by Boyer and the business entrepreneurs, possesses a leading position in the biotechnology industry and generates enormous financial benefits for Stanford. In this case, Genentech is a USO that developed from Stanford. Boyer was

the faculty entrepreneur, who not only conducted research with the university but also engaged in business activities outside the university. Cohen, on the other hand, was not a faculty entrepreneur. Although Cohen engaged in the patenting and licensing process, he was not involved in the company or any other business activities. This example indicates that different levels of faculty engagement are required in academic patenting, technology licensing, and USOs; faculty occupy different roles and responsibilities between patenting/licensing and USOs (e.g., Perkmann et al., 2013; Vohora et al., 2004). In the present investigation, I focus specifically on faculty founders of USOs to explain how faculty engagement in the business world influences faculty understanding of their academic roles.

In sum, the first cluster of the literature addresses the background of academic entrepreneurship and its higher education context. The shift towards entrepreneurial universities in the external environment is justified by the economic contribution of academic entrepreneurship and academic entrepreneurship's role in sustaining the financial stability of the university. The compatibility, however, between academic entrepreneurship and academic values of university research and teaching continues to be disputed.

The Compatibility Between Academic Entrepreneurship and Academic Roles

The second cluster focuses on the outcomes and consequences of academic entrepreneurship in universities. Specifically, scholars have focused the discussion on the influence of academic patenting and technology licensing on research and teaching (Campbell & Slaughter, 1999; Dasgupta & David, 1994; Drives, Lei, & Wright, 2018;

Louis, Blumenthal, Gluck, & Stoto, 1989; Nelson, 2004; Slaughter et al., 2004; Thursby & Thursby, 2010; Thompson, Ziedonis, & Mowery, 2018; Ziman, 2002). Scholars have pointed to two main concerns surrounding academic entrepreneurship: (1) the formation of an academic enterprise among universities and (2) the compatibility among academic entrepreneurship and research productivity and distribution, the role of basic science, and teaching. The studies examined in the section below provide empirical evidence on the effects of academic patenting on the production, diffusion, and dissemination of knowledge in the university.

Critics of Academic Enterprise. Critics have argued that academic patenting has a deleterious effect on the social value of science—it turns university research from a public good to a private good that is governed by individual and institutions' benefits (Dasgupta & David, 1994; David, 2003; Hackett, 1990; Nelson, 2004; Ziman, 2002). As universities engaged increasingly in entrepreneurial activities, they formed an academic enterprise (Etzkowitz, 1998; Slaughter & Leslie, 1997) that changed the nature of public research and the educational goals of the university. These critical arguments condemn the profit-seeking motives of the university and faculty and argue that patenting activities are harmful to the social benefits of academic science. For example, Cohen-Boyer's patent, which started the U. S. biotechnology industry, was accused of patenting behaviors that could harm the integrity of academic research and was seen as a marketing strategy of Stanford to generate profits (Eisenberg & Cook-Deegan, 2018). Critics have argued that Cohen-Boyer would have had the same effects without patent protection; and, thus, universities' behaviors as patent seekers "cannot be justified on any other basis

other than pursuit of revenue" (Eisenberg & Cook-Deegan, 2018, p. 80). Furthermore, university practices in patenting are criticized because these work against the policy goal of developing and diffusing technologies generated at the university, and they make these technologies less affordable and less accessible to the public. From the perspectives of these critics, university faculty are expected to provide reliable and innovative research in order to enrich society with influential and trustworthy knowledge (Etzkowitz, 1998; Ziman, 2002). Once commercial interests are involved, however, the fear enunciated by critics is that this trustworthiness of research might be compromised if private profits are involved.

Despite the patent critics' allegation, proponents of academic patenting and licensing argue that without patenting, many university inventions would not be recognized or transferred into practice; they might just deteriorate on the shelf as do many other published, but not patented, discoveries (Colyvas et al., 2002; Gambardella, 1995; Stokes, 2011). Because companies are interested in investing only in inventions that are exclusive to them, academic patenting and licensing can give them some protections from competitors. Particularly when university research in Bioengineering and Computer Science develops quickly, collaborations between the university and industry are expected and encouraged for development in technology (Schacht, 2009). Therefore, academic patenting and licensing enable firms to reach out to the university and sign contracts for exclusive licensing. What follows from the exclusive license is that university inventions are recognized in and transferred into practice, and thereby generate maximum utilities for society.

With an effort to resolve the debate over academic patenting, Colyvas et al. (2002) and Mowery et al. (2004) examined the ways in which university inventions entered into the marketplace and analyzed the quality and quantity of both university research and patents before and after the Bayh-Dole Act. Their findings suggest that there is no evidence to support the argument that only through patenting can university inventions be transferred into the marketplace. Although academic patenting is necessary in some cases for the inventions to be recognized by industrial partners, these scholars argue that it is not the only way. Instead, they conclude that the role of academic patenting varies significantly from case to case, university to university. However, they did not provide the specific case and settings where academic patenting works more efficiently, and, as such, the inconclusiveness does not illuminate or explain the matter further.

Indeed, some university policies are aimed at maximizing the revenue from academic patenting but not to transfer university inventions into the marketplace. However, the generation of university revenues was never an argument for the policies articulated in the Bayh-Dole Act, but in recent decades this has been an important objective of universities in their patenting and licensing policies (Jensen & Thursby, 2001). Whether the role of academic patenting in transferring university inventions into the public is an argument for the improvement of social good or simply for an increase financial profits for the institution remains in dispute.

The Compatibility of Academic Entrepreneurship with Research. Scholars have claimed that academic patenting and licensing, or other forms of commercialization of

science, have adverse effects on the advancement of science and knowledge distribution (Blumenthal et al., 1996; Campbell et al., 2002; Daguster & David, 1994; Krimsky, 2003; Nelson, 1990). Because of time-related considerations and competition in the patenting market, critics have argued that there is an automatic tradeoff between patenting and publishing because it is time-consuming to disclose inventions and flesh out patent applications. Blumenthal et al. (1997) present survey results from life science faculty responses to commercialization of research and note that there is a concern over possible delay of publications because of academic patenting. Furthermore, scholars have pointed out that patenting has a crowding out effect on the production of basic science in the university (Krimsky, 2003). Surveys of faculty, as well as anecdotal evidence, have suggested that academic patenting skews faculty's research agendas toward commercial priorities and compromises the role of basic science in the academy (Krimsky, 2003; Owen-Smith & Powell, 2001). More importantly, the increased engagement of faculty in academic patenting and licensing activities might have altered values in the scientific community, where scientists are not recognized for their scientific contributions but are praised for their entrepreneurial skills and abilities to generate revenue (Etzkowitz, 1998, 2003). To several critics of academic entrepreneurship (Campbell & Blumenthal, 1998; Slaughter et al., 2002; Slaughter & Leslie, 1997), the shift in academic values and scientific norms are signs of the incompatibility of academic entrepreneurship with knowledge production and distribution in the university, which has led faculty to be motivated by the commercial potential of science rather than peers' acknowledgement or intrinsic satisfaction of solving challenging problems.

In response to the scholarly concerns, empirical studies were carried out to investigate the influence of patenting and licensing on university research. However, these studies are fragmented and present mixed results.

Research Productivity. The majority of current literature has focused on the effects of academic entrepreneurship on research productivity in the university. Research studies were carried out to identify any potential tradeoffs between patenting, licensing, and creations of USOs and the quantity and quality of university research.

Early studies on academic patenting, such as Blumenthal et al. (1998) and Louis et al (2001), argued that academic patenting has negative effects on faculty research productivity due to the time conflicts between faculty engagement in academic patenting and faculty engagement in publishing. Also, academic patenting could also prohibit faculty from sharing their research results in open access journals. Murray (2002) was the first scholar who identifies a path of dual-knowledge disclosure that allows faculty to disclose their patents and publications at the same time. To operate a dual-knowledge disclosure, Murray found that faculty inventors would publish their scientific results in open access science journals and submit their patent application at the same time. She further pointed out that these paired patents and publications pertain to a nearly identical set of research findings, which suggests that the potential tradeoff between patenting and publishing can be resolved by a dual-purpose knowledge dissemination mechanism.

In line with Murray's research, Bresch et al. (2007), Stephan et al. (2007) and Azoulay et al. (2009) obtained positive results on the influence of academic patenting on research production and dissemination. They argued that patenting and publishing are not

in conflict but rather complementary. Azoulay et al. (2009) analyzed research outputs of 3862 life scientists in research universities and found that academic patenting has a positive effect on the rate and quality of publication—faculty who patented published more research and were cited more than their non-patenting counterparts.

Despite the positive effects found on research productivity, Calderini et al. (2009) argued that these effects vary by field. They investigated the effects of academic patenting on publications in the Chemistry and Engineering fields and found that although patenting leads to an increase in scientific productivity, this increase is much higher in Engineering than in Chemistry, because secrecy is less stringent in engineering research. Thus, they concluded that the effects of academic patenting on research dissemination depends upon how sensitive research acts towards secrecy and exclusivity.

Other scholars who focused on the technology licensing effect on publishing found mixed results. Murray and Stern (2007) found that the licensing of a patent results in a significant decline in citations to the research papers related to the patent, as well as a substantial lag in publishing the patent results to the public. However, Sampat and Ziedonis (2005) examined licensed patents from Columbia University and the University of California but only found more citations occurred after the patent was licensed. In line with Sampat and Ziedonis's argument, Thompson, Ziedonis, and Mowery (2014) and Drivas, Lei, and Wright (2018) found the licensing of academic patents has positive effects on the patent's related journal citations. They analyzed data on invention disclosures, patents, and licenses from the University of California and linked the issuance of a patent or license to scientific research and the number of citations of

published research related to the patent and license. Their findings suggest that there is an increase, with some delay, in the number of citations of published research related to the patent or license. They further explained this increase after patenting or licensing of a patent as a signaling effect, which indicates that technology licensing may act as positive signals of research potential in the fields linked to the licensed invention, and thereby could increase citations to patented publications linked to the license.

Although most current empirical results have pointed to a positive effect of licensing on research productivity, some scholars interpreted this positive effect otherwise (Drivas et al., 2017; Fehder et al., 2014; Sampat & Ziedonis, 2005). They speculated that the reason that publications associated with licenses or patents were cited more is because they signal market trends. University faculty thus followed that signal because of the commercial potential of the research (see Larsen, 2011). This indicates that university faculty may follow the line of research that attracts the attention of industrial licensees so that they can attract more industrial funding and develop more commercializable inventions. According to these scholars, academic patenting has a positive effect on faculty research productivity; however, such positive effects pertain only to the production and citation impact that the research has on commercial potentials.

The research that examined the effects of creations of USOs on the quantity and quality of university research, however, is both scant and limited. A few exceptions, such as Audretsch et al. (2006), found that there is no positive relation between research quality and faculty spin-off involvement among a sample of U. S. faculty members. O'Shea et al. (2005) did observe a positive relation between university spin-off formation

and the intellectual eminence of U. S. universities. Lowe and Gonzalez-Brambila (2007) examined faculty entrepreneurs' productivity among 15 research universities and institutes in the U. S. and found that the research productivity of faculty entrepreneurs does not decrease after they founded a firm. Van Looy et al. (2011) examined entrepreneurial activities of 105 European universities and found that the universities' research productivity coincided positively with the number of USOs created. In particular, their finding suggests an indirect relationship between research production and spinoff creations—the presence of USOs yield extensive contract research opportunities for universities that could be translated into collaborative research and publications. They concluded that USOs have positive effects on the production of university research. In contrast, Barbieri, Rubini, Pollio, and Micozzi (2018) assessed the attitudes of faculty before and after they created a USO and found a crowding out effect of USOs on co-publications between universities and industries and firms. They argued that even though USOs have been seen as a preferential mechanism to transfer university inventions to the marketplace, the establishment of USOs may hinder R&D collaborations between the university and industry.

While the above research contributes to the explanation of academic entrepreneurship's effects on the quantity and quality of research, this research also raises questions with regard to the unintended results and potential tradeoffs between academic entrepreneurship and research production in the university. Academic patenting and licensing have been studied frequently, however, the influence of USOs on research are largely neglected in the literature.

Research Distribution. A number of studies focused on the effects of academic entrepreneurship on the knowledge distribution in the scientific community. They focused specifically on the accessibility to and the flow of researchers' scientific findings in the context of academic entrepreneurship. For example, Blumenthal et al. (1996, 1997) argued that academic patenting caused a delay in the distribution of university research through publications. Murray and Stern (2007) found that academic patenting has a moderate negative effect on the rate of knowledge distribution in the university. They measured the rate of the distribution of knowledge by the number of articles that reference the focal article in a given year. They found that academic patenting is associated with a modest decline in the rate of knowledge distribution, and this decline becomes more pronounced as the number of years elapsed since the patent grant. Other scholars, such as Walsh, Cohen, and Cho (2007), investigated the influence of technology licensing on the willingness of faculty to distribute their research results to the public. They found that academic biomedical researchers who licensed are more likely to restrict others' access to their data than their non-licensing and non-patenting faculty in biomedicine. They reported that these licensing faculty were more aware of scientific competition and less likely to share materials related to scientific experiments to the public. Thus, they questioned whether or not licensing activity at universities might impose a "social welfare cost" (Walsh et al., 2007, p. 28). Conversely, drawing upon a panel dataset of 3862 academic life scientists and their patents, Azoulay, Ding, and Stuart (2009) found that academic patenting has a positive effect on the rate of knowledge distribution and a weak positive effect on the quality of these publications. In line with

Azoulay et al.'s (2009) findings, Magerman, Van Looy, and Debackere (2015) found that research publications that belong to a patent-paper pair receive significantly more scientific citations than their counterparts for which no patent document has been identified. That is, academic patenting has positive effects on circulation and distribution of scientific publications.

Although the results on the effects of academic patenting are mixed, research on the effects of technology licensing on knowledge distribution is consistent—the effects depend on the types of licenses. Thompson et al. (2014) and Drivas et al. (2018) found that non-exclusive licensing has a positive effect on knowledge distribution and circulation between the university and industry; only exclusive licensing has a negative effect on knowledge distribution.

Research Agenda. A university's research orientation—whether or not the research is basic or applied—can be reflected in the journal in which the research was published.[5] Previous research, such as Blumenthal et al. (1996, 1997), Owen-Smith and Powell (2001), and Walsh et al. (2007), argued that academic patenting and licensing have shifted universities' research orientation to a commercial end by incentivizing faculty to conduct more applied research. Fabrizio and Di Minin (2008) found that there was a negative association between patenting and the production of basic research, which signals a shift of a university's research focus to more commercially-oriented research.

[5] The measurement was drawn from Mowery et al. (2001) and other scholars who pursue this line of research. Although there are critics about this measurement, mainly I used their results as a demonstration of how the effects of academic entrepreneurship on basic science is discussed in the literature.

Thus, these scholars concluded that academic patenting and licensing activities have a potential downside for the scientific focus of university research.

With regard to these concerns, Thursby and Thursby (2002), who draw upon survey data, found that faculty engagement in technology licensing could lead them to conduct more applied and commercializable research instead of conducting basic science. In the following study, Thursby et al., (2007) further explained that although such increase in faculty efforts of conducting applied research prevailed, the efforts of conducting basic science did not decrease. Instead, it is likely that the basic science is compensated by the decreased leisure time of faculty. To put in another way, academic patenting does not compromise basic research; leisure is the activity that is most compromised, and the total research effort rises.

In line with Thursby et al., other scholars, such as Mowery et al. (2015), Van Looy et al. (2004, 2006), and Ranga et al. (2003), found no indication of a negative effects of academic patenting and licensing on basic research activities. Ranga et al.'s (2003) findings suggest that the relationship between basic science and applied research might be characterized by complementarity rather than tradeoff. Van Looy et al. (2004) also found that faculty who are involved in patenting and licensing published a similar number of publications in basic research as their non-entrepreneurial counterparts. Mowery et al. (2001) compared production of basic research before and after the Bayh-Dole Act and found that there is no evidence to show that the production of basic research declined in the university. They explained that because the tenure process is linked with a collegial culture that values publication and research productivity and

effects, faculty are more likely to value publication more than entrepreneurial outcomes in the tenure process. However, after tenure, faculty production of research and the acquisition of grants both decreased significantly—regardless of their involvement in entrepreneurial activities. Nonetheless, these scholars contended that the university research agenda is not skewed towards applied research or inventions.

Despite some inconsistencies in the above scholars' findings, current research suggests that academic patenting and licensing do not compromise the production and distribution of basic science in the university. However, this does not mean that academic entrepreneurial activities are compatible with academic norms and values in the university. Indeed, there have been signs to indicate that faculty are likely to withhold their scientific findings due to the secrecy involved in academic patenting and licensing (Blumenthal et al., 1998; Walsh et al., 2007). Scholarly research has noted that faculty who received industrial funding are more likely to deny others' requests for research data than those who do not (Czarnitzki, Grimpe, & Pellens, 2015; Czarnitzki, Grimpe, & Toole, 2015; Louis et al., 2001). These scholars suggested that faculty engagement in contract research or industrial research could lead to an increase in data withholding behaviors in the scientific community and thereby increase secrecy in the advancement of science.

The balance sheet for the influence of academic entrepreneurship on research is in dispute, and this uncertainty places academic work and the role of university, particularly for the public good, under suspicion, at least for critical scholars (Slaughter & Leslie, 1997; Slaughter et al., 2004). The majority of the scholarly research on academic

entrepreneurship has focused on its influence on university faculty research. What remains unclear is if and the extent to which academic entrepreneurship influences academic work beyond research—such as the teaching and instructional roles of faculty and their interactions with students.

The Compatibility of Academic Entrepreneurship with Teaching. The concerns regarding the effects that academic entrepreneurship has on teaching and education of students have been concentrated on the view that academic entrepreneurial activities divert faculty from teaching and the education of students (Campbell & Slaughter, 1998; Slaughter & Leslie, 1997; Slaughter et al., 2002). The criticism rests upon faculty's time conflicts between academic entrepreneurship and faculty commitments to teaching and the education of students. Campbell and Slaughter (1998) surveyed both faculty who were involved in industrial research and faculty who were not. They found that faculty involved were more likely to buy out (i.e., gain release from) their teaching hours and delegated their teaching to others. Kenney (1987) warned that faculty could direct a student into topic areas that are useful for that faculty member's firm, thereby using the student as a low-paid employee or that faculty could transfer the unpublished results of a student's work or ideas to that faculty member's company. Slaughter et al. (2002) pointed out that students are treated as "tokens of exchange," while these students work on industrial research or research related to spin-off firms (Slaughter et al., 2002, p. 23). The students, often doctoral students, receive minimum payment or no payment at all to perform research for their doctoral advisors, or principal investigators (PIs). This exchange is seen as exploitation of student labor (Mendoza, 2007), a symptom of the

deleterious effects of capitalism. Based on a survey of students who receive industrial funding from the private sector, Gluck et al. (1987) found that students indicated that they were required to work for the supporting company after completing their graduate training as a return for the support. Furthermore, once there are monetary incentives involved with inventions and research, the relationship between student advisees and the faculty advisor could change (Marshall, 2000). Campbell and Blumenthal (1999) found that faculty engagement in industries could limit the informal interactions between faculty and students, such as mentorship and conversations outside the laboratory with other faculty, staff, and students.

Other scholars have counter-argued that academic entrepreneurship does not move faculty away from teaching and service—entrepreneurial faculty are "neither capitalism slaves nor teaching fugitives" (Bozeman & Boardman, 2013, p. 88). Instead, academic entrepreneurship enhances faculty connections with the industries, which provides unique advantages for the students of these faculty members to obtain jobs and internships in these industries (Cutrer, 2005; Ponomariov, 2009; Winfield, 2005). Cutrer (2005), Winfield (2005), and Ponomariov (2009) examined faculty industrial engagement and found a positive relationship between university-industry interactions and student internship outcomes. They argue that entrepreneurial faculty are not beholden to industrial interests at the expense of teaching or education of students. Rather, faculty involvement with entrepreneurship has a positive influence on diversifying their student career options, which, potentially, could lead to an increase in student human and social capitals. Lin and Bozeman (2006) analyzed 443 curricula vitae of personnel affiliated

with NSF and DOE-sponsored research and found that faculty with industrial experiences support more PhD students throughout their careers than their colleagues with no industry experience.

There is also evidence that faculty participation in entrepreneurship can benefit student learning (Mars, 2006). Lin and Bozeman argued that student placement after graduation can increase significantly because of faculty linkages with industry, and, therefore, colleges and universities, they argue, should encourage faculty to engage in these activities even at the expense of a potential tradeoff with faculty leisure time.

As indicated above, literature on academic entrepreneurship has concentrated on its effects on research and teaching in the university. However, research and teaching are not the only roles that the university present to society—although they are acknowledged as the primary ones. Service is also an important role of the university to demonstrate their social value to society (Audretsch, Aldridge, & Oettl, 2006). The faculty service role often includes internal committee work and external service work to their professional associations or the community (AAUP, n.d.). In the area of faculty service, there is little or no scholarship on the influence of academic entrepreneurship on the service role of university faculty. This has led to an omission in the literature and resulted in scholarly neglect of the importance of the service role in the university as well as a weak tie between faculty participation in entrepreneurial activities and faculty commitments to service roles.

Entrepreneurial Identity of Faculty

The third and final cluster of the literature focuses on the traits as well as identities of faculty who are engaged in the entrepreneurial process. Mainly, this cluster in the literature examines characteristics of faculty entrepreneurial traits that propel them to engage in entrepreneurial activities. This literature builds upon the research on business entrepreneurs and extends and applies this literature to the academic environment to explain faculty entrepreneurs' behaviors.

The literature on entrepreneurial identity has identified several traits of entrepreneurs and the traits that make entrepreneurs among business entrepreneurs (Kerr, Kerr, & Xu, 2018). In general, business entrepreneurs have high aspirations for wealth, independence, and recognition (Brandstatter, 1997; Hornaday & Aboud, 1971). They are also found to be less agreeable, less neurotic, more open to experience, more extroverted, and more conscientious than non-entrepreneurs (Zhao, Seibert, & Hills, 2005). Entrepreneurs are often self-motivated in their approaches to work related activities and ambitious enough to take risks to grow businesses (Shaver & Scott, 1991). Although it is not entirely clear to researchers whether individuals with a given set of personality traits gravitate to entrepreneurship or whether the traits are developed endogenously by individuals after they become entrepreneurs, there is consistency across disciplines that demonstrates several personality traits that distinguish entrepreneurs from non-entrepreneurs. These traits include: (1) value a networking culture; (2) emphasize technological innovation and risk-taking; (3) opportunity seeking and driven by customer inclinations; and, (4) work as all-encompassing (Gill & Larson, 2014).

Apart from the literature that addresses these entrepreneurial traits, there are also studies that examine the construction process of an entrepreneurial identity under a social setting. An entrepreneurial identity is more than psychological traits but the "situated experiences" of individual entrepreneurs as well as the "meaning-making process" embedded in entrepreneurial activities (Gill & Larson, 2014, p. 522; see also Hjorth & Steyaert, 2004). Entrepreneurial identity is thus constructed in conjunction with "societal influences and the existing environmental conditions" (Clarke & Holt, 2010, p. 81). Individuals' educational experiences, together with their use of narratives, tacit knowledge, and reflections on their entrepreneurial experiences, all support entrepreneurial identity construction. Therefore, to become entrepreneurial means that individuals construct an entrepreneurial identity, where entrepreneurial values and motivations are incorporated into individuals' perceptional system (Ollila, Williams-Middleton, & Donnellon, 2012). Jain, George, and Maltarich (2009) investigated the role identity of faculty who are engaged in patenting and licensing processes. They found that these faculty adopted a hybrid role identity to make sense of their commercial behaviors. This sensemaking process of faculty to justify their involvement in commercial activities, however, is dependent largely upon the context of the institutions (Louis et al., 1989; Stuart & Ding, 2006). Faculty modified their roles based on their participation in commercial activities and added a commercial element onto their academic roles. Thus, a hybrid role identity was manifested in the perceptions and practices of these faculty, ranging from pure scientists, who adhered to Mertonian norms and focused on publications, to pure entrepreneurs, who possessed a business orientation. For faculty to

manage such a hybrid role identity, Jain et al. (2009) found that faculty would restrain themselves from entrepreneurial involvement to ensure that their academic persona was central to their professional identities. This required these faculty to delegate some entrepreneurial activities to their graduate students to ensure that academic activities and values were not compromised as a result of their entrepreneurial involvement.

In line with the research on the role identity of faculty entrepreneurs, Obschonoka, Goethner, Silbereisen, and Cantner (2012) examined the identity of faculty inventors at universities and found that scientists with low group identification rationalized their entrepreneurial intentions not so much on social norms and attitudes but more so on their self-initiatives. Among scientists with high group identification, entrepreneurial intentions were a function mainly of social norms. That is, self-identity and social norms work together in developing scientists' entrepreneurial intentions as well as attitudes.

Socialization and story-telling abilities are also identified as important means for individuals to construct an entrepreneurial identity through their entrepreneurial activities (Ollila et al., 2012). Socialization enables individuals to build a collective identity that is shared by other entrepreneurs and thereby forms a community. Entrepreneurs, by socializing with other entrepreneurs and stakeholders, engage in a specific discourse and function under norms of their entrepreneurial community. Story-telling refers to a narrative that individual entrepreneurs create based on their entrepreneurial experiences. They use these narratives of their entrepreneurial experiences to construct an entrepreneurial self that reflects their entrepreneurial motivations and goals. Through

these narratives they are able to persuade relevant stakeholders to their projects (Ollila et al., 2012).

Entrepreneurs also socialize with other entrepreneurs, share norms, and learn acceptable behaviors from one another (Ollila et al., 2012). In this socialization process, entrepreneurs establish and present, or enact an entrepreneurial self to others. Usually, the entrepreneurial self is enacted in specific situations, such as business meetings or fundraising events, with other entrepreneurs. Based upon the scholarly literature, whether or not this socialization process is applicable to faculty entrepreneurs is inconclusive.

If university faculty also build their entrepreneurial identities through socialization with other entrepreneurs and narratives about their entrepreneurial experiences, then this might explain entrepreneurial faculty's professional identities, which may be a combination of academic professional identities and entrepreneurial identities (Levin et al., 2020). In this regard, literature on entrepreneurial traits as well as the construction process of an entrepreneurial identity can serve as a framework to examine the perceptions of faculty entrepreneurs about their entrepreneurial experiences and construction of identity. Questions remain on what rationales faculty entrepreneurs rely on to integrate two identities—academic and entrepreneurial—in a hybrid role identity.

Gaps in the Literature

Notwithstanding that scholars' concerns over data withholding and increased secrecy have merit, the claims that academic entrepreneurship is responsible for elevated levels of secrecy in the scientific community are under-investigated (Shibayama, 2010).

There is a methodological issue with reliance, exclusively, on survey data, since the survey results could vary significantly from one another depending on the samples of faculty members or the sampling fields, as well as the participating institutions.

