Commercialization, Collaboration and Conflict of Interest: An Institutional Work Analysis of Academic Entrepreneurship in Canada

by

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Institute of Health Policy, Management and Evaluation
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Abstract

Recent health research and innovation policies have encouraged academic biomedical scientists to engage research commercialization and collaborations with the health products industry. These activities of ‘academic entrepreneurship’ have been valued for their ability to produce social, economic, and health impacts. However, these initiatives have also been met with concern for their potential to create conflicts of interest. This study examines how publicly-funded academic biomedical scientists in Canada value the activities of academic entrepreneurship and manage conflict of interest concerns. Drawing on neo-institutional theories, this research explores the institutional logic of entrepreneurial science, and the micro-level negotiations of ‘institutional work’ conducted by academic entrepreneurs in legitimizing entrepreneurial initiatives.

This mixed-methods study draws from a national survey of publicly-funded biomedical researchers (n = 1,618), and in-depth interviews with 24 academic entrepreneurs and 14 trainees. Analyses indicate that the institutional logic of entrepreneurial science tends to
be positioned as distinct to academic science, though this logic is heterogeneous. Exploring entrepreneurial scientists’ institutional work in valuing and navigating entrepreneurial activities, normative value is generated in these activities through proposals of their contributions to scientific processes and downstream clinical and societal impacts. Entrepreneurial scientists simultaneously claim adherence to academic norms, and use these to legitimize their entrepreneurial engagements. In navigating entrepreneurial activities, entrepreneurial scientists engage in strategies to maintain academic activities alongside entrepreneurial ones, and claim to avoid conflicts of interest.

In an environment of overall skepticism and uncertainty about academic entrepreneurship, entrepreneurial scientists engage in institutional work processes of change-through-maintenance, where appeals to the maintenance of academic norms serve to legitimize entrepreneurial activities. As entrepreneurial initiatives proceed in academic biomedical science and are legitimized by entrepreneurial scientists, this study calls for a need to scrutinize and regulate these initiatives, especially as potential conflicts of interest and their impacts tend to be obfuscated.
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Chapter 1
Introduction

1.1 Study Context

This study examines academic biomedical scientists’ values related to academic entrepreneurship or entrepreneurial science and the associated potential for conflicts of interest in academic biomedical research in Canada. Academic entrepreneurship is understood as the activities undertaken by academic scientists to push their research to market applications through commercialization activities, as well as associated collaborations with industry (Etzkowitz, 2008; Etzkowitz & Webster, 1998; Etzkowitz, Webster, Gebhardt, & Terra, 2000). Entrepreneurial science is thus taken to be a multitude of activities related to academic research commercialization, where academic-industry collaborations support these commercialization activities (Grimaldi, Kenney, Siegel & Wright, 2011). These entrepreneurial pursuits, where academic scientists engage with industrial actors and market and proprietary demands, are positioned as a significantly divergent set of norms and activities to academic science. Consequently, the emergence of entrepreneurial activities in academic research has been met with some concern for the potential of these activities to cause conflicts of interest and other harms for academic science and academic scientists, where commercial or industrial interests might overtake academic ones (Bekelman, Li, & Gross, 2003; Hampson, Bekelman, & Gross, 2008; Lemmens & Luther, 2008; Tereskerz, 2003). This has been especially true in the biomedical sciences, where conflicts of interest for academic scientists can have far reaching implications for medical evidence and human health.

Academic entrepreneurship in the biomedical science has been increasingly encouraged and facilitated by a number of health and innovation policy initiatives at governmental and organizational levels in Canada and internationally, where the social, economic and health impacts of these activities have been proposed. Yet little attention has been given to how academic scientists themselves value these activities, and how they understand
and manage the potential for conflicts of interest in this context. This study thus examines the ways in which publicly-funded academic biomedical scientists in Canada value entrepreneurial initiatives, and explores how academic entrepreneurs work to legitimize these activities in an environment where there is great promise and considerable concern granted to entrepreneurial science.

In Canada, health and biomedical research has been described as a key domain of capacity and potential in innovation and profit generation (Industry Canada, 2007). The transfer of academic research to practical market applications has been proposed to both bolster national economies and address health concerns through the creation of health products (Brimacombe, 2005). However, the Canadian context and climate of academic entrepreneurship and innovation has been criticized for its poor performance and underachievement in translating academic inventions to market applications (Jenkins et al., 2012; Sa & Litwin, 2011). This has sometimes been termed Canada’s “innovation gap” (Yakabuski, 2009). Measuring the performance of Canadian innovation, the Conference Board of Canada has consistently given Canada a “D” grade, and ranked it 13th amongst 16 peer countries. Despite scoring relatively high on publication performance and public research and development (R&D) spending, Canada has done poorly by measures of patents, technology manufacture, market share, and connectivity (Conference Board, 2013). In a 2011 International Review of Canada’s primary federal health research funding program, the Canadian Institutes of Health Research (CIHR), Canadian research commercialization was characterized as “wholly undeveloped” (CIHR, 2011).

In response to this so-called innovation gap, and increased attention to the commercialization of health research in Canada, several national strategies have been launched to promote commercialization activities amongst academic biomedical researchers (Atkinson-Grosjean, 2002; CIHR, 2005; Rasmussen, 2008). These innovation and commercialization policy levers rely on a claim that innovation and entrepreneurship can build Canada’s “knowledge economy”, and lead to diverse social impacts (Industry Canada, 2007). For example, federal initiatives such as CIHR’s
Commercialization and Innovation Strategy (2005) forms part of their Knowledge Translation (KT) Strategy, by positioning commercialization as the translation of research to user communities while contributing to Canada’s economic competitiveness and quality of life. This strategy has committed to move upstream publicly funded research to market through commercialization, and promises economic benefits for Canadians as a result of publicly-funded research. CIHR has initiated funding strategies to foster the commercialization of Canadian technologies, including the *Proof of Principle* grants, which provide funding to develop academic research into early commercializable technologies. Other initiatives include the *Centres of Excellence for Commercialization and Research* (CECRs), funded by the federal government as part of the *Networks of Centres of Excellence* (NCE) program. These initiatives involve public funds directed towards academic research initiatives that have clear business development plans, and involve collaboration and partnerships with industry. They symbolize a fundamental shift toward promoting and developing commercial applications in academic science through encouraging academic-industry collaborations in Canada (Atkinson-Grosjean, 2002).

As well, governments have invested in organizational structures such as *MaRS Innovation* in Toronto, an incubator organization aimed at facilitating linkages between academic research and commercialization. Initiatives forwarded by Genome Canada and the Canada Foundation for Innovation (CFI) also aim at building linkages between academic researchers and industry, and mandate collaboration and co-location between academic researchers and industry through government support (Downie & Herder, 2007). The Association of Universities and Colleges of Canada (AUCC), Canada’s leading advocacy group for higher education, has also supported the academic research commercialization agenda through an agreement with the federal government to triple research commercialization in Canada in exchange for greater federal investments in research (Metcalf, 2010). Through the support of the AUCC and the federal government, universities and academic research centres in Canada have been identified as integral organizations in fostering innovation and economic development (AUCC 2010; 2011; Sa & Litwin 2011).
Throughout, these federal and organizational initiatives assert the potential of publicly-funded academic health research to develop Canada’s economy and advance social benefits. Through the commitments of the professional bodies of higher education, academic scientists and trainees are placed as agents participating in entrepreneurship and contributing to economic development. At the organizational level, universities and academic research organizations have also supported the commercialization of academic research and collaborations between academic researchers and industry through technology transfer offices (TTOs), aimed at commercializing university research and managing academic patenting and product development (Debackere & Veugelers, 2005; Downie & Herder, 2007). Relatedly, universities are increasingly initiating entrepreneurship education and training programs (Sa, Kretz & Sigurdson, 2014), indicating their organizational commitments to encourage and pursue entrepreneurship amongst junior scholars and trainees.

Despite these policy and organizational initiatives and incentives for academic entrepreneurship in upstream biomedical science in Canada, there has been a lack of overall policy concern and attention to their potential detriments or harms (Downie & Herder, 2007). While much attention has been given to the potential for conflicts of interest when financial or industrial interests overtake academic or public interests in clinical research (Angell, 2008; Boyd, Cho, & Bero, 2003; Miller & Brody, 2005; Morin et al., 2002), there has been less attention to these concerns in the upstream, basic biomedical sciences. As such, despite the proliferation of policy attention to academic research commercialization and fostering the innovation agenda in upstream biomedical research in Canada, there has been relatively little governance or regulation of these initiatives.

In Canada, the ethics of research on human subjects funded by federal research funding agencies or in publicly-funded organizations is governed under the Tri-Council Policy Statement (TCPS, 2010). The TCPS suggests that conflicts of interest can be dealt with through mechanisms such as disclosure, oversight, and redefining roles so as to diminish
these conflicts. It further states that remedying conflicts of interest has the goal of maintaining trust relationships with research participants and the public. As the TCPS only governs research involving human subjects, there is no overarching piece of ethical or regulatory guidance for research not involving human subjects in Canada, such as in the case of the basic biomedical sciences, where research often involves the study of cells and proteins, rather than whole living organisms. As such, the management of conflicts of interest in entrepreneurial initiatives in upstream biomedical science and their impacts on public trust and medical research remain vague, and their remedies remain ad hoc.

Given policy and organizational initiatives aimed at incenting innovation and commercialization in academic biomedical research, ethical concerns about conflicts of interest, and a lack of regulatory oversight, this study examines how academic biomedical scientists in Canada understand and navigate these initiatives. This mixed-methods analysis examines how academic researchers normatively position academic entrepreneurship, and how academic entrepreneurs justify, navigate, and work to legitimate entrepreneurial activities in academic biomedical science. This study is thus attentive to the values of academic scientists, and how these values can shape scientific practice. Indeed, as biomedical research commercialization can “fall down the cracks between health policy and science policy” (Atkinson-Grosjean, 2005, p. 193), this study provides an empirical examination of how entrepreneurial scientists, who engage in and advocate for these initiatives, are shaping new norms of academic biomedical science.

1.2 Research Question and Conceptual Framework

This study aims to explore how academic biomedical scientists value entrepreneurial activities and the associated potential for conflict of interest, and examines how academic entrepreneurs engage in the legitimization of these initiatives in the context of academic biomedical research in Canada. To accomplish this, I draw from neo-institutional theories to examine how publicly-funded biomedical scientists in Canada position entrepreneurial science as an institutional logic, and how academic entrepreneurs engage in institutional work (Lawrence, Suddaby & Leca, 2009; 2011) to navigate the logics of academic and entrepreneurial science in order to legitimate entrepreneurial activities.
This study is also attentive to the potential for conflicts of interest in entrepreneurial activities, and seeks to examine how these are understood and managed in the context of entrepreneurial science in upstream biomedical research. This study was motivated by examining the question:

\textit{How do academic biomedical scientists in Canada value academic entrepreneurship, and how do they manage conflicts of interest in light of these values?}

To address this question, this study both seeks to examine the values of publicly-funded academic scientists at large in positioning the normative value of entrepreneurial activities, and also to examine entrepreneurial scientists as agents working to create value and legitimacy in entrepreneurial activities.

Firstly, this study seeks to empirically identify or establish the existence of an ‘institutional logic’ of academic entrepreneurship. Institutional logics consist of the norms, practices, values, beliefs and rules in which social realities are produced and reproduced (Thornton & Ocasio, 2008). The institutional logics of academic science and entrepreneurial science are often thought to be in conflict, though calls have been made to examine the nature of their divergence as well as their internal heterogeneity (Sauermann & Stephan, 2013). Through an examination of how academic biomedical scientists at large value entrepreneurial activities, this logic is examined. It is also due to this presumed difference between an academic and an entrepreneurial logic that conflicts of interest are said to arise for academic entrepreneurs. These differences in norms, practices, values and beliefs are often thought to be in conflict, where academic norms and practices may become overtaken by entrepreneurial ones.

Given the interests of this analysis in examining academic entrepreneurship and the potential for conflicts of interest, this study focusses on academic entrepreneurs, who may occupy both academic and entrepreneurial logics. Through examining how they value and navigate entrepreneurial activities, I examine how they legitimate entrepreneurial activities and claim to manage the associated potential for conflicts of
interest. Using theories of institutional work, these analyses examine how academic entrepreneurs interact with diverse and often conflicting institutional logics to initiate the change, maintenance or disruption of these institutions. By locating entrepreneurial scientists as active agents in shaping their research environments through their scientific activities and through their normative attitudes and values, this study examines how academic entrepreneurs generate legitimacy in entrepreneurial activities.

The question of how academic scientists value entrepreneurial activities, and how entrepreneurial scientists in turn work to negotiate the legitimacy of entrepreneurial activities is represented in Figure 1.1. This study both identifies the position and composition of an entrepreneurial logic in relation to academic science, and examines the institutional work to legitimize entrepreneurial activities in this environment. This investigation thus takes the existence of these diverse institutional logics as an empirical question, and recognizes that scientists can draw from both academic and entrepreneurial logics. By examining how academic entrepreneurs, as institutional workers, negotiate the space between academic and entrepreneurial science, in the context of health and biomedical research, this study investigates how these scientists shape new zones and norms of academic scientific practice.

Figure 1.1: Conceptual framework: An institutional work analysis of academic entrepreneurship in Canada
Notably, this study was undertaken as a piece of academic research it itself. My own positioning as an academic trainee, interested in transformations of academic science and the university, likely influenced the design, data collection, analysis and interpretation of this research. Located within the University of Toronto, which has faced both a history of conflict of interest ‘scandals’\(^1\), and increasing mandates and infrastructure to support research commercialization and interactions between academic scientists and industry, I approached the practices and norms of academic entrepreneurship with a certain amount of skepticism. Through linking the norms of entrepreneurial science with a body of scholarly and regulatory literature on conflicts of interest, and through using theories of neo-institutionalism, which often take actors’ representations and interactions with their social and organizational environments to be strategic, this study is critical of biomedical scientists’ representations of their entrepreneurial engagements. Though the recognition of a researcher’s “bias” or subjectivity in a domain of inquiry is often a taken for granted aspect of doing qualitative research, the study of academic scientific transformations is often a difficult terrain to navigate as an academic researcher. I thus approached this study cognizant of this subjectivity and positioning, and took this into account in my analyses.

This study uses empirical social scientific methodologies to examine how scientists construct and make sense of their research environments in legitimizing entrepreneurial activities. As a domain of research policy and conflict of interest concern however, this study also locates these understandings of research and scientific practice as strategic moments in the institutionalization of entrepreneurial science, and holds them up for normative inquiry. Table 1.1 lists the key terms and concepts used in this study.

| Academic Science/ Scientists: Research and activities conducted within academic research settings such as universities, funded through public or governmental funding sources, translated through academic pathways such as conference presentations and peer-reviewed papers in scholarly journals, and rewarded by academic career rewards |

\(^1\) Particularly the cases of Nancy Olivieri at the Hospital for Sick Children, and David Healy at the Centre for Addiction and Mental Health
such as tenure and promotion. Academic activities include research, teaching, and university administration, and scientific activities tend to adhere to norms of academic freedom, communalism and disinterestedness. In this study, this is the assumed institutional logic in which publicly-funded scientists located in academic research organizations position, and the existence and composition of an entrepreneurial institutional logic is examined against this.

| **Entrepreneurial Science/Scientists** | Market and industrial driven activities and initiatives in which scientists engage, including the commercialization of their research and collaborations with the health products industry (Etzkowitz, 1998; Etzkowitz & Webster, 1998). These initiatives are supported by national policy mandates, research funding structures, and organizational infrastructures (Etzkowitz, 2008; Etzkowitz & Leydesdorff, 2000). Academic entrepreneurs or entrepreneurial scientists are scientists located in academic research organizations who engage to differing degrees in business, proprietary, or industrial-facing research activities alongside academic research activities. They are thus distinct from purely academic scientists who do not participate in these activities, and industrial scientists who work in industrial scientific organizations and do not hold academic roles or obligations. |
| **Research Commercialization** | An aspect of entrepreneurial science or academic entrepreneurship in which academic scientists engage in activities to push their research to market applications (Etzkowitz & Webster, 1998). This includes activities such as the patenting of academic science, or the initiation of a spin-off company. These processes often involve organizational technology transfer offices as intermediaries. |
| **Collaboration with Industry** | A different but complementary aspect of academic entrepreneurship to research commercialization (Perkmann et al., 2013). This includes industry ‘pull’ activities in which academic scientists collaborate with or work on industry-designed and driven projects, such as consulting activities and business advisory board membership. |
| **Conflict of Interest** | A practical situation in which a primary interest may come into conflict with a secondary interest, causing an individual to overlook their primary obligations in favour of secondary obligations or interests, affecting their professional judgment (Thompson, 1993). The two interests at stake in this study are a primary |
interest in public-interest oriented academic science, and secondary entrepreneurial, proprietary, or business interests, where the overtake of the former by the latter may lead to harms to academic science and medical evidence (Hampson, Bekelman, & Gross, 2008). Conflict of interest is also understood in this study not just as a process, but also as a construct that may organize and constrain certain scientific practices.

**Institutional Logics:** Norms, practices, actions and value orientations that provide meaning to social life (Thornton & Ocasio, 2008). Institutional logics may co-exist, conflict, or challenge each other (Seo & Creed, 2002). The two institutional logics of interest in this study are an entrepreneurial logic, consisting of the norms and activities of entrepreneurial science, and an academic logic, consisting of the norms and activities of academic science. Though these two logics are often characterized as distinct from each other, this study measures this distinction empirically, and recognizes that they are also internally heterogeneous.

**Institutional Work:** The actions and discursive value orientations of individuals in organizations aimed at creating, maintaining and disrupting institutions (Lawrence, Suddaby, & Leca, 2011). This work is anchored by actors’ efforts at gaining legitimacy in their activities. In this study, institutional work is examined in the claims of legitimacy made by academic entrepreneurs in justifying and organizing their entrepreneurial practices. This work is often strategic, and plays out in scientists’ discursive claims about legitimacy and conflict of interest avoidance in academic entrepreneurship. Examining institutional work does not attempt to examine an overall, taken-for-granted change in institutional logic, or the institutionalization of new practices, and instead examines the workings out of processes of institutional change, maintenance, or disruption through the on the ground activities of actors located within institutional structures (Zilber, 2013).

**Institutional Change:** A process in which institutional logics and structures evolve over time (Battilana, Leca, & Boxenbaum, 2009; Bjerregaard & Lauring, 2012). This is understood as an ongoing and recursive process, accomplished through institutional work, as well as a final state of change or the institutionalization of a new or different institutional logic.

**Agency:** Actors’ ability or capacity to engage with other actors and norms, and to
interact with institutions to initiate institutional change or maintenance (Battilana & D'Anunno, 2009). In this study, this is examined through the ways in which scientists engage in activities to initiate institutional change, while they are also constrained by existing normative institutions, regulative practices, and structures. The agency of actors within institutions is also differential, with some actors holding more power and agency in initiating institutional change than others, depending on their organizational location, power and status.

**Legitimacy**: The perception that actors or their activities are socially acceptable, credible and consonant with relevant rules and norms (Reay, Golden-Biddle, & Germann, 2006; Scott, 2008). Legitimacy is understood as a tool of institutional work, and the means by which actors located in organizations survive and perpetuate their actions.

**Credibility**: An aspect of legitimacy or a legitimization process, where actions or constructs are given more or less credibility as accurately describing aspects of institutional life (Scott, 2008). In the context of this study, the credibility of claims about conflicts of interest are measured, where scientists are asked to assess whether situations of conflict of interest resonate with them and their practice.

**Routinization**: The process in which actions, norms or activities are made routine or normalized, either through the deliberate actions of actors or through institutional processes over time (Colyvas & Powell, 2006). In this study, routinization is examined in the ways in which entrepreneurial activities are made routine or similar to conducting academic research activities.

**Value/Values**: A measure of the institutional credibility and legitimacy of actions, norms or initiatives. The ways in which academic scientists value academic entrepreneurship forms the overarching research question of this study. The value of entrepreneurial science is examined in how scientists normatively position entrepreneurial activities, and the ways in which they designate and manage legitimacy in entrepreneurial activities.

Table 1.1: Key terms and concepts
1.3 Dissertation Outline

To address the question of how academic biomedical scientists in Canada value entrepreneurial activities and conflict of interest concerns, a mixed-methods, cross-sectional study design was used. In using theories of institutional work, this study examines small-scale changes and negotiations made within institutional logics and structures, rather than speculating on large-scale instances of institutionalization over time. Drawing from the ways in which academic entrepreneurs seek to legitimize entrepreneurial activities and negotiate potential conflicts of interest, this study demonstrates the legitimization of academic entrepreneurship as an ongoing and recursive process.

To situate the context of this study within current scholarship, a review of the relevant literature follows in Chapter 2. This provides an overview of scholarly work examining entrepreneurship in academic science, as well as the proposed problem of conflicts of interest arising from these activities. In doing so, this review situates the context of health research in academic entrepreneurship by linking together bodies of scholarship examining the benefits and practices of academic entrepreneurship in the biomedical sciences with the literature on the potential downstream harms of linkages between academic scientists and industry and commercial interests in research. Focusing specifically on the work of academic scientists as agents in navigating entrepreneurial activities, and on the context of biomedical innovation, this literature review examines quantitative studies investigating factors associated with academic entrepreneurship, as well as qualitative studies examining how academic scientists navigate entrepreneurial logics in academic settings. As well, a review of the literature on neo-institutionalism, and specifically institutional work, is provided. This review of relevant studies and theoretical work identifies important gaps amongst these bodies of literature and highlights the importance of this study.

Following the review of relevant literatures, the study methodology is detailed in Chapter 3. In order to examine how academic biomedical scientists value entrepreneurial
activities and conflict of interest concerns, a national, cross-sectional survey of biomedical scientists funded by CIHR was used to gather attitudes towards entrepreneurial activities and their incentives and conflict of interest implications. Following this, qualitative analyses drew from 38 interviews with a subsample of scientists; 24 of these were Principal Investigators (PIs) who had engaged in entrepreneurial activities, and 14 were trainee respondents, 4 of whom had participated in entrepreneurial activities. These interviews examined motivations for participating in entrepreneurial activities, the organization of these activities within academic laboratories, and understandings and management of conflict of interest concerns.

Interview analysis was inductive and interpretive and drew from an analytic framework of Constructivist Grounded Theory (Charmaz, 2006). The aim of this methodology was to capture both a cross-section of attitudes and values across an array of scientists, and to focus on entrepreneurial scientists and their values and efforts to navigate and legitimize entrepreneurial activities.

Following this, the three analytic chapters of this dissertation examine three distinct but interrelated aspects of scientists’ interactions with academic entrepreneurship and the institutional work done to justify and navigate these activities. Chapter four uses mixed-methods data to empirically examine an entrepreneurial logic, through exploring the legitimacy of entrepreneurial activities, the credibility of related conflict of interest concerns, and scientists’ experiences with these pursuits. As well, this chapter identifies the characteristics of the survey and interview sample of scientists, including their participation in entrepreneurial activities. The findings of this chapter demonstrate that entrepreneurial science tends to be valued as a distinct institutional logic to academic science, though this logic is heterogeneous, and different types of activities are valued differently. Scientists grant some credibility to concerns about conflicts of interest in upstream scientific practice, but tend to decouple these from downstream implications. Examining scientists’ participation in entrepreneurial activities, entrepreneurial scientists tend to be academically productive and also hold positive value-orientations towards academic entrepreneurship, demonstrating a mixing of academic and entrepreneurial logics amongst these scientists. This chapter thus provides an overview of the
institutional environment of scientists’ values and positions related to entrepreneurial science in Canada.

Chapter five draws on these mixed-methods findings and focuses on a qualitative analysis of the subsample of entrepreneurial PIs. Through an examination of what motivated them to participate in entrepreneurial activities, these analyses examine how entrepreneurial scientists designate normative value in these activities, and carve out legitimate domains of scientific practice. Entrepreneurial PIs identified value in entrepreneurial activities for their ability to contribute to scientific practices through the provision of material and intellectual resources. They also described the value of these activities in contributing to the downstream impacts of academic science: in producing societal and clinical benefits through pushing academic science toward the clinic. At the same time, they described an adherence to academic norms and practices, and claimed to avoid conflict of interest through a distance from the clinic. Through their interactions with academic norms in designating the normative value of entrepreneurial activities, they generated legitimacy in entrepreneurial activities as beneficial extensions to academic science. The institutional work that is done here is normative, discursive, and strategic, as entrepreneurial scientists claim value in entrepreneurial activities alongside claims to maintain academic norms and priorities and avoid conflicts of interest.

Chapter six then examines how academic entrepreneurs navigate entrepreneurial activities and legitimize their conduct in academic laboratories. Using qualitative interview data with entrepreneurial scientists, this chapter investigates how academic entrepreneurs explain their negotiations and considerations in including and conducting entrepreneurial activities within their academic laboratories. Entrepreneurial PIs engaged in a diverse array of managerial strategies to select entrepreneurial projects, and either combined or separated these from their academic activities. Strategies relied on distinctions made between laboratory spaces, times, and personnel, including an overall trend towards the shielding of academic trainees from most entrepreneurial activities. Through this, entrepreneurial PIs generated legitimacy in entrepreneurial activities through their designation as routine and manageable practices, where academic practices
could occur alongside entrepreneurial ones, and the boundary between them could be discerned and managed so as to avoid potential conflicts of interest.

These three chapters thus examine the what, why and how of academic entrepreneurship in academic biomedical science in Canada. Through an examination of how entrepreneurial activities are valued and navigated, I locate normative institutional work in scientists’ legitimization of entrepreneurial activities as academically aligned pursuits. I argue that entrepreneurial scientists engage in an institutional work process of change-through-maintenance, where scientists support institutional change through an appeal to the ability to maintain academic norms, practices and institutions alongside entrepreneurial science, and avoid potential conflicts of interest. Together, these examinations of the ways in which entrepreneurial science is carved out and normatively located as a legitimate domain of scientific practice inform how academic entrepreneurs can designate new norms of academic science, and how a decoupling from ethical concerns about conflict of interest can shape scientific practice. In the concluding section, I reflect critically on these legitimization processes and examine the implications of these analyses for health and research policy and ethics.
Chapter 2
Literature Review

2.1 Introduction

The literature examining academic entrepreneurship, and its mechanisms, harms and benefits, is vast and spans many disciplines (Landstrom, Harirchi, & Astrom, 2012; Rothaermel, Agung, & Jiang, 2007). For example, Science and Technology Studies (STS) has taken up issues in the production of scientific knowledge and examinations of how commercialization or market interests affect scientific values and practices. Studies in education have examined the nature of the university and higher education and how entrepreneurial initiatives have affected university structures (Mars & Rios-Aguilar, 2010). As well, scholarly literature on research and innovation policy has examined how policy initiatives aimed at incenting research and innovation productivity have influenced academic research organizations and researcher activities (Grimaldi, Kenney, Siegel, & Wright, 2011). An emerging, but still limited amount of this literature has been explicit to the context of health and biomedical innovation, where the health and medical impacts of research and innovation are considered.

In addition to, but largely independent of these studies that have described and analyzed processes, facilitators and rationales of academic entrepreneurship across disciplines, there has been a significant amount of scholarly and regulatory attention to conflicts of interest as a result of interactions between academic scientists and private industry in health and biomedical research (Bekelman, Li, & Gross, 2003). Conflicts of interest are proposed to arise when a scientist’s primary academic, scientific and public interests and obligations may become influenced or overridden by industrial or entrepreneurial interests, potentially leading to harms and detriments to research, threatening the evidence base of medicine, and threatening public trust in academic science. This literature lies largely in the medical, legal and bioethics domain, and speculates on the
locations and effects of conflicts of interest as a result of entrepreneurial activities, especially those between clinical researchers and industry.

The goal of the research study at hand is to examine how publicly-funded academic biomedical researchers in Canada value academic entrepreneurship and the related potential for conflicts of interest, and how academic entrepreneurs work to legitimize entrepreneurial initiatives. To accomplish this, I draw from the above bodies of literature, and focus on the activities of academic scientists in participating in, navigating, and valuing entrepreneurial science, and locate these scientists as agents embedded in institutional norms and practices. This review of the literature examines the nature of academic entrepreneurship, including factors associated with academic scientists’ participation in these activities, and examines studies attending to the health context of biomedical innovation. Following this, I examine the concerns identified with this phenomenon, usually related to conflicts of interest in the health research domain, and examine the descriptive, empirical, and regulatory literature in this field. Finally, I review neo-institutional theory and the ways this has been used to consider the institutionalization of entrepreneurship in academic science. I propose the importance of the use of theories of institutional work to examine the small-scale changes and negotiations initiated by academic scientists at the normative level.

This review thus both locates this study amongst other similar studies, and demonstrates important gaps in this literature. Amongst these bodies of literature, relatively little attention has been afforded to (i) empirically examining scientists’ values related to academic entrepreneurship and conflicts of interest, and how these influence the legitimization of entrepreneurial activities in academic science; (ii) examining how academic scientists engage with multiple institutional logics when the direction of institutional change is uncertain, and (iii) how the context of health research, and its related concerns, affect entrepreneurial engagements in the biomedical sciences.
2.2 Examining Academic Entrepreneurship

A significant body of literature has examined the phenomenon of academic entrepreneurship or the involvement of academic scientists in initiatives that promote economic and societal impacts from the results of academic research. Worldwide, universities and academic research organizations have initiated programs that aim to generate social impact and economic revenues from publicly funded or academic research, through promoting entrepreneurial science or academic entrepreneurship (Etzkowitz, 1998; Etzkowitz, 2008; Etzkowitz & Webster, 1998; Etzkowitz, Webster, Gebhardt, & Terra, 2000). Academic entrepreneurship has been analysed both descriptively, as an ongoing phenomenon in relation to external factors, as well as aspirationally, as a system which academic institutions ought to pursue. Through entrepreneurial initiatives in academic science, economic development becomes characterized as part of the mission or function of academic research and researchers. These characterizations, largely articulated under the “triple-helix” model of university-industry-government interactions (Etzkowitz, 2008) include collaborations between academic researchers and industry, as well as direct academic research commercialization initiatives such as patenting, spin-off company formation, and the acquisition of intellectual property rights over academic research. Through this triple-helix, governments and public institutions facilitate connections between academic and industry collaborators, leading to increased social applications of academic science, and the generation of ‘knowledge economies’. These initiatives fall under larger proposals, including the “third mission” of the university, to generate societal and economic impact; “Mode II” science, where academic science is directed at particular, applied ends (Gibbons et al., 1994; Nowotny, Scott, & Gibbons, 2003); as well as more critical descriptions of this phenomenon, such as that of “academic capitalism”, where the world of commerce and profit become intertwined with academic activities (Slaughter & Leslie, 1997).

The Bayh-Dole Act of 1980 in the U.S. is often cited as the paradigmatic case of legislation aimed at incenting innovation and academic entrepreneurship. This piece of
legislation designates intellectual property (IP) ownership of federally funded research to inventors’ organizations. Many have cited this as the legislative moment that catalyzed increased commercialization of academic research and patenting behaviour in the U.S. (Mowery, Nelson, Sampat, & Ziedonis, 2001; Shane, 2004; Thursby & Thursby, 2003). There have, however, been some accounts that have questioned the effects of the Bayh-Dole, including its efficacy in incenting entrepreneurial behaviours (Grimaldi, et al., 2011), where this has instead been attributed to a series of prior political decisions and events (Berman, 2008).

Canada lacks a harmonizing IP policy for federally funded research, and each research organization designates its own (Sa & Litwin, 2011). Trends do however indicate that public institutions in Canada are increasingly retaining the IP rights as the income from research commercialization becomes increasingly more prized (Downie & Herder, 2007). A landmark 1997 study by Slaughter and Leslie found Canada to be somewhat resistant to the forces that led other English-speaking countries (US, UK, Australia) to adopt national-level policies about technology and economic development through academic entrepreneurship. However, a more recent analysis of Canada’s academic and economic development policies found that Canada is “no longer the exception”, but pursues a number of initiatives to support the marketization of the academy and the involvement of academic scientists in entrepreneurial activities (Metcalfe, 2010).

This foundational body of literature situates the context of academic entrepreneurship in Canada and internationally. This literature thus provides the policy and organizational background for the pushes in innovation and entrepreneurship that drive academic scientists’ involvement in these activities. While this literature covers issues in academic research and innovation broadly, it does little to empirically examine why academic scientists might participate in these activities and how they might value them. As well, this literature tends not to attend to the potential harms that may result from these initiatives.
2.2.1 Scientists’ Propensity to Engage in Entrepreneurial Science

A number of related studies have drawn on these theories and proposals of value and benefit in entrepreneurial science and empirically examined factors associated with scientists’ participation in academic entrepreneurship. While a large amount of scholarship has examined the organizational structures that are involved in academic entrepreneurship, such as research funding initiatives and university infrastructures, there has also been much attention to academic scientists themselves, and their interactions with entrepreneurial science. This literature largely uses quantitative methodologies and seeks to examine the factors that incent academic scientists to engage in entrepreneurial activities. For the most part, these studies tend to examine factors associated with one particular type of entrepreneurial activity, rather than examining a range of entrepreneurial initiatives. The assumption in these studies is that entrepreneurial activities are beneficial and ought to be pursued; thus, explorations of factors associated with these activities aim to inform organizations and policy makers about how to encourage and facilitate these activities.

Studies examining the interplay between environmental or structural factors and scientists’ participation in entrepreneurial activities have found that regional economies in which scientists’ universities are located can increase academic commercialization activities by linking academic researchers and industry contacts (Casper, 2013). As well, scientists’ organizational location, and its role in encouraging industrial collaboration have been shown to facilitate academic entrepreneurship (D’Este & Patel, 2007; Lee, 1996; Perkmann, King, & Pavelin, 2011). Despite this, Goldstein et al found that individual characteristics such as academic discipline are more highly associated with entrepreneurial activities than institutional characteristics (Goldstein, Bergman, & Maier, 2013).