There is also limited research that examines the effects of USOs on academic research. In particular, although USOs have become a preferred form of technology transfer among colleges and universities (Lockett, Siegel, Wright, & Ensley, 2005), there might be a tradeoff between the creations of USOs and faculty research performance. Furthermore, although there is the suggestion that there is a potential shift in the scientific norms from open science to commercial science, as a consequence of increased entrepreneurial activities among faculty, there is no conclusive evidence to demonstrate how and why these norms could be at risk.

Questions remain on if and the extent to which faculty engagement in academic entrepreneurial activities influences their teaching and service roles at universities. Specifically, the ways in which these activities shape faculty's understandings of their academic professional roles and their motivations for both their academic and entrepreneurial work are undocumented. Moreover, faculty may not be the sole actors who carry out entrepreneurial activities at universities; undergraduate and graduate students may also have a modest or even prominent role. Mars (2006) suggests that there are new actors who have entered the field of academic entrepreneurship. Faculty perceptions and understandings of teaching and their work with students may lead to clarity on other entrepreneurial actors in the university. What is certainly absent in the scholarly literature are the perceptions of entrepreneurial faculty on both their own

entrepreneurial development and their motivations as well as on the development and motivations of other university entrepreneurial actors, particularly students.

Theoretical Frameworks: Institutional Theory and Identity Theory

Institutional theory (DiMaggio & Powell, 1983) provides one framework for the explanation of institutional behaviors and has potential to illuminate the rationales of entrepreneurial university faculty for their entrepreneurial activities within their role as university faculty. Identity theory (Burke & Stets, 2009) provides another framework for the explanation of entrepreneurial university faculty's construction and maintenance of a specific identity, which may be a hybrid identity that combines an academic professional identity and an entrepreneurial identity or two separate identities: academic and entrepreneurial.

Institutional Theory

In examination of the behaviors of public universities, institutional theory is often employed by scholars to capture the formation of new organizations at the macro-, meso-, and micro-levels (Cai & Mehari, 2015; Meyer & Rowan, 2006; Morphew & Huisman, 2002; Powell & Colyvas, 2010). Specifically, in academic entrepreneurship literature, institutional theory occupies a prominent role for the explanation of the interactions between institutional environments and individual actors and the ways in which institutional contexts influence individuals' behaviors, norms, and understandings (Klingbeil et al., 2018; Powell & Colyvas, 2010). Institutional logic, an important component derived from institutional theory, refers to those guidelines that inform institutional members, particularly faculty, about behaviors that are appropriate,

legitimate, and encouraged (Thornton & Ocasio, 2008). In this investigation, I employ institutional logics, specifically the logic of academic professionalism (Brint, 2018; Levin et al., 2020) and the logic of entrepreneurship (Brint, 2018; Etzkowitz, 2013), to explain the work and behaviors of individual faculty and the influence of their surrounding institutional environment on their behaviors.

When a new activity, such as a new technology or a new organizational system, first arrives in an institution, it brings, potentially, new values and behaviors to the institution. These new activities can create tensions or even conflicts with the existing values and structure of the institution. Typically, institutions will undergo a process of value infusion, where the logics of the new activities are infused into the existing institutional structure and upon its institutional members. This process of value infusion and gaining authority is referred to as *institutionalization* (Clark, 2017; Parson, 1956; Selznick, 1943, 1948).

Institutionalization often involves conflicts with existing activities at the organization, and such conflicts can lead to a condition of uncertainty in daily operations (Meyer & Rowan, 2006). If the conflicts are resolved, the tensions between the new activity and the existing structure dissipate, and the new activity becomes integrated into the existing rituals of the institution; otherwise, the new activity is rejected. To accept or reject the new values and behaviors is to follow institutionalized rules and shared goals of the institutional members and see if the new values and behaviors fit the overall institutional culture and environment. Some scholars have described this process as "rational theory of how" (Meyer & Rowan, 2006, p. 341), that is a way to explain how

certain rules and institutional goals are formed and why certain behaviors got accepted. Once institutionalized, the new behaviors are thus considered as legitimate, part of the routine, and taken for granted by institutional members. In essence, institutional theory explains how institutional norms are created, maintained, and abandoned in the process of seeking for legitimacy

In higher education, the rules, policies, and norms that colleges and universities live by are institutionalized (DiMaggio & Powell, 1983). These are created to fulfill demands of the external environment as well as guide faculty, staff, and students' behaviors. The higher education institutions are also *isomorphic* (DiMaggio & Powell, 1983), where the institutionalized rules and policies are similar across institutions in higher education. Once a policy or an activity becomes institutionalized at prestigious, leading universities, other universities will follow. By following behaviors of the leading institutions, other universities gain legitimacy (DiMaggio & Powell, 1983). For example, Colyvas (2007) examined and explained the institutionalization process of technology transfer practices in the life science department at Stanford, and Colyvas and Powell (2007) demonstrated that the adoption of technology transfer practices at Stanford led to numerous technology transfer activities in higher education, which spread from elite institutions, such as Stanford, to other universities. Gradually, since the 1980s, universities shifted their attitudes towards technology transfer of academic science from "vulnerable to venerated" (p. 219).

Within the university, however, the symbolic system of that university can vary by departments and fields (Clark, 1987). The culture and rituals of each department

influence the pace at which and the likelihood that the department will conform to the institutionalization of a new activity, either imposed by the university or external forces. For example, although government and funding agencies have encouraged technology transfer and commercialization at universities (Rasmussen, 2008; Wright et al., 2007), Engineering departments acceded to entrepreneurial expectations in full and Biology departments accepted these encouragements in part (Kraatz & Block, 2008). Other departments resisted and avoided participation in entrepreneurship, for example, Humanities (Besharov & Smith, 2014; Schildt & Perkmann, 2017). In the same vein, Stanford and MIT embraced academic entrepreneurship and normalized entrepreneurial behaviors among its faculty members, while other universities, such as Johns Hopkins University, practice entrepreneurship modestly (Brint, 2018). Conformity to the institutionalization of entrepreneurship is shaped by disciplinary areas and by a university's environment and culture. That is, academic entrepreneurship may be confined to particular disciplinary areas and within specific universities and their environments, and practices may differ based upon disciplinary areas and universities.

Institutional Logics

Originating from the institutional theory, the concept of institutional logics explains the rationales for institutional members to adopt institutional behaviors and conform to institutional rules (Thornton & Ocasio, 2008). Jackall (1988) posits that institutional logics are "a contingent set of rules, premiums, and sanctions" to which individuals within the institution need to conform (p. 112). Friedland and Alford (1991) define institutional logics as a set of "material practices and symbolic principles" (p. 248)

that provide actors within the institution the vocabularies, the motives, and a sense of self (i.e., identity). Building on these two definitions, Thornton and Ocasio (2008) conceptualize institutional logics as "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality" (p. 101). Hence, institutional logics are both the regulations and cultural assumptions of the institution (Thornton & Ocasio, 2008). Institutional logics are manifested in the interests, identities, values, and perceptions of individuals through institutionalization (Powell & Colyvas, 2010), and guide the individuals to evaluate and align their behaviors with their environments.

There can be several institutional logics coexisted in an institution to guide institutional behaviors (Gumport, 2000; Thornton & Ocasio, 2008). These institutional logics can work together or separately to serve as "a template for action" (Bastedo, 2009, p. 211) as well as a pattern where "a set of structures and systems…consistently embod[y] a single interpretive scheme" (Greenwood & Hinings, 1993, p. 1053). Institutional logics are thus principles and values that institutions use to justify institutional actions and behaviors as well as guide future strategies. However, among the different institutional logics, there is a hierarchy: some institutional logics serve as the dominant logics that override the others, particularly in decision-making in conflicted situations. The dominant logic provides legitimacy to actors within the institution. For example, if the actors' actions are well aligned with the dominant institutional logics, these actions gain legitimacy and can lead them to institutional resources, autonomy, and

power (Meyer & Rowan, 2006). Conversely, if their actions are not aligned with a dominant logic of the institution, individual members either act to negotiate with their institution or abandon their behaviors in order to maintain their institutional membership (Giddens, 1984; Thornton & Ocasio, 1999). In short, an institutional logic is more than a motivator of actions: institutional logic justifies action. By conforming to institutionalized rules and rituals, institutional members gain both legitimacy and resources.

Higher education institutions are guided by multiple co-existing institutional logics (Bastedo, 2009; Brint, 2018; Gumport, 2000; Levin et al., 2020). For example, scholars have identified that colleges and universities are guided by a logic of social inclusion that encourages students from historically underrepresented groups to participate in educational activities and pursue a higher education (Brint, 2018). Others found that there is a logic of the market that promotes revenue generation activities in the university, as well as the adoption of business strategies in managing higher education institutions (Gumport, 2000). Community colleges and four-year institutions alike are found to incorporate a neoliberal logic in their institutional behaviors that justify institutional engagement in the marketplace (Levin et al., 2020). Of all these institutional logics, there are two primary institutional logics that govern faculty work and faculty behaviors. These two logics are the logic of academic professionalism (Brint, 2018; Levin et al., 2020) and the logic of entrepreneurship and innovation (Brint, 2018; Etzkowitz, 1998, 2003).

The logic of academic professionalism refers to a system that governs and organizes faculty work in the university as well as a logic of actions that justify faculty behaviors (Boyer, 1990; Brint, 2018; Clark, 1987; Levin et al., 2020). University faculty are seen as academic professionals who have gone through rigorous academic training, have expertise in their subject areas, and are trusted to set up their own work agenda and conduct independent work (Levin et al., 2020). As academic professionals, faculty devote their expertise to teaching and research, as well engage in peer reviews for journal articles, community-based research, service learning, and service activities abroad (Becker, 1998; Boyer, 1990). For example, faculty in medicine, law, or psychology can maintain private practices; engineering faculty can provide consulting to firms and companies on a contractual basis. Under the logic of academic professionalism, faculty's work is governed and organized by their professional associations, as well as their institutions, and depicted by faculty conformity to professional norms and ethics (Brint, 2018; Clark, 1987). As Clark (1998) states, the academic profession is based upon norms and values from the discipline, the institution, the national system, and the academic profession at large. The discourse of university faculty is hence shaped by their departmental environments and their universities, as well as their peers in the international professional community who share the same research interests. Brint (2018) describes academic professionalism as a system that governs the core functions and missions of higher education institutions and facilitates the inter-relationships between the university and its stakeholders, such as the government, students and families, and the society at large. Under this system, colleges and universities are sorted into several

divisions, based on the highest degree that the institution awards, the level of selectivity in the institution's admissions, and the institutional type, such as whether its governance control is public, private, and nonprofit or for profit. In particular, the research university occupies the top tier in the divisions that award doctorate degrees, has higher selectivity, and produces more than 80% of published research and articles. The core functions of the research university are acknowledged widely to generate knowledge as well as to educate talented students in different professions and transport them to economic and knowledge sectors and industries. Faculty work in the research university is thus oriented to fulfill these functions through faculty participation in research, service, and the education of students.

Although faculty work is set to fulfill the functions as well as meet the expectations of their universities, the quality of faculty work is not judged or evaluated by the leadership of their universities. Rather, university faculty are experts in their professional fields whose work quality is governed and evaluated by other faculty or professionals who share the same research interests in their fields (Brint, 2018). Because university faculty have gone through rigorous academic training and possess expertise knowledge, faculty work is evaluated effectively by others who have experienced similar training and are able to understand the specific domain of knowledge. In this regard, the academic profession is a relatively close and self-perpetuating system, where university faculty "develop their own incentives and their own forms of cooperation around the subject matter and its problems" (Clark, 1987, p. 381). In the system of academic professionalism, university faculty are also oriented to solve problems in their

disciplinary fields and share their research results through conferences and journal and book publications with their professional communities. In this regard, university faculty are also members of their professional associations who are subject to the norms and values that are shared within their communities. In essence, faculty work is oriented to "advance knowledge, not to serve society or the economy" (Brint, 2018, p. 32). Although Brint contends that faculty work is not completely detached from social and economic implications—university research can generate both knowledge and economic spillovers—he argues that academic professionalism prioritizes faculty work to focus more on the former than the latter. The ethos of academic professionalism thus lies in knowledge generation and advancement, and any other activities should be placed in subordinated and supporting roles.

Within the system of academic professionalism, there are also different subcultures of disciplines that depict faculty behaviors. In Science, Technology, Engineering, and Mathematics, Technology (STEM) fields, faculty work has been depicted and oriented by Merton's descriptions of scientific norms for decades (Greenwood, Díaz, Li, & Lorente, 2010; Stuart & Ding, 2006). Mertonian norms are *communalism, disinterestedness, universalism,* and *organized skepticism* (Merton, 1954). Communalism indicates that science should be open to encourage exchange of ideas among scientists so that they are able to build upon each other's work to advance science. Universalism indicates that science should be evaluated only on its merits: other demographic factors, such as race, gender, and ethnicity, should not be considered in, or affect, the evaluation of the quality of science. Disinterestedness means that science

should not be disturbed or hindered by commercial interests or political influence, because science needs to have a monetary-disinterested role in order to provide an independent voice in society. As such, a scientist's mission is to expand and advance human knowledge in an open and communal way; and by sharing discoveries within the scientific community, scientists are rewarded by peer recognition of their scientific work and merit (Merton, 1954). As such, faculty research should not be constrained by market forces on economic contributions. Neither should faculty align their intellectual pursuits with a private market agenda for any personal gains or financial benefits. Instead, Merton addresses the independence, academic freedom, and autonomy of the academic work of faculty, and, in turn, notes that faculty should be disinterested from any commercial pursuits of their research so that they are able to provide an independent voice in and judgement of society. Therefore, under the system of academic professionalism, STEM faculty work has been oriented towards publications and knowledge generations, as well as serving in an independent role and conducting monetary-disinterested research in society.

Levin et al. (2020) described the logic of academic professionalism as an identity that is derived from "the personal attributes and history of individual faculty, their self-categorization as an academic, their adherence to both role expectations as well as socially accepted behaviors" (p. 6). This academic professional identity is reflected in the ways that faculty perform their daily work and is embedded in faculty perceptions of research, education, and institutional and academic cultures. In this regard, faculty's self-ascribed identity, their perceptions of research, and their discipline affiliation are major

components in the academic professional identity of tenure track faculty. Drawn from evidence that combines individual level analysis as well as standard norms from group identity, Levin et al. (2020) suggested that faculty interpret their prior and present socialization, past experiences, and expectations from their current institutional and social environments, and make justifications for their work behaviors. In particular, Levin et al. address the role of personal experience in the construction of the professional self and note that academic professionalism is more than just an outer "organizational self" but also an inner professional self (p. 18). Academic professionalism defines faculty's code of conduct and assists faculty interpretations of social and institutional expectations, as well as informs faculty actions and work.

In addition to the logic of academic professionalism, scholars have also observed a new institutional logic in the university—the logic of entrepreneurship and innovation (Brint, 2018; Etzkowitz, 2003). If the logic of academic professionalism defines a closed system that is controlled and governed by professionals themselves and professional associations, the logic of entrepreneurship and innovation advocates for a more open system that stresses the connections between the university, the faculty members, and outside entities. The logic of entrepreneurship and innovation arises in the contemporary era when there has been an increased emphasis on technological innovation to drive economic growth. Because of this emphasis on technological innovation, the logic of academic professionalism, however, is under attack for defending the relevance of academic research (Brint, 2018). There have been increased demands from legislators, policy makers, and the public for academic research to have practical implications for

society and commercial applications in the marketplace (Audretsch et al., 2006; Mowery et al., 2004). Thus, the logic of entrepreneurship and innovation is centered on the connectivity and relevance of faculty research to the marketplace (Brint, 2018; Etzkowitz, 2000). Brint (2018) described the logic of entrepreneurship and innovation as a system of academic innovationism—a complementary and sometime competing system to the system of academic professionalism (Brint, 2018). In line with market logic (Gumport, 2000), academic innovationism focuses on applied research and the commercial potential of the research. In order to foster entrepreneurship in the academy, funding agencies have sought to add a component of research commercialization to the already established Mertonian norms of science (Fini & Lacetera, 2010; Vallas & Kleinman, 2008). As such, faculty research is oriented largely to funding availability and market controls. In addition, in the system of academic innovationism, new organizations and departments are created to support faculty engagement in entrepreneurial and innovation activities in the university. The new organizations and departments have also brought a new set of rules, norms, and cognitions that foster research commercialization and entrepreneurship by engaging faculty in patenting and licensing, cooperative research with industries, and creation of USOs (Audretsch et al., 2006; Powell & Colyvas, 2008). Etzkowitz (1998, 2003) has named this new set of norms as the entrepreneurial norm that is different from Mertonian norms in the scientific community.

Etzkowitz (1998, 2003) argues that the emergence of these new entrepreneurial norms is a result mainly of the formation of *the entrepreneurial university*, which has led to changes in the structure of faculty work in the academic profession. The

entrepreneurial university plays a prominent role in the *triple helix* (Etzkowitz, 1998)—the interactions between universities, governments, and industries—and is more connected with the external environment through bilateral or trilateral networks. In the entrepreneurial university, faculty work is primarily guided by the logic of entrepreneurship and innovation, where faculty are encouraged to participate in economic activities that are beyond traditional research, teaching, and service work. The model of the entrepreneurial university also emphasizes a "managerial core" (Clark, 1998, p. 2), where the management in the university is strengthened to achieve more efficient and effective performance. There is also a trend of professionalization of staff and management, where new organizations, such as a Technology Transfer Office, are created and recruit professionals to facilitate economic activities of the university. Nonetheless, the adoption of the logic of entrepreneurship to justify commercial activities on campus enacts a business protocol among university faculty—faculty use of words or symbols that are borrowed from the private sector and the marketplace (Powell & Colyvas, 2010). Faculty language and vocabulary shift to align with those of their business counterparts in order to engage in dialogues of commerce and achieve mutual understandings of their commercial behaviors and norms (Powell & Sandholtz, 2011). Faculty are more inclined to protect their intellectual properties and participate in patenting and licensing activities (Etzkowitz, 1998). As such, under the logic of entrepreneurship and innovation, the entrepreneurial model of the university is enacted, and the economic mission of the university is emphasized. The role of the university in the triple-helix is strengthened and becomes more prominent.

Despite the dramatic distinctions between the above two logics, these two logics may not be entirely incompatible. A group of scholars has argued that the logic of academic professionalism and the logic of entrepreneurship and innovation are conflicted in their guidance of the conduct of research in the university (Sauermann & Stephan, 2013). Other scholars instead argue that the two logics work together to guide faculty behaviors in the academic sector and that conflicts are reconcilable (Bastedo, 2009; DiMaggio & Powell, 1983). For example, historians of science observed that science and commerce are two main guidelines for scientific departments and they found a co-evolution of the two logics in the university, with overlapping features between the two (Rosenberg, 1982; Stokes, 2011). Greenwood et al. (2011) state that "academic science departments…function in a context where the logics of science and the logics of commerce are both in play" (p. 318). Thus, although these two logics—science and market— prescribe competing behaviors, such as publication and academic patenting, they work together to provide ways to explain complexity and changes within the university.

When the world of business and the world of science are brought closer together, the conduct of research is also blended with business values and entrepreneurial norms (Hackett, 1990; Sauermann & Stephan, 2013). Then the prominence of the two institutional logics in the university determines how the institution reacts and this reaction can vary by institution, by discipline, and, more importantly, by individual (Greenwood et al., 2011). The enactment of an institutional logic can thus depend upon not only the institutional context but also individual faculty's interpretation and internalization of their

institution's logics. Although scholarly research on academic entrepreneurship shed some light on this potential, there is insufficient explanation for why and in what ways scientific research norms might change or have changed in the university, including whether or not faculty perspectives are consistent in relation to the entrepreneurial norms and scientific norms across disciplines and institutions.

Identity Theory, Institutional Logics, and Institutional Theory

An identity is a set of meanings that define who a person is in terms of their roles (role identities), group or category memberships (social identities), or as unique individuals (personal identities) [Burke & Stets, 2009; Stryker & Burke, 2000). These meanings are attributed not only by the individual but also by others, and these meanings can influence the individual's behaviors (Gee, 2000; Stryker & Burke, 2000). The core of an identity is therefore "the categorization of the self as an occupant of a role, and the incorporation into the self" (Stets & Burke, 2000, p. 225). Under this categorization, individuals internalize the meanings and expectations that are associated with a category and behave accordingly. In this way, individuals who belong to one category or one group have shared identities that contain common values, beliefs, norms, and understandings of experience.

A person who sees him/herself as an entrepreneur will have shared identity standards of other entrepreneurs. Their entrepreneurial behaviors can be met with ambivalent responses from those in their social, professional, and familial environments (Burke & Stets, 2009). Faculty internalize the responses they receive from others and interpret these as positive, negative, or mixed. Positive feedback is likely to reinforce

entrepreneurial behaviors. However, it remains unknown whose and what feedback entrepreneurial faculty use to gauge their entrepreneurial views and behaviors. It is important to note that faculty may need to either adjust their entrepreneurial activity or leave the institutional environment if they do not receive positive feedback. Therefore, changes in the institutional environment (or in the identity groups of those who inhabit that institutional environment) can strengthen or weaken an entrepreneurial faculty member's group identity, which could in turn affect that individual's commitment to the group.

Identity theory explains how individuals' perceptions and values are shaped by their social, cultural, and economic structures, and, in turn, influence their construction of identities and the ways they behave under different circumstances (Bothma, Lloyd, & Khapova, 2015; Burke & Stets, 2009). Identity theory indicates that humans have a fundamental need for self-definition and for finding their own place in society (Mead, 1934; Tajfel, 1972). While institutional theory claims that individuals' identities are re-constructed under the process of institutionalization, identity theory perceives individuals' identities as an outcome of negotiations between individual perspectives and the values and norms set by the environment (Lok, 2010). Hence, identity theory is useful in providing theoretical links between individual identity and institutional logics. When there are conflicts between individuals' perspectives and their institutions' dominant logics, in order to behave in ways that are consistent with their identities, individuals need to either modify their categorizations of the self or change the environment surrounding them (Powell & Colyvas, 2010). However, if they fail to make these

modifications of either their identities or their environments, their ties with the institutions are dissolved, and they will leave the institution (Powell & Colyvas, 2010). Studies on individuals' identities can reveal how individuals justify their behaviors within the institution and how individual actors' behaviors can in turn enhance the institutional logic or logics that are aligned with them (e.g., Lok., 2010; Powell & Colyvas, 2010).

Identity construction on the individual level is subject to a number of sensemaking and verification processes (Burke & Stets, 2009). To act and justify their actions, individuals make sense of their behaviors by aligning their behaviors with either their internal motivations or external expectations (Powell & Colyvas, 2010). In addition, individuals seek verification from others on their identities. When the perspectives or the behaviors associated with a certain identity are verified by others, this identity is likely to maintain a prominent role in guiding their behaviors; if their perspectives are not verified, individuals are likely to adjust or abandon their behaviors in order to obtain verification. The outcomes of constructing an identity within an institutional context can thus be seen as the outcome of a personal compromise, or a temporary truce with the environment, until one's identities are aligned with their identifications with a particular logic (Lok, 2010). Although it is often assumed that institutional members simply adopt or maintain the identity that is deemed most appealing or resonant for their institutions (Lok, 2010), there are other forces that provide legitimacy for individual behaviors and enable individual behaviors outside the dominant logics of their institutions (Powell & Colyvas, 2010).

Several studies that draw upon institutional theory have examined the ways that individual actors construct or reconstruct self-identities when a new institutional logic enters their institution (e.g., Thomas & Davies, 2005). These studies point to an interaction between the individual identity and the logics of their institutions, where individual identity is derived from individuals' participation in multiple discourses within the institution. Identity then shifts and evolves continually: Individuals' identities are not fixed or stagnant but are discursive and change within the institutional environment.

Because there are competing institutional logics that act upon individuals in the institution, the relationship between institutional logics and identities of institutional members is contingent upon the institutional context and environment (Lok, 2010). Identity can thus be seen as the institutional notion of who or what any social actor might or should be in a particular institutional context, and, by implication, how the actor should act. Because identity and behaviors are closely linked (Burke & Stets, 2009), the construction of an identity in response to a particular institutional logic involves the attainment of institutional legitimacy and institutional support for that identity (Lok, 2010), as well as individual sensemaking for the behaviors based on that identity (Powell & Colyvas, 2010).

Identity and institutional theory and literature lead me to formulate the idea of faculty dual roles in both their academic and entrepreneurial work. Specifically, the construction of entrepreneurial identity may not be compatible with faculty's academic selves, which could create a breach in their academic identities and lead to misalignment between their values and their behaviors. Yet, how faculty entrepreneurs bridge the

differences between the entrepreneurial identity and academic identity is not explained in the scholarly literature. It is likely that the misalignment of faculty identity and behaviors would require a modification of faculty's behaviors or values, on the one hand, and balancing strategies to maintain control over their multiple roles. on the other hand. Identity theory is thus employed to explain how the construction of entrepreneurial identity is consistent with, if at all, faculty academic goals and academic values.

Research Questions

There are three research questions that guide this study.

(1) What are the entrepreneurial motivations of faculty participants?

(2) How and in what ways does academic entrepreneurship shape faculty understandings of their academic roles in research, teaching, and services?

(3) How is a balance obtained, if at all, between faculty entrepreneurial role sand their academic roles?

Chapter III METHODS AND METHODOLOGY

Introduction

In this chapter, I describe the research methodology and methods that I utilized for the investigation of academic entrepreneurship. First, I provide the methodological orientation of the investigation as well as the worldview that guides the construction of my research design (Creswell & Creswell, 2017). I then provide the rationales for my choices of research methods, including a description of the research settings as well as approaches to data collection and data inquiries. After detailing the procedures of data collection, I explain the strategies that I employed to analyze data, as well as to ensure the trustworthiness of this investigation. At the end of the chapter, I also provide a discussion of the limitations of the investigation.

Methodological Approach

In line with previous work on institutional theory that offers interpretative accounts of the institutionalization processes, I deployed a qualitative methodology to explore the situated experiences of individuals within an institutional setting, and I addressed the embodiment of individuals' perspectives and perceptions based on their shared "socio-linguistic meanings" (Lok, 2010, p. 310). Qualitative research is situated in "interpretive, material practices" (Denzin & Lincoln, 2005, p. 3) and is particularly useful to explore new ways or new perspectives for specific phenomena. Through the collection of in-depth data on individuals' lived experiences, qualitative research reveals how people attribute meanings and perceive the natural settings around them (Miles & Huberman, 1984). In this way, qualitative researchers are able to explain social or human

problems in a more comprehensive way and with more detailed information from the accounts of individuals and groups within the phenomenon (LeCompte & Schensul, 1999). In the process of a qualitative inquiry, the researcher acknowledges not only the context in which the phenomenon occurs but also the meanings derived from individuals' experiences with or within the phenomenon. As such, I employed a qualitative methodology with an interpretive approach to uncover the experiences of individuals in the context of academic entrepreneurship. In this way, I was able to be reflexive in the interviewing process and explain faculty perceptions based on theories.