More attention has been afforded in this literature to the material, intellectual and social resources of scientists in their engagements with academic entrepreneurship. For example, spin-off company formation has been significantly associated with increased
laboratory resources or assets held by academic researchers in the form of laboratory personnel and trainees, as well as the novelty of their research (Landry, Amara, & Ouimet, 2007; Landry, Amara, & Rherrad, 2006). As well, academic scientists’ network capacities and social capital, especially in the form of relationships with industry have been shown to facilitate patenting and research commercialization (Lin, Fang, Fang, & Tsai, 2009; Owen-Smith & Powell, 2003; Powell, Koput, & Smith-Doerr, 1996; Santoro & Gopalakrishnan, 2001), especially where academic scientists’ time spent working in industry can provide access to new social networks and scientific capital (Dietz & Bozeman, 2005). Access to financial resources, have also been found to be associated with research commercialization activities (Hoye & Pries, 2009), and the receipt of industrial grants has been shown to increase academic researchers’ propensity to be involved in industrial research activities (Bozeman & Gaughan, 2007). Scientists’ academic discipline has also been found to be a significant influence on entrepreneurial activities, with academic scientists in more applied disciplines being more likely to engage in these pursuits (Estabrooks et al., 2008; Lee & Rhoads, 2004; Lee, 1996; Perkmann, et al., 2011). Finally, individual demographic features have been shown to play some role, for example academic entrepreneurship is more likely in males (Colyvas, Snellman, Bercovitz, & Feldman, 2012), though the influence of age is inconclusive, as entrepreneurial activities have been associated with both increased age (Boardman & Ponomariov, 2009; Haeussler & Colyvas, 2011), as well as more junior scientists (D'Este & Patel, 2007; D'Este & Perkmann, 2011).

Significantly, many of these studies demonstrate an association between academic scientists’ quality and prestige and participation in entrepreneurial activities. These studies have found positive associations between participation in entrepreneurial activities and academic productivity in the form of scholarly publications (Gulbrandsen & Smeby, 2005; Haeussler & Colyvas, 2011; Lowe & Gonzalez-Brambila, 2007). As well, positive relationships have been found between participation in patenting and academic researcher productivity and status (Breschi, Lissoni, & Montobbio, 2007; Coupe, 2003; Guena & Nesta, 2006), and academic researchers with industry support were found to be more academically productive than those without (Harman, 2001).
Examining these connections between academic productivity and participation in entrepreneurial activities, studies by Blumenthal and colleagues in the U.S. have found that industrial support of academic researchers is consistent with academic publishing, and academic tenure and salary, though increased percentages of industry funding could ultimately decrease participation in academic activities (Blumenthal, 1996; Blumenthal, Gluck, Louis, Stoto, & Wise, 1986; Zinner, Bolcic-Jankovic, Clarridge, Blumenthal, & Campbell, 2009). Similarly, Fabrizio and Di Minin (2008) locate a complementarity between some patenting and publication activities, though they found a decline in publications for repeat patenters.

A number of studies have also examined how researchers’ normative attitudes toward entrepreneurial science affect their participation in these activities. Benner and Sandstrom (2000) found that positive attitudes, and normative agreement with entrepreneurial activities are associated with intentions to disclose inventions to technology transfer offices and initiate commercialization. As well, repeat commercializers are characterized as having positive attitudes toward commercialization (Hoye & Pries, 2009), and academic researchers who have had collaborative experience with industry are more likely to agree with the advantages and disagree with disadvantages of commercialization (Rabino, 1998).

Related to these studies of normative attitudes, studies of motivations to participate in entrepreneurial activities have found that scientists engage in entrepreneurial activities for a range of reasons, usually based on the perceived benefits of these activities. These benefits include learning the skills of industry research and accessing funding and other in-kind resources from industry (Baldini, Grimaldi, & Sobrero, 2007; D'Este, Mahdi, Neely, & Rentocchini, 2012; D'Este & Perkmann, 2011). As well, perceived benefits to graduate students and research organizations (Crespo & Dridi, 2007), and reputational rewards and intrinsic satisfaction (Lam, 2011) have motivated scientists’ participation in entrepreneurial activities. Notably, patenting activities are increasingly becoming included in academic recognition metrics, and some scientists report engaging in patenting activities in order to gain prestige (Baldini et al., 2007), alongside personal
perceptions of benefit in patents, related to research ownership (Owen-Smith & Powell, 2001a).

These studies of scientists’ participation in entrepreneurial activities thus aim to quantify and examine factors relevant to scientists’ entrepreneurial participation, and provide insights into demographic, academic and attitudinal characteristics associated with participation. Through findings that entrepreneurial activities are associated with laboratory resources, prestige and merit as well as positive value orientations towards entrepreneurial science, this literature situates facilitators for academic entrepreneurship. Lacking from these accounts, however, is attention to the potential conflicts of interest and harms embedded in these activities, especially as entrepreneurial activities can often be facilitated by close relationships and networks between academic scientists and industry. Further, though this literature often examines the case of academic entrepreneurship in biotechnology or the life sciences, it often does little to situate academic entrepreneurs as health-oriented scientists.

2.2.2 Academic Entrepreneurship and Health Research in the Biomedical Sciences

Much of the literature on academic entrepreneurship uses the case of biomedical research as an exemplar, but little is specific to the health context of this research (French & Miller, 2012). The limited body of literature on academic entrepreneurship in health examines the pathways of health innovation from “bench to bedside”, as well as the organizational conditions and actions of agents in the unique health context of biomedical innovation. Overall, this literature engages with the nature of translational research of basic research to market and clinical applications as a source of medical knowledge production (Crist, Schafer, & Walsh, 2004). As an organizational structure to support innovation in health, the role of academic medical centres or academic health science centres have been examined in developing commercial products and addressing health care needs (Toner & Tompkins, 2008). These organizations have been valued for their potential to effectively meet clinical needs through in-house translational and clinical research (Dzau et al., 2010). Indeed, accounts of innovation in biomedicine encourage
integrated innovation from basic research to clinical care, and encourage the integration of health innovation and translation throughout research and care systems (Dzau, Yoediono, ElLaissi, & Cho, 2013). These pathways are seen to be more productive when they are dynamic and iterative rather than linear, rely on actors located in different organizational structures, and draw from public-sector institutions as much, if not more, than private sector firms and investments (Lander & Atkinson-Grosjean, 2011).

Examining actors or agents in these health and translational research pathways, clinicians and scientists have been shown to hold different interpretations of the meanings and scope of translational medicine and their role in this pathway (Mitra, 2013). As well, the proximity between these actors and patient populations through these arrangements has both been characterized as a benefit of commercialization and innovation, where new technologies can be implemented internally (Toner & Tompkins, 2008), and problematized for the use of patients as research tools (French & Miller, 2012). In French and Miller’s (2012) examination of the “entrepreneurial hospital”, an emerging mission of the hospital is characterized as a site where patients and care infrastructures constitute resources for entrepreneurial aims. As such, patients are cast as resources for both improving the cost effectiveness of care and also for commercial potential, thereby transforming patient disease as a source of potential value. Examining underlying morals and values in academic spin-offs in health, Lehoux et al examine how health and wealth agendas may occur concurrently, and the values of spin-off innovators in relation to this. Despite a general characterization of these as competing objectives, they found overriding values towards health ends in the development of academic spin-offs, and trade-offs of market-oriented approaches for these health ends (Lehoux, Daudelin, Hivon, Miller, & Denis, 2014).

Taken together, this literature demonstrates the unique context of ‘translational research’ in health and biomedicine and linkages between basic science, clinical research and patient populations. As well, this literature notes the importance of attending to academic scientists’ health-related values in their entrepreneurial pursuits, and the role of the mission of their organizational location towards producing health ends. Through
strategic initiatives aimed at addressing a health and wealth agenda in biomedical innovation, as well as the proximity between biomedical scientists in hospitals or academic health science centres and patient populations, the importance of considering this health context in a study of academic entrepreneurship in the biomedical sciences in highlighted. Though this literature is attentive to the health and patient implications of biomedical innovation, little of this work has directly engaged with the health and medical research implications of conflicts of interest as entrepreneurial science in biomedical research promotes clinical applications.

2.3 Harms of Academic Entrepreneurship and Conflicts of Interest

The policies and activities of academic entrepreneurship, especially in the context of health innovation, have not proceeded without criticism. A significant body of academic literature and policy and regulatory initiatives have addressed how the interests of academic scientists – who are proposed to have scientific and public obligations - and industrial collaborators or commercial interests may come into conflict. These conflicts of interest are understood as “a set of conditions in which professional judgment concerning a primary interest tends to be unduly influenced by a secondary interest” (Thompson, 1993, p. 573). Academic scientists are thus said to be at risk of being in situations of conflicts of interest when industry-based or commercial interests overtake their academic or public interests, and cause them to conduct research that promotes profit and overlooks public benefit, and generally promotes bias within research processes (Baim et al., 2007; Bekelman, et al., 2003). Many scholars have highlighted the harms that might come to universities, the public, and patient populations from the involvement of industry and the profit motive in academic research. Initiatives that have promoted industry collaboration and commercialization in academia have been described as fundamentally changing the role of universities in society from structures that serve the public interest to organizations that operate for private profit and financial gain (Bok, 2003; Krimsky, 2003).
Conflicts of interest have been described at various stages of academic and clinical research (Baim, et al., 2007; Caulfield, Einsiedel, Merz, & Nicol, 2006; Glaser & Bero, 2005; Johns, Barnes, & Florencio, 2003; Lemmens, 2004; Norcia, 2005). They have been shown to imply bias that can negatively affect research topic choice, study design and methodology, data analysis and interpretation, data reporting and dissemination, and study outcome (Hampson, Bekelman, & Gross, 2008). Industry sponsorship of research has been shown to over-emphasize the safety of the products and bias the outcomes of research studies in favour of industry (Lexchin, Bero, Djulbegovic, & Clark, 2003; DeVries & Lemmens, 2006), and may lead to biases which distort academic research agendas toward research that has commercial benefit, rather than research that may address the health needs of the public (Cooper, 2009; Krimsky, 2003; Lemmens & Luther, 2008; Monbiot, 2003). In the context of clinical research, biased research processes and outcomes have been shown to threaten the safety of human subjects in clinical trials, bias systems of evidence based medicine, and diminish public trust in medical research (Glaser & Bero, 2005). These proposed implications of conflicts of interest thus threaten both the activities of individual scientists, and the evidence base of health and medical research itself (Miller & Brody, 2005), through systems in which the results of clinical trials are often skewed in favour of the industry sponsor.

As well, patents and related activities of intellectual property acquisition have been described as fostering fundamental shifts away from cultures of open science towards secrecy, in systems where researchers seek personal ownership over their research (Krimsky, 2003). Heller and Eisenberg (1998) argue that patents may create an “anti-commons” in biomedical research, where increased IP protection slows innovation. Though IP protection claims to incent innovation, these arrangements may lead to a stifling of innovation in the long run (Williams, 2013), and the development of fewer, rather than more, health products (Gold, Kaplan, Orbinski, Harland-Logan, & N-Marandi, 2010). Additionally, patents have been understood as constraints on access to health products, especially for developing nations, where they place financial barriers on necessary medicines and override societal interests (Barton & Emanuel, 2005; Johnston & Wasunna, 2007).
The negative impact of industrial involvement in academic research on academic publishing practices has also been explored. Specifically, practices of ghost-authorship have been identified, where academic scientists are presented as primary authors on papers that were authored and designed by industry, and thereby bring structural biases into published academic research and evidence (Krimsky, 2003). Empirical studies have shown that these practices have been widespread in the academic scientific and medical literature (Flanagin et al., 1998; Ross, Hill, Egilman, & Krumholz, 2008). Indeed, these practices may extend beyond ghost-authorship and into the domains of actively shaping the research, writing and publication of scholarly articles. Sismondo has argued that ghost-authorship or ghost-management, where industry shapes research, writing and publication processes, is present throughout scientific publication in medical journals (Sismondo, 2007; Sismondo & Doucet, 2009).

Some attention has also been given to studying the effects of entrepreneurial initiatives and conflicts of interest on academic scientists’ commitments to teaching and training activities. It has been argued that university faculty who engage in entrepreneurial activities may be less committed to teaching and training activities, resulting from multiple conflicting commitments as supervisors, employers and private-sector-interested agents (MacDonald & Williams-Jones, 2009). As well, some limited empirical research has shown that faculty in large research-intensive organizations may demonstrate lower commitments to teaching (Lee & Rhoads, 2004). From the trainee perspective, a survey of academic trainees in the life sciences found a minority of students (23%) to have been denied access to information due to secrecy and industrial pressures, and this had negatively affected their educational experiences (Vogeli et al., 2006).

Relatedly, analyses of conflicts of interest have also examined the issue of institutional conflicts of interest. These institutional conflicts, or those of senior directors or trustees at academic institutions, can be financial or non-financial, and involve organizational-level decisions to act in favour of organizational profit and prestige over decisions to protect research integrity and quality (Barnes & Florencio, 2002). These institutional
conflicts of interest can have detrimental effects on the organization as well as its members, especially due to the unequal power relationship between faculty members and institutional demands (Resnick & Shamoo, 2002). These institutional conflicts of interest have been relatively under-addressed and unregulated, despite many attempts to suggest remedies and solutions (Liang and Mackey, 2010; Resnick & Shamoo, 2002).

The literature on conflicts of interest and related harms in academic health science thus examines the implications of scientists’ commercial interests in research and the potential for industrial overtake of academic science. As such, this literature is attentive to the ways in which academic scientists’ interests in intellectual property or financial gain may implicate harms to research practices and commitments, and downstream harms to medical evidence and health care. Though this literature tends to take clinical research as its object, it demonstrates a need to attend to these issues in upstream biomedical research spaces. This is especially relevant as entrepreneurial initiatives intensify, and are increasingly encouraged and incented by academic research organizations and funding bodies. A closely connected body of literature examines regulatory mechanisms to address these proposed conflicts of interest.

2.3.1 Policy and Regulatory Responses

There has been significant regulatory and policy response to conflict of interest issues, in attempting to curtail and mitigate the negative effects of industrial or commercial interests in research. While the majority of these conflict of interest policies focus on potential conflicts of interest in clinical research, they also point toward potential sources of conflict of interest in basic biomedical research, such as through owning equity interests in the products of research (AAMC, 2008). Primarily, remedies and protections against conflict of interest rely on disclosure of scientists’ financial interests or industry ties in the name of transparency, including disclosure in academic journal publications, and disclosure to research participants in clinical trials. There have, however, been noted problems with disclosure, including increased bias associated with disclosure, and problems associated with the perceived burdens of disclosure (Loewenstein, Sah, & Cain, 2012). Other, and potentially stricter, remedies that have been suggested include
professional and academic sanctions against those who have been involved in activities of research misconduct, the complete separation of those who conduct research from financial interests in the outcome of the research (Lemmens & Luther, 2008), or filing legal claims to deal with specific practices, such as ghost authorship (Stern & Lemmens, 2011). As well, systems-level transparency measures have been recommended to improve accountability amongst investigators with financial interests in research, such as the mandatory registration of clinical trials (Ross, Gross & Krumholz, 2012).

On the other hand, there have increasingly been calls for more complex and multivariate responses to academic-industry relationships. These calls attend to the need to account for variety in these relationships, and the ways in which different types of entrepreneurial activities may entail significantly different benefits as well as harms (Nelson & Bierer, 2011; Taylor, 2013). These suggestions to account for the multitude of entrepreneurial initiatives, as well as to support their benefits alongside regulating their harms, seek broader approaches to conflict of interest management, and have prioritized discovery, while also seeking to protect trainees, patients and institutional credibility (Nelson & Bierer, 2011). These emerging permissive policies on entrepreneurial activities encourage entrepreneurial engagements, so long as potential detriments are curtailed.

Despite these attempts at regulating conflicts of interest, the uptake and interpretation of these policies by scientists tends to be varied (Chimonas, Frosch, & Rothman, 2011). For example, a study of conflict of interest policies at Canadian universities found these documents to be lacking in content, in that they provided unclear definitions and did not clearly explain the procedures of conflict of interest management (Williams-Jones & MacDonald, 2008). Another study of conflict of interest policies in Canadian academic health science centres found a high degree of variability amongst the scope of conflict of interest policies, meaning that researchers in similar organizational settings may face different environments when dealing with conflicts of interest (Lexchin et al., 2008). Examining attention to institutional conflicts of interest amongst the same group of policies, they found over half of academic health science centres in Canada to be lacking an institutional conflict of interest policy (Rochon et al., 2010).
Despite many attempts at regulating and curtailing conflicts of interest for academic scientists, there may still be an overall uncertainty in the appropriate regulation of conflict of interest across domains of health research. Academic scientists may be unaware of these policies in their organizations and how to respond to them, and stricter policies on conflict of interest cessation may not take into account the range of types of entrepreneurial engagements. This literature thus provides the regulatory backdrop to conflict of interest management for entrepreneurial engagements in academic health research. However, these studies tend not to examine how academic scientists interpret these policy and regulatory instruments, and tend not to examine why it is that scientists engage in relationships with industry at all.

2.3.2 Scientists’ Perceptions of Research Ethics and Conflicts of Interest

Despite the range of causes and effects of conflicts of interest in academic research related to academic scientists’ participation in entrepreneurial activities, and remedies to address these, empirical studies show that academic scientists themselves tend not to recognize conflicts of interest in their own activities and engagements. For example, a study of clinician- scientists’ perceptions of conflict of interest policies at their institutions found that scientists involved in relationships with industry maintained a confidence in their own ability and discretion in managing these relationships, and supported self-regulation of these relationships (Boyd, Cho, & Bero, 2003). As well, scientists or physicians who hold many ties to industry may not consider their ties to be directly related to any one particular project and thus assert a confidence in their ability to separate different studies (Okike, Kocher, Wei, Mehlman, & Bhandari, 2009). Examining institutional financial conflicts of interest amongst university leaders, these individuals tended not to recognize their relationships with industry as creating any conflict, and thus even research leaders who may be adjudicating conflicts of interest may not recognize them (Campbell, Moy, Feibelmann, Weissman, & Blumenthal, 2004). Similarly, examining authors of clinical practice guidelines who may influence the practices of a large number of physicians, Choudhry, Stelfox and Detsky (2002) found
that despite the majority of these authors holding ties to industry, only a very small minority of these ties were declared, and that guideline authors believed that industry ties were influencing the recommendation of others, but not their own recommendations. Scientists and physicians engaged in entrepreneurial activities thus tend to defer and deflect potential conflicts of interest to other scientists, and rely on their own self-management of these activities.

Relatedly, several studies have examined scientists’ perceptions of ethics more broadly, and explored how scientists perceive ethics regulations and policies on their scientific practices. These studies have shown that scientists can engage in processes of “purposive decoupling” of ethics policies from academic research settings, where they comply with ethics regulations only in perfunctory ways (Smith-Doerr & Vardi, 2014), and tend to distance ethical issues from their everyday scientific practices (Smith-Doerr, 2008; 2009). Indeed, scientists found the imposition of formal ethical requirements to be insulting to their moral character and scientific practices (Smith-Doerr, 2009). Similarly, Brosnan and Cribb’s (2014) study of neuroscientists found that scientists had little knowledge of the discipline of bioethics, and found ethical issues identified in bioethics to be distant from laboratory settings, calling for a need for attention to ethical issues the day-to-day practices of scientists.

This distancing between scientists and ethical concerns has also been described in terms of “ethical boundary-work”, wherein scientists delineate their own ethical spaces in which they operate, and separate their scientific practices from ‘less ethical’ positions (Wainwright, Williams, Michael, Farsides, & Cribb, 2006). This ethical boundary-work can involve processes in which scientists contrast their own practices with those of less ethical others, often to justify controversial research methods (Hobson-West, 2012). Scientists working in contentious or contested biomedical research areas tend to be aware of the controversy surrounding their research, and may draw differential ethical boundaries around regulatory, professional, and personal ethical spheres (Brosnan, Cribb, Wainwright, & Williams, 2013).
As scientists tend to distance themselves from concerns about conflict of interest, these external ‘accusations’ of conflict of interest can hold normative weight for academic researchers by suggesting that researchers who are in conflicts of interest are themselves unethical (Brody, 2011; Williams-Jones, 2011). As studies show that scientists tend not to recognize conflicts of interest in themselves, and tend to distance from issues of ethical concern that are divorced from their day-to-day scientific practices, accusations of conflicts of interest may curtail adequate recognition and management of these activities. Indeed, the presence of a conflict of interest for a researcher may not actually be unethical or necessarily yield an instance of research misconduct, but instead identify a situation or problem to be managed, regulated or controlled in particular ways (Smith & Williams-Jones, 2009).

In sum, scientists involved in relationships with industry that may lead to conflicts of interest may not recognize these in their own scientific practices. They can engage in processes of decoupling and ethical boundary-work to separate their own scientific practices from those of other scientists, and from formal ethics requirements or policies. This literature thus indicates scientists’ tenuous relationship with ethical guidance and regulation, as well as difficulties in recognizing situations of potential conflicts of interest in their own research practices. This highlights a need for further examinations of how ethical concerns, specifically those of conflicts of interest related to scientists’ entrepreneurial activities, can influence scientific practices and the ways in which scientists legitimize their practices. This literature also calls for a need for ethical guidance and regulation that is grounded in the meaningful day-to-day practices and experiences of scientists.

2.4 The Institutions of Academic and Entrepreneurial Science

A significant body of scholarship on commercial or entrepreneurial activities in academic science has indeed examined the day-to-day practices and experiences of academic scientists as they engage in entrepreneurial activities. This literature has empirically
examined shifts between the institutions of academic and entrepreneurial science, without much explicit attention to conflicts of interest. These studies are largely located in the sociological and STS literatures, and examine how scientists and related professionals navigate entrepreneurial initiatives, and in turn how these initiatives form novel organizational and institutional arrangements in academic science. Much of this literature uses qualitative and archival research methodologies and is situated within a neo-institutionalist theoretical paradigm. These studies have examined shifts from academic norms and values, such as Mertonian communism in science, toward the legitimization or taken-for-grantedness of more entrepreneurial norms in academic research practices. Thus, there is a presumed distinction and tension between an institutional logic of academic science, comprised of the values, aims, and goals of academic research, and an entrepreneurial institutional logic and its values, aims and goals (Thornton & Ocasio, 2008). However, this conflicting logics view has increasingly been questioned and is often presumed without empirical examination. Indeed, Sauermann and Stephen (2013) argue that a conflicting logics view can overstate differences across scientific sectors and ignore heterogeneity between scientific disciplines and organizations.

From this neo-institutionalist paradigm, the work of Colyvas, Powell and colleagues takes the case of Stanford University to examine processes of institutionalization, or the remaking of boundaries between public and private science (Colyvas, 2007; Colyvas & Powell, 2006, 2007; Powell, Owen-Smith, & Colyvas, 2007). These studies examine longitudinal processes wherein entrepreneurial activities, and relationships between academic researchers and private sector partners, become legitimized and taken for granted. Powell and colleagues have also described the boundaries between public and private science as being remade or redrawn, where these two entities become more similar and more closely joined together over time (Colyvas & Powell, 2006; Powell & Owen-Smith, 1998). The work of Owen-Smith and Powell has also examined the remaking of boundaries between public and private science, and institutional changes in university research, usually related to faculty engagement in patenting activities (Owen-Smith, 2005; Owen-Smith & Powell, 2001a, 2001b; Owen-Smith & Powell, 2002; Owen-
Smith & Powell, 2003). Vallas and Kleinman describe these boundaries as becoming increasingly blurred by university-industry relationships. They have described a process of “asymmetric convergence” between academic and industrial research norms and practices, where institutional logics have become more similar, but also closer to the workings of industry (Kleinman & Vallas, 2001; Vallas & Kleinman, 2007). As well, Bjerregaard (2010) has described shifting institutional logics and conflicts between commercial and academic norms, where shared cultural spaces are created between academic scientists and industry.

Also examining the ways in which scientists navigate the presumed conflicting logics of academic and industrial science, Smith-Doerr’s (2005) study of scientists’ decisions to work in the biotechnology industry examines how scientists legitimize their work in this sector. It is suggested that rather than undertaking an institutionalization process wherein old institutional logics are replaced with new ones, a comingling takes place, where scientists appeal to conflicting or seemingly contradictory logics to legitimize their activities. Also examining the legitimization of scientists’ activities through their responses to organizational changes in universities as a result of biotechnology commercialization, Jong (2008) outlines how scientists (1) co-opt other groups within the university to support expansion of scientific activities; and (2) co-opt groups outside the university to support this expansion. In doing so, they challenge the institutions of the university to introduce entrepreneurial activities as legitimate. As well, Popp Berman (2012) proposes a “practice selection model” where scientists intermingle institutional innovations with exogenous changes and experiment with a variety of logics as each one gains strength. In this model, there is no single shift in logics, but instead a comingling and ongoing interaction between logics, as influenced by external public policy environments.

Conceptions of boundaries or the boundary-work of scientists have also been prominent in accounts of the management or navigation of the nexus between academic research and entrepreneurial science. A study of university researchers by Slaughter et al (2004) found boundaries had been diminished between public and commercial funding, and
between basic and applied research, and found boundaries to be in flux in the domain of academic science and intellectual property ownership. Similarly, Biscotti et al’s (Biscotti, Glenna, Lacy, & Welsh, 2009) study of U.S. agricultural biotechnology scientists found that scientists aim to construct independent professional identities as scientific investigators through the mixing of private industry and public funds in their research, thereby engaging in symbolic boundary activities to retain professional identities and designate the inflow of monetary resources into different domains of scientific conduct. Tuunainen and Knuutila (2009) describe the boundary work that is done at the university-industry interface as boundary maintenance, where academic researchers use cultural resources to distinguish public or academic scientific research activity from corporate and entrepreneurial development. These boundaries can be shaped or created and redefined by external structures, such as regulatory or policy initiatives, or the physical location of laboratories (Tuunainen, 2005). Boundaries can also be influenced by historical or cultural features of the university, such as the legal rules and regulations that govern universities, or by contracts which define the boundaries of academic and industrial activities (Tuunainen & Knuutila, 2009).

In sum, these in-depth and largely qualitative studies have examined how actors interact with the institutions of academic and entrepreneurial science, and how they in turn shape and are shaped by these institutions. As noted previously, these studies tend to assume the existence of distinct academic and entrepreneurial logics as well as a conflict between them, and tend to speculate on overall institutional change over time. Missing from these accounts, however, is attention to the navigation of academic entrepreneurship where the direction of institutional change is uncertain. Similarly missing from these accounts is specific attention to conflicts of interest in the conduct of health-oriented research, and how this affects the organization of academic entrepreneurial spaces and institutions.

### 2.5 Theories of Neo-institutionalism and Institutional Work

As demonstrated here, studies examining the ways in which academic scientists navigate and negotiate entrepreneurial activities draw from an institutionalist theoretical orientation, and understand institutions as structures, norms, rules, practices and
processes that guide and are guided by actors (Scott, 2008). These studies tend to be longitudinal in nature, and study processes of institutional change or the institutionalization of entrepreneurial or industrial activities in academic research over time. They rarely, however, attend to processes of institutional maintenance or the ways in which academic scientists interact with institutional changes and shape their institutional structures through micro-level processes that may lack any clear directionality. To address these processes, I turn to Lawrence, Suddaby and Leca’s theories of institutional work. The concepts of institutional work can be used to examine the ways in which institutions are “worked out on the ground, in the day-to-day behaviours and experiences of actors” (Zilber, 2013, p.82). Institutional work examines the “action of individuals and organizations aimed at creating, maintaining or disrupting institutions” (Lawrence, Suddaby, & Leca, 2011, p.1). Institutional work thus focuses on activities of agents that create, maintain or disrupt institutions, rather than the accomplishments of institutionalization (Lawrence, et al., 2009).

Institutional work is a subset of neo-institutional theories, which take actors as the focus of their inquiry, and examine how their actions- as embedded agents- enact, shape, maintain, reproduce or change institutions. Scott defines institutions as being “comprised of regulative, normative, and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life” (Scott, 2008, p.48). Scott’s neo-institutional framework thus suggests three ‘pillars’ that support institutions: regulative, normative, and cultural-cognitive. Studies in the regulative pillar examine how institutions constrain or regularize behaviour through activities of formal or informal rule-setting, monitoring and sanctioning. The normative pillar examines how normative rules create prescriptive and obligatory dimensions in social life, by creating and defining values and norms. Finally, the cultural-cognitive pillar examines shared cognitive conceptions that constitute the nature of social realities, involving the taken for granted routines of social life (Scott, 2008). These three elements or pillars of institutions have been used across disciplines to explore the various aspects of institutional structures, each characterizing a different aspect of institutional engagement. Similarly, DiMaggio and
Powell (1983) identify coercive (regulative), normative, and mimetic (cultural-cognitive) aspects of institutions.

Neo-institutional theory thus attempts to account for both organizational features and institutions that condition the behaviour of agents, as well as the actions of these agents in shaping institutions and organizations. Some have identified this as a “the paradox of embedded agency” (Battilana & D'Aunno, 2009), or the problem with constructing actors as both having agency to change institutions and organizations, and also being determined or constructed by these institutions and organizations. Countering theories of solitary rational actors who operate without influence from organizations or institutions, neo-institutionalists take actors to be embedded in and influenced by organizational and institutional arrangements, yet also as holding agency in shaping and constructing these organizational fields and institutions.

An institutional work examination can thus explore the stability of institutions, and the processes by which they are maintained and reproduced, as well as how organizational structures and processes acquire meaning and continuity for actors embedded within them (Suddaby, 2010). Institutional work focuses on the on-the-ground negotiations of institutions by actors, and includes creating, maintaining and changing institutions (Lawrence, et al., 2011). This approach highlights the role of institutional actors as purposive and skilled institutional agents, as well as the ways in which their practices interact with institutions, thus capturing both agency and structure (Zilber, 2013). These theories do not only account for grand changes in institutions, or the processes by which these are created, such as in the case of institutional entrepreneurship (Battilana, et al., 2009), but also to the processes of institutional maintenance or disruption in the meanings associated with institutions (Lawrence, et al., 2011; Lawrence, et al., 2009; Suddaby, 2010).

It is often under conditions of institutional complexity or uncertainty when individual actors play an important role in shaping institutions (Pache & Santos, 2013). Indeed, institutional change is often understood as a process in which institutional contradictions
and human praxis interact (Seo & Creed, 2002), making locations of institutional uncertainty or contradiction an important space for institutional work investigations. Between contradictory elements in institutions, Hargrave and Van de Ven (2009) find a source of productivity and institutional innovation through processes of institutional work. They describe a both/and management of contradictions, where actors recognize a contradiction of institutional elements, frame this as complementary, and use this as a source of innovation. In Pache and Santos’ (2013) typology of responses to competing institutional logics, they outline a process of compartmentalization where individuals segment their compliance with competing logics, as well as combination, where actors blend values, norms and practices between competing logics. These responses and negotiations of actors in spaces of institutional uncertainty and contradiction highlight the importance of actors’ normative values, practices, resources and legitimacy in their activities, as agents of institutional work.

Importantly, institutional work, as a subset of neo-institutional theory, focuses on actors’ engagements with organizational and institutional legitimacy. Legitimacy, by means of social acceptability and credibility, is a requirement for actors within organizations to survive, and “is not a commodity to be possessed or exchanged, but rather a condition reflecting perceived consonance with relevant rules and laws, normative support, or alignment with cultural-cognitive frameworks” (Scott, 2008, p.59-60). Indeed, actors’ acquisitions of legitimacy are the tools of institutional work, where their perceived legitimacy can initiate institutional change or maintenance. The focus of institutional work on actors as agents within institutions and organizations, who are responsive to and shape these institutions, centres the importance of legitimacy for these actors through their engagements with activities that are perceived to be consonant with rules, norms and cultural-cognitive frameworks. This legitimacy may thus cohere with existing institutional logics, or may be generated through the creation of new institutional logics. Processes of institutionalization, however, require not just legitimacy, but also taken-for-grantedness, making legitimacy just one part of the institutionalization process (DiMaggio & Powell, 1983). Though it is individuals who engage in legitimizing work, this work extends beyond self-justification, and is an inherently social process that
necessarily appeals to broader institutions, organizations, and social groups (Smith-Doerr, 2005). The legitimization of a new role or set of practices for actors is often accomplished in micro-processes that facilitate continuing change efforts (Reay, Golden-Biddle, & Germann, 2006). Thus, for organizations the pursuit of legitimacy may be to insure survival, but for individuals these pursuits are related to social acceptance, status and identity (Pache & Santos, 2013).

To date, theories of institutional work have not been used widely in studies of academic entrepreneurship. As well, despite promises of institutional work in focusing on the ongoing work to maintain or challenge existing institutions, little of this literature has examined the ‘messy’ institutional work at the stage at which the directionality of institutional change is uncertain (Zilber, 2013). Despite many examinations of the underpinnings and potential uses of this theory, there have been relatively few studies that have put these theories into practice. In general, studies using an institutional work framework have examined the negotiations made by actors between a number of competing or co-existing institutional logics, and the institutional work required to manage these contradictions. For example, Zietsma and Lawrence’s (2010) longitudinal study of the forestry industry examines the competing activities of various actors in response to B.C. forestry initiatives. They found a recursive relationship of boundary work and ‘practice’ work to initiate change as well as maintain various institutions. Examining the implementation of liberal democracy in Malawi, Bjerregaard and Lauring (2012) found similarly that entrepreneurs engaged in activities across multiple institutional spheres to balance institutions, drawing from contradictory institutional logics to support different ends. As well, in a study of the legitimization of Nurse Practitioners in Alberta, stages of role legitimization included processes of cultivating opportunities for change, followed by actions to fit new roles into prevailing systems, and finally in proving the value of the new role (Reay, et al., 2006). While these studies provide important insights into how actors navigate divergent institutions and draw from a range of institutional logics to legitimize activities and practices, they tend to be longitudinal and speculate on an overall direction of institutional change. These studies examine actors’ roles in the processes of institutional change, but may not capture the full
potential of institutional work theory in examining ongoing and uncertain negotiations with institutions.