Reflexivity is particularly important within a qualitative orientation (Crabtree & Miller, 1999; Silverman, 2000). Reflexivity refers to recognition of the influence a researcher brings to the research process. It highlights potential power relationships between the researcher and research participants that might shape the collected data. Given that the topics of this dissertation could be sensitive to some faculty participants, I was careful in my approaches to the interviews because I did not want to imply any negative intent from me concerning their entrepreneurial behaviors. In this way, I wanted to ensure that faculty participants were not defensive about their entrepreneurial behaviors. As a graduate student researcher, I employed extensive probing to ensure that I captured comprehensive and relevant information. Therefore, I reviewed faculty profiles on their university websites, as well as information related to their spin-off firms, prior to the interviews. In this way, I prepared myself with faculty background information so that I could ask questions regarding their entrepreneurial involvement accordingly. The results of the interview are based solely on the faculty participants' understanding of their

situations (Merton, Fiske, & Kendall, 1990). As a researcher, I remained neutral in my attitudes towards faculty engagement in university spin-offs. A qualitative interpretive research approach enabled me to maintain separation from my participants.

Academic entrepreneurship is a complex phenomenon, and those faculty involved in entrepreneurship could each interpret their involvement differently. An interpretive approach allowed me to draw upon interview data from individual faculty. In this way, I was able to capture themes not prevalent in the scholarly literature, as well as identify different perspectives of individual participants. In doing so, I could address any issues in faculty responses promptly to uncover lived experiences of and perspectives on academic entrepreneurship. I conducted an inductive analysis of data, and I reported faculty experiences and perceptions through the use of direct quotations from individual participants and included my interpretations of their perceptions.

Research Design

In this section, I provide a detailed overview of my research design. Because I was interested in exploring faculty perceptions of their professional roles in relationship to their entrepreneurial experiences, I chose an interactive approach to interviews (Maxwell, 2013). This interactive approach allowed me to be reflexive in the operationalization of every stage of the project (Maxwell, 2013). In this way, the data collection process and the data analysis function together simultaneously and influence one another. I was thus able to adjust my interview approaches and address any patterns and questions that arose in data analysis. Through this qualitative approach, I addressed individual experiences as well as the institutional context within which academic

entrepreneurship is nested (Creswell & Creswell, 2017). Maxwell (2013) suggests that the research design should address the different sets of issues that are essential to the coherence of a study.

The research design was guided by the research questions. Data were collected from 40 interviews with faculty entrepreneurs across three University of California (UC) universities. These faculty entrepreneurs all had their own startup companies or participated in spinoff firms within the university. In addition, I made several visits to the Entrepreneurship Centers at each campus and observed daily activities at the Centers. I also encountered Directors and many students affiliated with the Centers through casual conversations. Fieldnotes and anecdotal data from the Directors of academic entrepreneurship were collected and used to contextualize and triangulate the faculty interviews. The heart of my study, however, was the time I spent interviewing and interacting with faculty participants and their graduate students to capture their perceptions of the culture of academic entrepreneurship in their universities. My background in Education as well as my role as a doctoral student researcher enabled me to identify faculty perspectives in their responses, which they may take for granted, and compare their perspectives with their institutional policies and missions, as well as the Directors' views. In this way, by drawing upon these multiple sources of data, I intended to provide a detailed account of these faculty entrepreneurs' perceptions of their work in their universities as well to ensure the trustworthiness of the investigation (Creswell & Creswell, 2017).

Research Setting

I selected the University of California (UC) as the investigation site for three reasons. First, following Etzkowitz's definition of the entrepreneurial university (2003), I wanted to select universities that "have the abilities to both formulate academic goals and translate knowledge produced within the university into economic and social utility" (p. 296). More importantly, I aimed to select universities that are also at different stages of the entrepreneurial process. The UC system is the largest university system in the United States. It has unity in institutional policies regarding academic entrepreneurship yet differentiation in resources and support for faculty entrepreneurs on each campus. Second, since environmental factors, such as state economy and policies, can be influential to academic entrepreneurship at universities, it is appropriate for this investigation that all faculty participants work in the same state and conform to the same state policies. Thus, by selecting the UC as my site for investigation, I can minimize external influence imposed on faculty members and address the institutional differences that can shape faculty experience and perceptions. Third, the selected universities need to have established some equivalencies of Entrepreneurship Centers or have connections with Incubators to serve as the focal points of local and regional innovation ecosystems so that a technology transfer mechanism is established in the university. UC universities fulfill all of the above criteria and are therefore selected for this investigation.

To identify and distinguish different entrepreneurial stages of universities within the UC system, I categorized the UC universities based on the outputs of their entrepreneurial activity. I used three variables as indicators of the outputs of academic

entrepreneurship: the number of patents developed, the number of firms created, and the total revenue generated by technology licensing (Bozeman, Fay, & Slade, 2013; Powers & McDougall, 2005). I relied on the data from USTPO (2016) report on licensing revenues generated by UC campuses, as well as the UC reports on the economic impact of their campuses. USPTO (2017) reported that in year of 2016, UC Los Angeles (UCLA) generated (all the following figures are in thousands) $65,700 from licensing. UC San Francisco (UCSF) generated $30,297. UC San Diego (UCSD) is $16,361, UC Davis (UCD) is $13,513. UC Berkeley (UCB) and UC Irvine (UCI) generate, respectively, $9,873 and $7,994. UC Riverside (UCR) comes close to $5,130, UC Santa Barbara (UCSB) is $3,891, UC Santa Cruz (UCSC) is $267. According to UC economic impact report (2018), 1267 companies were created in the UC since 1980, and 511 are still active today. Of the 511 companies, there are 111 affiliated with UCLA, 46 with UCI, 10 with UCR. Consulting both reports, I grouped UCLA, UCSD, and UCSF as the high entrepreneurial universities; UCB, UCD, and UCI are the middle entrepreneurial universities; UCSB, UCSC, and UCR are the beginning entrepreneurial universities[6]. Geographically, UCLA, UCI, and UCR are all located in the Southern California and represent different entrepreneurial stage. Therefore, I chose these three universities as my study sites to recruit faculty participants.

For faculty participants, I recruited the specific individuals because they were in the departments of Computer Science and Bioengineering and they had participated in the

[6] UC Merced was not included in the USPTO report on utility patent grants, and according to the UCOP technology commercialization report (2016), UC Merced generated $0 dollars from royalty and licensing income. Therefore, UC Merced is not considered in the sampling pool for this investigation.

creation of university spin-off firms (USOs). The departments of Computer Science and Bioengineering are selected for the investigation because they generate the largest number of USOs in the selected UC universities. My selection of the sample fields of highly entrepreneurial engineering departments is not intended to be representative of U. S. universities or the full range of all disciplinary fields of study. Rather, I sought to provide insight into the nature and dynamics of the academic life of faculty entrepreneurs. In addition, the data from faculty entrepreneurs from the high entrepreneurial disciplines provide perspectives on the direction that academic entrepreneurship may be headed. In these highly entrepreneurial disciplines, the norms of academic entrepreneurship are in developed forms and come into sharp focus on the behaviors of faculty members. These particular faculty entrepreneurs' practices and priorities may represent a standard that faculty members in other departments may adopt to develop and execute their entrepreneurial practices. Furthermore, research in both Computer Science and Bioengineering have both theoretical and practical implications in research and the industry but with some distinctions. In this way, the distinct features of the two fields cover different dimensions of academic entrepreneurship, and thus make the two fields an interesting case for the investigation.

A list of faculty entrepreneurs in the three universities was identified from the websites of Entrepreneurship Centers. Entrepreneurship Centers facilitate technology transfer from the university to the marketplace and identifies commercial opportunities for faculty research. The Center has the information of all the entrepreneurial faculty and is possibly the best resource to identify these faculty within universities. The

entrepreneurial faculty information is typically available on the university website under the office of Research and Economic Development. Since the three universities selected in this study are all public institutions, this information is open to the public. After diving into the website of Office of Research and Economic Development at UCR, Office of Applied Innovation at UCI, and I created a list of faculty members who met the criteria of the sample selection from the three university websites. Then, I worked with the Entrepreneurship Center and Office of the President at the UC campuses to publicize my study among the entrepreneurial faculty. I sent interview invitation emails to every identified entrepreneurial faculty member on my list. I also used referral emails from the Directors to recruit faculty. If the faculty did not respond to my first round of emailing, I sent them a second email to follow up with the interview inquiry. After two rounds of emailing, I stopped reaching out to faculty who did not respond. The final sample of faculty consists of 40 faculty members from three UC campuses, ranging from Associate professors to Full professors (summarized in Table 3.1).

Table 3.1 *The Number of Faculty Participants*

Designation	**University**	**Department**	**N**
Faculty	UCLA	Bioengineering	5
		Computer Science	5
	UCI	Bioengineering	5
		Computer Science	5
	UCR	Bioengineering	10
		Computer Science	10
Director	UCI	Applied Innovation	1
	UCR	Technology Transfer	1
	UCLA	Technology Licensing	1
		I-Corp	1

Descriptions of the Research Setting. In providing a context in which this investigation was carried out, I describe the environment for academic entrepreneurship at the state level and the institutional level. The context for phenomenon is important in qualitative research. Here the context is three specific universities and the State of California. By addressing each university context for academic entrepreneurship, I aimed to illustrate the differences in university support for academic entrepreneurship and contextualize participants' behaviors and perceptions within their university environment. In this way, the descriptions of the research setting assisted my explanations of faculty perceptions and their balancing strategies towards academic entrepreneurship.

The State Context for Academic Entrepreneurship

There was an innovation initiative at the state level in California to incentivize academic entrepreneurships at universities in 2014. Assembly Bill 2664 on Innovation and Entrepreneurship Expansion appropriated $22 million dollars to the UC to stimulate the UC's capacity for innovation. With the support from state investment, UC established 30 new research centers and incubators to accelerate technology transfer (Bay Area Council Economic Institute, 2015). Under the innovation initiative, UC also implemented educational programs with a focus on entrepreneurial training for both faculty and students to develop skills and motivations to start new companies. In this regard, the state initiative has fostered numerous entrepreneurial-related supporting organizations and programs across UC campuses.

While a university's primary purpose is not to create companies—that role rests with its graduates—the state's macro-goals for economic growth provide imperatives for

the UC to translate their faculty research into economic drivers of its local communities (Bay Area Council Economic Institute, 2015). According to the UC report on economic impact (UCOP, 2016), UC developed approximately 1,300 companies and attracted an additional $9 million dollars from venture capitalists between 1968 and 2015. There were 93 startup companies created within the UC, which generated a total of $114.8 million. These UC affiliated companies spanned 12 fields, including the medical therapeutics sector, software and services, research tools, and electronic systems and components. Overall, Bioengineering and Computer Science are the two fields that developed the most affiliated startups. The companies and revenue generated represent the level of entrepreneurial engagement of UC in the state.

The Institutional Context for Academic Entrepreneurship

Although all the participating universities, UCLA, UCI, and UCR, conform to the same institutional policies and rules on academic entrepreneurship, the level of institutional support, as well as the opportunities within the campuses' surrounding environment, differ. UCLA established the largest entrepreneurial center and has the longest history of technology transfer among the three universities. The advanced level of academic entrepreneurship at UCLA can be seen as a result of its geographical advantages as well as its academic reputation. The UCLA campus is in close proximity to a large urban neighborhood of the Los Angeles area that attracts numerous investors, businesses, and resources to the community. Many bio-technology companies are clustered in the Los Angeles area, which provide business opportunities and industrial

access to UCLA faculty members. In addition, the establishment of a medical center enhances UCLA's medical research and thereby contributes to its academic reputation.

UC Irvine is located in Irvine, California, an area which is a center of consulting companies and firms and attracts many investors (UCI Applied Innovation Center, n.d.). The Applied Innovation Center was established in 2015 at UCI, with the aim to facilitate faculty and students' initiatives to entrepreneurship. The missions of the Applied Innovation Center are thus to encourage and facilitate faculty and students to participate in entrepreneurial activities as well as develop entrepreneurial and innovative projects (UCI Applied Innovation Center, n.d.).

UCR is located in Riverside County, California, where the average income of the individuals in the local community is approximately $35,000 per year, lower than the Irvine and Los Angeles areas (US Census, 2016). The beginning of technology transfer activities did not take off at UCR until 2015, when university leadership changed, and a new Vice Chancellor showed support for academic entrepreneurship. In addition, the Riverside region has also implemented several initiatives aimed at engaging the university in its surrounding community and serving the economic growth of the region. As such, academic entrepreneurship has become a legitimate activity on campus and is promoted to UCR faculty and students.

Institutional theorists (e.g., Greenwood et al., 2008; Powell & Colyvas, 2008; Thornton & Ocasio, 2010) note that institutional logics are reflected in the perceptions, sensemaking, and behaviors of institutional members. Through the examination of faculty perceptions and their sensemaking processes at the three universities, the present

investigation uncovers the different stages of the institutionalization of academic entrepreneurship at the micro-level and faculty sensemaking processes of their institutional logics.

Data Collection

The data collection process in this investigation follows Maxwell's (2013) structure of qualitative research design. Qualitative research relies upon multiple data sources. Maxwell (2013) suggests the use of an open and iterative approach to collect data. Thus, qualitative researchers can pre-structure their study but do not determine precise directions. Rather, qualitative researchers are flexible with directions and guided by the rationales and themes of their subjects. I followed this open approach to my data collection for this investigation. I first pre-structured the design by following the procedures for observation and fieldwork (Burgess, 1984; Brinkmann & Kvale, 2015; Mulhall, 2003; Seidman, 2013), including interviews with faculty and Director (although I did not use interview data from Directors as a primary source). I used an iterative approach to analyze the data during the data collection process. In this way, I was able to reflect on my data collection experiences and adjust my approaches during this process. By doing so, I developed themes based on my own reflections of the interviews, and I incorporated these themes in subsequent conversations with faculty. As a result, data analysis was cumulative.

Data Sources. Data were collected from two sources: (1) faculty interviews and (2) fieldwork that included reviews of university economic reports, mission statements and policies in each entrepreneurship center, observations of entrepreneurship workshops

and seminars at the Center, and conversations with Directors at Entrepreneurship Centers. Faculty interviews were semi-structured, and some of these faculty interviews continued through follow-up emails to clarify and confirm some of the interview questions with faculty participants regarding their responses during the interview sessions. Fieldwork was conducted at the three Entrepreneurship Centers through observation and informal conversations with Directors and students. Notes were taken during the conversations with Directors and throughout observations of entrepreneurship workshops and seminars. Below is a detailed account of how and why I selected these sources of data for this investigation.

A semi-structured interview format allows the individual researcher to address issues of the phenomenon of interest from the participants' views and be reflexive in the interviewing process (Brinkmann & Kvale, 2014; Kvale, 2007). Semi-structured interviews are particularly useful for exploring new and emerging patterns in participants' perceptions. The researcher is also enabled to immediately follow-up and clarification are important features of semi-structured interviews. I was particularly careful in my interview approaches because I did not impose any preconceptions on faculty participants. Nor did I want to take faculty words without further probing. Instead, I work with an interview protocol that contains a list of all the important questions that I needed to cover with the participants (Atkinson & Delamont, 2010; Holstein & Gubrium, 2003; Rubin & Rubin, 2011). The interview protocol includes simple descriptions of the questions that enables the researcher to move through different questions during the interview as she sees fit and check off questions as they are addressed through

conversation with the participants. Therefore, the interview protocol was constructed based on previous literature and findings from the literature, but also allowed followed-up questions with faculty given their own responses. In this way, faculty participants provided their responses to the research questions and therein elaborated their perspectives regarding specific questions.

Specifically, I adopted a dilemma analysis approach to interviews. Dilemma analysis is referred to as a qualitative analytical method that focuses on participants' reactions to specific situations that yield ambiguous answers—that is, dilemmas (Van Vugt, 1997; Van Vugt, Van Lange, & Meertens, 1995; Webb & Foddy, 2004). This approach can be used as a secondary method in a focused part of interviewing for researchers to obtain the core of the participant's "processes of thinking, assessing, valuing, and judging" (Marshall & Rossman, 2014, p. 128). Dilemma analysis was employed widely in developmental psychology and adapted in other disciplines for studies of complex phenomena and processes. For the present investigation, academic entrepreneurship can lead to dilemmas in faculty making decisions on various scientific issues. That is, faculty attitudes towards their choices in specific situations, such as publication compared to commercialization, can be ambivalent. Therefore, I employed a dilemma analysis approach during the interview process to explain how faculty entrepreneurs make decisions and justify their behaviors under certain hypothetical controversial situations. These hypothetical situations were created based on the controversial situations identified in the literature (see Chapter 2). Faculty were asked a set of questions about their approaches to controversial situations involved in academic

entrepreneurship, for example, how would they deal with secrecy involved in contracted research. This set of questions was followed by further probing on how they justify their approaches and decisions in these situations. By doing so, I uncovered the influence of academic entrepreneurship on faculty behaviors and sensemaking process in the university.

In addition to qualitative interviews, I conducted fieldwork at the Entrepreneurship Centers to triangulate data (Delamont, 2016). Fieldwork is particularly useful for educational research in that it allows researcher to examine social relations in which the research subject is embedded. This fieldwork enhances the researchers' understanding from initial entry into the field to the final write up of a report (Delamont, 2016). I visited the Entrepreneurship Centers several times throughout the data collection process to interview the Directors and to observe their events and workshops. I took fieldnotes when I interviewed Directors and paid attention to their descriptions of faculty entrepreneurs on their campus and how engaged their faculty entrepreneurs were with the Centers. There were also many workshops and social events on entrepreneurship created at the centers. I observed at these entrepreneurship workshops and noted how faculty and students were engaged in these workshops and what questions were noted frequently in these workshops. These fieldnotes were used as a complementary source to aid the explanation of faculty perceptions of their entrepreneurial involvement and their perceived difficulties in striking a balance between entrepreneurial work and academic work.

Interview Protocol. The interview protocol is comprised of three sections (see Appendix A). The first section consists of descriptive questions that concern the participants' experience with entrepreneurship. Prior to the interview, I collected data on the participants' working title, salaries, service work, number of publications, and teaching workloads. In this way, I was able to identify and compare extrinsic factors that might have influenced participants' perspectives. By asking participants about their entrepreneurial motivations and ways of balancing their entrepreneurship and research, teaching, and service activities, I was able to capture both the perceived benefits and challenges participants described in making sense of their entrepreneurial activities.

The second section is a set of questions informed by dilemma analysis, which focuses on faculty perceived dilemmas or challenges that concern the integration of their entrepreneurial participation with their professional roles. All faculty participants were asked about their experiences in dealing with conflicts, difficult decisions, or dilemmas they encountered in their entrepreneurial activities. As well, I gave them a specific dilemma that was identified in the literature about faculty participation in entrepreneurial activities in the university, and I asked them what they would do if they faced this dilemma situation and what would guide their decision making. In this way, I sought to identify how faculty respond to and make sense of their entrepreneurial activities in complex situations. For example, faculty participants were asked to describe their responses to situations where they were requested by other researchers to share the data of their research that they collected for a federal project as well as for their company. The faculty participants were asked if their responses would be the same to both requests.

Based upon the dilemma analyses, I asked faculty participants about the dilemma surrounding their entrepreneurial activities and their academic roles—research, teaching, and service.

The final section includes questions about faculty participants' motivations and experiences with the phenomenon. Specifically, I organized and categorized questions into three parts to explore (1) individual concerns, (2) motivations, and (3) the perceived costs and benefits of participating in entrepreneurship. For example, some interview questions that pertained to individual concerns included, "Do you think your entrepreneurial participation will affect your merits or promotion negatively in your university?" "Do you think you are treated differently in your department because of your entrepreneurial participation?" There were as well questions that addressed collective concerns, such as "Do you think the privatization of knowledge will damage the public value of higher education?"

The interview protocol also includes participant's department, faculty status, gender, and institution, as well as interview schedule and ethical considerations. This interview protocol was tested in a pilot study with a faculty entrepreneur from the University of Southern California who was not included in the sample. The use of a pilot interview enabled me to review and revise research instruments (Eisenhardt, 1989). Although no significant modifications were made to the interview protocol, the pilot study did allow for minor corrections and refinements of some interview questions.

Procedures of Data Collection. The data collection process consisted of three stages, which respectively included fieldwork at the Entrepreneurship Centers, a pilot

study, and faculty interviews (see Fig 1.). This approach was pragmatic in nature but also addressed the perspectives of different groups of stakeholders involved in the academic entrepreneurship phenomenon. The first stage consisted of Director interviews and document and website review, followed by a pilot study with one faculty entrepreneur from an outside institution, and then faculty interviews in the three universities.

The first stage was fieldwork. With the goal to identify key institutional strategies related to academic entrepreneurship, I first identified entrepreneurial strategies and innovation on the University of California Office of President (UCOP) webpage. From there, I went on to each participating university's websites on academic entrepreneurship and identified programs and offices that are related to their campus practices. I then immerse myself in the documents to gain an understanding of each participating campus culture related to entrepreneurship. Through the websites of entrepreneurship centers on each campus, I created a list of faculty entrepreneurs who have founded their start-ups within their institutions for participant recruitment. Furthermore, in order to triangulate the interview data as well as gain a more accurate understanding of the entrepreneurial practices, I reached out to Directors at each Entrepreneurship Center at the participating UC universities and conducted one-on-one interviews with the Directors. The interviews with Directors provided a context for academic entrepreneurship from organizational and institutional perspectives. The first stage of the data collection was carried out to contextualize faculty interviews under their respective institutional contexts.

The second stage of data collection was the pilot study with one faculty entrepreneur from a different university than the participating universities in this

investigation. Although these data were not included in the data analysis, they were used to modify and validate interview questions with faculty participants. In this way, I sought to identify any potential issues with the interview questions as well to address important aspects of faculty entrepreneurs' experiences that might be neglected in the original interview protocol. By doing so, I was able to capture a comprehensive and accurate account of faculty participants in the actual interviews regarding their understandings of their roles and sensemaking of their behaviors.

The final stage of data collection was semi-structured interviews with faculty entrepreneurs from the three campuses. I confined my recruitment of faculty participants to the School of Engineering to minimize disciplinary differences in faculty perceptions. In addition, to obtain an equal number of faculty participants from each participating campus that have a relative matching faculty profile, I further focused my recruitment within departments of Bioengineering and Computer Science. This is because the two departments span out the most university spin-offs of all the departments, even at the early-stage entrepreneurial university, UCR. This gives me not only a more matching profile of faculty participants across the three campuses but also a relatively larger pool to select faculty participants. In this way, the final list of faculty entrepreneurs was created based on (1) faculty involvement in university spin-offs, and (2) faculty's research in Bioengineering or Computer Science.

Recruitment emails were sent to every individual on the final list, and then sent a second time to those who did not respond. There are 40 faculty responded and participated in the interviews (see Table 3.1). All interviews were semi-structured in

nature, which is used to capture faculty perceptions regarding their entrepreneurial engagement. As well, the researcher was able to be reflexive during the interviews and to probe further the meanings and experiences derived from faculty participants' response. Each interview took approximately 60 to 90 minutes and was recorded with the participants' consents. There is only one exception with a participant from UC Riverside. This participant did not want to be recorded, so I took notes during the interview instead. These notes were used to enhance the researcher's understanding of academic entrepreneurship but were not included in the finding presentation.

All interviews were conducted in between June 2019 and March 2020. All interviews are audio-recorded, and each lasted between 60 and 90 minutes, which allowed for adequate exploration of faculty experiences with regards to entrepreneurship and their positionality in the entrepreneurial process. Interview questions are framed by institutional theory and focused on how faculty perceived their roles in the entrepreneurial process as well as their responsibilities to the academic institutions (i.e., research, teaching, and service). It includes a series questions concerning how their participation in entrepreneurship shape their perceptions of their academic responsibilities to the institutions, to their students, and to the scientific community.

Data Analysis

In the identification of relevant themes in faculty responses, I employed a thematic analysis approach (Braun & Clarke, 2006) to organize data and generate findings. Thematic analysis focuses on identifiable themes and expressed patterns of behaviors. As stated by Leininger (1985), individuals' perspectives and experiences are

meaningless when viewed alone; however, when researchers bring different components and fragmented perspectives together, they become a theme that is much more prominent in the phenomenon. Thus, the purpose of thematic analysis is to identify "thematizing meanings" (Holloway & Todres, 2003, p. 347) from fragmented experiences and perspectives of individuals who live within the phenomenon, and, by doing so, I was able to describe patterns across the data from individuals' responses. For qualitative researchers, to carry out a thematic analysis is to link different ideas and components that are seen to fit in a meaningful way in order to present a coherent argument (Braun & Clarke, 2012). Themes were generated in an inductive way in this investigation with guidance of institutional theory and identity theory. In this way, the themes capture the participants' perceptions as well contribute to the theoretical development of academic entrepreneurship (Braun & Clarke, 2006).

Analytical Framework.

An analytical framework is used in qualitative research as a decision rule to help researchers decide their choices with regard to which themes or patterns to select from the qualitative data (Braun & Clarke, 2006). I based my approaches to data analysis upon institutional theory, specifically, institutional logics. I paid attention to individuals' use of rationales and explanations in their sensemaking of their entrepreneurial behaviors, and to their justification of their entrepreneurial activities in relation to their academic roles. Two institutional logics—the logic of academic professionalism and the logic of entrepreneurship and innovation—were adopted to guide the analysis of the faculty sensemaking process. The logic of entrepreneurship and innovation is seen as a

complement and sometime competing logic to the logic of academic profession (Brint, 2019; Etzkowitz, 2003; Levin et al., 2020).

The discussion below provides codes and frameworks of each institutional logic I relied upon to analyze faculty perceptions and justifications of their entrepreneurial behaviors. Through analytical lens of the two logics, I explained the ways in which these faculty resolve the competing tensions between the two logics.

The Logic of Academic Professionalism. Based on Brint (2019) and Levin et al.'s (2020) conceptualizations, the logic of academic professionalism is framed as both a system and an identity that regulates faculty work. Faculty not only conform to the standards and ethical conduct set by their professional associations but also meet the expectations of their institutions. Faculty are conceptualized as autonomous individuals who can act as a social benefit, independent from managerial and market control (Freidson, 2001). They are viewed as professional experts who are trusted to provide their best judgement for their clients (Brint, 2006) and have ethical responsibilities for the well-being of society (Mitchell & Ream, 2015). The logic of academic professionalism is reflected through the ways that faculty conduct research, teach and mentor students, and serve scientific and institutional communities (Hwang & Powell, 2011; Levin et al., 2020). Most importantly, the logic of academic professionalism values faculty work for its contributions to the scientific and knowledge community rather than for its commercial contributions or worth in the marketplace. The essence of the logic of academic professionalism thus lies in faculty values for science and knowledge, the conduct of research for the sake of knowledge advancement rather than commercial

interests or use, and a conformity to Mertonian norms (e.g., Braxton, 1986; Slaughter & Rhoades, 2004; Ziman, 2000).