Overall, this literature on neo-institutionalism and institutional work highlights a need to examine negotiations in the institutionalization of academic entrepreneurship when direction of institutional change is uncertain. This also calls for the need for empirical grounding when studying the location of multiple institutional logics, without speculating on the overtake of one institutional logic with another, and where actors work in a recursive relationship with institutions. This body of work also locates the importance of institutional legitimacy as a tool of institutional work, as actors navigate potentially conflicting logics in diverse institutions, and work to legitimize initiatives. Finally, this demonstrates the need to draw on institutional work theories given the central place of academic agents as actors in reshaping scientific norms in the domain of academic entrepreneurship.

### 2.6 Summary and Discussion

This review of literatures on academic entrepreneurship and conflict of interest concerns highlights the wealth of scholarship that has examined innovation and commercialization agendas in health research, and also highlights the importance of bringing these bodies of scholarship into conversation. While the research, innovation, and entrepreneurship literature tends to support proprietary interests and closely networked ties between academic scientists and industry collaborators, literature on conflicts of interest describes the harms that these entanglements may imply. As well, though much of the literature on academic entrepreneurship examines the activities and incentives of academic scientists in the biomedical sciences, little of this literature is specific to how biomedical research is a domain of health research, and how this impacts the activities of scientists and the outcomes of their scientific activities. On the other hand, the conflict of interest literature is attentive to how commercial research arrangements can have impacts on health research agendas and patient populations, but may not be resonant for biomedical scientists engaged in entrepreneurial activities. In being explicit to how entrepreneurial imperatives in the biomedical sciences are a matter of health policy and practice as well
as research and innovation policy and practice, this study attends to how scientists’ engagements with entrepreneurial activities in the biomedical sciences inform health product development and translation, and how the downstream impacts of these entrepreneurial activities may both benefit and harm patient populations and medical research and practice at large.

This review of relevant literatures suggests several important features and gaps in this heterogeneous body of scholarship, and demonstrates the need for a study of academic entrepreneurship that is attentive to both the ways in which entrepreneurial science is valued and practiced, and the ways in which it may imply certain conflict of interest implications. Understanding the introduction of entrepreneurial activities into academic science as a time of institutional change and uncertainty, where the institutions or logics of the academy and the market may comingle or contradict each other, there is a need to both empirically examine scientists’ evaluations of these institutional logics, and also inquire into their negotiations of these logics where the direction of institutional change is uncertain. This highlights the benefits of an institutional work approach in this context, where academic scientists are understood as agents working to negotiate and legitimize entrepreneurial activities, and especially as health-oriented scientists who may face translation and impact imperatives as well as conflict of interest concerns.

The chapters that follow draw from and enhance this existing literature in several important ways. Firstly, Chapter 4 empirically examines how academic scientists normatively value and position the institutional logic of academic entrepreneurship and the credibility of conflict of interest concerns, thus adding to institutional theories of academic entrepreneurship by providing an empirical examination of an entrepreneurial institutional logic. As well, this chapter examines academic and attitudinal factors associated with academic entrepreneurship, thereby adding to innovation literatures by examining academic factors associated with entrepreneurial activities, but also doing so purposively to examine an overlap between academic and entrepreneurial logics. Following this, Chapter 5 explores the normative institutional work done by academic entrepreneurs in the ways in which they value and legitimize their entrepreneurial
activities as beneficial to academic science at large. This chapter adds to literature on scientists’ motivations and values associated with conducting entrepreneurial activities, and is attentive to negotiations related to downstream health impacts of research. Finally, the organization and navigation of entrepreneurial activities within academic laboratories is explored in Chapter 6. Drawing again on institutional work theories, this chapter adds to the literature in this domain by examining how entrepreneurial activities are negotiated in academic laboratories, including domains in which boundaries are maintained or broken, and how conflict of interest concerns, both explicit and implicit, are understood and managed.
Chapter 3
Methodology

3.1 Overview

This study uses a mixed-methods approach, and draws from a national survey of publicly-funded academic biomedical researchers, and in-depth interviews with a subsample of these researchers who had been involved in activities of academic entrepreneurship, as well as interviews with trainee academic scientists. Academic biomedical researchers funded by CIHR were surveyed to examine their demographics and academic characteristics and rates of participation in entrepreneurial activities, as well as their normative attitudes to entrepreneurial activities and conflict of interest concerns. Survey data are used in Chapter 4 to indicate the legitimacy of entrepreneurial activities and credibility of proposed conflict of interest concerns amongst academic biomedical scientists, and in doing so, empirically position the institutional logics of academic and entrepreneurial science, and intersections between the two. Following this, qualitative interviews with a subset of this population explored entrepreneurial scientists’ experiences with academic entrepreneurship, including their motivations for engaging these pursuits and the management of these activities in their academic laboratories, as well as their negotiations of related conflicts of interest concerns. Interviews with trainee scientists examined their attitudes and exposure to entrepreneurial activities. These qualitative analyses in Chapters 4, 5, and 6, situate entrepreneurial scientists as institutional workers in interacting with their institutional environments, and examine how they generate value and legitimacy in entrepreneurial activities.

This cross-sectional mixed-methods design allowed for both an overarching and generalizable picture of Canadian academic scientists’ practices, attitudes and values towards entrepreneurial science and associated conflict of interest concerns, as well as an in-depth exploration of how and why entrepreneurial scientists engage, and generate legitimacy, in entrepreneurial activities. The analysis was thus sequential and
explanatory, where the focus was on the qualitative analyses, which added theoretical depth and meaning to quantitative findings (Cresswell 2003). This data analysis model (Figure 3.1) uses quantitative survey findings as a starting point, and in-depth qualitative analyses to provide a situated and theoretical analysis of academic entrepreneurship and the associated potential for conflicts of interest in academic biomedical science in Canada. The survey protocol was approved on September 25, 2007 (#21175), and the interview protocol was approved on June 7, 2011 (#26468) by the University of Toronto Health Sciences Research Ethics Board.

Figure 3.1: Sequential explanatory design, adapted from Cresswell, 2003.

3.2 Quantitative Analysis: National Survey of Academic Biomedical Researchers

3.2.1 Survey Overview

The questionnaire items used for this study were drawn from a larger survey examining the preferred impacts of health research in Canada, disseminated to biomedical scientists who had been funded by Canada’s federal health research funding agency, the Canadian Institutes of Health Research (CIHR) in 2009-10, as well as a representative sample of Canadian citizens. Analyses of the survey of citizens, and comparisons between citizens and researchers have been published elsewhere (Miller et al., 2013; Miller et al., 2014). The data used for this study were drawn from the survey of CIHR-funded biomedical scientists, and relevant questionnaire items examined their demographic features and participation in activities of entrepreneurial science, attitudes towards entrepreneurial activities, and attitudes towards conflict of interest implications and positive incentives of
academic entrepreneurship. Survey data collection occurred between October, 2010 and February, 2011.

### 3.2.2 Instrument Design

Relevant sections of the survey instrument were designed from a review of relevant empirical, policy and ethics literature on academic entrepreneurship and conflicts of interest, examined in Chapter 2. The instrument was pre-tested and refined with 4 CIHR-funded biomedical scientists who were able to comment on the applicability of the instrument and its resonance in their own research settings. The instrument was modified and re-tested according to each participant’s feedback. A reproduction of the sections of the survey used in this study is located in Appendix A.

Firstly, section C measured respondents’ attitudes to entrepreneurial activities using 5-point Likert scales (Strongly Agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree), with a ‘Don’t Know’ option. By asking whether academic biomedical researchers should engage in a series of activities when the type of research they were doing made this possible, these items aimed to assess the normative appropriateness of these activities. These activities were selected to represent a range of activities of research commercialization and collaborations between academic scientists and industry, as diverse activities likely have diverse meanings and valuations for academic scientists (Perkman et al., 2013). Question (a) examined attitudes to the appropriateness of selecting research topics for their commercial potential; question (b) examined attitudes toward the appropriateness of developing commercial products from the results of research (i.e., creating spin-off/ start-up companies, doing further development); question (c) examined attitudes toward an activity of collaboration with industry (consulting); question (d) examined the collaborative activity of co-authorship with the health products industry; finally, question (e) examined the appropriateness of patenting research.

Secondly, section D measured respondents’ attitudes towards proposed conflict of interest implications of academic-industry relationships, as well as incentives for these
activities. These items also used 5-point Likert scale with a Don’t Know option, and negative (conflict of interest) items and positive (incentive) items were interspersed. These items were posed as a series of statements about relationships between academic scientists and the health products industry, and attempted to elicit attitudes to the appropriateness of these implications and incentives, often proposed in the academic and policy literature. As these items aimed to elicit normative attitudes to implications of entrepreneurial activities, the term “conflict of interest” was not used, and these items measured this construct through the harms proposed by academic-industry relationships. These items examined (a) attitudes toward the import of inappropriate bias into research activities that involve industry collaboration; (c) the problem of collaboration with industry fostering secrecy and discouraging interchange and cooperation between researchers; (e) the potential for harm to research participants when industry is involved in biomedical research; and (g) the potential for loss of public trust in academic researchers who collaborate with industry. Positive incentive items examined (b) the appropriateness of academic career reward for researchers who collaborate with industry; (d) the appropriateness of increasing public funding for initiatives that involve collaboration with industry; and (f) the potential for the real-world application of research that involves industry collaboration.

Demographic characteristics collected in section E aimed to gather information on scientists’ general and academic characteristics, as well as their participation in entrepreneurial activities. These items included gender (E1), primary field of research (E2), professional qualifications (E3), number of peer-reviewed journal articles published in the previous five years (E4), year of completion of highest degree (E5), academic rank (E7), number of research personnel and trainees supported (PIs only) (E8), trainee career goals (trainees only) (E8), primary work/organizational affiliation (E9), percentage of time engaged in research, teaching or clinical practice (E10), and primary sources of funding (or that of supervisor for trainees) (E11). Demographic data collection also captured recent (past five years) participation in a range of activities of entrepreneurial science (E6). These items aimed to capture both activities of research commercialization
(b,c,d) and collaboration with industry (a,e,f,g,h) as aspects of entrepreneurial science. These items also provided the basis for the selection of interview respondents.

3.2.3 Study Sample

The population of interest was publicly-funded academic scientists conducting basic biomedical research in Canada. CIHR’s publicly-available listings of studies funded in 2009-10 were used to identify all biomedical scientists, selected amongst CIHR’s funding categorization themes (biomedical research, clinical research, public health research, health services research), who had received research grants or doctoral or postdoctoral funding (n = 4,781). A title, keyword and abstract review were then used to eliminate non-biomedical research studies (8), studies with missing abstracts (148), duplicate studies (211), and research conducted outside of Canada (1,135). The contact information of this penultimate sample of scientists (n = 3,279) was then located through public Internet searches, either of primary email addresses, or supervisor contact or postal addresses for trainees (doctoral and postdoctoral). An additional 19 individuals who were deceased, retired, out of country, had piloted the survey instrument, or where no contact information was available were removed, and the final sample of eligible respondents was 3,260.

These eligible respondents were stratified by researcher type and availability of contact information. Respondents were contacted according to the Dillman tailored design method (Dillman, Smyth, & Christian, 2008), which included up to five individual contacts, through a combination of Internet and paper-based methods. Principal Investigators (i.e. not doctoral or postdoctoral grant recipients) were contacted by direct email (except for the fourth of five contacts), and trainees were contacted either through direct email or postal address, or through their supervisor’s email or postal address. The first, second, third, and fifth contact provided potential respondents with a link to the web-based survey. The fourth contact provided potential respondents with a paper-copy of the survey at their postal addresses.
3.2.4 Data Analysis and Interpretation

Survey responses from both Internet and paper-based surveys were entered into spreadsheets and coded for analysis using SPSS data analysis software (v. 21), with indications of where data were missing. Two additional groups of respondents were excluded as ineligible at this juncture: those who indicated in item E2 that their primary field of research was not biomedical research, and those who indicated in item E10 that they spent no time on research activities. These exclusions aimed to focus the sample on biomedical scientists who were active researchers. Data analysis was largely conceptual, descriptive and exploratory, and analyses aimed to examine the constructs of the legitimacy of entrepreneurial activities within academic science, and the credibility granted to conflict of interest concerns and incentives of academic entrepreneurship. Through an analysis of factors associated with participation in entrepreneurial activities, the overlap of entrepreneurial and academic logics was examined. In examining these constructs and phenomena, survey data were used to provide evidence for how scientists value and locate the institutional logics of entrepreneurial science, and how these interact with the institutional logics of academic science. This analysis thus aimed to provide an overview of the institutional environment of academic entrepreneurship in Canada, and to situate the qualitative interview analyses of the institutional work done by entrepreneurial scientists.

Table 3.1 indicates how attitudinal survey items were used to measure three overarching constructs of interest, and in doing so, provide empirical support for how academic scientists at large value the legitimacy of entrepreneurial activities, and where they ascribe credibility to concerns about conflicts of interest and positive incentives for entrepreneurial activities. Items measuring the perceived normative appropriateness of entrepreneurial activities (C(a)-(f)) aimed to assess and locate the perceived legitimacy of these activities for academic scientists, where agreement entailed designations of legitimacy. Through the legitimacy granted to each of these activities, the institutional logic of entrepreneurial science was examined, including the extent to which this did or did not not align with academic ideals, practices, and logics. Items measuring attitudes to
conflict of interest concerns (D (a), (c), (e), and (g)) aimed to measure the credibility of these statements as adequately capturing concerns about harms caused by entrepreneurial activities for academic scientists. Here, agreement with these statements was taken to be a granting of credibility. Finally, agreement to survey items examining incentives of academic entrepreneurship (D (b), (d), and (f)) aimed to capture the credibility of these proposals, as well as potential overlaps between academic reward and funding structures and entrepreneurial activities. These items were analysed descriptively and conceptually, and Likert scale data were dichotomized (i.e. combining strongly agree/agree as well as strongly disagree/disagree categories) in order to show response patterns.

<table>
<thead>
<tr>
<th>Survey item</th>
<th>Measuring</th>
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<tbody>
<tr>
<td><strong>Legitimacy of Academic Entrepreneurship</strong></td>
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<tr>
<td>C (a) When academic biomedical researchers start to plan their studies, they should make efforts to choose research topics that are likely to have commercial applications.</td>
<td>Perceived normative appropriateness and legitimacy of research commercialization (planning)</td>
</tr>
<tr>
<td>C (b) Academic biomedical researchers should make efforts to develop commercial products from the results of their research (e.g., do further development, collaborate with industry, create ‘start up’ companies).</td>
<td>Perceived normative appropriateness and legitimacy of research commercialization (developing commercial applications)</td>
</tr>
<tr>
<td>C (d) Academic biomedical researchers should make efforts to consult for the health products industry (e.g., sit on business advisory boards).</td>
<td>Perceived normative appropriateness and legitimacy of collaboration with the health products industry</td>
</tr>
<tr>
<td>C (e) When academic biomedical researchers publish in scientific or medical journals, they should make efforts to publish jointly with employees of the health products industry.</td>
<td>Perceived normative appropriateness and legitimacy of co-authorship with the health products industry</td>
</tr>
<tr>
<td>C (f) Academic biomedical researchers should make efforts to patent their research.</td>
<td>Perceived normative appropriateness and legitimacy of patenting of academic research</td>
</tr>
<tr>
<td><strong>Credibility of Conflict of Interest Concerns</strong></td>
<td></td>
</tr>
<tr>
<td>D (a) “Academic biomedical research that involves collaboration with the health products industry is more likely to be inappropriately biased in favour of industry in its design, analysis or the presentation of results.”</td>
<td>Perceived credibility of inappropriate bias in research in favour of industry in academic-industry collaborations</td>
</tr>
<tr>
<td>D (c) “Collaboration with the health products industry fosters secrecy and discourages exchange and cooperation between academic researchers.”</td>
<td>Perceived credibility of secrecy/discouraging interchange in academic-industry collaborations</td>
</tr>
</tbody>
</table>
D (e) “When the health products industry sponsors academic biomedical research, there is increased risk of harm to research participants.” Perceived credibility of risk of harm to human research participants in academic-industry collaborations

D (g) “The public does not trust academic researchers who collaborate with industry.” Perceived credibility of loss of public trust in academic-industry collaborations

<table>
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<tr>
<th>Credibility of Positive Incentives of Academic Entrepreneurship</th>
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<tr>
<td>D (b) “Academic biomedical researchers who collaborate with the health products industry should be more highly rewarded in their academic careers than those who do not collaborate with industry.”</td>
</tr>
<tr>
<td>D (d) “More public funds should be invested in academic biomedical research that involves collaboration with the health products industry than in academic biomedical research that does not.”</td>
</tr>
<tr>
<td>D (f) “The results of research developed from collaborations between academic biomedical researchers and the health products industry will better address real-world problems.”</td>
</tr>
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</table>

Table 3.1: Constructs measured by survey item

Demographic data were presented descriptively, and some items were aggregated and transformed in order to describe a meaningful overview of the sample, and provide meaningful independent variables for a multivariate model. In describing respondents’ organizational location, respondents located in university settings were separated from those in other organizational locations (hospitals, hospital research institutes, university research institutes), as these other organizational locations may entail distinct research translation mandates for academic scientists. As well, descriptions of scientists’ professional qualifications separated those indicating they held medical degrees from other scientists, as it was expected that clinical training might impact their attitudes and values towards entrepreneurial science.

In order to assess how scientists’ demographics, academic characteristics, and attitudinal factors are associated with their participation in entrepreneurial activities, a multivariate, ordinary least squares (OLS) linear regression model was conducted. Trainee respondents were excluded from this analysis as they were measured by different
demographic and characteristic items, and were assumed to have less control over their academic laboratory environments. This precarious position of trainees in relation to entrepreneurial activities is examined in Chapters 4 and 6 of this thesis. This analysis of PIs’ involvement in entrepreneurial activities aimed to examine overlaps between scientists’ academic characteristics and attitudes to entrepreneurial science and their participation in these activities, thereby indicating areas in potential overlap of academic and entrepreneurial logics. For the dependent variable, measuring participation in entrepreneurial activities, a scale of participation in entrepreneurial activities was calculated using agreement to items in question E6 (0-8). Independent variables measured demographic items, including gender (female as reference category); academic rank and qualifications (Full Professor, Associate Professor, Assistant Professor, Scientist/Other; Holder of MD degree); seniority (time since completion of highest degree); organizational location, separating university based scientists from those in organizations that may have more translational mandates (i.e., hospitals, hospital research institutes, university research institutes); funding sources (internal, federal councils, non-Canadian councils, private foundations, federal/provincial departments, private firms, public funding with commercialization design); academic time spent on research and teaching; and academic productivity (number of papers published in the previous five years, number of research personnel and trainees).

To assess the role of attitudes and values in scientists’ participation in entrepreneurial activities, the multivariate analysis also included composite measures, based on 5-point Likert scale responses to the three constructs of interest, with the Don’t Know option excluded. The legitimacy of entrepreneurial activities was measured by attitudes to entrepreneurial activities (5-25), credibility of conflict of interest concerns was measured by attitudes to conflict of interest implications (4-20), and credibility of academic incentives of academic entrepreneurship was measured by attitudes to positive incentives of academic entrepreneurship (3-15). The use of these attitudinal scales as independent variables aimed to measure the effects of these value orientations and assessments on participation in academic entrepreneurship. Principal component analyses were used to
determine the components of these scales, and Cronbach’s-alpha measures were used to test their internal consistency.

Assumptions of the model were tested using statistical analysis software (SPSS) to assess generalizability of the model. Independent variables were entered into the model simultaneously (forced entry) in order to test the underlying theoretical assumptions of the model. Results are reported as non-standardized coefficients (betas) and their standard errors, and standardized coefficients (β) are reported to allow comparison between variables. A p value of \( \leq 0.05 \) was used to measure the statistical significance of independent variables. Goodness of fit of the model was determined with the \( R^2 \) (adjusted and nonadjusted) coefficient of determination. These analyses are presented in Chapter 4.

3.2.5 Rigour of Instrument and Analysis

Several steps were taken to insure the validity and reliability of the survey instrument. Face validity of the survey instrument was accomplished through pre-testing the survey with lay respondents as well as expert respondents (n = 4), where the survey instrument was iteratively modified based on their feedback. Versions of the survey were adapted until they were resonant with the practices and activities of academic biomedical scientists. Content validity was strived for through the use of thorough reviews of relevant academic literature to develop the survey items. Through reviews of this literature and discussion with experts, these survey items aimed to assess a full range of entrepreneurial activities, incentives, and conflict of interest concerns. Internal validity and construct validity were also attempted through the use of a diverse range of questions aimed at measuring constructs of interest. As well, Cronbach’s coefficient alpha measures (≥0.6) were used to measure and insure the internal validity and reliability of scales used in multivariate analyses.
3.3 Qualitative Analysis: In-depth Interviews with Entrepreneurial Scientists and Trainees

3.3.1 Overview and Orientation

Following the dissemination of the survey instrument, qualitative interviews were conducted with a subsample of academic biomedical scientists, drawn from the survey population. These interviews aimed to augment the survey data by providing an in-depth exploration of how academic entrepreneurs value entrepreneurial activities and conflict of interest concerns in the context of their academic scientific practices. The subsample of interest were scientists who had engaged in a range of entrepreneurial activities, as well as trainees, who were selected iteratively according to emerging areas of interest in the data. The approach to qualitative data collection, analysis and interpretation drew from theories of Constructivist Grounded Theory (Charmaz, 2006). These theories centralize the study of action, and examine how agents understand and make sense of their actions and social realities. Through interpretation, analyses render an interpretive portrayal of these agents and their organizational and institutional environments, rather than an exact picture of their realities. Using theories of institutional work, entrepreneurial scientists were located as active agents in pursuing institutional legitimacy, and in interacting with diverse institutions to initiate institutional change or maintenance through their actions at the micro-level. Interview analysis thus drew from both Grounded Theory in allowing themes to emerge from scientists’ experiences and interpretations of their engagements with entrepreneurial science, and drew from theories of institutional work in locating scientists as institutionally embedded agents who interact with diverse institutions in shaping their research and institutional environments.

3.3.2 Sample Selection

Following the completion of the survey, a subsample of researchers were purposively selected from the pool of survey respondents who agreed to be re-contacted for qualitative interviews (indicated in question E12). Interview participants were selected iteratively, based on their responses to survey items and themes emerging from the
As the interest of this investigation was in examining entrepreneurial scientists, survey responses were used to select an initial pool of researchers who had participated in a variety of entrepreneurial activities. Specifically, scientists were selected who had participated in at least one activity of research commercialization (measured by items E6 b,c,d) as well as at least one activity of collaboration with industry (measured by items E6 a,e,f,g,h). It was assumed that these scientists had participated in a range of entrepreneurial activities and would be able to speak to an array of experiences and interactions. In total, 435 survey respondents met these criteria. Of these 435, 409 were Principal Investigators (PIs) and 26 were trainees (PhD students and postdoctoral fellows). In an attempt to capture a diversity of attitudes and experiences within this entrepreneurial subgroup, initial groupings were made based on scientists located in universities and those located in hospitals (using survey item E9). Due to the interest of this study in investigating scientists’ interactions with conflict of interest concerns, groupings were also made based on those scientists who were concerned about these implications (determined by agreement to three or more items measuring the construct of conflict of interest implications), and those who were not concerned about these implications (determined by disagreement to three or more of these items measuring conflict of interest concerns). Alongside these initial two sampling cuts, respondents were sampled for variability in career stage and location across Canada to initially sample for maximum variation.

Potential interview participants were contacted by email to participate in an interview, and were provided with a copy of an information sheet about the interview (Appendix B). One week after the first contact, those who had not responded were sent a follow-up reminder email to inform them about the interview and invite their participation. As interviews progressed, it became apparent that the differences between groups of respondents were minimal, and that organizational location and survey indications of attitudes to conflicts of interest did not determine their interactions with and values towards entrepreneurial science. As all interview respondents had participated in entrepreneurial activities, they described their own negotiations and management of these activities, and did not clearly group along positive and negative attitudinal, or
organizational lines. Further recruitment strategies thus sampled ‘neutral’ scientists, who had responded in the ‘neither agree nor disagree’ categories of the survey instrument to conflict of interest items, as it was expected that these scientists might negotiate entrepreneurial activities differently from those with strongly positive or negative attitudes and provide unique perspectives. As with the previous categorizations, the ‘neutral’ scientists discussed largely similar strategies of negotiation and management to other groups, with no unique qualities of this neutral group. In total, 102 entrepreneurial scientists were contacted to participate in an interview, and 24 interviews were conducted with entrepreneurial PI respondents. No trainees agreed to participate in an interview from this initial recruitment strategy. PI interviews were conducted until thematic saturation was reached, that is, when gathering new data no longer provided new theoretical insights.

The initial selection of interview participants only aimed to recruit trainees inasmuch as they fit the overall sampling criteria of entrepreneurial participation. However, a dominant theme emerging from interviews with entrepreneurial PIs was the shielding or separating of their trainees from most entrepreneurial activities as these were seen to be antithetical to trainee progression benchmarks, themes examined further in Chapter 6. This prompted a need to inquire into the trainee perspective, and assess their exposure and attitudes towards academic entrepreneurship. Thus, in order to specifically recruit trainees for participation in interviews, recruitment and inclusion criteria were expanded to recruit trainees who had participated in any one entrepreneurial activity, as very few trainees had participated in both an activity of research commercialization as well as a collaborative activity. 38 individuals with available contact information met these inclusion criteria and were contacted to participate in an interview; of these, three agreed to participate. Following this low recruitment rate, trainees who had received funding from private firms or funding designed to incent to the commercialization of their research were included in the criteria (determined by survey item E11). An additional 26 contactable individuals met these criteria, and one agreed to participate in an interview. In a final attempt to inquire into trainee attitudes and experience with academic entrepreneurship, especially amongst junior scientists who hoped to pursue an academic
career, trainee respondents who had indicated that they were interested in pursuing a career in academia (indicating ‘yes, definitely’ or ‘yes, probably’ to question E8) were recruited; 124 contactable individuals met these criteria and were contacted to participate in an interview, 10 of these individuals agreed to participate. After a total of fourteen interviews with trainees from across organizational settings were conducted, little thematic depth was established. Trainees’ experiences and exposures were highly diverse and dependent on their laboratory dynamics and organizational capacities, and as such thematic similarities amongst their experiences were not discernable. Unfortunately, recruitment constraints precluded the inclusion of more trainee participants that might be able to build further thematic depth.

3.3.3 Interviews

Respondents who agreed to an interview were given a choice of their preferred mode of interview contact and were interviewed face-to-face, (if researchers were located in Toronto), on the telephone, or by Internet video-conferencing (e.g., Skype). After agreeing to the interviews, participants were again sent the information sheet and the consent form for the interview to review in advance. For those interviews that did not occur face-to-face, participants were asked to return (via fax or email) a signed consent form, or to consent verbally for the interview; for interviews that were conducted in person, participants were asked to sign a consent form. As well, participants were asked for their permission for the interviews to be tape-recorded. All individuals who agreed to an interviewed also signed the consent forms, completed the interviews, and consented to have their interviews tape-recorded. Interviews lasted between thirty minutes to two hours, and were conducted between August 2011 and April 2012. In total, 38 academic biomedical researchers were interviewed; 24 of these were PIs and 14 of these were trainees. Preparation for each interview also included a review of participants’ websites to gauge their laboratory size and activities, and an overview of their recent publications to examine their types of scientific activities.

The interview guide for this study underwent several iterations. Initially, a similar interview guide was used for both PI and trainee groups; however, due to the different
nature of the experience of each group, a separate interview guide was developed for trainee respondents. The initial version of the PI interview guide explored (1) the nature of participants’ commercialization activities and collaborations with industry; (2) their motivations for participating in these activities; (3) the organization of entrepreneurial activities within their academic laboratories; and (4) whether their research had ever been affected by a conflict of interest, and whether this had been addressed by any regulatory mechanisms at their research organizations. Further iterations of the guide were modified to include a preliminary question about the type of research that each participant conducted in their academic laboratory, and the conflict of interest line of questioning was modified to suggest an association between entrepreneurial activities and conflicts of interest as a concept and connection to be examined and considered, rather than directly asking participants about their own experiences with conflicts of interest, as this did not initially generate productive discussions. As well, to further probe conflicts of interest or harms related to entrepreneurial activities, participants were asked if there were any trade-offs or compromises required to conduct their entrepreneurial activities. In doing so, the interview guide attempted to probe the issue of potential conflict of interest, construed broadly, rather than naming the problem as such, and thus constraining discussion. This final version of the PI interview guide is located in Appendix C.

In trainee interviews, probing the entrepreneurial engagements of trainee participants revealed that only four individuals had personally engaged in entrepreneurial activities in some way, usually through collaborations with industry or industry funding of their research. The trainee interview guide was thus modified to focus on trainees’ exposures and attitudes to entrepreneurial science. Trainee interview participants were asked about (1) the type of research they conducted; (2) their career paths and goals, including their interests in industry careers and academic entrepreneurship; (3) their exposure to entrepreneurial activities in their laboratories or research organizations, and whether they could envision themselves engaging in these activities. Similar to PI interviews, I asked trainee respondents about what trade-offs or compromises might need to be made to conduct entrepreneurial science with specific probes about bias, secrecy, and downstream
concerns in the conduct of these activities, as well as the concept of conflict of interest more broadly. The final version of the trainee interview guide is located in Appendix D.

At the end of each interview, participants were given the opportunity to reflect on anything further about the topic that had not specifically been asked of them, and that they thought was relevant to their experiences in this domain. They were also given the opportunity to ask any questions or share any information ‘off the record’, once the tape recorder was shut off. Following each interview, detailed memos were written to describe the interview setting, interactions with interview participants, and any emerging themes or patterns in the data.

3.3.4 Data Analysis and Interpretation

All interviews were transcribed verbatim, and uploaded to QSR NVivo qualitative data analysis software (v. 7) for coding and analysis. Interview transcripts were de-identified to maintain the confidentiality of interview participants. Data collection and analysis occurred iteratively, and interviews were conducted and modified as themes from these interviews emerged. Due to significant differences in interviews between PI and trainee participants, these two categories of participants where analysed as discrete groups. In the tradition of Grounded Theory, the analysis and interpretation of interview data drew themes from interview participants’ accounts of experiences, and attempted to examine how scientists interviewed make sense of their own values and institutional environments. As well, in an attempt to situate the findings within relevant literature and theories of what is known about academic entrepreneurship, analysis simultaneously drew from a theoretical framework which recognizes the existence of certain institutions of academic and entrepreneurial science which scientists must navigate, and located entrepreneurial scientists as institutional workers in strategically justifying and legitimizing their research practices. This analysis was inherently interpretive, in that I took participants’ descriptions as strategic representations of their research practices, and recognized my analyses of these as constructions of reality, grounded in empirical data.
Initially, a series of preliminary open codes were used to categorize and describe concepts and analytic categories arising from the data. From there, these initial open codes were grouped into larger axial codes, in order to locate larger categories and themes emerging from the data. Using methods of constant comparison, data were compared with data, and data were compared with codes and themes in order to generate coherence. In-depth memos were then written, organized around axial codes, as well as organized around the main questions of the interview guide. From there, theoretical codes were developed in the PI data in order to integrate themes into theories, and map relationships between codes, analytic categories, and emerging themes.

In the process of theoretical coding, I wrestled with what seemed to be contradictions in the data, and located these contradictions as moments of institutional work and the strategic legitimization of scientific practices. These theoretical codes were then re-applied to the interview data to examine coherence, and modified to account for scientists’ descriptions of their research practices and values. Throughout this process, extensive memos were kept to explain coding decisions, analytic categories, relationships between categories, and the significance of emerging themes with respect to the literature and overarching theoretical framework. These in-depth memos, summaries of data and excerpts of interview transcripts were discussed with members of my thesis committee for further refinement. The final stages of data analysis occurred in the writing of drafts of this dissertation, where connections between chapters and the coherence of thematic assumptions and assertions were tested and re-tested against each other, as well as the academic literature.

3.3.5 Rigour of Analysis

Rigour of qualitative data collection and analysis was maintained through both triangulation of themes developed with quantitative data collected, and by a reflexive qualitative research process. Though the quantitative instrument surveyed a different overall population of researchers (all CIHR-funded biomedical researchers and not just entrepreneurial scientists), examinations of values towards entrepreneurial activities and conflict of interest concerns could be observed in both quantitative and qualitative data,
and were compared and contrasted in data analysis. Drawing from Charmaz’ (2006) four criteria for rigour in constructivist qualitative research studies, I developed an in-depth familiarity with the research setting, including repeated observations and close links between observations and analytic categories created to gain credibility. This was accomplished though reviewing the websites and publications of interview participants prior to their interviews to familiarize myself with their research and organizational locations, as well as discussing with them their research and research environments. Secondly, I attempted to provide new theoretical insights to the study problem to achieve originality. This was accomplished by reviewing relevant literature in the field before and during the study to avoid repetition, and by examining interdisciplinary understandings of entrepreneurial science to provide new insights into this complex issue, specifically by combining an in-depth exploration of academic entrepreneurship in the basic biomedical sciences and simultaneously attending to understandings and management of associated conflict of interest concerns. In addition, I reflected on taken-for-granted meanings and institutional structures to achieve resonance; this was an integral component of the study design, as one of the primary goals was to unpack and reflect on the legitimization processes of entrepreneurial scientific conduct and understandings associated with conflict of interest concerns. Finally, my analyses were directly applied to Canadian health research policy contexts and to the theoretical literature in the field. I was thus able to provide insights into this area of emerging policy and ethical concern, and therefore was able to achieve usefulness in the study. Additionally, an audit trail of the research process was maintained by documenting all data collection and analysis decisions through memos, and by tracking data coding decisions in data analysis software.