The Logic of Entrepreneurship and Innovation. Based on Brint (2018) and Etzkowitz's (1998, 2003) descriptions of entrepreneurship and innovation in the university, the logic of entrepreneurship and innovation can be referred to as both the imperatives and capacities of universities to engage in commercialization activities and contribute to the economic growth and job and wealth creation through faculty research and educational activities. At the university level, the logic of entrepreneurship and innovation is reflected through universities' creation of new organizations to support the commercialization of research (Brint, 2018), as well as the incorporation of new curricula and actions to educate entrepreneurial students (Etzkowtiz, 1998, 2003). The logic of entrepreneurship and innovation also represents a specific set of norms and behaviors in faculty work, where individual faculty are encouraged to conduct research that is more applied and relevant to the marketplace and has commercial potential. Faculty work, however, is valued more by its effects upon society than its contributions to knowledge (Etzkowitz, 1998). Under the logic of entrepreneurship and innovation, individual faculty are synonymous to entrepreneurs who are likely to adopt risk-taking and opportunity-seeking behaviors for the pursuit of wealth creation (Powell & Colyvas, 2010; Powell & Sandholtz, 2011; Shane et al., 2003). The distinct codes for the logic of entrepreneurship and innovation can include faculty emphases on the use of knowledge and the application of research, intentions to collaborate with industries, and conduct of commercial research.

Under the logic of entrepreneurship, faculty can rate the value of their research by its social or economic outcomes, rather than its scientific effects (Etzkowtiz, 2013). In line with this logic, faculty also value independence and autonomy in their work environment (Shane et al., 2003). The logic of entrepreneurship can be reflected in faculty attitudes to collaborate with industrial and business partners on innovative research and this includes their intentions to start their own business.

In addition, because I was interested in faculty motivations to participate in entrepreneurial activities within their faculty appointments, I borrowed components from the entrepreneurial identity literature and compared them with faculty perceived entrepreneurial motivations to detect the similarities and differences between faculty entrepreneurs and business entrepreneurs. According to Ollila, Williams-Middleton, and Donnellon's (2012) review of entrepreneurial identity, individuals' use of symbols in the socialization process signal their entrepreneurial selves in the construction process of an entrepreneurial identity. Therefore, the analysis draw attention to faculty use of symbols and story-telling to construct an entrepreneurial self. Their use of symbols and stories to illustrate their entrepreneurial motivations and their use of story-telling skills to construct an entrepreneurial self are intended to persuade their relevant stakeholders.

Outline of Analytical Approaches.

Thematic analysis was carried out in five steps (Braun & Clarke, 2006). The first step was to transcribe all the interview data. Faculty interviews were audio-recorded and were transcribed by a third-party transcribing organization. Next, to familiarize myself with the data, I read and re-read the data several times and took notes in order to

formulate ideas. The third step was to generate initial codes. From the transcribed interviews, I sorted those participants' perspectives that were either similar or identical to one another and combined the similar ones together under one general theme. In the initial coding, five general themes were identified and generated, which include internal motivation to participate in entrepreneurship, external imperatives for entrepreneurship, conflicts with research, complementary to research, complementary to teaching, and perceptions of service roles. Then, I compared all six themes with the analytical framework. In comparing the themes with the analytical framework, I paid attention to the linkages between faculty perceptions and the two institutional logics. Finally, I grouped the data that were in line with the meanings of each institutional logic.

For example, each faculty participant was asked about their motivations to engage in entrepreneurship, and some participants stated that they were motivated to participate in entrepreneurship because they wanted to see the application of their research and use their research to make a social impact. This motivation is in line with the logic of entrepreneurship and innovation, as Shane et al. (2003) state that entrepreneurs are driven by their intent to make an impact on society. I extracted these quotations from the interviews and coded them under the code of "impact." Other participants exhibited an academic self in their interviews. They expressed that their participation in spin-off firms enables them to access more data that can be useful for their research. This motivation conforms to the purpose of academic entrepreneurship, which is to advance knowledge generation and benefit their research activities. Therefore, I coded these quotations under the codes of "curiosity-driven." Additionally, some faculty participants related the story

of how they started their businesses and why they attributed missions to their startups. When participants related a story about their entrepreneurial experiences and expressed pride in their entrepreneurship as much as they expressed pride in their research contributions, I placed their quotations under the code of "story-telling." By repeating the process of searching for and comparing quotations with the analytical framework, I extracted quotations and coded them by categories of the analytical framework. Whenever I could not find a category in the analytical framework to fit the quotation, I placed the quotation in a new code of "new and developing code." After completing the sorting process for all initial sorting and coding, I turned back to the new code category and read all the quotations to see if they were similar or identical to one another. From there, I was able to re-organize the new code category and develop these quotations into new codes.

After I coded all the interviews, I went back to examine coherence within the codes. If the code was coherent among the selected quotations while distinct from the other code, then I developed it into a theme based on its relevance to the research questions (Huberman & Miles, 2002). For example, under the code of academic professionalism, some faculty participants indicated that they constrained themselves from further participation in academic entrepreneurial activities when they found they could not maintain an appropriate balance for their research work and teaching. Under the same code, some faculty also indicated that they buffered the commercial pressure from industries to maintain the scientific agenda of their research. I combined these quotations under the logic of academic professionalism and developed them into one strategy that

faculty used to obtain a balance at work—buffering and segregation. In this way, the final stage of the data analysis was to repeat the above process and develop all the interview data into multiple themes. Once the themes were collected, I gave names to each theme and organized them by their relevance to each of the research questions.

In the presentation of findings, the development of themes was not dependent on quantity or frequency—themes were captured and developed based on their prominence in participants' perceptions. I did not use percentages or any quantified measure to present faculty perceptions. This approach is consistent with qualitative conventions and is used widely by qualitative researchers. Thus, instead of specific numbers, I used formulations such as, "the majority of participants" (Meehan Vermeer & Windsor, 2000, p. 372), or many participants (Taylor & Ussher, 2001, p. 298), or "a number of participants" (p. 249). In the present investigation, if there were more than half of the participants from the same discipline or from the same institution who indicated similar rationales or explanations, I used the words "majority" or "many" to suggest the prevalence of the themes in the data.

Trustworthiness and Reliability.

A critical feature of qualitative research is assurance of trustworthiness, that is, the degree to which a study's findings are sufficient and well-described to explain the research questions (Merriam, 2009). In the present investigation, I adopted several strategies to increase the trustworthiness and reliability of the data and findings. First, data were obtained from varied sources, such as reviews of institutional documents as well as interviews with Center Directors. Since faculty interviews a\were the bulk of the

data, Director interviews a\were used to triangulate the faculty interview data. I compared faculty, Directors, and students' perspectives in each department and on each campus to identify any inconsistencies based on role and individual experiences. The findings are trustworthy because the diverse perspectives from different groups of participants yield similar conclusions regarding academic entrepreneurship on each participating campus. In addition, I also implemented member checking and peer review strategies to ensure the accuracy of my interpretation throughout the data analysis process (Merriam, 2009). I followed up with faculty participants through emails to clarify any ambiguity in their responses during the interviews. I attended to my positionality and subjectivity as an Asian female student and consulted with my advisor and committee members who possess expertise on my research topic regarding coding and data interpretation. Through member checks and interrater reliability checks, I refined my interpretations with the goal to increase reliability of my analysis.

I used Nvivo, an online coding application and project management tool, and Dedoose, an online qualitative data analysis application, to track and organize my documents, transcripts, fieldnotes, memos, data files, and other materials. I also maintained a written account of an interview summary for each faculty participant that documented my thoughts and reflections about the participants right after each interview.

Chapter IV FINDINGS

Introduction

The findings from this investigation are organized around the research questions, that is, the ways in which academic entrepreneurship influence faculty work motivations and perceptions of academic roles in their institutions. The chapter is divided into three sections. The first section provides both internal motives and external incentives for faculty participants to participate in university spin-off firms.[7] Through the analysis of faculty perceived importance of these incentives in motivating them to pursue entrepreneurial activities, faculty entrepreneurial motivations are examined and explained. Faculty perceived motivations for entrepreneurship, whether these are generated from internal or external sources, act as a foundation to build up my arguments regarding their perceived influences of academic entrepreneurship on academic roles. Structured as such, the first section answers the research question regarding why university faculty engage in entrepreneurship.

Findings suggest that faculty entrepreneurial motivations are formed and fostered by external incentives rather than internal motives. Faculty entrepreneurs state explicitly that they do not possess the traits or characteristics of business entrepreneurs; they claim that they are academics first and are not driven by the money in their entrepreneurial activities. Instead, they perceive that their entrepreneurial involvement is stimulated by

[7] Previous research refers to university spin-offs as startup companies that are based on university patents and licenses and are led by university faculty. However, in the present investigation, I found that faculty also engaged in spin-off firms that are not based on their patents but on their research ideas as well. Therefore, throughout the chapter, university spin-offs are defined as startup companies that are led or founded by university faculty, with or without a patent.

external incentives that come in part from federal initiatives on academic entrepreneurship, enhanced by a market demand for innovation. The federal agenda for entrepreneurial research serves as a "top-down" force that shapes faculty research orientation and intentions in the university. The appropriation of federal funding for academic entrepreneurships provides legitimacies as well as imperatives for faculty to create and participate in university spin-offs. Concurrent with the federal role, the state government in California has recognized the role of entrepreneurship in the generation of employment and business opportunities, and, therefore, encourages creation of individual-led, innovative start-up companies. Academic entrepreneurship is one main sources of creation for these innovative startups. Thus, in conjunction with the federal agenda, faculty members, particularly those at research universities, are encouraged to transfer their research into commercializable products and launch their business ideas within the university.

Furthermore, the Office of Technology Transfer in the university plays a mediating role between government initiatives and market demands to facilitate faculty engagement in entrepreneurial activities. As faculty participants indicated, academic entrepreneurship is an alternate avenue for their institutions to generate income, and by encouraging faculty to participate in entrepreneurial activities, universities can diversify their funding sources without losing their research control to industries. In this regard, I argue that faculty engagement in academic entrepreneurship is more likely to be a faculty response to the economic demand of external forces, such as federal and state governments, or companies, on university research rather than faculty self-interest—

although self-interest in entrepreneurial activities is an indispensable part of their entrepreneurial motivations. Faculty participants also mentioned that since the development of knowledge in the industrial sector has growth so fast, faculty are also motivated to conduct more market relevant research so that they can keep up with the knowledge expansion in the industry. Taken together, faculty entrepreneurial motivation is stimulated by the federal agenda on innovation, fostered by state and local supports for entrepreneurship with the aim to maximize social impact, and enacted by individuals' interests in academic entrepreneurship.

The second section answers the research question regarding the compatibility between academic entrepreneurship and academic work (i.e., research, teaching, and service) and faculty balancing strategies towards their multiple roles. The discussion relies solely on faculty interviews and offers evidence based on faculty's own perceptions. The section first identifies changes that are embedded in faculty perceptions of their academic roles and then offers the strategies that faculty employed to adapt to these changes. A hybrid logic of academic professionalism and entrepreneurship is prevalent in faculty responses to the purpose of conducting research, the value of science, the commercial trend within the scientific community, the increased secrecy that surrounds science, the diverted goal of education, and the approaches to teaching and mentorships, as well as faculty's service roles to the department, the professional community, and the society at large. The hybrid logic also serves as a legitimating source for faculty participants to justify their behaviors and rationalize their decision-making processes.

There is a shift in faculty's perceived value of research from the development of knowledge towards the application side of knowledge. This is evident in faculty's expression of their intentions to "make an impact" in society as well in their justification for applied research that is beneficial to life improvement in society and maximization of the return of public investment in research. These intentions differ from Merton's scientific ethos for basic science, where research in its essence is valued for its contributions to knowledge advancement. Although faculty claim that the primary goal of research is to work on important yet unanswered questions in science, they have nonetheless emphasized that the application of knowledge is equally important, or even more so, as the knowledge itself, especially in an age where technological innovation is rated highly and celebrated. As such, for faculty entrepreneurs in Computer Science and Bioengineering, the value of research might have extended and shifted towards the applied side and use-inspired research (Stokes, 2011). Furthermore, there is also a social component in faculty justification for their entrepreneurial activities, where they indicate that the public money that funds their research will be optimized if faculty research can in turn generate benefits to society. A utilitarian ethos is implied in the purpose of public investment in research and underscored in faculty responses to the contribution of academic entrepreneurship as an instrument to maximize social benefits. Lastly, with regard to the purpose of university research, faculty participants assert that public research should develop a broader social mission beyond knowledge generation. By conducting entrepreneurial research, these entrepreneurial can fulfill such a social mission.

In spite of previous literature that suggests that faculty tended to buy out their teaching hours to focus on their entrepreneurial activities, I did not find that the faculty participants were "fugitives" from teaching. I was particularly careful in my interview approaches to ask questions because I was aware of the implicit biases that may occur in faculty responses to defend their involvement in entrepreneurial activity. However, after finishing all the interviews, I conclude that teaching is indispensable in the formation of faculty's academic entrepreneurial identity. Faculty see themselves as academics first and foremost who enjoy teaching and value the educational experiences with their students. Many participants indicated that they decided to come back to their university positions after several years of working full time at their businesses because of their values in education. They expressed their enjoyment in their interactions with students and the inspiration they gained from the academic atmosphere in the university. Additionally, some participants indicated that there were also family reasons that supported their interests to stay with, or come back to, their university job. For example, their academic career is beneficial for their own children's education. Likely if faculty did not gain satisfaction from the teaching part of their academic work, or if they did not value the educational part of work with students, they would leave the university and remain at industrial jobs. The reason that these faculty entrepreneurs remained in the university is because of their academic identity that underscores teaching and education, that is, their preference for an academic career.

There is evidence in faculty responses that show the emergence of entrepreneurial education in engineering education at the research universities. Some faculty participants

from UCLA noted that their students have high entrepreneurial intentions; their engineering students take courses from business schools and participate in startup companies, and, more importantly, are motivated to become entrepreneurs. Apart from student entrepreneurial motivation and intentions, faculty participants also emphasized an institutional goal of entrepreneurial education at their universities. They pointed out that there have been an increased number of business courses and co-curricular activities to facilitate students and faculty in entrepreneurial activities at the engineering school. The engineering departments at UCI have also incorporated an entrepreneurial track in the course plan for their engineering students. Thus, faculty participants justified their entrepreneurial involvement by linking it with the educational goal of the university. They stressed that through academic entrepreneurship, they are able to integrate their entrepreneurial experiences in their class instruction and connect with students who have entrepreneurial ambitions.

Finally, faculty's perceptions of their service roles, however, differ from one another. This is likely because the service work includes a broad range of activities, and, therefore, there is no unified understanding across faculty regarding the role of service in their professional and entrepreneurial lives. Although all the faculty participants expressed some "grief" over service work, they all serve on committees, either internally or externally. Yet, their preferences for the nature of the committees differ from one another. Some faculty participants viewed their service roles as a "give back" to the society, some viewed service as volunteering work to the professional community, and many would rather see service as departmental politics and to be avoided. The majority

of participants tended to use entrepreneurship as a way to avoid departmental politics: In comparing between the department governance and external engagement with the business world, faculty entrepreneurs would prefer to spend their time on the latter so that their time are better used, and they can contribute to the society. From their perspective, departmental meetings as well as committee work in the institution are inefficient, unstructured, and bureaucratic.

The third section answers the last research question by identifying balancing strategies that faculty entrepreneurs employed to maintain their roles in both their entrepreneurial activities and the university. In general, there are four strategies that faculty employed to avoid controversy and conflicts: delegation of duties, seeking legitimacy, pausing, and separation. In developing the strategies, faculty entrepreneurs are calculative of costs and benefits; they are cautious of potential conflicts and threats to their institutional status. They are aware that the likelihood of spinning off a profit-making business is rare and requires considerable time investment. Therefore, they ensure that they calculate the costs and benefits before they are committed. If faculty think that entrepreneurial business takes too much of their time that should have been spent on research and teaching, they delegate duties to others in the business: They delegate to their students or their business partners. If they cannot delegate their duties to others, they either pause their entrepreneurial business or pause their academic job to maintain a balanced role in the university. Some faculty participants indicated that they took two years of leave of absence to pursue their business. After two years, they sold or closed their companies and came back to their academic jobs. For faculty participants

who engaged in entrepreneurial activities while maintaining their academic positions, they ensured that they separated their entrepreneurial businesses from their academic work. That is, they worked on their business on their own personal time during the weekends and at a different location from their academic institution. In this way, faculty participants intended to avoid potential conflicts of interest between their academic work and their entrepreneurial work. Furthermore, some faculty participants also aligned their entrepreneurial activities with the educational goals of their institutions. By seeking institutional legitimacy for their entrepreneurial activities, faculty participants maintain a balance in their value systems that justifies their involvement in both the academic world and the entrepreneurial world. Faculty participants employed different and multiple balancing strategies to justify their entrepreneurial activities to themselves and to their university. In contrast to the other two university's faculty, however, UCLA faculty participants did not express with the same emphasis or the deliberateness the need to balance their entrepreneurial work with their academic roles. This suggests that academic entrepreneurship might have been taken for granted at UCLA and thus does not require additional justification from faculty members, whereas academic entrepreneurship has not been institutionalized at UCI and UCR at the same levels as at UCLA, and faculty members at UCI and UCR need to defend their entrepreneurial activities.

Part I: Faculty Entrepreneurial Motivations

To explain faculty motivations to pursue entrepreneurship, I examined faculty's entrepreneurial motivations from both their intrinsic motivation for academic entrepreneurship and their perceived entrepreneurial traits that are necessary to become

entrepreneurs, as well as the external incentives in the environment that drove them to engage in entrepreneurial activities. Entrepreneurship literature has relied predominantly on examinations of entrepreneurs' traits (Xu et al., 2013). However, the entrepreneurial traits alone may undermine the prominence of social factors in the construction of one's self-understanding (Shane et al., 2003), and thereby these are not sufficient to describe the holistic view of faculty perception of their work and roles. Therefore, I distinguish personal experiences and individual traits from environmental incentives to explain why faculty engage in entrepreneurship. The description of external environment and personal experiences relies exclusively on faculty self-understandings of their experiences and preferences and their interpretations of their external incentives and imperatives. In doing so, I explained the micro-foundation of academic entrepreneurship through faculty perceptions and self-understandings of their entrepreneurial engagement and motivations within their faculty positions in the university.

Internal Motivation.

The entrepreneurship literature suggests that the entrepreneurial traits that drive individual entrepreneurs are the strive for independence, pursuit of wealth creation, and propensity to take risks and seize opportunities (Shane et al., 2003). My findings point to nearly opposite traits found in faculty entrepreneurs. Indeed, the participants expressed close to an abhorrent attitude towards risk-taking behaviors, opportunity seizing behaviors, and capitalization behaviors. Moreover, they tended to draw a line between themselves and those entrepreneurs in business and declared that they are not engaged in

entrepreneurship for the money they may acquire. They said that they do not possess the same traits as a typical entrepreneur—they possess the traits of academics.

> First is about my personality. I like the lower risk. And secondly, I'm not interested in money. I like the part of academia where I can work on problems that interest me. And if one day I find out that whatever it is I'm working on right now is actually not that interesting, I can switch it, almost from day to day. And so, that part of the freedom [in academia], I like very much. I have both the freedom to continue with something for a long time that I like, but I also have the freedom to drop something very quickly that I don't like, and that's something that's very important to me. (Paris, Computer Science, UCLA)

> I think there's a general point here, which is that if you look the personality type who becomes a professor and the personality type who works in early stage companies, they're very different personality types, typically. So, by having this set up, the professor can get some of, let's call it benefit of being able to start a company and contribute in that way without the risk that a different personality type might want to take on much more readily. (Rajesh, Computer Science, UCR)

> The thing I enjoy the most, which is also the thing I'm most excited about, which is also the whole reason we got involved with working with any companies, is… [to] make better drugs. And I want to show that.... I feel like some period of my career has been successful… Later down the road it may help us find, "Oh, here's some new problem that we didn't think about in the first place," but right now…what motivates me is the toolkit that we have to change what a drug would be. (Arthur, Bioengineering, UCLA)

> My purpose is not to have a company. My purpose is to have a technology. But it turned out later on that having a company would help the development and the use of this technology, which suits my purpose. I want to best use it [the technology] and keep improving it, and, because of that, I need to be involved. It's not like that I developed this thing, so that I can sell it to a company just for the money… and let the company take it and use it however the way they want to... But that's not my goal. My goal is really to provide that to the growers in agriculture that people can use it and help manage this disease. (Wendy, Bioengineering, UCR)

The above statements show that faculty participants distinguish themselves from business entrepreneurs because they recognize an occupational difference in traits between academics and entrepreneurs. The logic of academic professionalism is prevalent in their

responses, where they see their personal enjoyment lies in solving scientific problems rather than in making money. Wendy and Arthur further pointed out that they could have just sold their inventions to a company if they were interested only in making money. However, they decided to create an USO based on their inventions because they enjoy tackling problems in application and developing better drugs. Through a USO, they can also have more control over their own inventions and be responsible for their customers than selling their inventions to a company.

Although that faculty participants declared that they are committed to the development of better technologies (drugs), it was evident in faculty justifications that they articulated an entrepreneurial value in their perceptions of their academic jobs. When asked about their most enjoyable part of their work, Paris and Rajesh explained that it was the independence and the free pursuit of work that they valued most—they have no supervisor and can work on problems of personal interest. The ethos of the U. S. academic profession lies in its fundamental values for researchers' independence and academic freedom, which to some degree coincides with the characteristics of entrepreneurs. But, such professional ethos is established on the premise that university faculty produce independent and monetary-disinterested research that benefits society. However, based on the participants' responses, although they value the independence and individualistic nature of their academic work, they nonetheless adopt commercial behaviors within their academic roles. In this regard, faculty participants are not traditional academics either: They import commercial values from their entrepreneurial practices to their work ethic in their academic roles.

Apart from the self-characterization, faculty participants indicated a prime motivational difference from the business entrepreneur—that is, they were not motivated by financial gain. To faculty participants, sometimes they have to buffer the pressure for the financial returns of their research because they are not driven by the financial gains and want to ensure the quality of their research work.

> We have this invention and we play around with starting a company based off of that, and we're at the point where we're talking to different investors and trying to raise money for that [the invention]. But it turns out that the venture capitalists' world, the first question that they would ask is: "How soon can they see 10 times return of their investments?" And they're typically looking at five years for 10 times return for their investment. We often come to this point as the stopping point, because, by its nature, malaria diagnosis tools would be used only in the third world country, where typically it's very poor and the country will typically not be able to afford very expensive medical diagnosis, or care… (Tom, Bioengineering, UCI)

> UCLA actually makes it very easy to start companies based on research, so it's a very simple thing to go and have a conversation [about launching a business] and [discuss] whatever it takes. But every time I've decided against it. Every once in a while, we get an idea like that, and we just think about it for a while, and then we say no. I just don't have time for it. The possibility of starting a company that makes sizeable income is actually very low, lower than you thought, and [it's] not worth my time (Paris, Computer Science, UCLA)

Tom perceives his entrepreneurship rather as a scientific project than a profit-making company. He indicated that he would stop his involvement with the company if his invention of the diagnosis tool for malaria was used to make money for the investors rather than to improve public health in "'the third world country." He also disliked the tone of investors who are only eager to see returns of their investments rather than any meaningful progress made in science and society. To him, academic entrepreneurship has a social mission—to use technology to solve social problems and benefit people who are in most need. Thus, he avoided reference to profits and monetary returns of his

engagement in spinoff firms. For Paris, although academic entrepreneurship is promoted in his institution, he did not jump to every entrepreneurial opportunity that was provided to him. Instead, he resisted some entrepreneurial ideas because he values his time applied to and his contribution to research and teaching more.

Many faculty participants indicated that the reason they engage in entrepreneurship is the same as the reason that they remain at their university: that is, to satisfy their curiosity about the world, whether the world of science or the world of business.

> I think probably some faculty may be motivated by that [money], but I think more it's like we are technically curious, and we enjoy being involved. Even though I will never do it again, I enjoy the things I learned from that [the spinoff company], such as legal issues, and consulting problems. I just enjoy learning, on an ongoing basis of different things, and particularly, the insights I get from working with the company…I think it really informs us. It [academic entrepreneurship] makes us much better faculty. (Cong, Computer Science, UCI)
> I did the startup because I found it interesting and it was fun. But my university research is more fun. The startup was just fun enough and had enough of a promise to maybe make lots of money that I deemed it worth my time. Same thing with the other startup. But I'm still a professor and I enjoy being a professor. (Harry, Computer Science, UCI)

However, although faculty claimed that their entrepreneurial engagement is simply curiosity-driven, they do show a strategic and calculative side of their personalities in their approaches to entrepreneurship. They calculate the costs and benefits involved and then make cautious decisions about their engagement in entrepreneurial activities. If their calculations suggest that the entrepreneurship is not worth their time investment, then they conclude that they should cease these activities and devote themselves fully to their academic roles.

> There's a tradeoff, right? If it's consuming time and not making enough money to justify that time, then it's worth giving up. If my first company had started making me $100,000 a year, I might've decided to take a leave of absence from being a professor because that be enough money to support me and my family and be worth it. But it wasn't… Although I might have been able to build it up to more money over time, …[it] would have just taken way too much time and taken too long. (Harry, Computer Science, UCI)

> [M]y experience was that you can spend an awful lot of time on those things and nothing comes from it. So, it's largely a waste of time beyond a certain thing. The few that you see are these high-profile, very successful, but there's a lot of other ones that don't go anywhere for whatever reason, and ultimately you lose a lot of time working on doing that. If there's a benefit to you, fine, but otherwise that can be time which is not the best invested, as far as moving within the system. (Eliot, Bioengineering, UCR)

> We use the SBIR [Small Business and Innovation Research] money to develop the technology beyond what we could have done in the university... But, it was never our intention to really commercialize it, because we knew the market was not ready for it…We don't have that kind of money, so we just sold our tool to the company and let them develop the technology. (Ross, Bioengineering, UCR)

Harry perceived this entrepreneurial involvement as a matter of "trade-offs." He weighed the costs, risks, and benefits involved in the entrepreneurial activities before he decided to invest his time and efforts. Eliot and Ross were also mindful about the costs involved in academic entrepreneurship and were strategic about attending to the relationship between academic entrepreneurship and their academic roles. Although they admitted that the additional income generated from the entrepreneurship was a benefit for them, they compared that to the benefit that their entrepreneurship could generate for them with the risks and costs involved. If the benefits did not outweigh the costs and risks, they would pass on the idea.

Almost all faculty participants claimed that academic entrepreneurship is not expected to make money; rather, academic entrepreneurship is carried out as an alternate

avenue to “publish” their research results—only, in this case, the influence of their research results can reach a broader audience and have a more immediate contribution to society. In “publishing” their research results to the public, they not only make contributions to society but also gain autonomy in the conduct of research. This is a reciprocal relation: If the results of their research can attract a larger audience, their research is more likely to secure funding; and, if they have more funding for research, they can hire more graduate students and more staff to support the development of their research.

> I would say that is a necessary step to gain my academic freedom, which is to get a funding that I needed to support the kind of research that I wanted to do, so it was a necessary step to enjoy my academic freedom. And at the same time, you get a funding to do research and what do you produce? A couple publications. Only a few people might read it. Most people won’t even know it. At a minimum, you need to let the world know that you're accomplished all that research results. (Tom, Bioengineering, UCI)

> So, in the current engineering school, we are evaluated [for] our research on number of publications, and then if we do technology transfer we also have patents. Then one patent is equivalent roughly to one publication. So, if a researcher or faculty does 10 patents in one year, then that counts 10 publications. (George, Bioengineering, UCR)

According to Tom, academic entrepreneurship is a necessary mechanism to attract funding and thereby enhances his research productivity and academic freedom. Most importantly, the social impact that his research could make through academic entrepreneurship is greater than that of any of his publications. Slightly different from Tom’s views, George argued that patents are equally important to publications in the merit review system, and therefore it makes sense to him to engage in entrepreneurial activities to gain academic prestige.