3.4 Mixed-methods Data Analysis and Interpretation

The qualitative and quantitative data were combined to enable an analysis of academic entrepreneurship in Canada that both provides an overview of how academic biomedical researchers value and locate legitimacy in entrepreneurial science, as well as an in-depth examination of how a subsample of entrepreneurial scientists engage with and generate institutional legitimacy in these activities and do institutional work to this end.
Quantitative data thus provide an empirical examination of the logic of entrepreneurial science, and establishes the institutional environment of academic entrepreneurship in the biomedical sciences in Canada. Qualitative analyses then examine the agents of institutional work in conducting and legitimizing entrepreneurial activities, and explore how they value, navigate and work to legitimize entrepreneurial activities within their academic research worlds.
Chapter 4
The Institutional Environment of Academic Entrepreneurship in Canada

4.1 Introduction

This chapter aims to situate the institutional environment of academic entrepreneurship in Canada. This chapter describes the demographics of the sample of scientists surveyed and interviewed for this study, and then examines how they locate an institutional logic of entrepreneurial science. This is accomplished through an examination of the legitimacy granted to entrepreneurial activities within the academic research enterprise, as well as the credibility of conflict of interest concerns, and incentives for entrepreneurial activities. Following this, I examine factors related to scientists’ participation in entrepreneurial pursuits in order to establish domains of overlap or convergence between academic factors, normative attitudes, and entrepreneurial participation. Finally, excerpts from qualitative interviews with entrepreneurial scientists and trainees examine their initial experiences with entrepreneurial activities.

Much of the literature examining the shifting institutions of academic science towards the inclusion of entrepreneurial activities tends to assume a distinction between these two institutional logics. Here, institutional logics are understood as a set of norms, symbols, practices, beliefs and rules that are produced and reproduced by actors, and which provide meaning to social life (Thornton & Ocasio, 2008). Implicit in these theories of institutional logics is that there are multiple logics, each governing different social sectors, and that actors often have to grapple with diverse, discrete institutional logics (Zilber, 2013). Scholarly examinations of academic entrepreneurship using neo-institutional theories, in turn, tend to assume that the institutional logics of academic and entrepreneurial science are oppositional, and demonstrate processes of the overtake of one institutional logic with another. These studies, examined in section 2.4 of the literature review, tend to assume that these institutional logics are both monolithic, and also necessarily distinct. For example, using archival materials and qualitative interviews
with academic scientists and administrators, studies by institutional theorists such as Owen-Smith, Powell, Colyvas, Kleinman and Vallas examine institutional shifts or convergences from academic to commercial or entrepreneurial science. Yet, the composition of each of these logics, and the potential overlaps between them, is rarely examined empirically.

There has, however, been increased attention to understanding the internal heterogeneity, as well as the similarities between academic and entrepreneurial institutional logics. Sauermann and Stephan (2013), for example, summarize the literature that assumes divergent logics across axes of the nature of the work conducted, characteristics of the workplace, characteristics of workers, and disclosure of research results, and find important relationships and convergences across these axes. They thus call for a need for empirical research examining contrasts between academic and entrepreneurial science across multiple dimensions. The analyses in this chapter draw on this literature by providing empirical support for whether and how entrepreneurial science may constitute a different, novel, or oppositional institutional logic to academic science, rather than assuming this divergence in logics or their internal homogeneity.

A distinct body of empirical literature has examined factors associated with academic scientists’ participation in entrepreneurial activities. Though this literature is not explicit to the theoretical underpinnings of institutional logics, it also locates entrepreneurial activities as distinct activities to be measured or incented. These studies, detailed in section 2.3 of the literature review, tend to be quantitative in nature, and examine academic factors associated with entrepreneurial behaviour. The analyses in this chapter draw on this literature by using similar methodologies to examine factors associated with academic scientists’ participation in entrepreneurial activities, but do this purposively to study potential areas of overlap between the institutional logics of academic and entrepreneurial science.

I thus draw from and aim to enhance both of these bodies of literature by empirically examining whether and how entrepreneurial science is experienced as a distinct logic to
academic science. In what follows, I describe the data sources used for these analyses and hypotheses based on the literature. Following this, I descriptively examine relevant results. In the analysis and discussion of this data, I establish that entrepreneurial science tends to be granted low legitimacy and is thus a mostly distinct logic, but also that this entrepreneurial logic is heterogeneous, with some activities being more academically aligned than others. In examining the potential for conflicts of interest as a result of this distinction in logics, concerns related to upstream scientific practices are acknowledged, but the downstream harms that result from these tend to be granted low credibility. Examinations of participation in entrepreneurial activities indicate that despite scientists’ experiences and values of entrepreneurial activities as distinct or foreign, academic entrepreneurs increasingly locate in both academic and entrepreneurial logics, and hold the capacity to legitimize entrepreneurial science through these means. This chapter thus situates academic entrepreneurship in Canada through examining the characteristics of entrepreneurial scientists, normative values toward academic entrepreneurship, and the ways in which academic and entrepreneurial logics are or are not perceived as being coherent and aligned.

4.2 Data Sources and Hypotheses

The data for this chapter derive from responses to the national survey of CIHR-funded scientists, and qualitative interviews with PIs and trainees, as described in Chapter 3. To describe the characteristics of the survey sample, trainee respondents (doctoral students and postdoctoral fellows) were separated from PI respondents, as these groups were measured by somewhat different demographic data, and hold significantly different levels of power and autonomy in determining their laboratory environments. Details of the survey sample are presented descriptively, using data transformations described in section 3.2.4 of the methodology chapter, and missing data were excluded. Continuous variables (i.e., year completed highest degree, numbers of research personnel and trainees, number of journal articles published, and percentages of time spent on research, teaching and clinical practice) are presented as minimum, maximum and mean values, with standard deviations, and rates of those who had spent any (i.e. ≥ 1%) time on research, clinical, and teaching activities are indicated. The overall rate of participation
entrepreneurial activities is examined through a calculation of those who had participated in any one or more entrepreneurial activity. Details on interview participants are also discussed descriptively, and data used to describe the characteristics of these scientists drew from a review of their websites, and in interviews where they indicated their type of research and types of entrepreneurial engagements.

To assess scientists’ attitudes towards entrepreneurial activities, and their incentives and conflict of interest related harms, responses to survey items in sections C and D are presented descriptively, and dichotomized (combining strongly agree/agree, as well as strongly disagree/disagree categories) for analysis. The extent to which respondents agreed or disagreed with the appropriateness of entrepreneurial activities aimed to capture the legitimacy of entrepreneurial activities within academic science. By examining the normative value and legitimacy of a range of entrepreneurial activities, it was expected that different activities would hold different normative weights for academic scientists, as these entail significantly different formulations of entrepreneurial engagements (Perkmann et al., 2013). Examining attitudes towards commonly cited conflict of interest concerns aimed to assess the credibility of these claims. It was expected that scientists might be concerned with negative implications associated with conflicts of interest, as these are commonly cited implications raising a range of concerns related to conflicts of interest (Bekelman, Li, & Gross, 2003). In contrast, it was also expected that they might not see ethics concerns that are divorced from their scientific practices to be credible implications (Brosnan & Cribb, 2014; Smith-Doerr, 2008).

Finally, it was expected that respondents might be supportive of the positive incentives of entrepreneurial science, as these initiatives directly aim to incent scientists’ activities (Etzkowitz, 2008; Etzkowitz & Webster, 1998; Etzkowitz, Webster, Gebhardt, & Terra, 2000), and as such, ought to be resonant with these scientists.

The final quantitative analysis uses an Ordinary Least Squares (OLS) multivariate linear regression model to investigate factors associated with PIs’ participation in entrepreneurial activities, and as such, how academic entrepreneurship differs and is aligned with academic characteristics and normative attitudes. This analysis was largely
exploratory and aimed at examining and theorizing these potential overlaps and convergences, rather than revealing causal factors associated with academic scientists’ participation in entrepreneurial activities. The dependent variable for this model is an index of participation in entrepreneurial activities as measured in survey item E6, on a 0 to 8 scale (mean: 1.91, SD: 1.935, alpha: 0.742). Independent variables drew from PIs’ demographics and academic characteristics (presented in Table 4.1, following).

Examining attitudinal factors associated with scientists’ participation in entrepreneurial activities, a principal component factor analysis revealed three main factors across these attitudinal items. These aligned with the three constructs of interest: legitimacy of academic entrepreneurship (eigenvalue: 3.7), credibility of conflict of interest concerns (eigenvalue: 1.8), and credibility of incentives of academic entrepreneurship (eigenvalue: 1.2). As such, these three groupings of measures were used to generate scales of attitudes to entrepreneurial activities, ranging from 5 (negative attitudes to these activities) to 25 (positive attitudes about these activities) (mean 17.03, SD: 3.54, alpha 0.765), attitudes to conflict of interest concerns, ranging from 4 (high concern about conflicts of interest) to 20 (low concern about conflict of interest) (mean 11.55, S.D. 2.88, alpha 0.708), and attitudes to incentives of academic entrepreneurship, ranging from 3 (positive attitudes towards incentives for academic entrepreneurship) to 15 (negative attitudes towards incentives for academic entrepreneurship) (mean 11.89, S.D. 20.7, alpha 0.635).

Assumptions of the model were tested using SPSS software to insure generalizability of findings. Multicollinearity diagnostics indicated collinearity between clinical time and holding an MD degree, and so the clinical time variable was excluded from the final analysis. Residuals of the model were normally distributed and independent (Durbin-Watson: 1.922). Results are presented as unstandardized betas (and their standard errors), and standardized Betas (β) and their significance value in the model to permit comparisons. R² and adjusted R² measures indicate the goodness of fit of the model.

In this multivariate analysis, it was expected that attitudes towards the appropriateness of entrepreneurial activities and incentives for these activities would be positively associated with participation in these activities, as scientists who hold more favourable attitudes towards entrepreneurial activities are more likely to engage in them (Benner &
Sandstrom, 2000; Hoye & Pries, 2009; Lam, 2010; Shinn & Lamy, 2006). As well, it was expected that higher concern for conflict of interest implications would decrease participation in entrepreneurial activities, where the presence of these concerns would decrease propensities to participate in these activities, or where increased participation might reduce concerns (Rabino, 1998). It was also expected that participation in entrepreneurial activities would be more common among men (Bercovitz & Feldman, 2008; Colyvas, Snellman, Bercovitz, & Feldman, 2012), as well as more experienced or highly ranked researchers (Boardman & Ponomariov, 2009; Haeussler & Colyvas, 2011), scientists located in non-traditional research settings (i.e., not universities), or organizational locations with more translational mandates (D'Este & Patel, 2007; Lee, 1996; M. Perkmann, King, & Pavelin, 2011), scientists with more laboratory personnel (Landry, Amara, & Ouimet, 2007; Landry, Amara, & Rherrad, 2006; Landry, Amara, & Saihi, 2007), scientists who have published more papers and who are more academically productive (Breschi, Lissoni, & Montobbio, 2007; Coupe, 2003; Guena & Nesta, 2006; Gulbrandsen & Smeby, 2005; Haeussler & Colyvas, 2011; Harman, 2001), and finally, recipients of industry-relevant funds (Bozeman & Gaughan, 2007).

Following the presentation of the multivariate analysis, qualitative analyses draw from interviews with entrepreneurial PIs and trainees and examine their experiences with entrepreneurial activities. The theme of “learning to be entrepreneurial” emerged from entrepreneurial PI participants’ discussions of their initial entrepreneurial engagements, demonstrating the ways in which these scientists perceived procedural difficulties and uncertainties in undertaking entrepreneurial activities. Drawing from interviews with trainees, these participants demonstrated uncertainty about academic entrepreneurship as a whole, and tended to lack exposure to entrepreneurial activities. Taken with the quantitative results of the survey data, these qualitative analyses demonstrate academic scientists’ experiences interacting with entrepreneurial activities and demonstrate how these are experienced as divergent formulations of research activities.
4.3 Describing the Study Sample

4.3.1 Survey Respondents

In total, completed surveys were returned from 1,749 individuals (54% response rate). Of these, 1,614 were classified as eligible respondents: those who indicated that they were primarily conducting basic biomedical research, and those who had spent at least some time conducting research activities. In Table 4.1, PI respondents (n=1,204) were distinguished from trainees (PhD Students or Postdoctoral Fellows, n =410), as they were measured by some different demographic, orientation, and characteristic measures.

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Organizational Location</th>
<th>PI</th>
<th>Trainees</th>
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<tr>
<td></td>
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<td>291 (24.2%)</td>
<td>207 (50.4%)</td>
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<tr>
<td></td>
<td>Male</td>
<td>Other (Hospital Research Institute, University Research Institute, Hospital)</td>
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<td>203 (49.5%)</td>
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<td>5 (4.6)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% time spent on research</td>
<td>Min</td>
<td>10</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>100</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>74 (17.0)</td>
<td></td>
<td>94 (9.9)</td>
</tr>
<tr>
<td></td>
<td>Any</td>
<td>100</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>% time spent on clinical</td>
<td>Min</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>practice</td>
<td>Max</td>
<td>80</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>3.1 (10.0)</td>
<td></td>
<td>1 (6.8)</td>
</tr>
<tr>
<td></td>
<td>Any</td>
<td>12</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>% time spent on teaching</td>
<td>Min</td>
<td>0</td>
<td>Max</td>
<td>75</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----</td>
<td>---</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>Primary research funding sources (or that of supervisor for trainees) N(%)</td>
<td>Private foundations</td>
<td>485 (62.5%)</td>
<td>229 (55.9%)</td>
<td></td>
</tr>
<tr>
<td>Internal funding</td>
<td>525 (45.1%)</td>
<td>259 (63.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal or provincial government departments and agencies</td>
<td>298 (25.7%)</td>
<td>71 (17.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Canadian research councils</td>
<td>217 (18.8%)</td>
<td>84 (20.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding from private health products firms</td>
<td>279 (23.9%)</td>
<td>84 (20.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public funding that is designed to encourage the commercialization of research</td>
<td>247 (21.3%)</td>
<td>80 (19.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic Rank/Professional Qualifications N(%)</td>
<td>Full Professor</td>
<td>630 (52.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate Professor</td>
<td>325 (27.0%)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>224 (18.6%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (Clinician/Scientist/Other)</td>
<td>132 (11.0%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical (MD) Degree</td>
<td>169 (14.0%)</td>
<td>10 (2.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhD Student</td>
<td>N/A</td>
<td>298 (72.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postdoctoral Fellow</td>
<td>N/A</td>
<td>113 (27.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trainee career goals: Academia N(%)</td>
<td>Yes, definitely: 112 (27.3%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, probably: 170 (41.4%)</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No, probably not: 64 (15.6%)</td>
<td>No, definitely not: 16 (3.9%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Trainee career goals: Industry N (%)  

<table>
<thead>
<tr>
<th>Yes, definitely:</th>
<th>14 (3.4%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, probably:</td>
<td>136 (33.2%)</td>
</tr>
<tr>
<td>No, probably not:</td>
<td>147 (35.9%)</td>
</tr>
<tr>
<td>No, definitely not:</td>
<td>29 (7.1%)</td>
</tr>
<tr>
<td>Don’t know:</td>
<td>80 (19.5%)</td>
</tr>
</tbody>
</table>

Table 4.1: Characteristics of survey sample (n = 1,614; PIs n=1,204; trainees n=410)

The majority of PI respondents were male, while roughly one quarter were female. These demographics shifted amongst trainee respondents, with a near even split between male and female respondents. Examining the academic rank of these scientists, the majority of PIs were Full Professors, and the majority of trainees were PhD students, while 14% of PIs held medical (MD) degrees, and 2.4% of trainees held medical degrees. The majority of both PIs and trainees indicated that their primary work affiliation was a university.

PIs supported on average 2 research personnel and 5 trainees. Examining academic productivity, PI respondents had published a maximum of 150 papers in the previous five years, and a mean of 22 papers; trainee respondents had published a maximum of 48 academic papers in the previous five years, and a mean of 5. Examining time allocations within academic laboratories, all respondents had spent at least some time on research activities, as this was an inclusion criterion for this study. An average of 74% of time was spent on research by PIs and an average of 94% of time spent by trainees. Twelve percent of PIs and 3% of trainees spent at least some on clinical practice, with a mean of 3% of time for PIs, and a mean of 1% for trainees. The large majority (96%) of PIs, and 46% of trainees reported spending at least some time on teaching activities, while PIs reported spending a mean of around 20% of time on these activities, trainees spent a mean of 4% of time on teaching.
Examining respondents primary funding sources for PIs, or that of their supervisor for trainees, in the five years preceding the survey, especially those from entrepreneurial sources, 23.9% of PIs and 20.4% of trainees reported funding from private firms, and 21.3% of PIs and 19.5% of trainees reported receiving public funding with commercialization design. Finally, examining trainee respondents’ career aspirations or goals, 70% indicated that they would like to pursue a career as an academic researcher (yes, definitely or yes, probably), and 37% indicated that they would like to pursue a career in the health products industry (yes, definitely or yes, probably).