Contrary to Tom and George's statements, other faculty participants expressed that their involvement in academic entrepreneurship could lead to some constraints on their research—even though they disagreed that their entrepreneurial activities are important ways to exercise their academic freedom. This reasoning may seem contradictory; however, it makes sense to these faculty participants because academic entrepreneurship can be a double-edged sword to their academic careers. To these faculty entrepreneurs, academic entrepreneurship brings them additional resources and capital, and thus they would have more autonomy and leverage in conducting the research based upon their own interests. However, the constraint lies in the demand from their investors who need to be convinced that faculty research possesses unique benefits and contributions in developing profitable products and technologies.

> One of the things I didn't like about it was just you have very little control. If you want to be a responsible consultant [for startup companies], you have to do however much they need whenever they need it. So, I didn't enjoy the burstiness of that. I much prefer getting on a plane one day a week, and knowing where I'm going, and coming back and not having, all of the sudden I need to spend four days doing something (Charles, Computer Science, UCI).

Charles' statements indicated that faculty roles in entrepreneurial firms constrain their autonomy as professionals because they become consultants who are employed by the company, and thus they have to offer whatever the company needs instead of what interests them. These faculty statements may have a contradictory element but suggest that there is considerable complexity involved with academic entrepreneurship. The contradiction is resolved in practice because these faculty give priority to their academic roles, and when there is a conflict between the role of the academic and the role of entrepreneur, the faculty opt for the academic role.

> If I started spending too much time on the business and not enough time being a professor, that's exactly what happened with the Company A.[8] I wanted to be a professor, I prefer being a professor and anything I do on the side, to make extra money, I don't want it to interfere with my professor role. And that's what happened with the Company A. I just realized that it took up way too much time and annoyance in my spare time to be worth it. (Harry, Computer Science, UCI)

Many faculty participants had similar views to Harry's: They saw themselves first and foremost as academics. They stated explicitly that they would constrain themselves from their entrepreneurial activities if it took too much time away from their scientific work. They are even repulsed by the idea of entrepreneurship for the sake of money—even though they are not against either to the idea of making extra money from their research. In their justification, they perceive their entrepreneurship and their academic work equally; these are both ways to provide financial stability for their families. As well, they indicate that they make contributions to society through both academic work and entrepreneurial work.

The above discussion suggests that faculty are not motivated intrinsically to become entrepreneurs. The external environment is understood by faculty participants as the provider of incentives for them to engage in entrepreneurships. The section below delineates evidence of faculty's perceived influence of external forces imposed upon them and motivate them to initiate entrepreneurial behaviors.

External Pressure and Incentives

Previous research demonstrates that federal agencies play an important role in incentivizing academic entrepreneurship at universities—through either direct funding for

[8] Here I assign a pseudo name to the professor's company in order to protect the confidentiality of the professor.

faculty business or research programs that can lead to the commercialization of the research. This is evident in faculty participants' perceptions as well. For example, several Computer Science faculty participants indicated that their companies were funded by the Defense Advanced Research Projects Agency (DARPA). In addition, the Small Business Innovation Research (SBIR) I and II grants from the National Science Foundation (NSF) also served as legitimate sources for all faculty and students who have entrepreneurial ideas to obtain seed funding for their businesses. But, apart from the existing research that shows federal agencies as pulling factors for academic entrepreneurship, faculty participants pointed out that federal agencies can be pushing factors—pushing faculty to pursue entrepreneurial activities instead of pursuing scientific projects because of declined funding.

> I've always considered federal grants the gold standard of funding, right? Because they're difficult to get, so they have a status to the reward. They also come with a negotiated, indirect cost rate, which helps support the university, which is important. Private foundations don't necessarily have the same indirect cost rates, which is not as good for the university. The drawback though is that there are certain restrictions on some of the federal money. I'll give you two examples that have affected me greatly. One is I do embryonic stem cells and I do fetal tissue work. So, both of those have come under fire in the last decade or so, where President Bush put a restriction on embryonic stem cells and we thought we were going to lose a million-dollar program project grant from the feds. And now, President Trump is putting some restrictions and the use of fetal tissue with federal dollars, and those restrictions did not exist on private money or state money. So, it may become less desirable to have depending on the politics, and this is when the issue comes in. When politicians get involved in science, who knows what's going to happen, right? Because they're not scientists, so they don't necessarily understand. (Jerry, Bioengineering, UCLA).

> I don't want to get into a theological argument here, but my research could be debased if I'm not allowed to use federal dollars for fetal tissue-related work. Then I would have to go to state funding, which doesn't really exist or private funding, which is difficult to get. So having my own business can really help in that situation. (Jerry, Bioengineering, UCLA)

> I want to cure diabetes. If the Congress happens to be run by a bunch of idiot old white men who don't believe in science, that doesn't affect the fact that I want to cure diabetes. And unfortunately, all those idiots are old, so they're funding the NIH because they didn't want to die. If I was an environmental science, it would actually be a very different story. The people [in] environmental science are freaking out rightfully because these idiots… In case you can't tell, I have very strong feelings. These morons…decided that the climate is not changing and the best way to handle that is to stop funding the evidence production. Those people are truly affected by this government. I don't believe them. It comes from taxpayers and as the popular vote showed in 2016 there are far more science advocates than there are science deniers by about, was it three or five million? I forget the popular vote. (Berry, Bioengineering, UCI)

Based on the faculty statements above, the disinvestment from the federal government has affected faculty research. One consequence is that faculty were disappointed by the ways that the government allocates their funding and that their research funds are determined by politicians who do not understand science. The Bioengineering faculty struggled with federal redistributions of funding and decided to pursue other funding sources—such as their entrepreneurial business. The Bioengineering faculty participants pointed out that federal grants have become more and more difficult to obtain. There have been increasing restrictions on the use of cells. Furthermore, it has become difficult for faculty to communicate with the federal government and its agencies on scientific solutions for public issues. Therefore, these faculty members chose to become a more entrepreneurial self and generate their own funds for research. In Bioengineering faculty's responses, academic entrepreneurship was used as an outlet for the frustrations with government disinvestments in and misconceptions of science. These faculty participate in entrepreneurial activities to detach their research from federal restrictions. As such, insufficient governmental support for research likely sparked an entrepreneurial ethos in faculty, where they seek new ways to secure funding for their research.

Apart from the influence at the federal level, the university and industries are important sources of incentives for faculty to engage in entrepreneurial activities. Faculty participants noted the pressure from the university level for them to generate revenue. By their engagement in entrepreneurial activities, faculty can bring money to their university.

> I've been at UCR for 15 years. I definitely feel that the institution as a whole has become more entrepreneurship and entrepreneurial, which…certainly looking for a diversification of funding sources. That's been going in higher education since probably…the end of the Cold War, at least, if not since the 50s. And I think it accelerated drastically in the 90s, and we'd caught up about 10 years ago or so, [and] decided this is what we needed to do... I've definitely seen that, although not all of that has been stuff that's affected me…But I would say there's mild economic pressures, particularly within engineering, to demonstrate this kind of relevance to open up revenue streams for the college. Because there's an idea that…if some of these…startups and things become successful, that somehow, through magical unknown means, but there are situations that they [startups] may end up with money flowing back through grants…With a grant coming back, or through donations back, or just for general prestige for the university, …raises the bar. So there's certainly pressure for that… especially when it comes to merit review files… (Sheldon, Computer Science, UCR)

> [P]ublic investment in education has dropped off over time. So, the university is looking for other sources of revenue… [F]aculty have ideas or come up with new potential inventions. If those can be converted into patents for other source of revenue streams, it's tremendously beneficial for the university. So, you have to ask, what is the core mission of the university? Is this part of the core mission or is this sort of a non-core, side-like sort of thing? ... I think it's perfectly fine to have faculty involved in entrepreneurial efforts, and if they generate money and it benefits the institution that's great. But I don't really believe that that's central to the mission of the university, and therefore it should not be central to where the majority of my time should not be placed on those types of activities. (Eliot, Bioengineering, UCR)

The university's drive to become an entrepreneurial university might has led to unintended pressures on faculty, as indicated by the two faculty participants from UCR. The economic pressure to open up revenue streams for the college, as well as the pressure to apply grants to enhance institutional prestige, has pushed faculty to engage in more

entrepreneurial research and activities. Faculty's perceived linkages between economic development and academic entrepreneurship confirm the assertions of previous literature that documented an economic development mission of the university. Additionally, according to Sheldon, academic entrepreneurship is also associated with institutional prestige. Sheldon's statement indicates a process of the institutionalization of academic entrepreneurship at UCR—faculty participation in academic entrepreneurship is legitimated because it enhances the institution's prestige. This need for prestige, and ultimately legitimacy, then, makes it imperative for faculty members to engage in academic entrepreneurship so that their universities can gain prestige.

Although faculty participants indicated they prefer the flexibility and independence in their academic career, several expressed that the salaries in academia are not comparable to those in industry. Particularly for Computer Science faculty participants, they indicate that they make less than their students who work in large tech companies. Rapid development of knowledge in the private sector make these faculty question their choices of staying in academia.

> But I might be able to have a different impact. I could provide other things for my family. Sending my sons to college would certainly be economically more obviously simple, if my salary were two to three times larger. But would I be as happy? I don't know. There are times when I'm plenty unhappy with my job here… but on a year to year basis. (Sheldon, Computer Science, UCR)

Taken together, faculty entrepreneurs are not necessarily capitalists, nor simply entrepreneurs who are set upon the commercialization of their research results. Federal funding for research has declined for basic research and is redistributed towards more applied fields. The market has also led faculty to conduct more market relevant research.

Among these changes and market incentives, faculty infuse an entrepreneurial ethos in themselves and generate their own funding for research. Although they engage in spin-off firms and other entrepreneurial activities, they articulate a hybrid logic of academics and entrepreneurship in their justification for their entrepreneurial involvement so that they can continue their entrepreneurial activities within their academic positions.

Owen-Smith and Powell (2001) find that life science faculty rationalize their decisions on invention disclosure based on their calculations of the costs and benefits involved in the processes. In the present investigation, faculty in Computer Science and Bioengineering also rationalize their involvement in entrepreneurship—they move cautiously towards entrepreneurship because they want to maintain their academic status; they also make calculations of the costs and benefits involved in starting an entrepreneurship so that they can maximize their benefits while avoiding potential risk. As such, faculty entrepreneurial motivation is formed based on rational considerations and emanates from their values for science and technology and is shaped by external pressures from the government and the market.

Part 2: When the Two Worlds Collide—Balancing Entrepreneurial Influences

When faculty entrepreneurs work at the intersection between the world of science and the world of business, their daily activities could vary based on how they prioritize their roles—sometimes one might take precedence over the other. In the world of science, faculty conduct research, instruct classes, and serve on committee boards or engage in other service activities. In the world of business, faculty secure investment from venture capitalists, develop technologies, meet with business partners, and socialize with other

entrepreneurs. In their decisions of prioritizing these different tasks, faculty participants follow a hybrid logic of academic professionalism and entrepreneurship, but the prominence of each logic in faculty perceptions is determined and reinforced by their institutional environments as well as their engagement in the activities. For example, faculty's increase in their engagement in one specific role or one type of activity reinforces the logics associated with the role, and thereby influences their commitment to the other role.

The section below explains how faculty participants perceive the relationship between the entrepreneurial role and the academic role and how they obtain a balance through alternation between the two roles. These explanations are based upon faculty self-understandings of their research, teaching, and service roles and if and how academic entrepreneurship influences their academic activities from their own accounts. A number of issues arises in relation to faculty's dual roles as academics and entrepreneurs once they become involved in entrepreneurial activities.

Research: Shifted Values and Changed Norms

Faculty entrepreneurs' understandings about the relationship between their entrepreneurial activities and their research activities have shifted towards more reciprocal than conflicted behaviors. At the most general level, faculty participants perceived the relationship between the two as complementary and reciprocal; however, when in specific situations where academic entrepreneurship imposes potential threats to their research, faculty participants noted that they alter their research agenda and research norms to reconcile the potential conflicts between the two roles.

In spite of scholarly research that suggests that academic patenting can lead to a delay in faculty publications, faculty participants expressed that their engagement in entrepreneurial activities does not influence their research productivity and that they will continue to make the effort to ensure that their research productivity remains the same. The influence of academic entrepreneurship, however, lies in faculty's logic of their research goals and endorsement of research norms. The section below explains (1) faculty perceptions of the fundamental values of research, (2) faculty endorsements of research norms at their institutions, and (3) faculty perceived compatibility of academic entrepreneurship with research. The explanations focus upon what underlies faculty perceived influence of academic entrepreneurship on research and the relationship between the logic of academic professionalism and the logic of entrepreneurship.

Perceptions of Research Agenda. To many participants, the value of conducting research lies not only in discovering and exploring the unknown of the universe but also in the application of research results into society to improve human lives. They see themselves as use-inspired and applied researchers (Stokes, 2011). Although faculty participants did not deny the value of basic science, nor did they express a declined priority in generating fundamental knowledge, they advocated for applied research nonetheless. They emphasized the importance of applications of knowledge in society. This is because, in their perception, knowledge has been accumulated to the extent that is difficult to make another scientific breakthrough; but, the accumulation of knowledge has enabled human beings to apply knowledge into use in society.

> The research in my field does not have direct application or can be translated into a product that people can use immediately…but it is important for me to think

> how we can use research to benefit the human society and human lives… [and] how my research can also contribute to the improvement of these social lives … [Science and its application] are both important. (Wendy, Bioengineering, UCR)

> It takes an accumulation of knowledge and many years of research so that we can finally reach to a point that we can say, "Okay, now we have the knowledge, and the technology, and we can do something real now." But it's not that easy. I want to cure cancer, and I'm going to do some research on all cancer cells, so that I can device tools…It's not like that. Even if you know the mechanism and have the money, but how do you treat it? How do you block it? How do you treat patients? That's another level of question. (Zhang, Bioengineering, UCLA)

Stokes (2011) has described scientists whose research is conducted to solve practical problems as *use-inspired* researchers. The above statements from the Bioengineering faculty indicate that they are indeed use-inspired researchers. Wendy perceived that the important research question for her, at the current stage of her career, lies mainly in how to use her research to improve society. Zhang added that the conduct of basic research and the application of research are not in conflict but reinforce each other. Zhang indicated that at times basic knowledge can be advanced only if the researcher has an in-depth understanding of how the research results are applied in practice and used on patients. For both of them, it is an evolving process, rather than an abrupt transition, to shift from a role as basic scientists to a role as use-inspired entrepreneurs. Their research has a dual purpose—that is, to advance knowledge in both science and practice. To them, by developing use-inspired research and technologies, they may be inspired by ideas that can in turn contribute to the development of basic science. Both faculty participants acknowledged that the development of technology is indispensable from the development of basic science—"when a worker wishes to get his work well done, he must have his tools sharpened first." (Wendy, UCR). They also addressed that the application of

research is more challenging than basic research for most researchers because it requires different skills from that provided in their academic training. However, it is because the application of research is challenging that faculty are intrigued and want to learn how to apply research into use through their entrepreneurial involvement.

Furthermore, since there have been numerous federal initiatives on innovation and entrepreneurship, in order to secure research funding, faculty have to align their research agenda with the federal agenda. As a result, gradually, faculty perceptions of research are shifted towards more innovative and applied research agenda.

> [A]s a junior faculty member here, I've made a proposal to the Air Force Office of Scientific Research, AFOSR, which funds basic research, like ONR does for the Navy, or the things for they do basic research…I pitched them something. And the program manager came back to me and said, "Oh, that's great, we love it. But we noticed that you have a background in game theory…and we think that would be applicable to this. If you would augment the proposal that way, we feel we could accept it." So I said, "Okay." That was a significant commitment, particularly as a junior faculty member. It is not defined as my entrepreneurship, but it clearly adjusted the direction of my research over the next three years or four years. (Sheldon, Computer Science, UCR)

Sheldon's statements indicate that federal agencies, such as AFOSR, have played a directing force on faculty research. In order to secure the research funding, faculty sometimes have to make compromises in order to conduct research that fits the agencies' interests. Such compromises can change their research agenda. This constitutes federal control over research, as Sheldon noted, and faculty have little power to resist. Instead, the university should take an active role in protecting their faculty research agenda to "resist the pressures from the external pressures on applied research," said Sheldon.

Endorsement of Research Norms. In the present investigation, faculty endorsement of research norms suggests a modified version of Merton's descriptions of

communalism, universalism, disinterestedness, and organized skepticism. Merton's description of scientific norms refers to an ethos of science, that is, scientists' full endorsement of open communication of scientific findings and the conduct of science for the sake of knowledge rather than any material interests. However, the modified research norms, instead, refer to a commercially-driven research agenda, increased secrecy surround research, and a declined intention of sharing research tools and materials. Although faculty participants collaborate with others, such as their colleagues and graduate students, on research, they acknowledged that there has been increased secrecy around their collaborative work and thus their hesitancy in sharing materials.

When asked about their practices of data sharing, Computer Science faculty advocated for open science—they preferred to publish in open access journals and there was little or no appeal to the pursuit of intellectual property. In contrast, Bioengineering faculty indicated that the protection of intellectual property is a necessary step for faculty and scientists to share their research results.

> The other thing that we've done is structured it in such a way, which is common for what we do at this company, [is that] we do it in the open source. In this way, we give back all the data to the world. Instead of doing all the things to protect the system, we put it back into open source, so everybody in the world can use it and benefit from it. Our software has gotten much, much better because we have half a dozen paid professionals who are working on it at the company but also because we have other unpaid researchers that use our data and in turn benefits our system. (Potter, Computer Science, UCLA)

> In computing, we don't patent, one most people don't like patenting and it's very difficult. What do you mean your patent a program? It is the same program if you change a few commas or things here and there. Plus, there is a long tradition of free open source [in computer science]. In that respect, universities' [technology transfer office] in general are not prepared for this kind of innovation or patenting a computing technology, because it's different, and very difficult to demonstrate it is novel and unique. (Wesley, Computer Science, UCR)

According to Potter and Wesley, patenting is a time-consuming activity in Computer Science, because it is difficult to demonstrate the novelty and the effects of algorithm in practice. In Computer Science, faculty entrepreneurs' spinoff firms are often platform based, such as online software or mobile apps. They make their software or apps open source so that any software engineer or computer scientists can use the data. In this regard, the strength of the spinoff firm relies more on the researchers' innovative ideas than on patented intellectual property from their research. Thus, open communication of knowledge is particularly valuable in Computer Science to invoke innovation and ideas. Additionally, to Computer Science faculty, science and property are two separate issues: Although they generate revenue based on their research, they think that science should be free and accessible to the public so that everyone can utilize it and build upon it to make contributions to knowledge advancement. They are firm supporters of open access, because by making data available to all, this will lead to more innovative ideas. These actions for open access contribute to the diversity of research and enhances both theoretical understandings and practical implications of research.

In some contrast, Bioengineering faculty participants expressed different understandings regarding patenting and intellectual property protection. Bioengineering faculty participants acknowledged the importance of open communication of science, and they articulated the logic of entrepreneurship in their justification of commercialization of research. These Bioengineering faculty claimed that patenting is an important way for faculty members to protect their rights over their intellectual work and this encourages more faculty to share their novel research with the scientific community. More

importantly, patenting is a necessary mechanism for university inventions to be recognized by industries and potential investors. In particular, because of the high costs associated with bioengineering research, the data withholding behaviors are justified.

> There's a bit of a caveat to that as well, especially in the hard sciences. If you publish something like you make a new chemical, right? There's a cost to making that… If all of a sudden, something's really hot and exciting, and 1,000 people want it, you can't afford to give it to them. So, one step that the NIH has done, at least in my field, is they've set up what's called the repository. Agency people consider it valuable to be contributing to that repository and let it be handled there. When requests came in, those would be doled out from that repository, not from an individual lab. It saves time, and effort, and money, and that's supported by the NIH, but if that's not pulled up, then it can be expensive for an individual investigator to distribute his reagents. (Jerry, Bioengineering, UCLA)

> Ten years ago, I was very concerned because that's when the patents started really happening, right, in life sciences. Very concerned because you couldn't necessarily get reagents from people and it was stifling your action, and that was a worry, but what I've come to realize is that without intellectual property protection, no pharmaceutical company is going to take… what you have, and commercialize it because they can't, right? They don't have coverage. So, you have to. If you want to get something as a drug, you have to patent it because if it's not patented, then nobody owns the rights and there's no profit for the people that are taking it forward to the public. And they're motivated by profit. So, it's pretty much a necessary evil, right? That's how I look at it now and I'm changing. I'm moving over to the dark side, if you will in that for a company to be successful, it's got to be able to own its technologies. If one puts a company hat on, you have to do that. It's for two reasons. One, for the company and, two, to actually get a drug to the market, there has to be property. (Potter, Bioengineering, UCLA)

> One real challenge is that, it's not always easy to find out what particular companies are doing. So, there's a lot of secrecy about projects, particularly in the early stage. Like I mentioned, my existing industry connections are largely through connections I otherwise already had. It's pretty difficult to find, you know, if we go into some new area, who are the people that work on that? Because academic labs put out papers all the time, they have a lab website, they try and describe everything that they're doing very thoroughly. Companies are just black boxes. (Arthur, Bioengineering, UCLA)

Jerry attributed the changed norms to the pressure from two entities. From his perspective, the market on the one hand, pushes faculty to patent their IPs so that faculty IPs and inventions can be identified by the interested parties and sold in the market. The federal government, on the other hand, pulls faculty back by reinforcing data-sharing behaviors of faculty with the public through federal funding. Potter pointed out that academic patenting is an effective way for university inventions to be recognized by industries. In his justification, industrial recognition helps the invention to transfer from university labs to the marketplace, and thereby enhances the technology transfer process in the university. Even though Potter described the commercial trend in academic research as "moving to the dark side," he has nonetheless embraced the idea and insisted that it is "a necessary evil." To Potter, and other faculty participants, when the logic of entrepreneurship prevails over all aspects of academic work, it has imposed norm-changing behaviors on faculty. As Arthur explained, industrial research is similar to a "black box" that scientists outside the industries do not have the information and access to what the industries are doing. Because industrial research is attached to commercial goals and competition, industrial scientists have to keep their research confidential in order to ensure the uniqueness of their technology and maintain advantages in the marketplace. Thus, in order to keep up with the knowledge development in the private sector, faculty have to seek research collaborations with industries. Then, academic patenting and licensing are inevitable if faculty want their research to be recognized by industrial partners.

Compatibility with Research. Despite the shifted academic research norms and values among faculty participants, the majority of faculty participants indicated that academic entrepreneurship is compatible with their research; at least, the two are not incompatible with each another. The reciprocal benefits of academic entrepreneurship lie in the access to data as well as the capital and funding that faculty can gain from their entrepreneurial experiences.

> There have been some commercial successes with biologics. Immuno-therapeutics are now becoming very important for cancer…and that's what we're working on, so you become aware that it's out there. Investors are interested in that now because it's clear that some drugs could make them money. So, if you have the sentiment where you think you can raise funds for this, then that's what you should do. If there was nobody that was excited about the field, it wouldn't be much good, right? It's an up-flowing of enthusiasm on many people's part that causes commercialization to move forward…and move forward the research as well. (Jerry, Bioengineering, UCLA)

> I think it's very much complimentary… First, [what] motivates me most, is …[t]he work that we do as an academic lab…But we are limited in the range of experiments and inquiries that we can make. For example, it's very difficult for us to do large scale science, and that's because funding that can be difficult, academic labs also operate in the timescale of students graduating and getting trained. And so, one thing we've taken advantage of with both of the companies that we've worked with, is they often have highly skilled technicians that can do these large-scale experiments that just aren't accessible to us. And that's been really exciting because we can get different science done than we would have been able to do otherwise…. Especially, systems biology as a field needs to show that it has important things to say about how you develop new drugs. And drug development largely does not happen in an academic environment for a variety of reasons, that one of which is that it costs just an enormous amount of money to put forward a compound. A lot of the final steps, the clinical development of compounds happens in industry. And if we're going to contribute to that process, we have to be involved in it. (Arthur, Bioengineering, UCLA)

> [T]he other thing I found beneficial [to research] is that… having a company using it, and having their customers start to use it, gives us a pipeline of ideas of like what should be working on next. I wanted to have people tell me, "Here's 20 things we want," and now my students and I can look at those things and see, "Oh, there's an interesting research problem there. Let's work on that." It's a

> really good source of ideas about things that are interesting technical problems…and also gives us a source of research ideas. (Charles, Computer Science, UCI)

Jerry articulated the logic of entrepreneurship in his justification for his entrepreneurial behaviors: academic entrepreneurship draws industrial attentions and brings money and funding back to the academic research. In this way, Jerry perceives that academic entrepreneurship and research are compatible because contributes to the advancement of not only commercial activities but also the research conducted in the university. In his perspective, the advent of academic entrepreneurship in the university ultimately leads to the rise of Bioengineering research in the past 10 years. Arthur indicated that academic entrepreneurship enhances research in two ways: (1) large scale testing and experiments, and (2) tacit knowledge from practice that contribute to the advance of research. He explained that there are certain limitations in running a bioengineering lab in the university because of the scale and range of experiments that can easily exceed the university capacity. However, by creating a firm within the university, he is able to collaborate with industries to do more research on the application side of bioengineering research. He emphasized that it is imperative for system biologists to demonstrate how the knowledge developed in research can contribute to the development of drugs. Comparably in Computer Science, Charles expressed that academic entrepreneurship is a source of new ideas that enables faculty entrepreneurs to catch up with the expansion of knowledge in the industry. In particularly, when knowledge and technology have been predominantly developed in the industrial sector, by creating a tech firm within the university, faculty entrepreneurs also have the data to work with to develop research.

Almost all faculty participants stressed the importance of diversifying funding sources for academic research. This is because the costs to conduct research have become increasingly expensive. Neither federal funding nor industrial funding alone is enough to cover the expenses of a research lab. Particularly in a period when federal and state funding for higher education is not stable and varies from year to year, the public university has to obtain funding from elsewhere, such as the private sector. However, the increased dependency on private funding can generate other issues for universities, for example, declines in control of research and losses of ownership of faculty intellectual property. Thus, creation of USOs is the most favored source of revenue generation is academic entrepreneurship. By encouraging faculty members to commercialize their research, universities can be less dependent upon external sources and bolster institutional reputation and prestige in the market.

> If universities want to maintain some independence from corporations and other bodies that might want to influence their research or their opinions, then they have to find some other source of funding, and direct funding from corporations is not a good idea because then they [the corporation] might have undue leverage [on research], right? Although it's not happened to me, several of my colleagues here in computer science have created companies based on their research here, but then the university owns the patent, which I think is a good idea, right? Because the public is funding us to do this research and if it turns out that the research can have a benefit back to the public, that's a win-win situation for me. (Mike, Computer Science, UCR)

Mike pointed out that academic entrepreneurship three major benefits for universities: It increases university incomes, secures the research control within the university, and enhances the benefits of public research in society. In this regard, to Mike and many other faculty participants, academic entrepreneurship is not only compatible with research but also enhances research.

Despite the above statements, there are also issues with faculty evaluation and promotion incurred from the promotion of academic entrepreneurship in the university. One group of participants stated that the evaluation relies heavily upon the quality of research and therefore faculty engagement in entrepreneurial activities can distract them away from publishing and hinder them in advancement in the merit system.

> [T]he reward system in the university is on publications. The more publications, the better publications you have, the better you do, and our focus is on publication. Once you publish something, you cannot patent it anymore. You have to patent first, and then publish. But, we're all in such a hurry to publish. Plus, when you look at the CV of somebody in computer science: "Yeah, I have, patent, patent, patent, patent." Okay, nice, but what do I get from patents is nothing related to my tenure promotion. (Mike, Computer Science, UCR)
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> There's been some faculty here that have basically not advanced on the proper time scale for their merits, because they're working on their patents. But then as soon as their patents hit, then they advance very quickly, so it catches up, they're able to catch up. But you're right, again, I think a mixture is always better. (George, Bioengineering, UCR)
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> There's no pressure in that, if you didn't do it, it looks negatively. There's not that. But there is, in that, if, let's say someone started a company, and it's used in research and getting it out into the world, and your name known, then at least that should be mentioned, as a positive thing. How positive is unclear. Different groups, like the Academic Senate, I think, would prefer not to see that at all, and say no again. But the deans would love to see that, so it depends who you're talking to. (Sheldon, Computer Science, UCR)

Mike and George indicated that there are delays in patenting that could lead to a hinderance for faculty advancement in the university merit system. Sheldon also pointed to institutional barriers that come from different governance bodies in the university and these may influence faculty participation in entrepreneurial activities. If faculty entrepreneurs have a supportive dean who advocates for academic entrepreneurship, they are likely to maintain productivity in both entrepreneurial and research activities. However, if they are in an environment where the university culture is dominated by

academic values, then they are likely to face barriers in starting an entrepreneurial business.

> Normally, when people leave for any reason to go to a company, one or two things will happen. Sometimes they start their own company, but certainly much more often they just leave to join another company. And then for those who start their own company, what happens most of the time is that they take a leave for two years, and then at that point they will stop being so active in the company and they come back to be a professor. So, it means that at that point they may either still maintain a stake in the company or they may sell their stake in the company. (Paris, Computer Science, UCLA)

Another consequence of academic entrepreneurship is that, potentially, there is a brain drain of faculty from the university to industries. According to Paris, faculty can become involved extensively in entrepreneurial activities, and eventually they leave their institutions to pursue their entrepreneurial business.

As indicated above, at the most general level, faculty participants did not perceive that academic entrepreneurship has a negative influence on the production of research; they see that the academic role and entrepreneurial role entail reciprocal benefits. However, they did recognize potential consequences with academic entrepreneurship that could harm research and lead to declined value in basic research and a brain drain of faculty to industries. Moreover, the university environment for academic entrepreneurship plays an important role in faculty reconciliation of their roles between academic entrepreneurship and research. Almost all faculty concerns noted above are from UCR, which is a beginning university in the entrepreneurial process. UCR faculty participants expressed concerns over conflicted roles with university goals and potential delays in their merit system. However, UCLA and UCI participants did not express the same concerns. Instead, they exhibited a taken-for-granted attitude towards academic

entrepreneurship and saw the two as “very complementary” (Arthur, UCLA) as they were accustomed to entrepreneurial norms.

Teaching: Enhanced Instruction and the Emergence of Entrepreneurial Education

Faculty participants hold some concerns about the influence of academic entrepreneurship on research; but, they have expressed an almost unified positive attitude towards the influence of their entrepreneurial activities on teaching. They indicated that academic entrepreneurship benefits their teaching by enhancing their instructional approaches and diversifying career options for their students.

Although Slaughter et al. (2002) suggest that academic entrepreneurship may divert faculty from teaching activities, the present investigation does not find evidence to support this claim. When asked whether there is a time conflict between their academic entrepreneurship and their teaching, faculty participants indicated that this was not the case for them. Instead, many faculty participants expressed value for teaching and align themselves with the role of teaching role in the research university, even more than the role of research.

> We’re tasked with educating the next generation. That’s the primary reason that the state of California is paying our salaries, is to help educate the next generation. Our goal is to expand human knowledge, right. To separate fact from fiction, to separate truth from falsity, and to expand human knowledge, in general. (Wesley, Computer Science, UCR)

> I think research faculty at universities like this, we like to think we’re changing the world, because we’re coming up with these new ideas and writing these papers, but I think the way that we’re actually changing the world is we're actually teaching students, and then they’re going off and changing the world. (Mike, Computer Science, UCR)

> I enjoy interacting with my students. I enjoy meeting with them, talking with them, and observing their study styles, their personality, their communication

> style. I learn so much myself, and that's why I enjoy that. The more different styles of students I interact with, the more I enrich my own experience as well. So, I kind of enjoy that, but I also understand that it's extremely time consuming to spend so much time talking to different students. But that's part of what I enjoy doing, and I don't mind spending the time doing that. (Tom, Bioengineering, UCI)

> I think the other thing that made me realize that was my mentor went to the University of Wisconsin in 1976, and so in the year 2006, we had like a 30 year anniversary for him. He founded the database group at Wisconsin, and we invited a lot of our alumni to come back, and we filled an auditorium with alumni of our database group. The way we started the celebration day was everybody got up and said one or two minutes about what they were doing, and by the time 200 people had done that, I think those of us who were teaching went, "Oh, wow, okay." This is what we did. All these people are at Microsoft and Google. So, it was a little bit eye-opening, I think, to see where everybody had ended up and how much they liked it and things. I think it was also that, combined with watching my kids' college experience, and going, "Okay, interesting." (Charles, Computer Science, UCI)

The four faculty all perceived that the primary goal of the university resides with its students rather than with economic goals. Charles attached personal stories to his understandings of the purpose of teaching. He noted that it was a rewarding moment for teachers to know that they have enriched students' lives and that students are grateful for teachers' contributions to learning. Based on statements such as these, faculty entrepreneurs have not necessarily, if at all, moved away from teaching. Although there could be time conflicts with teaching that stem from faculty's entrepreneurial engagement, these faculty entrepreneurs have developed ways to cope with and legitimize their conflicting roles as teachers and entrepreneurs.

> I think the situation with our department is that even some of us engaging in entrepreneurship and startup company and all of that, it seldom becomes compromising obstacle for the faculty to fulfill the primary duty to the department. The primary duty to the department is like teaching and research. And those who engage in a lot of entrepreneurial activities typically can handle it pretty well, so it does not translate into situation where the department needs to

> intervene, or the other colleagues need to see something that they need to say something about. (Berry, Bioengineering, UCI)
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> I'm very cognizant of conflict of interest issues and my main job as an employee at a public university is to make knowledge available to the public and [to] students… What I think is interesting is another flip side of this… is having stuck my toe in the murky waters of commercialization, I can explain things to students in a different way. A lot of my students now… are gearing up to go into biotech and pharmacy, and that wasn't true 10 years ago. Having ventured into that arena, I can provide information to students about that that I couldn't do a few years ago. So it's actually increasing my ability to teach in some regards because that's what the students are leaning now. The careers for life sciences, at least in our area, are largely going to be in industry, not in academics anymore. (Jerry, Bioengineering, UCLA)

Both Berry and Jerry thought that academic entrepreneurship does not compromise their role in teaching, as long as faculty members fulfill their departmental expectations on teaching. They indicated that faculty are trained to multitasking—both to teaching and research—and as long as they fulfill the departmental requirements, they can use their time at their own discretion and pursue their other interests besides research and teaching. Jerry further pointed out that academic entrepreneurship enhances the role of teaching in the university because it improves professors' instructional approaches and makes it more connected with the industrial sector so that students can be better prepared when they graduate to work in the industry.

Many faculty participants concurred with Jerry and saw their involvement in academic entrepreneurship improved their teaching skills. They integrated their entrepreneurial experiences with instructional approaches and drew upon examples for practice to explain knowledge to students. As well, they engaged students in the resolution of practical problems. In doing so, they viewed this engagement as the enhancement of student learning experiences and outcomes.

> The fact that we had this open source system… was used for teaching at UW [University of Wisconsin], [it] got us an opportunity to get feedback, and then the company was able to use that feedback to improve the system, and now everybody who uses it, including the students who are going to use it later in my course, they all benefit from a much better piece of software. I think there's a lot of positive stuff. When we do research here, once in a while we come up with something that really helps the system a lot. Like some of the master's projects have made major improvements, and then they've incorporated those improvements after they inspect them carefully and help the students to harden down to make them professional grade. Then they incorporate those things. But everybody benefits from there being a new thing in the system. I think it's been a win-win kind of a relationship. (Charles, Computer Science, UCI)

> I think it enhances my ability to communicate certain things to the students by giving them direct access to research results that they would not be aware of unless they went and read the literature or in some cases, I even show them stuff before it's on the market. So, it keeps them interested. They understand that what I'm talking about isn't just book learning. (Wesley, Computer Science, UCR)

> One of the classes I teach is sophomores and in 10-week class they learn how to build. And one of the things they build is an optical heart rate monitor…[b]ut what the project really is, is knowing when to look at the raw signals and decide if you should even tell the person a heart rate number or if the signal is garbage and you shouldn't.... I show them some lawsuits over the areas in the field. I never would've thought of doing that before my entrepreneurial activities. Students love it. That's really important stuff. (Victor, Computer Science, UCR)

All three faculty participants perceived that their teaching approaches are enhanced because of their involvement in entrepreneurial activities. They can demonstrate theories in better ways; they have better communications with students; and, they can engage students in problem-solving cases that will prepare them for future work. Charles was able to open the data from his entrepreneurial firm (i.e., the open software system) to his students so that students can engage in coding for practical situations and solve practical problems in his software system. He added that if students can incorporate these experiences in their resumés, they will be more competitive in the job market. Wesley echoed this view and stressed that students will be more engaged in learning if they are

exposed to practical issues. His entrepreneurial experiences keep students interested in the class. Furthermore, as Victor pointed out, it was necessary to integrate his entrepreneurial experiences in instruction because these motivated students to think from a practical perspective and enabled them to foresee technical issues before their users. According to Victor, it is important for engineers to learn what is detrimental or useless data from the application and practices of research so that as designers and engineers they avoid unintended consequences, such as the unrecognized stroke in the heart rate monitor.

Criticisms of higher education from the public have focused on the diluted value of college degrees (Hersh & Merrow, 2015), and students and families blame higher education for inadequate preparation of students that result in lack of skills and knowledge necessary for students' future careers (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004; Slaughter et al., 2002). Faculty participants recognized these criticisms, acknowledged them, and applied their entrepreneurial experiences into their teaching to respond to these criticisms of higher education. They first pointed out that there is a strong financial incentive from the marketplace to attract students, and many of college graduates from Bioengineering and Computer Science choose to go into the industry rather than stay in academia. They emphasized that teaching and instruction need to be more applicable and more connected with the industries in the university so that it benefits students in the job market. For example, Paris from UCLA indicated that a Microsoft research team has recruited doctoral students from universities since the late 1990s. On campus recruitment not only boosted doctoral student enrollments in the

following years but also created a divergent industrial career path for doctoral students. Since industrial jobs offer high salaries, many doctoral students are drawn to an industrial career instead of staying in academia. As Paris added, many companies also offer access to data, in addition to money. Companies such as self-driving car companies, bioinformatics companies, Facebook, and Google have created large data sets that "people cannot get to unless they work there." Paris concluded that undergraduates and graduates enter industrial sectors for "the money and the data." As a result, it is imperative for faculty members to incorporate more industrial skills in their instruction of students. As Paris indicated, many of his doctoral students will enter industrial sectors and do not want to stay in academia. Thus, to Paris, academic writing skills are not attractive or necessary in industry; rather, the ability of to develop entrepreneurial projects as well as the gaining of entrepreneurial experiences are more beneficial to his students.

Other faculty members also noted the credentialization of higher education has made university teaching less efficient and less credible. Harry from UCI pointed out that there is an "unreasonable pressure" for people to have university degrees, and the consequence is that college admission standards are dropped, students are not academically prepared for college level learning, and faculty are demanded to curve the grades and not fail students. "This is silly," said Harry (Computer Science, UCI)

Apart from the demands from students and families on the preparation of job skills, universities have also set an entrepreneurial goal for their engineering education. For example, the University of California has implemented several educational programs

to engage their students in entrepreneurial activities. These educational programs are often led by faculty members or business entrepreneurs from the industry and focus on students' problem-solving skills by engaging them in real life situations to solve problems. Some faculty participants are instructors of these entrepreneurship programs. They noted that by integrating their entrepreneurial experiences in their instruction and leading entrepreneurial projects, they can enhance the educational goals of the university.

> We set up a pathway for the students, if they are interested, to continue to work on a project and take the idea to the next phase beyond graduation. After they graduate, after they get their degree, if they're still interested in the project then they can take that into Applied Innovation and apply for funding, apply for spaces, and set up a company there. So, the campus is very motivated to encourage that to happen. (Toby, Bioengineering, UCI)

> My opinion is that the reason why there's collaboration is not so much is because of the value of the research; the reason is the value of the students. The companies want to get to the students to increase the chance of the students will come and work with them. (Han, Computer Science, UCR)

At UCI, entrepreneurship is included in the undergraduate curriculum and designed as an alternate degree track for engineering students to follow. UCI faculty lead entrepreneurial teams of students to work on projects that can be commercialized into the marketplace or solve technical problems to improve technologies. Professor Tom, as one of the faculty who had entrepreneurial experiences, was encouraged to lead these entrepreneurial teams. Thus, he believes that there is a reciprocal benefit of faculty engagement in entrepreneurial activities on teaching, where faculty can not only impart their tacit knowledge in entrepreneurship to students but also gain inspirational ideas by leading student entrepreneurial projects. Similarly, at UCR, although entrepreneurship is not set

as a path for engineering students, engineering faculty have begun to teach entrepreneurship courses and lead programs within the department.

> What really matters and what are people doing in practice, I think, gives you a guideline of what you are doing... You don't just have the theory of what you're doing, but you've actually watched people do it, and you can help the students know what matters and what doesn't, and that's what we should really teach students in college. What we found in Wisconsin, and what we're finding here I think as well, is that companies are seeking us out for our students, because they know more than the average student. They're a little bit more useful out of the starting gate. They require less teaching before they realize how they need to do things. (Charles, Computer Science, UCI)
>
> I think it's [entrepreneurial experiences] valuable, and I think it's very important. I don't know if you know the EPIC program. The EPIC program is the training, not just for faculty, but for students too. So, they have a bunch of teachers that come in and teach you the nuances of how to do patents, how do you start a business, how do you do financing, and things like that. I think that's been very useful. In fact, they've had some of the EPIC classes here at my lab. So, they come in and use our lab rooms and invite people to use it... one summer I encouraged all of my collaborators and students to please attend this seminar that talks about the whole EPIC program, the whole entrepreneurship program. But it's really just encouraging them to attend seminars. (George, Bioengineering, UCR)

Faculty from UCI and UCR perceived their engagement in entrepreneurial activities as an intangible asset, and this asset provides their students job opportunities. Industries seek out students through their connections with faculty members. These industrial connections are the intangible assets that faculty can leave to their students. Thus, faculty participants not only make sense of their entrepreneurial experiences by linking it to the education of students but also encourage their students to pursue entrepreneurial activities as these are "valuable and important" (George, UCR).

Participants from UCLA did not express enthusiasm about teaching entrepreneurship or encouraging students to become entrepreneurs. Nor did they express eagerness to justify their entrepreneurial business. When I asked them about their

perception of academic entrepreneurship, they behaved as if they already knew my motivations in asking the question and they were calculating in their responses to me. They first admitted bluntly that there were potential consequences of academic entrepreneurship: They offered a laundry list of potential consequences. Then they responded to each item on the list and provided their solutions to avoid them. Within these response arguments, they emphasized their commitment to self-sufficiency and efficiency and noted that this justifies their involvement in entrepreneurial activities. As long as they are capable of conducting both research and entrepreneurial activities and adhere to professional standards, they can avoid unethical conduct and should be allowed and encouraged to engage in entrepreneurial activities. For them, if faculty are capable, the positive outcomes of academic entrepreneurship outweigh the negative consequences.

UCLA was therefore a different case for faculty entrepreneurship. UCLA faculty entrepreneurs did not defend their entrepreneurial behaviors or seek additional legitimacy for their entrepreneurial activities. They had internalized the positive or negative consequences of academic entrepreneurship and integrated their entrepreneurial experiences as part of their academic work at UCLA. UCI and UCR faculty, instead, needed to align academic entrepreneurship with the educational goals of their university in order to make sense their entrepreneurial behaviors to themselves as well as to their institutions. In addition, UCLA students are more entrepreneurial than students at the other two institutions, and therefore it is not imperative for UCLA faculty to encourage their students to be more entrepreneurial—they do not need to incorporate an

entrepreneurial ethos in their instruction because their students are already entrepreneurially oriented.

> I think students are incredibly savvy now, and many of them are taking things like classes in the business school or taking advantage of other [entrepreneurial] opportunities. [When I was a student,] I didn't take any classes about, say, industry-related drug development. And really, all I've learned has either been through colleagues who were my classmates and then went out to industry. Or I have some close friends who work in industry now, but none of my knowledge about the biotech environment is from some academic class or something like that… There're some things that happen on the department level. Like we very recently are going to start bringing in people from industry to actually give department seminars, so that students can get to meet those people. I guess I don't cover much related to industry in class. But people in my lab, I'm very active in them having some connections to some industrial collaborators who are involved with our research. So, for example, the research collaborations, students in my lab have been actively involved in the discussion process with those industrial collaborators, and they always interact with them[collaborators] directly. (Arthur, Bioengineering, UCLA)

Arthur's statement sheds some light on the characteristics of engineering students at UCLA: They take business classes outside of the engineering school and are engaged in industrial research and collaboration. Furthermore, the engineering department at UCLA has also taken the lead in bringing industrial experts and business entrepreneurs to their programs so that students are exposed to the job market and well-connected with the industry. Additionally, UCLA has the largest number of university programs and student organizations that are dedicated to incentivizing student entrepreneurship (see Chapter 3). Many of these programs are student-led; seldom are these programs led by UCLA faculty members. Because of these entrepreneurial minded students, UCLA faculty are less enthusiastic than those from the other two institutions to incentivize and encourage their students in entrepreneurship programs.

Despite the individual differences in teaching approaches, faculty participants, in general, apply the logic of entrepreneurship and innovation in their perceptions of teaching and the education of students at their institutions. This logic of entrepreneurship imposed a teaching goal of workforce preparation upon faculty work. In particular, if the university embraces an environment for entrepreneurship, and promotes an educational agenda for student innovation, then it is likely that their faculty members links their entrepreneurial behaviors with their teaching roles and perceive academic entrepreneurship as ways to enhance instructions and student learning. Thus, it is less likely for faculty to perceive academic entrepreneurship as in conflict or incompatible with teaching.

Nonetheless, based on faculty responses, these faculty are not fugitives from teaching. Some faculty participants took leaves of absences and worked full time in industry for several years; however, they chose to return to the university job eventually because they have a passion for education. The rewarding moments of teaching cannot be found in any other jobs or work environments in which these faculty members are involved, including their entrepreneurial activities.

Service: The Grief Over Politics and Social Mission

In a research university such as the UC, research and publications occupy a large proportion of faculty members' time. Teaching is typically next in line; it takes various amount of times depending on the quarter (Finkelstein, Conley, & Schuster, 2016). Service, however, has not been seen as playing a prominent role as the other two in faculty members' perceptions of their academic roles. The findings on faculty perception

of their service roles are also mixed. There is no unified understanding of service work among faculty participants. Nor there are any specific requirements on the types and levels of faculty involvement in service activities in their institutions. Some faculty participants serve on internal committees, such as recruitment and graduate admissions committees within their departments. Some participants serve on external committees, such as editorial boards of journals and review publications. Some faculty serve multiple committees and are more engaged in governance than others. Despite their acknowledgement of the importance of service work, almost all faculty participants tended to decrease their time in serving on committees and participating in department meetings. There seems a missing causal link here to explain the misalignment of faculty behaviors and perceptions. Faculty participants expressed frustration and anxiety over service work. Their concerns come from two main sources: departmental politics and the ineffective decision-making process.

> When I was department chair, there would be professors in the department who plainly hate each other, and problems like that inevitably bubble up to the department chair. And those problems I don't like. So, this thing of being in the middle of a really intense conflict where it falls on me to make sure that work still gets done, that is not my favorite cup of tea. So, I would say in the last 10 years, that has given me some of the most grief. But other than that, the thing that annoys me the most are when people are not willing to work. And so, I've often felt that as long as people are willing to work hard, I have almost unbounded patience, but if people are not willing to work, then I really have a hard time with it. (Rajesh, Bioengineering, UCLA)

> I think for me, if you do a department level, a university level service, that can be the source of the most grief. I've decided that I am old enough and cranky enough that I just don't need that in my life anymore. I've actually stopped offering my services at the department level. (Ron, Computer Science, UCI)

> Whenever there are funding and resources involved, there's always politics. So that's the biggest frustration, in terms of how to manage and navigate through the

> politics, is always the part that I don't enjoy. And that could also be a common thing that most of the faculty members don't enjoy. We just need to put up with it, these kinds of politics. (Potter, Bioengineering, UCR)
>
> The service one…probably it's most of the grief. You know, organizing people who don't want to do things, oh, you know, and doing that sort of stuff. On the other hand, occasionally, you feel like you did something useful there. (Sheldon, Computer Science, UCR)

According to faculty responses, compared to research and teaching, service work is the least rewarding role for faculty—although sometimes it can be useful, most of the time it is pure "politics" in a department that is "fighting for resources and funding." In particular, serving as the department chair, Rajesh and Potter saw the role as more managerial than professional: Department chairs have to manage highly individualistic people who "plainly hate each other" and who cannot work with one another. Moreover, there is always departmental politics involved in service work. Ron stated that he stopped attending department meetings to avoid nonsensical arguments: They do not like the politics and they are not political. But this does not translate into a diminished role of service in faculty work—as Sheldon pointed out—the service work can turn out to be meaningful, but it only happens "occasionally."

Most faculty participants saw their department meetings as time consuming and inefficient. Although the decentralized structure of the decision-making process in academic departments equalizes faculty power and roles in the department, it comes at the price of prolonging the decision-making process, according to faculty participants at UCI. University faculty are seen as individual careerists (Rhoades, 1998), who react and respond differently to the same issue. Because faculty are unlikely to agree numerous

matters in their department, service at the departmental level hampers faculty productivity and efficiency.

> If I'm ever a chair, this is how I'm going to run faculty meetings. You have to stand in room only. It gets better before you walk in. You have to drink a liter of water and if you leave you can't come back. So, the people, my age and up, they're gone. The young people don't want to be there because they don't have tenure. Meeting is over in 25 minutes. So, they deal with that. That's how you handle the service. (Berry, Bioengineering, UCI)

> When you run your lab you're in charge of how efficient it is. Your meetings can be short to the point and you don't have to be nice. I mean, we all like each other but you can be blunt, and then classroom is the same way. I'm in charge of how efficient it is. I can set my office hours I can cut students off if they're here for too long and say, "No, you should do it." Service is basically meetings and then you're just in a room of people who can't stop talking. And that actually is the hard part because you don't have control over it. (Cong, Computer Science, UCI)

> I think my challenge is I didn't grow up in an academic culture, and I enjoyed the faster pace, slightly more centralized structure in industry, and so my patience for that is probably not as high as it should be. So, I'm sort of an impatient... It's like I'd rather not be involved in a laborious process where we're all going to decide how many [things to do.] For me, that's a challenge. I've often said I like living in the United States, but I'd kind of want to work in Singapore, which is to say if you have a benevolent dictator, they can cover the less important decisions. That's not a bad thing necessarily, I mean as long as they're really a benevolent dictator. Again, from a life perspective, last two years notwithstanding, things have been pretty good here, but I do like having a more centralized... We should have people to make some of the decisions that we worry about as faculty. (Charles, Computer Science, UCI)

All the three faculty emphasized the importance of efficiency and effectiveness to them in a work environment; however, these long department meetings are not effective and waste their time. The frustration with inefficient meetings is common among faculty participants. Faculty are perceived as individualistic and careerist professionals who have adapted themselves to managing their own labs and work schedule (Rhoades, 1998). This individualistic trait of the academic profession has inherent conflicts with a collective

culture of decision-making processes in the department. As Charles pointed out, a centralized system, for example the political system in Singapore, might be preferred in the workplace because decisions can be made faster and thus benefits the efficiency of the university. Although there is no standardized way to judge which system is better—the context matters—at least among faculty participants, the inefficiency of the decision-making culture in academe has affected their work and become stressful.

Because of the frustration with the department level service work, faculty participants chose to engage in external service and educational committees instead. For example, some faculty participants aligned their service work with their passion for teaching, where they serve on education committees in their university. Other faculty participants aligned their service work with the community engagement role of the university and thereby justified their entrepreneurial engagement in research centers as part of their service to the community.

> Then we spend a fair bit of time doing service. There're multiple levels you can do that at. The levels that interest me are the ground floor, so helping to do curriculum and courses and things like that. I helped to co-found the data science major here, and I was involved in working with the people who created the software engineering major. I like doing things that relate to what are the students going to be doing. I'm interested in that. I have zero interest in university politics, so I avoid the middle level. Then I'm very involved in external service. (Tom, Bioengineering, UCI)

In order to shy away from politics involved in service work, Tom avoids the middle level management and turns to external services and educational activities—the activities where he thinks that he can make a substantial contribution to society. Many faculty participants adopt the same strategy—avoid departmental level service and engage in external activities. They articulated an entrepreneurial logic in their justification of their

choices of service work. They indicated that their engagement in external committees has more effect on and is more beneficial to society than departmental service.

The majority of faculty participants perceived their service roles as their *pro bono* work and opportunities to give back to society. Although patenting and licensing, as well as the creation of spin-off firms, do not count as service, faculty participants saw an indirect link between their engagement in academic entrepreneurship and the service role of the university. They saw that their entrepreneurial activities generate social benefits, such as increased employment and economic contributions, and thereby enhances the role of the university in the community.

> Earlier on in my life, I very much took on board that the mission of professors is to both do research and service as well as teaching. I just really took that on board, and I had the good fortune that I come from a family of volunteers who volunteer for all kind of stuff. And so, for me the way I see service is that it's volunteer work and it just happens to be part of my job description that I should volunteer, okay, so I volunteer. And I think that in that sense I'm a better citizen than many professors who have the same job description as I have, but they spend half of their life fighting the service part. (Paris, Computer Science, UCLA)

> We all like to give our chair a lot of grief, but he's really not getting paid to be chair. I mean, he's willing to do the job. I think at universities, sometimes they're underappreciated, so that's... I view service at that leadership level within the department at university as being... That can be a source of grief, just because of our academic culture. (Charles, Computer Science, UCI)

Paris perceived his service role as his volunteering work to the society that he provided for free. Moreover, he indicated that by providing service work he can be a better citizen than others. In his view, his volunteering is a public good, where he used his time that could have been used on grant applications and other entrepreneurial activities on leading the department. However, based on these statements, Paris also sees volunteering as a

sacrifice of his time, or behaviors that will make him look like a better citizen, and therefore this contradicts his claims on public good.