Table 4.2 displays respondents’ indications of their participation in activities of research commercialization or involvements with the health products industry (i.e., activities of entrepreneurial science) in the five years preceding the survey.

<table>
<thead>
<tr>
<th>Participation in commercial applications of research or involvement with the health products industry in the previous 5 years</th>
<th>PIs N (%)</th>
<th>Trainees N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities of research commercialization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disclosed inventions to a TTO</td>
<td>568 (47.0%)</td>
<td>45 (11.0%)</td>
</tr>
<tr>
<td>Named on patents</td>
<td>460 (38.1%)</td>
<td>47 (11.5%)</td>
</tr>
<tr>
<td>Helped create spin off company(ies)</td>
<td>142 (11.8%)</td>
<td>6 (2.2%)</td>
</tr>
<tr>
<td><strong>Activities of collaboration with industry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract research for industry</td>
<td>368 (30.4%)</td>
<td>36 (8.9%)</td>
</tr>
<tr>
<td>Paid consultancy for industry</td>
<td>302 (25.0%)</td>
<td>8 (1.9%)</td>
</tr>
<tr>
<td>Co-authored academic paper(s) with industry</td>
<td>246 (20.3%)</td>
<td>32 (7.8%)</td>
</tr>
<tr>
<td>Sat on industry business advisory boards</td>
<td>175 (14.5%)</td>
<td>2 (0.5%)</td>
</tr>
<tr>
<td>Worked in industry</td>
<td>55 (4.6%)</td>
<td>37 (9.0%)</td>
</tr>
<tr>
<td><strong>Total n participating in one or more entrepreneurial activity</strong></td>
<td>800 (66.2%)</td>
<td>118 (28.7%)</td>
</tr>
</tbody>
</table>

Table 4.2: Scientists’ participation in entrepreneurial activities, measured by survey item E6 (n = 1,614; PIs n= 1,204; trainees n=410)

Overall, minorities of researchers had participated in each of these activities, though an overall majority of PIs (66.2%) had participated in at least one entrepreneurial activity.
Forty-seven percent of PIs and 11% of trainees had disclosed inventions to their organizational technology transfer offices (TTOs), and 38% of PIs and 11.5% of trainees had been named on a patent, while 12% of PIs and 2% of trainees had participated in creating a spin-off company. PI respondents had participated more actively than trainees in collaborations with industry, with between 20-30% of respondents conducting contract research, acting as a paid consultant or co-authoring with industry, and 14.5% of PIs had sat on business advisory boards. Trainees’ participation in these pursuits was more limited, and fell below 10% in each activity. Around 5% of PIs had spent time out of the academy working in the health products industry, while around 10% of trainees had spent time in industry.

4.3.2 Interview Participants

Responses to items displayed in Table 4.2 also determined the sample of PIs who were interviewed for this study, as described in the study methodology in Chapter 3. In total, 24 entrepreneurial PIs and 14 academic trainees were interviewed for this study, as described in section 3.3.2. Table 4.3 displays certain demographic, organizational, career, and scientific aspects of the participants interviewed. PI participants were located in universities, hospitals and research institutes across Canada, with many respondents holding cross-appointments in multiple departments or across multiple research organizations. All but two of the PIs were located within or affiliated with U15 universities, the group of leading research-intensive universities in Canada. Three PIs were clinician-scientists, holding medical degrees and practicing clinical medicine as well as basic biomedical science. Seventeen biomedical PIs were located in faculties of Medicine and the Life Sciences, and four were located in faculties of Engineering and the Physical Sciences.
<table>
<thead>
<tr>
<th>ID</th>
<th>Faculty</th>
<th>Organizational location</th>
<th>U15</th>
<th>Academic Rank</th>
<th>Type of Science</th>
<th>Type of Entrepreneurial Engagements</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Medicine &amp; Life Sciences</td>
<td>Hospital &amp; University</td>
<td>Y</td>
<td>Full Professor; Senior Scientist</td>
<td>Endocrinology</td>
<td>Co-authored; Consulting; Contract Research; Disclosure of inventions to TTO</td>
</tr>
<tr>
<td>R2</td>
<td>Medicine &amp; Life Sciences</td>
<td>Hospital Research Institute</td>
<td>Y</td>
<td>Full Professor; Senior Scientist</td>
<td>Cancer</td>
<td>Business advisory boards; Consulting; Disclosure of inventions to TTO; Patents</td>
</tr>
<tr>
<td>R20</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; Hospital Research Institute</td>
<td>Y</td>
<td>Full Professor; Senior Scientist</td>
<td>Cancer</td>
<td>Contract research; Disclosed inventions to TTO; Patents</td>
</tr>
<tr>
<td>R3</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Associate Professor</td>
<td>Biochemistry</td>
<td>Co-authored; Contract research; Disclosure of inventions to TTO; Patents</td>
</tr>
<tr>
<td>R5</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Full Professor</td>
<td>Neuroscience</td>
<td>Consulting; Contract research; Disclosure of inventions to TTO; Patents</td>
</tr>
<tr>
<td>R7</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; Hospital</td>
<td>Y</td>
<td>Full Professor; Senior Scientist</td>
<td>Biochemistry</td>
<td>Co-authored; Consulting; Contract research; Disclosure of inventions to TTO; Patents</td>
</tr>
<tr>
<td>R8</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Full Professor</td>
<td>Physiology</td>
<td>Business advisory boards; consulting; contract research; Disclosure of inventions to TTO; Contract research</td>
</tr>
<tr>
<td>R9</td>
<td>Medicine &amp; Life Sciences</td>
<td>Hospital Research Institute &amp; University</td>
<td>N</td>
<td>Full Professor; Senior Scientist</td>
<td>Imaging</td>
<td>Business advisory boards; Contract research; Disclosure of inventions to TTO; Patents</td>
</tr>
<tr>
<td>R11</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Full Professor</td>
<td>Obstetrics</td>
<td>Consulting; Contract research; Disclosed inventions to TTO; Patents</td>
</tr>
<tr>
<td>R12</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Assistant Professor</td>
<td>Neuroscience</td>
<td>Business advisory boards; Consulting; Contract research; Worked in industry; Patents; Spin-off company</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------</td>
<td>---------------------</td>
<td>---</td>
<td>---------------------</td>
<td>--------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>R13</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; University Research Institute</td>
<td>Y</td>
<td>Assistant Professor</td>
<td>Biochemistry</td>
<td>Co-authored; Consulting; Contract research; Business advisory boards; Disclosed inventions to TTO; Patents; Spin-off company</td>
</tr>
<tr>
<td>R14</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Full Professor; Senior Scientist</td>
<td>Physiology</td>
<td>Co-authored; Consulting; Contract research; Business advisory boards; Disclosed inventions to TTO; Patents; Spin-off company</td>
</tr>
<tr>
<td>R17</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; Hospital Research Institute</td>
<td>Y</td>
<td>Full Professor; Senior Scientist</td>
<td>Stem cells</td>
<td>Consulting; Contract research; Business advisory boards; Disclosed inventions to TTO; Patents; Spin-off company</td>
</tr>
<tr>
<td>R18</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>N</td>
<td>Full Professor</td>
<td>Cancer</td>
<td>Co-authored; Business advisory boards; Disclosed inventions to TTO; Patents; Spin-off company</td>
</tr>
<tr>
<td>R19</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Full Professor</td>
<td>Biochemistry</td>
<td>Consulting; Contract research; Disclosed inventions to TTO; Patents</td>
</tr>
<tr>
<td>R21</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>Full Professor</td>
<td>Genetics</td>
<td>Contract research; Consulting; Disclosed inventions to TTO; Patents; Spin-off Company</td>
</tr>
<tr>
<td>R24</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; Hospital &amp; Hospital</td>
<td>Y</td>
<td>Full Professor; Senior</td>
<td>Cellular biology</td>
<td>Contract research; Business advisory boards; Disclosed</td>
</tr>
<tr>
<td>ID</td>
<td>Name</td>
<td>Institute</td>
<td>Position</td>
<td>Department</td>
<td>Activities</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------</td>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>R25</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; Hospital</td>
<td>Full Professor; Senior Scientist</td>
<td>Genetics</td>
<td>Consulting; Business advisory boards; Disclosed inventions to TTO; Patents</td>
<td></td>
</tr>
<tr>
<td>R27</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Full Professor</td>
<td>Cell biology</td>
<td>Contract research; Disclosed inventions to TTO; Patents</td>
<td></td>
</tr>
<tr>
<td>R28</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; University Research Institute</td>
<td>Full Professor</td>
<td>Genetics</td>
<td>Consulting; Disclosed inventions to TTO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering &amp; Physical Sciences</td>
<td>University</td>
<td>Full Professor</td>
<td>Physiology</td>
<td>Contract research; Disclosure of inventions to TTO; Patents</td>
<td></td>
</tr>
<tr>
<td>R6</td>
<td>Engineering &amp; Physical Sciences</td>
<td>University &amp; University Research Institute</td>
<td>Full Professor; Senior Scientist</td>
<td>Imaging</td>
<td>Business advisory boards; Consulting; Contract research; Disclosure of inventions to TTO; Patents; Spin-off company</td>
<td></td>
</tr>
<tr>
<td>R10</td>
<td>Engineering &amp; Physical Sciences</td>
<td>University</td>
<td>Professor Emeritus</td>
<td>Imaging</td>
<td>Co-authored; Disclosed inventions to TTOs; Patents; Spin-off company</td>
<td></td>
</tr>
<tr>
<td>R22</td>
<td>Engineering &amp; Physical Sciences</td>
<td>University</td>
<td>Associate Professor</td>
<td>Assistive technology</td>
<td>Contract research; Disclosed inventions to TTO; Patents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering &amp; Physical Sciences</td>
<td>University</td>
<td>Asst Professor</td>
<td>Biochemistry</td>
<td>Co-authored; Contract research; Industry funding</td>
<td></td>
</tr>
<tr>
<td>R15</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>PhD Student</td>
<td>Neuroscience</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>R16</td>
<td>Medicine &amp; Life Sciences</td>
<td>University &amp; Hospital Research Institute</td>
<td>PhD Student</td>
<td>Stem cells</td>
<td>Disclosed inventions to TTO; Industry collaborations</td>
<td></td>
</tr>
<tr>
<td>R23</td>
<td>Medicine &amp; Life Sciences</td>
<td>University</td>
<td>PhD Student</td>
<td>Biochemistry</td>
<td>Co-authored; Contract research; Industry funding</td>
<td></td>
</tr>
<tr>
<td>R26</td>
<td>Medicine</td>
<td>University</td>
<td>PhD Student</td>
<td>Genetics</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>&amp; Life Sciences</td>
<td>University &amp; Hospital Research Institute</td>
<td>Y</td>
<td>PhD student</td>
<td>Cell biology</td>
<td>Funding from private firms</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------</td>
<td>---</td>
<td>-------------</td>
<td>--------------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td>R31 Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>PhD student</td>
<td>Cell biology</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>R32 Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>PhD student</td>
<td>Biochemistry</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>R34 Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>PhD student</td>
<td>Neuroscience</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>R35 Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>PhD student</td>
<td>Neuroscience</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>R36 Medicine &amp; Life Sciences</td>
<td>University</td>
<td>N</td>
<td>PhD student</td>
<td>Cell biology</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>R37 Medicine &amp; Life Sciences</td>
<td>University</td>
<td>Y</td>
<td>PhD student</td>
<td>Cell biology</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

| Trainees – Postdoctoral Fellows |
| R30 Medicine & Life Sciences | Hospital | Y | Postdoctoral Fellow | Genetics | Consulting |
| R33 Medicine & Life Sciences | University | Y | Postdoctoral Fellow | Biochemistry | None |
| R38 Medicine & Life Sciences | University | Y | Postdoctoral Fellow | Genetics | None |

Table 4.3: Summary of characteristics of interview participants (n = 38)
PI participants had engaged in a variety of types of basic science, from cell and molecular biology, to imaging research. As well, they had participated in a wide variety of entrepreneurial activities: all had disclosed inventions to their organization’s TTO, many had been involved in patenting, and ten had initiated a spin-off company. Many had also engaged in a wide variety of collaborative activities, including consulting, contract research, and business advisory board membership. Though the sampling frame and selection criteria did not deliberately select for ‘star’ or highly accomplished researchers, many of those who participated were highly accomplished in their academic careers. These scientists had published extensively in the academic literature, had large laboratories, and supported many research staff and trainees. Many were currently holding or had held positions as Chairs, Department Heads or Directors of research institutes or units.

Eleven of the trainees interviewed were PhD students and three were postdoctoral fellows. Like the PI sample, these trainees were located in a range of organizational and research settings across Canada, and those located in research institutes also had an affiliation with a university; all except one were located within a U15 university. These trainees were affiliated with Faculties of Medicine and Life Sciences, and were conducting a variety of scientific practices, usually related to cell biology. Despite attempting to sample for entrepreneurial trainees, interviews revealed that only four of these individuals had personally engaged in entrepreneurial activities in some way.

4.4 Examining Attitudes to Academic Entrepreneurship

4.4.1 Survey Respondents’ Assessments of Academic Entrepreneurship

In order to examine the survey population of CIHR-funded biomedical scientists’ attitudes to entrepreneurial activities, and in turn where they locate the institutional logics of entrepreneurial science, the following analyses draw from their responses to questions examining the constructs of legitimacy of entrepreneurial activities, and the credibility of conflict of interest concerns and incentives for academic entrepreneurship. Figure 4.1
displays scientists’ attitudes to the normative appropriateness and legitimacy of entrepreneurial activities, as activities that academic scientists ought to pursue.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Agree (%)</th>
<th>Neutral (%)</th>
<th>Disagree (%)</th>
<th>Don’t Know (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent</td>
<td>54</td>
<td>31</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Develop commercial products</td>
<td>35</td>
<td>29</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Consult</td>
<td>38</td>
<td>34</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Choose commercial applications</td>
<td>27</td>
<td>21</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Co-Author</td>
<td>70</td>
<td>23</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 4.1: Responses to “In your opinion, should academic biomedical researchers participate in the following activities, when the type of research they are doing makes this possible? Academic biomedical researchers should make efforts to…” n =1,614

Respondents most strongly agreed that scientists ought to engage in patenting activities (54%), followed by developing commercial products from the results of their research (35%), consulting (27%), choosing research topics with commercial applications (9%), and finally co-authoring with industry (3%). There was majority disagreement with the appropriateness of choosing research with commercial applications (70%) and co-authoring scientific articles with industry (73%). Notably, respondents demonstrated a significant degree of neutrality, indicating that they were hesitant to either positively or negatively assign value to any of these activities. There was, however, a very low level of uncertainty or “Don’t Know” responses to these items.

Figure 4.2 displays responses to items measuring attitudes towards concerns related to conflicts of interest resulting from interactions between academic researchers and industry, and Figure 4.3 indicates responses to items examining incentives of academic entrepreneurship. These responses measure the constructs of credibility of conflict of interest concerns, incentives for academic entrepreneurship, as well as zones of potential overlap between academic rewards and entrepreneurial pursuits.
The majority of respondents indicated concern about the impacts of collaborations with industry on increasing secrecy in the scientific research enterprise (59%) and increasing bias as a result of relationships between academic researchers and industry (55%). Agreement to these proposed implications reflected credibility in threats of industry on upstream scientific practices, rather than downstream harms. In fact, respondents had overall minority concern that industry involvements would threaten public trust in the academic research enterprise (31%), or cause an increased risk of harm to research participants in clinical trials (13%), and granted low credibility to these claims. As with attitudes to the appropriateness of participation in entrepreneurial activities, respondents demonstrated a significant degree of neutrality in their responses to items associated with conflicts of interest. As well, and especially when considering the proposed downstream harms of these entrepreneurial activities, scientists also demonstrated a relatively high degree of uncertainty by selecting a “Don’t Know” response. This uncertainty also denotes a low degree of credibility and some skepticism about these claims.
In examining attitudes to proposed positive incentives for entrepreneurial activities (Figure 4.3), the credibility of these claims and the potential overlap of academic reward systems with entrepreneurial science are examined. There was high disagreement with external incentives or facilitators of academic entrepreneurship as measured by academic career reward for scientists who collaborate with industry (84%), as well as public funding initiatives that might incent these activities (84%). Levels of neutrality or uncertainty were relatively low in response to these incentives, demonstrating a certainty in the rejection of these proposals. As for the credibility of the claim that collaborations with industry will produce applied outcomes in the form of addressing real world problems, attitudes were mixed, with roughly one third of respondents agreeing to this claim (30%).

4.4.2 Factors Associated with Academic Entrepreneurship

The multivariate OLS linear regression model is presented in Table 4.4. This analysis indicates factors associated with PIs’ participation in entrepreneurial activities, and as such indicates academic characteristics and normative orientations associated with academic entrepreneurship.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Unstandardized Coefficients, beta (SE)</th>
<th>Standardized Coefficients β</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>0.181 (.133)</td>
<td>.038</td>
</tr>
<tr>
<td><strong>Academic Rank and Qualifications</strong></td>
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<td></td>
</tr>
<tr>
<td>Full Professor</td>
<td>-0.340 (.488)</