In essence, faculty participants did not like politics, but they cannot change the volume of politicized decision-making in their departments and universities because academic norms encourage debate and discussion over every issue, no matter how minor. Most faculty participants aid that departmental politics were the main reason that they are involved in external services. I found one exception to this rule. Professor Paris is the only faculty who explicitly stated that he enjoys politics, and he does not think politics is a bad thing. Rather, he indicates that politics can help achieve peoples' goals and realize their agenda. However, even so, Professor Paris acknowledges that faculty would shy away from their service roles if there are too many processes and politics involved in decision makings.

It is evident in faculty responses that academic entrepreneurship has influenced faculty perceptions of research, teaching, and service roles in various ways. For many faculty participants, academic entrepreneurship brings them accesses as well as resources to research, so that they can expand their research labs, hire more graduate students, and build connections with the industries. However, the challenges instead lie in the insufficient institutional support as well as the controversial situations involved in the allocation of financial resources between their academic and entrepreneurial projects. As to the teaching and service role, the perceived influence of academic entrepreneurship varies from individual to individual. The variation in faculty responses is perhaps due to the differential effect of the level of institutional culture for academic entrepreneurship as

well as the degree of faculty entrepreneurial engagement. But most likely, there might be a survivor bias in faculty perceptions, that is, for faculty who stayed at the university, they are likely to have decreased their entrepreneurial engagement so that their entrepreneurships do not influence their academic roles. For those who have higher entrepreneurial engagement, they are likely to have left the university and thus are not included in the participants.

Balancing Strategies: Is There a Way?

As indicated above, faculty participation in entrepreneurship has led to changes in faculty's typical work environment and daily activities. These changes may add some difficulties for faculty to balance their various priorities and transition between their multiple roles. Faculty entrepreneurs needed to adjust and adapt their behaviors to maintain both roles as entrepreneurs and faculty in the two environments. Before they began their businesses, faculty evaluated the uncertainty involved around their startup businesses, made cost-benefit analysis of their entrepreneurial participation, and then decided whether or not they were able to act. Once they decided, however, they needed to make certain that their academic work was not compromised, and their entrepreneurial engagement was compatible with their other work activities. Then, how to obtain a balance at work was particularly critical for faculty entrepreneurs to maintain their dual roles. Based on faculty interviews, I identify four balancing strategies that faculty employed: *delegation of duties*, *pausing work*, *separating resources*, and *seeking legitimacy*.

***Delegation*.** The first and most common strategy is delegation—that is, faculty delegate entrepreneurial duties and responsibilities to their students, postdocs, or business partners so that they have less involvement in the companies and can maintain their independent roles of researcher. The graduate students or postdocs then become the CEO of the company and are responsible for developing company products and managing employees. Faculty, on the other hand, are listed as the founders of the company and serve on the advisory board to provide consulting services to the company. In this way, faculty can avoid potential conflicts that may harm their academic roles in research, and more importantly, they can maintain their faculty status as well as keeping up with the business world. In fact, many faculty participants indicated that they were first reached out by their students with business ideas and then started the company based on students' ideas. Their roles were mainly in facilitating their students in starting a company and providing consulting to their students' businesses rather than actively acting as an entrepreneur to manage company activities. This finding is consistent with Jain et al's (2009) findings on faculty who patented and started businesses within the university, which they found that faculty will constrain their entrepreneurial roles in order to maintain their academic identities.

> Usually what I do is also have the students included. So usually the student's involved in the research, and so it's perfectly fine to include the student as part of the patent. So then they also can spend part of their time. So even though it does take a lot of time, if you delegate and spread it out, then usually you can manage with that. (George, Bioengineering, UCR)
>
> Another challenge point is that the timelines of industry in academia are very different. So, in our research collaborations, the companies generally move extremely fast in putting together their development work and then moving compounds to the clinic. While academia moves a little bit slower because we

> work with students, they take classes for a couple years and then can get finally into their work. I always make sure to serve as a buffer between the industrial collaborators and the students to make sure that that matches up as best as possible. Because they shouldn't feel the pressure of the industry timelines, because those just don't work in an academic environment. And I have seen...immense stress as a result of the company expecting that they were going to have basically their whole research project done in a week, and that just not being possible in an academic environment. (Arthur, Bioengineering, UCLA)
>
> I mean usually it's difficult for the faculty to do, unless you're really motivated to do it. Usually what happens if it reaches such a level where we want to start a startup company, I would encourage either a post-doc, or even a student that just graduated to say, "Hey please take the idea, and start up a company." Then the faculty would just simply advise. But for the faculty just to say, "Hey, I'm going to go to 50% time, and do 50% in a new company." That's a big commitment. (Mike, Computer Science, UCR).

One common strategy shared by the three professors is to delegate any entrepreneurial activities to their students or postdocs, either in the patenting process or taking a lead in starting companies. They all acknowledge that it is too costly for faculty members to start a company themselves; they prefer to serve as consultants and advise the students instead. The delegation of duties to students also implies that faculty participants are not entrepreneurs; they are strategists who prefer to stay behind the screen, guiding and advising others to fight in the business world. In some cases, they also serve as a buffer between the industrial demands and their students, as Professor Arthur indicates, where they buffer the stress and the pushes from their business partners and make more time for their students to deliver the results.

Pausing. Another strategy that is adopted by faculty participants is to pause their entrepreneurship until they fulfill their academic responsibilities and maintain their productivity in research. They maintain their roles as founders in their business as well as their roles as faculty at universities, but they work on their entrepreneurship only in

summer or in their spare time. By university regulations, faculty entrepreneurs can claim at most one day a week to work as consultants to external companies and firms. Therefore, faculty entrepreneurs often pause their business activities during the academic quarters and return to their entrepreneurial roles during summer.

However, some faculty pause their academic roles instead to pursue their entrepreneurial businesses. According the university policy, faculty can take up to 2 years of leave of absence to pursue industrial and business opportunities. In these two years, faculty academic roles are paused so that faculty's entrepreneurial involvement will not count against their academic merit. In this way, they do not need to switch constantly between their two roles and can focus on one role only. However, as Professor Paris pointed out, there are usually two consequences come out from the pausing strategy: faculty either leave the university eventually or they sold their companies to come back teaching. In either situation, faculty eventually have to give up one of their roles between entrepreneurs or academics.

Although many faculty participants indicate that they come back to the university for the education, some of them also make careful calculation of costs and benefits involved in entrepreneurial businesses. They articulate an entrepreneurial logic in analyzing the risks and costs of their entrepreneurial business before they pause the academic clock.

> There's a trade-off, right? If it's consuming time and not making enough money to justify that time, then it's worth giving up. If the hedge fund had started making me $100,000 a year, in the first year, I might've decided to take a leave of absence from being a professor because that be enough money to support me and my family and be worth it. But it wasn't, I made, I don't know, $5,000 in one year, as a hedge fund. And although I might have been able to build it up to more

> money over time, finding clients and satisfying all the regulatory demands, in my opinion, would have just taken way too much time and taken too long (Harry, Computer Science, UCI).

As Harry states, there is a trade-off between entrepreneurial and academic commitments, and the pausing strategy allows faculty to trade their time at one job to more time at the other. In trading off, they weigh the costs and benefits of each job; they compare the salary of their academic job and the profits of their entrepreneurial business; and, they calculate the amount of work-life balance that each of the jobs allows. As such, their decisions are not driven purely by profit but through an approach that weighs both the values and meanings of the job to themselves and to their family members.

Separating. If faculty want to maintain both roles in their participation of their entrepreneurial activities, they separate resources and spaces in their entrepreneurial firms from their university work. In particular in the public university, the office spaces provided for the faculty are based on the premise that faculty can fulfill their research, teaching, and service responsibilities. Hence, any of their other work besides research, teaching, and service are conducted elsewhere. Therefore, faculty entrepreneurs separate their entrepreneurial work and academic work in two different spaces and make certain that they do not mix resources. As the two participants stated below, by separating their academic resources and their entrepreneurial work, they can avoid any potential conflicts that may be held against their academic roles and research integrity. In this way, they can continue their independent research roles at their university labs while continuing their development of technologies within their entrepreneurship.

> This is the challenge of all public universities. In that respect we have at the big disadvantage compared to private universities. Universities such as Stanford and

> UC have a lot for example, I always had to make sure that everything that's related to the company was separate from my university lab whereas at places like Stanford and USC, you could have your company in the lab. (Mike, Computer Science, UCR)

> In a private university, on the door of the university lab, it could say laboratory for “Professor X” and it will also say “and Company Y”. Right? And the students can be paid from the NSF fund and the other student is paid from the company, and they're sitting in the same lab. Whereas in a public university, we are not allowed to do that. We cannot set up a company inside the university. A typical story in the private university is that, if you are a professor who gets an SBIR, or funding from a venture capitalist, you can go to the dean and make a deal with him to set up a company. The university owns a certain percentage of that company… but in the UC university, we are not allowed to own a percentage of the company. We cannot do that. We cannot have a comingling of the company and doing research in the university… I’ve been to places that private universities, where the startup company can use the university resources. For example, the accounting of the university is done by accountants of the university, and it is a win-win situation because it will cost too much to hire an accountant from outside or pay a bookkeeper to do that (Wesley, Computer Science, UCR)

As indicated by the two UCR professors, the separation of resources is necessary to maintain their academic statuses in the institution; however, it does come at a cost, which is overworking. Many faculty participants indicated that they generally work around 55 to 60 hours a week. Sometimes, they would spend four days working at universities and then fly to the Bay Area to work on their businesses. Then, when their entrepreneurships become too time consuming, or the switch between the two roles demands too much efforts, many faculty participants would have to pause, either pause their entrepreneurships or pause their academic work, in order to maintain a balance in their lives.

> It’s hard to say. I would say a typical work week for me would be like 60 hours, probably. Faculty work, more than 40-hour weeks, as you're probably aware, which is why many of our students choose not to follow in our footsteps, because they're like, “I don't want to work like that. That’s not what I want for my life.” But I'm not sure. It's hard to say. I probably spend... A guess would be maybe one

> to two days a week on my teaching duties, averaged, and then probably four days a week on research, and so if that adds up to like six days, that would probably make sense (Paris, Computer Science, UCLA).
>
> That's a challenge. When I was in between academia and academia, actually, one of the other reasons I left academia the first time was because my kids were getting to the age... I'm trying to remember how old they were. I think kindergarten was the older of the two. I wanted to have more family time…I think it [academic] can be, if you're able to manage your workaholism, but it wasn't all that family friendly for me. We had one of the top database groups in the world, and we were all really excited and really working many hours a week, and it was hard to... I found work life balance was something that I didn't know how to do at that point. When I [left academia] and went to the startup, and actually used my weekends for weekend things, my wife was like, "I'm not sure what to do with you, because you're home at night." I think work life balance can be a challenge, and so I did not come back to academia until my son graduated from high school. I moved down here right after he graduated from high school, because we wanted to get them through that, and I wanted to not have... I didn't want to have the academic lifestyle. Now it's my wife and I, and she's a teacher, and I'm a teacher, so it's different. But there's definitely a balance challenge (Charles, Computer Science, UCI)
>
> Even companies, they work slightly longer hours, but they're able to decouple from work better I think, on weekends in particular. It's hard for academics. I mean the good news is you can do your 60 hours whenever you want, which is not healthy... but you have total freedom. (Jerry, Bioengineering, UCLA)

Paris determined that he works 60 hours per week, a figure similar to that of all faculty participants. As indicated by some faculty members, the working culture in academe is "not healthy" (Charles, Computer Science, UCI): They sacrifice family time. As noted by Charles, the job at the startup company has a better work-life balance for him than his job in academia. At the startup company, he was able to spend his weekends and nights with his wife and children, which was not the case in his faculty job. When he realized that his entrepreneurial involvement and academic work had become too daunting for him to maintain a balance, he chose the pausing strategy and left the university. Jerry further explains that one of the challenges in academic work is that faculty cannot decouple from

work but think about research and work at the same time. Then, academic entrepreneurship adds more difficulties for these faculty entrepreneurs to decouple from work. When they cannot separate their two roles anymore, they choose to give up one of the two roles.

Legitimatizing. In foregoing any institutional conflicts for their entrepreneurships, faculty entrepreneurs sought to escape the restrictions that traditionally circumscribe the commercial activities at universities by seeking a source of legitimation. For example, the DARPA program for software prototype development, to a greater degree, serve as a legitimizing source for CS faculty entrepreneurial activities. Also, Bioengineering faculty also legitimize their entrepreneurial activities by aligning their entrepreneurship with a social mission to improve lives of human beings. Computer Science faculty align their entrepreneurial activities with one of the educational goals of their university—to prepare students to innovate. The underlying rule for faculty entrepreneurs is that their engagement in entrepreneurial activities must be logical and make sense to themselves first and are aligned with the institutional goals for teaching in their universities. They view the academic world and the entrepreneurial world as equal, and their entrepreneurial goals are no different from their academic goals in generating benefits to their university and society at large. If the scale is tilted towards either end of the dual roles and breaks the balance, faculty entrepreneurs would be likely to leave either the institution or the entrepreneurial business.

Although faculty entrepreneurs all exhibit some degree of blending and integrating of market logics with academic values, the two roles—academic and

entrepreneurial—are more compatible for faculty from a higher entrepreneurial university than for faculty from less entrepreneurial universities. In the role of researcher, faculty entrepreneurs perceive the two roles as compatible when their entrepreneurial activities can bring resources to their research and are thus legitimized by federal funding. In the role of teacher, faculty perceive the two roles as compatible if their entrepreneurial activities are linked with the educational goals of the university and if they are able to integrate their entrepreneurial experiences with teaching. In the service role, although most faculty participants attempted to remove themselves from politicized service environments, they perceived the two roles as compatible if their entrepreneurial activities enhance the engagement of the university in the community.

Development of Entrepreneurial Identity and the Entrepreneurial Profession

In balancing their roles in the world of science and the world of business, faculty entrepreneurs have infused an entrepreneurial ethos into their approaches to maintain work productivity and efficiency as well as to diversify funding and resources to support their career and scientific goals. During this process, they construct an entrepreneurial identity where they strive for independence and autonomy, develop financial literacy and legal knowledge, and are motivated to make a contribution to society. However, the entrepreneurial identity of faculty entrepreneurs is different from those in the world of business. Faculty entrepreneurs do not take risks and are not driven solely by the profits generated; they socialize with other scientists and their students more often than they do with investors or other entrepreneurs. They use symbols and story-telling skills to

articulate an entrepreneurial self and with some distinctions from the business entrepreneur. They add academic values to their representation of entrepreneurial selves.

> If you have incremental growth every single year, you would expect the number of publications to increase, the number of faculty to increase, number of students to increase. And with that, the number of patents. Right? Where most of what we do, our big product is students. The next product is publications. The third product is patents. I would just keep it roughly the same, but then the goal is to continue to do good research…and look for opportunities to work with industry and also state agencies and federal agencies. (Potter, Bioengineering, UCR)

> I mean it [academic jobs] really is a multifaceted job, because you can't just sit in your office and write papers. You have to get out and do the networking, chase down the funding, work with the students. Then yeah, if some good IP comes out of it, then yeah, you usually want to try to do technology transfer. It's really just a balance of all those different things, and sort of seeing where the opportunities are… There's a fair amount of overlap. I mean I think when you talk about really specific applied research, that's what the companies will do. If you say here's a technology, a pharmaceutical company's going to want to really dive deep on that technology. Whereas, with the university maybe not so deep, but bigger breadth, right? So maybe you're looking at different purposes, or developing a larger portfolio of IP, as opposed to a company which would say, "Let's do more research in this one area that dives really deep." I think there's more breadth at the university, and more depth at the industry. (George, Bioengineering, UCR)

George and Potter perceived a multi-purpose to their academic careers: Research and teaching are important, but equal to patenting, economic engagement, and networking. In their view, the academic profession has become increasingly entrepreneurial, where faculty become both professionals and managers—regardless of their involvement with entrepreneurship.

> The sciences, for a large measure, in order to conduct your research, you need grant funding to support that research. To some degree you have to be entrepreneurial to bring in money, to write proposals, to make contacts to bring in money to support your research. That's one aspect of entrepreneurial, but it's just a sort of more traditional academic entrepreneurial approach. (Jake, Bioengineering, UCLA)

As Jake indicated, faculty in the university are not only oriented to develop knowledge but also need to develop funding raising skills to support their own research. Faculty need to write grant proposals to convince federal agencies or private foundations to invest in their research projects. In this regard, faculty act similarly to entrepreneurs—even though some faculty are more similar to entrepreneurs while others are more similar to academics—they all have to find their own funding and hire their own teams.

Despite some overlapping characteristics between university faculty and the entrepreneurs, faculty statements pointed out that faculty entrepreneurs are not authentic entrepreneurs: They do not possess the social networks and the propensity for risks and profits as do entrepreneurs in businesses and industry. Faculty participants used story-telling skills to present an entrepreneurial self in a life between academic entrepreneurship and university faculty roles. They also used personal experiences and family influences to explain how they became engaged in entrepreneurial activities and how they reconcile the tensions between their entrepreneurial roles and academic roles. Although they claimed that they are not political, they expressed concerns over political change and corruption in the funding environment for research. They conform to professional standards and university policies, but they search for personal control by establishing connections with industries and funding agencies. Academic entrepreneurship is one of the controls that these faculty establish as leverages to negotiate with their universities and to resist the federal and industrial controls over their research. In this regard, despite the conflicts and the high demands of time that emanate from faculty's dual engagement, faculty entrepreneurs chose to become entrepreneurial in

generating resources necessary to support their own work so that they can enhance their professional control over research and teaching, and, to some extent, to avoid departmental-level service.

Chapter V CONCLUSIONS

Discussion

Academic entrepreneurship is linked with the economic mission of the university that is meant to generate university revenue growth by the commercialization of academic research, and thereby to contribute to the national economy. However, such an approach neglects the educational missions of the university, and thus has distanced the university from its traditional roles in academic and social activities. The present investigation focuses on faculty entrepreneurs' experiences in university-spinoffs (USOs) and examines the compatibility of faculty participation in USOs with their traditional academic roles. The findings from the present investigation underscore the importance of educational components and shifted research norms in academic entrepreneurship. By uncovering faculty entrepreneurs' experiences in balancing their dual roles under different institutional environments for entrepreneurial activities, the present investigation sheds light on the micro-process of the institutionalization of academic entrepreneurship. The findings also point to a number of topics for further research on entrepreneurial education and the development of the entrepreneurial university.

To explore these questions, I conducted interviews with faculty members and Directors in three public universities. Motivated by the lack of research that examined the educational outcomes of academic entrepreneurship, I was initially set out to examine why faculty participated in entrepreneurial activities that are beyond their traditional work scope, and whether or not their entrepreneurial activities are compatible with their academic roles in the public university. I employed institutional theory (Thornton &

Ocasio, 2008) and identity theory (Burke & Stets, 2009) as my theoretical frameworks. Institutional theory serves as a theoretical foundation to explain the institutionalization process of academic entrepreneurship in the public university. Initially, I adopted four institutional logics identified previously in the literature as my analytical framework. However, as the data analysis proceeded, I found that the data speak to only two institutional logics, that is, the logic of academic entrepreneurship and the logic of entrepreneurship and innovation. Hence, although I explained the logic of science and the logic of the market in the literature review, I did not use them in the analysis. Furthermore, by focusing on the two most prevalent yet distinctive logics, I was able to speculate on which of the two logics are more dominant in faculty sensemaking processes as well as their identities.

Identity theory was also used to capture individuals' perceptions and sensemaking process of their entrepreneurial behaviors within their academic roles. Identity theory indicates that individuals seek verifications from others to aid their sensemaking of behaviors (Burke & Stets, 2009). An entrepreneurial identity formation requires individual to go through socialization with other entrepreneurs who share similar motivations and goals. Identity formation for entrepreneurial faculty also relies upon their ability to use story-telling skills to present their entrepreneurial selves to others. With reliance upon identity theory, I was able to probe participants further on whether or not their entrepreneurial involvement is compatible with their academic obligations.

Regarding the day-to-day work in their universities, faculty participants talked about issues far more in-depth than the ever-present questions about funding

appropriations and oversight. Not only did the federal government shift the funding towards the more applied and developmental research but also the universities joined the chorus of demands to justify faculty productivity based on faculty's involvement in entrepreneurial work. As the investigation proceeded, I found that academic entrepreneurial activities have not become "taken-for-granted" among faculty entrepreneurs in the universities that are at the beginning and middle stages of the entrepreneurial process. I based my approaches to this analysis upon two distinct institutional logics—the logic of academic professionalism and the logic of entrepreneurship and innovation. I focused my analysis on faculty entrepreneurs' use of logics to justify their entrepreneurial activities in relation to their academic roles. By doing so, I was able to show the extent to which the logic of entrepreneurship was embedded in the faculty sensemaking process of their entrepreneurial behaviors. Beneath the tip of the iceberg, there seems to be a broad agreement among faculty entrepreneurs about the boundaries of academic entrepreneurship—what are deemed appropriate and legitimate, and what needs to be constrained and restricted. Particularly, for faculty entrepreneurs who are from a high entrepreneurial environment, they have internalized the logic of entrepreneurship and innovation to reconcile the conflicts between their two roles and resolve competing tensions between the logic of entrepreneurship and the other logics in the university.

My findings suggest, first, that faculty entrepreneurs are not motivated intrinsically by the profits or the fame that are associated with their entrepreneurial activities. Rather, faculty entrepreneurial motivations are shaped largely by the external

forces from the federal government and the market. This finding is consistent with Lam (2011) and Shane et al.' s (2003) work on entrepreneurial motivation insofar that financial incentives are not the only, or even a major, influencer on faculty entrepreneurial activities. Instead, if the creation of USOs involves too much risks, faculty would pass on the entrepreneurial idea—they dislike the costs and risks and that would outweigh any financial benefits they could generate from the firms. Faculty entrepreneurs chose to engage in entrepreneurial activities, nonetheless, because they want to make "an impact" based on their research. Faculty entrepreneurs claimed that their USOs can smoothen the technology transfer process that makes the university inventions transition into the marketplace faster, and thereby bolster academic innovation. As Rhoten and Powell (2010) point out, the public university has transitioned from *land-grant* to *patent-grant*. Thus, in a *patent-grant* university, faculty are motivated to engage in entrepreneurial activities because they perceive that their entrepreneurial goals have a social purpose that can contribute to the economic well-being of society.

Indeed, there is an entrepreneurial turn in the social and political environment after the enactment of the Bayh-Dole Act—academic entrepreneurship has become more accepted, embraced, and integrated in the public university system than before. Not only the federal government but also the market has signaled the university to place more emphasis on the commercialization of research. For research universities, there have been both federal funding incentives and market demands to increase investment in commercial research. Most importantly, based on faculty interviews, the lack of availability of federal funding for basic science research is a critical condition that shapes

faculty entrepreneurial motivation. Because of the federal disinvestment in science, faculty have become more entrepreneurial in raising funding for their research, and they seek funding from other sectors besides the federal government. Because of federal restriction on research, faculty have turned to other activities, such as creation of their own business, to relieve themselves from the frustration with federal disinvestment. Although the majority of faculty entrepreneurs perceived a clear distinction between themselves and those business entrepreneurs, they have nonetheless adopted an entrepreneurial ethos to gain control over the environment and increase their leverage over research.

Second, there appears to be agreement on boundaries of academic entrepreneurship and what are deemed legitimate and what are deemed illegitimate behaviors in the entrepreneurial process. Any entrepreneurial activities that could and do harm faculty academic roles are illegitimate and therefore restricted. Faculty constrain themselves from further engaging in entrepreneurial activities if they think their entrepreneurial activities have taken away too much of their time from their academic responsibilities. Here, time is an important factor in faculty perceptions of boundaries of academic entrepreneurship. Faculty entrepreneurs ensure that they can obtain a balance among their academic work, entrepreneurial activities, and personal and family time. If they find that they have overcommitted themselves to their work, they will choose to leave either the university or their entrepreneurial firms.

Although a balanced work environment is found to be important for faculty entrepreneurs, a substantial majority of faculty participants indicated that their

engagement in USOs are more compatible than in conflict with their academic roles. In particular, the more entrepreneurial the university is, or the more entrepreneurial the departmental environment is, the more compatible and legitimate faculty entrepreneurial involvement is. For example, some activities in their USOs, such as application of patents and development of technologies, are credited and evaluated in the tenure system at the university. But others, such as allocation of financial resources and research agenda, are considered to pose conflicts with traditional academic obligations and thus are not legitimate, especially in the university that is at the beginning stage of the entrepreneurial process. Therefore, in the early stage of faculty entrepreneurship, to cope with the conflicts, faculty entrepreneurs have to use different strategies to ensure that their status as public employee is not jeopardized so that they can maintain their roles in the university as well as their roles in entrepreneurship. In the development of balancing strategies, faculty entrepreneurs have re-worked their academic identities and employed new institutional logics to make sense of their entrepreneurial behaviors to their institutions and to themselves.

Third, my findings on faculty perceptions of research reveal a complex pattern of faculty norms and attitudes under the influence of academic entrepreneurship. With regard to research norms, the majority of faculty participants perceived their entrepreneurial activities as a mechanism for the distribution of university research. They did not object to the idea of commercialization of research activities. Nor did they deny that there was increased secrecy involved with research. However, they perceived their entrepreneurial behaviors are in line with their research goals and do not compromise

their fundamental values for the disinterested role of science. The contradiction in faculty responses suggests a complexity in the scientific norms in the university; the norms adopted by faculty entrepreneurs are not the same as Mertonian norms. However, they are not perceived as conflicted with the Mertonian norms either. Instead, they are extensions of Mertonian norms on open science and disinterestedness of university research—a hybridization of science and entrepreneurial behaviors.

There is also a difference found in faculty norms towards intellectual property protection, and the difference is closely associated with academic discipline. Faculty entrepreneurs in Bioengineering substantially more approve the idea of patenting and intellectual property protection, whereas Computer Science faculty entrepreneurs are more committed to the norms of open science and free distribution of knowledge. In their justification, Computer Science faculty indicated that the knowledge developed in the public university should be free and accessible to the public so that everyone can contribute to the development of knowledge. Then, the open science enhances the public good of the society. In contrast, Bioengineering faculty employed the logic of entrepreneurship and argued that the public good can be enhanced only when faculty's intellectual property is protected. By protecting faculty intellectual property, faculty are more motivated to share their research results with the community, and faculty research can be better recognized by pharmaceutical companies. Indeed, this difference is closely associated with the nature of the research in both disciplines. Moreover, such difference is also rooted in the costs of research for each discipline: the making of a bio-technology related product can cost much more than writing programs and development of software.

Thus, even though Bioengineering faculty entrepreneurs may not be fundamentally objective to the norm of open science, they are realistic about the costs and returns of the investment on their research.

Furthermore, instructional norms and teaching goals have become more diverse and complex in the context of academic entrepreneurship. Faculty entrepreneurs expressed that their instructional approaches are enhanced because of their involvement in entrepreneurial activities. They are able to integrate their entrepreneurial experiences in instruction and make their classes connected to the real-life situations. In this regard, faculty entrepreneurs' teaching pedagogy is highly aligned with John Dewey's education philosophy that students can learn best when they interact with the environment and apply their knowledge into real-life situations. Although the field of engineering has had an experimental component in instruction, there has been a new theme in engineering education—entrepreneurial education. Given that there is increased demand from the federal government on students' abilities to innovate, the future of teaching in engineering will become more entrepreneurially-oriented and incorporate tacit knowledge about venture creations, product designs, and legal practices,

Fourth, my findings also indicate that there is a likely shift in the university research agenda toward the applied end. The role of basic science could be compromised if the momentum towards applied research continues to increase. Although faculty entrepreneurs argued that there is a natural symbiosis between basic and applied science, where science can be inspired by use, they did not deny that some of their colleagues who do only basic research could struggle with obtaining funding with the present

environment of overt promotion of applied research. They also noted that sometimes they have to shape their research goals to make them applicable to society. However, whether or not such shift in faculty research agenda will incur important changes or issues in the landscape of science and future direction of science requires more research.

Fifth, because faculty entrepreneurs have developed a new set of norms and values in their entrepreneurial process, they have also reworked their academic identities and added a component of entrepreneurial ethos and norms. Powell and Sandholtz (2012) described scientists who engaged in venture capital funded startups as *amphibious entrepreneurs,* who import tools and strategies of organizing ideas from the academy into their entrepreneurial firms. In the present investigation, faculty participants are *amphibious entrepreneurs* as Powell and Sandholtz described, but more importantly, they also export values and logics from the entrepreneurships into their academic work. They stress self-efficiency: they take pleasure in the fast-paced work environment and the centralized control in the world of business. As a result, when they return to the academic environment from their entrepreneurial business, they become frustrated with the slow pace of decision-making and the democratic structure of governance in academic departments. Thus, faculty entrepreneurs struggle to re-adjust their behaviors to make sense of their academic roles—they disengaged themselves in departmental governance and turned to external engagement. In this way, they claimed that their time was used more efficiently.

In addition, in developing an entrepreneurial identity, faculty entrepreneurs also expanded their social network and constructed stories to convey an entrepreneurial self.

In line with Ollila, Middleton, and Donnellon (2012), my findings suggest that faculty entrepreneurs have collaborated in research with industrial scientists and with researchers in the private sector. Moreover, faculty entrepreneurs have built connections with legal firms and venture capitalists for their entrepreneurial business. Their network has expanded beyond the scientific community and intruded into the business world; their collaboration has also diversified with not only scientists or researchers but also managers, other entrepreneurs, and lawyers. This expanded network reflects that faculty entrepreneurs have constructed an entrepreneurial identity beyond their academic work. In socializing with people outside the scientific community, faculty entrepreneurs have developed story-telling skills to present an entrepreneurial self to others. In this way, they are academics but also entrepreneurs; their entrepreneurial stories start from their academic roles and passion for research and transition into their experiences in realizing their ideas in the business world.

Sixth, the present investigation sheds light on the strategic goals of the entrepreneurial university where entrepreneurial behaviors and ventures have become acceptable to and even compatible with research, teaching, and service. The institutionalization of academic entrepreneurship is reflected in the ways that UCLA, UCI, and UCR faculty members make sense of their entrepreneurial behaviors. UCLA faculty participants have internalized the entrepreneurial norms as part of their academic work and daily activities. They have transcended the pitfalls from the past and internalized the rationales and logics for academic entrepreneurship. UCI and UCR faculty, however, continue to seek additional legitimating sources to make sense their

entrepreneurial activities. The differences in faculty sensemaking of entrepreneurship among the three universities indicate the level of embracing an entrepreneurial culture on each campus. Furthermore, it was evident that all the faculty participants share the similar or identical behavioral norms in research and entrepreneurial activities; however, their values and practices of teaching vary by university. UCLA and UCI faculty participants have recognized the value of academic entrepreneurship to teaching and education of students, and thus they incorporate an entrepreneurial focus in their curricula. UCR faculty participants, in contrast, did not recognize the implication of academic entrepreneurship for their instruction. Nor did faculty at UCR align their entrepreneurial goals with their teaching goals. In this regard, UCLA and UCI campuses have institutionalized entrepreneurialism whereas UCR has not, and thus does not fit in the category of an entrepreneurial university. This is consistent with Etzkowitz's (2013) findings on the entrepreneurial university, where the university develops from the commercialization of research and extends to incorporate an entrepreneurial ethos in numerous aspects of campus life, including in teaching and educational activities.

Seventh and finally, the investigation uncovers a multi-stage process of the development of the entrepreneurial university—from its early stage in the adoption of business behaviors and management strategies, to the commercialization of research, to the integration of entrepreneurial goals into teaching and the education of students, and to the construction of an entrepreneurial community. This finding extends previous scholars' findings on the characteristics of the entrepreneurial university. Clark (1998) identified five characteristics of the entrepreneurial university: diversified funding,

strengthened management core, expanded development periphery, stimulated academic heartland, and integrated entrepreneurial culture. In the present investigation, I conclude that the incorporation of entrepreneurial education is another important characteristic of the entrepreneurial university. At UCLA, entrepreneurial education is well-integrated into campus life, where their engineering students are entrepreneurial and business-oriented. UCLA faculty have taken for granted the incorporation of entrepreneurial education into their instruction. At UCI, faculty recognized the importance of entrepreneurial education and began to lead student teams to work on entrepreneurial projects. Although UCI faculty's perceptions of entrepreneurial education is not as prominent or as taken for granted as those of UCLA faculty, they were able to align their entrepreneurial goals with the educational goals for enhancing their student entrepreneurship and innovation abilities. However, such alignment is missing in UCR faculty perceptions. The difference in faculty recognition of entrepreneurial education not only reflects the level of institutional environment for academic entrepreneurship but also indicates the process of creating the entrepreneurial university.

The UC universities' mission includes not only the generation of knowledge but also the education of their students. UC faculty have also adopted this value and express their devotion to teaching. Faculty entrepreneurial involvement can have some meaningful influence on their students; it diversifies their graduate students' career options and enhances students' overall learning experiences in the university. This is not tokenization of students, what Slaughter et al. (2002) argued, but uses educational goals of higher education programs to fulfill the social missions of the university. The present

investigation suggests that faculty entrepreneurs have aligned their teaching goals with their students' demands rather than their own.

With regard to the service role of faculty entrepreneurs, the present investigation finds that the service role is one of the important linkages that connects the logic of academic professionalism and the logic of entrepreneurship. Although Etzkowitz (1998, 2003) and Clark (1998) noted the presence of the logic of entrepreneurship in research and teaching roles in the entrepreneurial university, they did not discuss the role of service and how the service role of faculty is presented in the model of the entrepreneurial university. The present investigation demonstrates that faculty entrepreneurs are more inclined to serve the external community than serve on internal committees. They attribute their entrepreneurial activities to a social mission of the university that solves social problems as well as contributes to the economic well-being of the local community. Therefore, some faculty entrepreneurs justify their entrepreneurial activities through the lens of service: Their engagement in entrepreneurial activities is part of their service work to the community and to society at large. In this way, the service role of the entrepreneurial university is enhanced, and the university's connections with the local community are strengthened.

Although the service role of the entrepreneurial university in the external community is strengthened, its internal service might be weakened. The weakened commitments to internal service are evident in faculty entrepreneurs' shared dissatisfactions over service, especially over departmental meetings. However, this dissatisfaction over service work might not be uncommon in academic life. From Clark's

research on faculty cultures in academic departments (1987) to Finkelstein, Conley, and Schuster's (2016) research on academic work, faculty attitudes towards departmental level services are divided: some faculty are more engaged in departmental level service while others hold negative views of departmental meetings because they foster unappealing departmental politics. Based upon this investigation, faculty want to serve as good citizens, or they want to achieve merit, or advance in the tenure and promotion system, or fulfill all of these goals. In this investigation, some faculty entrepreneurs do perceive their service to their department fulfill their role of good citizens. However, despite this citizenship view, the majority of faculty entrepreneurs perceive their departmental meetings as inefficient. This raises the question of whether or not the current practices and purposes of departmental meetings fit the model of the entrepreneurial university. More research is needed to explain the service role's connection to the entrepreneurial university and to the decision-making processes in academic departments.

Implications for Theory Development and Future Research

Theoretical Implications and Development

A number of entrepreneurship scholars (Klingbeil, Semrau, Ebers, & Wilhelm, 2019; Perkmann et al., 2017; Shane et al., 2003; Siegel & Phan, 2005) as well as scholars associated with institutional theory and institutional logics (Powell & Colyvas, 2010; Thornton & Ocasio, 2008) have called for research to focus on the largely unexplored mechanism that links macro-level institutional logics with individual level motivations and behaviors. The present investigation provides insight on how faculty entrepreneurs

connect the linkages between the macro- and micro- levels of the logic of entrepreneurship through sensemaking and mitigations with different coping strategies. I first highlight the role of faculty entrepreneurs as intermediators who reconcile the tensions between conflicted institutional logics as well as the tensions between macro-level incentives and individual level values and motivations. In reconciling the tensions, faculty buffer the pressure from federal disinvestment in basic research and the commercial incentives from the marketplace and maintain their academic selves by their devotion to education and their contributions to community development. In doing so, faculty entrepreneurs serve as intermediators who reinforce the institutionalization of the logic of entrepreneurship and apply the logic into the university's daily practices. Therefore, the present investigation proposes a multi-level theorization of the institutionalization process, where faculty play important roles in linking macro-level logic with micro-level processes and practices.

Institutional theorists, such as Meyer and Rowan (2006), Powell and DiMaggio (1987), argue that the institutionalization of a new activity enhances the prominence of the logics associated with that activity and legitimizes behaviors related to those in the institution. Once a new activity is institutionalized in elite institutions, other institutions will follow. Powell and Colyvas (2010) explain that the institutionalization process is reflected in individual members' discourse, vocabularies, and sensemaking processes. Although institutional theorists provide important insights into the institutionalization process, they do not distinguish the extent of institutionalization. In higher education, the logic of academic entrepreneurship was introduced to colleges and universities in the

1980s. However, the extent of entrepreneurial activities on campus is not the same across higher education institutions. Even within the same university system, some universities are further advanced than others in integrating and transmitting the logic of entrepreneurship to their institutional members.

In the present investigation, faculty entrepreneurs reconcile and internalize the tensions between the two institutional logics, and, during this process, they construct an entrepreneurial identity within their academic positions. However, the level of faculty internalization of academic entrepreneurship differs across the three campuses. UCLA has acceded readily to the expectations imposed by the logic of entrepreneurship, and their faculty members see entrepreneurial activities as a taken-for-granted activity; however, faculty from the other two campuses have not achieved such internalization. Hence, faculty have different degrees or levels of internalization and application of the logic of entrepreneurship, and, in this regard, the institutionalization process of academic entrepreneurship likely entails several stages and is tiered in multiple levels.

At the early and first stage of the entrepreneurial university, as Clark (1998) indicates, universities adopt management strategies from the private sector to strengthen the effectiveness and efficiency of university operations. Special organizations are established on campus to support campus administration. Universities form collaborations with industries and companies to build partnerships and generate revenues. The early stage of the entrepreneurial university is characterized by an entrepreneurial approach and intention of the university to strengthen its management core and diversify its funding and revenue sources.

At the second stage of the entrepreneurial university, although the university has embraced the new activity onto their campus and established policies to support entrepreneurial activities, the logic of entrepreneurship and innovation has not been institutionalized in all departments across the university. In the early stage of the entrepreneurial university, the more entrepreneurial departments on campus will respond more actively than the other departments to incorporate entrepreneurial activities as part of departmental norms. Faculty members who are in the entrepreneurial department will be open to new entrepreneurial activities and will allocate their time among the entrepreneurial and academic roles based on the time-intensity of research goals relative to their departments. The supporting organizations, such as the Technology Transfer Office, play a crucial role in this process because they are the main contacts for faculty to build connections with business entrepreneurs and industrial partners. These organizations assist faculty to integrate the logic of entrepreneurship into their research by training and preparing faculty to work with other entrepreneurs in business. In this stage, faculty are socialized with people outside the university, and the logic of entrepreneurship is reflected, in the main, in faculty perceptions of their research. However, in this second stage, faculty begin to internalize the logic of entrepreneurship and apply this logic to their other academic roles, such as teaching and service.

In the third stage, faculty entrepreneurs also integrate the logic of entrepreneurship into their instruction or add a component of entrepreneurship into their course curricula. Faculty entrepreneurs are motivated to share their entrepreneurial experiences with the other members in the university and thereby foster the

institutionalization process of academic entrepreneurship. By aligning the logic of entrepreneurship with university missions, faculty entrepreneurs become advocates for the logic of entrepreneurship and reinforce the logic of entrepreneurship on campus. Hence, through faculty engagement in and reinforcement of entrepreneurial activities, the logic of entrepreneurship and innovation becomes institutionalized and integrated into almost every aspect of faculty work. In the third and final stage, academic entrepreneurship is taken for granted for by faculty members in the university, and the values and norms associated with academic entrepreneurship are shared by all faculty members as well as other members in the institution.

The present investigation sheds light on the process of institutionalization. The more institutionalized the logic of entrepreneurship, the more prevalent it is reflected in faculty perspectives as well in different aspects of their academic lives. Built upon the institutional logic of entrepreneurship, the present investigation suggests that the more integrated the logic of entrepreneurship is in faculty perceptions, the more likely faculty will use the logic of entrepreneurship to guide their behaviors, and thus the more prominent entrepreneurship will be in faculty identity. Literature on faculty identity stresses that research and teaching are the focal activities that comprise faculty identity in the research university (Levin et al., 2020). However, the proliferation of academic entrepreneurship in the university has changed the dynamics between research and teaching and has encouraged a new way of faculty organizing research, teaching, service activities, and entrepreneurial activities in the university. On the one hand, the logic of entrepreneurship and innovation has altered the way in which faculty perceive the value

of research and the purpose of teaching aimed at students. On the other hand, the social network that faculty entrepreneurs create in the industrial sector adds new perspectives on and values to their academic work and thus changes their perception of the academic profession as a whole. In constructing a new entrepreneurial identity, faculty attribute a social mission to their research while they maintain their academic values. In this way, they legitimize their entrepreneurial self in the university. Identity theory notes that individuals seek verification from others to justify their behaviors, and faculty entrepreneurs adopt strategies for verification, such as audience segregation and impression management, to verify their entrepreneurial and academic selves from different audiences.

Implications for Practice

Faculty entrepreneurs in the present investigation have by-passed the Mertonian scientific ethos by deliberately blurring the boundaries between the world of science and the world of entrepreneurship. They infuse an entrepreneurial ethos by applying for funding, generating resources, and by employing multiple logics to maintain their legitimacy and adhere to public values for the research. However, if these changes in research norms do not contribute to academic roles, academic entrepreneurship represents nothing new but is simply a business dressed up with academic jargon. The present investigation suggests that the goals for academic entrepreneurship should be distinguished from that of business entrepreneurship—the goals of academic entrepreneurship should be to solve social problems rather than making profits. Furthermore, because of its unique setting of conducting entrepreneurial activities in an

academic environment, the purpose and scope of academic entrepreneurship should also be broader than economic development and extends to the education of students. In particular, university faculty are essentially academics first and foremost who do not perform optimally if they are given a specific set of goals. The overt focus on commercial potentials and profit margins of faculty's inventions could instead limit faculty innovation abilities and discourage them from further participation in social and community engagement.

This, then, signals a change in the legitimization of public higher education, in fundamental values about what it should be and do to uphold its legacies and retain social support. The shift for U. S. research universities, from expectations to fulfill an ever-expanding array of social, democratic, and community functions to prioritizing of economic functions and responding to preferences and demands of the market, is a change in how campuses conduct themselves. In order to balance all the various demands from the market, governments, and students, and not compromising the traditional values of education and service, universities are obligated to consider practices that can link their economic mission with social values and as well use academic entrepreneurship to solve social problems.

Development of Academic Entrepreneurial Identity

Academics move cautiously, and entrepreneurs move quickly; academics study problems, and entrepreneurs solve problems; academics function in constraint, and entrepreneurs create possibility; academics focus on patterns in the research, and entrepreneurs focus on expectations of their clients. A common assumption is that

academics and entrepreneurs live in different worlds—that is, the expectations and norms are different in these two worlds and there is no overlap. However, in the present investigation, the faculty participants bridged the world of entrepreneurs and the world of academics—they work on business entities that are affiliated with the university and generated based on their research. They not only conform to rules that are established in professional communities as well as those in the business world but also merge both academic norms and capitalist behaviors in their academic work. In this way, faculty entrepreneurs construct an academic entrepreneurial identity that blends academic values with an entrepreneurial ethos to accomplish both their academic and entrepreneurial goals.

While constructing an academic entrepreneurial identity, faculty entrepreneurs also faced criticism that focuses on faculty motives for profits or their intentions to align academic values with business goals—or sometimes both—as academic entrepreneurship's prime purposes are revenue generation and economic returns. A social stigma is thus associated with their entrepreneurship: What if these faculty entrepreneurs take advantage of their unique positions in the two worlds to gain reputations and generate benefits for themselves? To overcome such stigma, faculty entrepreneurs have incorporated a social mission in their entrepreneurial activities as well as in their entrepreneurial identities. They argue that by combining creative, scientific solutions, and business principles, they can solve social issues in an effective way. The integration of social missions in their entrepreneurial practices and as the blending of academic values in their construction of entrepreneurial identities enable them to function effectively in

the two worlds and combat the social stigma that are traditionally associated with entrepreneurial activities.

In maintaining an academic self, faculty entrepreneurs sought to detach themselves from the commercial values of entrepreneurship but aligned their entrepreneurial goals to educational goals of the university. Faculty entrepreneurs added educational values to their entrepreneurial behaviors and thus enhanced their autonomy and legitimacy. By integrating their entrepreneurial behaviors with their academic identities where faculty conform to the codes of research for the public good and benefit to society, faculty entrepreneurs are set free to engage in commercialization activities and make profits for themselves.

The present investigation suggests that the academic entrepreneurial identity is comprised of a social mission to solve problems and an educational goal for cultivating more entrepreneurial students, as well as business work ethics to become efficient and self-sufficient at work. Simultaneously, faculty entrepreneurs expand their social network beyond the academic community to the world of business and construct stories to present their entrepreneurial selves. The construction of an academic entrepreneurial identity might be inevitable because in a world where funding is stagnant and the competition for resources is fierce, faculty have to rely on themselves for career development. In the face of uncertainty, faculty are obligated to think and act as entrepreneurs: self-reliant, innovative, and knowledgeable about how to network and stand out from the crowd.

Barriers to the Entrepreneurial University

If the university wants to promote the entrepreneurial ideal and transition into the entrepreneurial model, then identification of institutional barriers is a necessity. The present investigation reveals several institutional barriers that are identified by faculty entrepreneurs as limits to their progress in entrepreneurial participation. First, the tenure system is based primarily on publications, with some exceptions. It is unlikely, then, for faculty members to embrace entrepreneurial norms before they obtain tenure. As Computer Science faculty member Wesley noted, entrepreneurial activities do not contribute to his tenure. He could not achieve promotion, no matter how successful his entrepreneurial business if he does not have sufficient publications. However, in the department of Bioengineering, faculty in contrast to Computer Science, indicated that their patents are recognized and valued in their departments and can contribute to their tenure process. Bioengineering faculty noted that one high quality patent can equal one good publication in their evaluation and merit review. There are departmental differences in what counts as faculty work and productivity.

A physical space for academic entrepreneurship is also important element for faculty to transition from their academic roles into their entrepreneurial business. Particularly for public universities, faculty's office spaces are only provided for faculty to do academic related work. Faculty entrepreneurs must separate completely their entrepreneurial activities from their academic research. A physical space for entrepreneurship is particularly useful for faculty to switch roles and to enact an entrepreneurial self.

To many scholars and policymakers, academic entrepreneurship is misconceived either as the evil to the academic integrity of science or the "silver bullet" to all issues in higher education. The present investigation sheds light on this issue and argues that academic entrepreneurship could be beneficial for traditional academic work due to its contributions to social and economic environments. However, if profit-making becomes a goal on the part of faculty, then the association can become detrimental to the academic identities of faculty and erode the public value of university research. Therefore, the integrity of academic entrepreneurship requires dedicated efforts from a wide range of stakeholders, from the community level, the higher education institutional environment to the departmental culture and the personal motives of faculty.

If the university wants to resist the market influence and gain the research controls back from the industries, it needs to invest in faculty research. More importantly, if the university wants to enhance its role in the community, it needs to engage their faculty members in social outreach and in economic activities in the community. This also requires the community to invest in university research and make connections with the faculty research and engage faculty in the community development. In this way, academic entrepreneurship can be compatible with, and even enhance, the academic roles of faculty.

Implication for Future Research

Further research can focus on the education of student entrepreneurship in the context of academic entrepreneurship. As the findings suggest, academic entrepreneurship is no longer limited to faculty; students have become increasingly

important in the creation of patents and USOs in higher education. Furthermore, the federal government has invested in encouraging full participation of college students in entrepreneurial activities and cultivating an entrepreneurial orientation. It is thus imperative for universities to incorporate an entrepreneurial component in their STEM curriculum. Student engagement in entrepreneurial activities can also help to resolve the tensions of student employability skills and facilitate students' professional development for their future careers. However, how the engagement of students in entrepreneurial activities influences their college learning and experiences remains unknown. More importantly, what are the best practices and pedagogies to introduce entrepreneurship to STEM students are questions that require further research.

In addition, more research can address both faculty mentorship of students and student mental health in the context of academic entrepreneurship. My findings suggest that there is a changed dynamic in mentoring relations between faculty and students due to faculty-student partnerships in entrepreneurial activities. Doctoral students particularly have a close mentoring relationship with their faculty advisors and are more likely to form collaborations with their faculty advisors. However, doctoral students are also the vulnerable group in this relationship because their advisors can play a crucial role in students' educational future careers. A simple conflict could damage students' mental health and professional development (e.g., Evans et al., 2018; Levecque, Anseel, Beuckelaer, Van der Heyden, & Gisle, 2017). Therefore, there is need for future research to investigate how collaborative entrepreneurial activities influence students' relations with their advisors, their learning trajectories, career outcomes, and mental health.

Moreover, future research can address how intellectual property and legal issues play into faculty-student co-inventorship of patents so that both the student and the faculty are protected in controversial situations to avoid conflicts.

As indicated in the present investigation, institutional context plays a significant role in shaping faculty entrepreneurial participation. Future research can focus on faculty entrepreneurs from private universities and compare academic entrepreneurship between the public and private university. In this way, a comparative study of the public and private university can enhance understandings of how institutionally based frameworks shape the influence of academic entrepreneurship on academic roles of university faculty. In qualitative research, interviews can be conducted with not only faculty entrepreneurs who maintained their positions in the university but also those who left the university because of their intensive engagement in entrepreneurial activities and compare the two groups. In quantitative research, longitudinal data on faculty engagement in entrepreneurial activities can further understandings of how academic entrepreneurship influence academic roles and the missions of universities. A comparative and longitudinal data will further our understandings of academic professional identity, explain more clearly the characteristics of academic professionals as compared to those with similar backgrounds, interests, and experiences, and enable us to speculate on different stages of academic life.

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Appendix A.

Opening Introduction

Hi, I am Suki Wang, a PhD candidate in the Higher Education Policy program at UCR. The purpose of this interview is to explore your experience with Entrepreneurship and spin-off firms. I want to begin to explain how faculty identity may have changed or become re-constructed due to your experiences with entrepreneurship. I will focus on three aspects of the experience: your perspectives on the benefits of your involvement in entrepreneurship to the notion of "public good"; how you characterize yourself and your roles in this process; and, what are your personal motives for engagement in entrepreneurial activities.

I want to reassure you that this is not a public conversation. You will provide consent for this interview, and I will not disclosure your name publicly. If I use a quote from the interview, I will use very general language to describe you, such as "an engineering professor in a UC campus." I will be tape recording this conversation so that I have an accurate record of what you have said. This tape recording will be transcribed for further analysis, again preserving confidentiality. If you have any concerns about the questions, you do not have to answer any question and you can withdraw from this interview at any time. Thank you for accepting this interview.

Interview questions

The first set of questions concerns issues related to your background and your perspectives on conflict of interests, money-making behaviors that are involved in the spin-off firms, and your sense of the major issues facing the entrepreneurial process at universities**.**

A. Identity and Role Conflicts

a. People like yourself who we might call the "boundary-spanner" that connect the academic and business worlds have been the recipients of considerable criticism in recent years. Scholars have criticized the faculty entrepreneur as "money-making" "self-interested" and "disengaged in

teaching and distant from students" What do you think of these criticisms? Do they contain kernels of truth? Or are they misguided? Why?

b. How would you describe yourself, academic, a scientist/engineer, or an entrepreneur?
    i. Do you see these roles are combined? If so, in what ways?
c. What are the characteristics do you think that make a successful academic entrepreneur?
    i. Do you think these are the traits that make you successful in entrepreneurship?
d. In your experiences with entrepreneurship, have you encountered conflicts? If so, are these conflicts mainly with colleagues or with others working with you on your entrepreneurial activities?
    i. How did you resolve the conflicts? And has it influenced your other work?

B. Balance with Academic Work

a. What satisfaction or enjoyments do you get from entrepreneurial activities?
b. Do these satisfactions interfere with your satisfactions in other professional roles? If so, how?
c. What do you view as the relationship between entrepreneurial activities and your research? Are the two mutually reinforcing? Or do they lead in different directions? How so?
    i. Can you explain whether or not your research direction has changed after your participation in entrepreneurship?
    ii. Can you discuss the reason for these changes? What circumstances or meanings have changed for you? When did they change? How did you feel about these changes?

d. What do you view as the relationship between entrepreneurial activities and your teaching? Are the two mutually reinforcing? Or do they lead in different directions? How so?
e. What do you view as the relationship between entrepreneurial activities and your service? Are the two mutually reinforcing? Or do they lead in different directions? How so?

C. Dilemma Analysis

The second set of questions are intended to find out more about your approaches in some hypothetical yet controversial situations.

a. What would you do if you were engaged in a contract research, but the contracted company forbids you to publish any research before the results was patented and licensed exclusively to the company?
b. What would you do if a colleague reaches out to you for your data and ask for sharing some of the results of your research? What are the factors or things that would influence your decisions in this situation?
c. If you have a spin-off company idea, what would be the factors that will influence your decisions to actually launch the idea?
d. If your spin-off firm demands your involvement more than one day a week, and your business partners have demanded you to be more engaged in the company, what would you do in that situation? What would be your approaches to handling the balance between your academic work and your entrepreneurial work?

Identifying Information

1. Academic discipline:
2. Academic status:
3. Years working in this institution:
4. Years working with RED center: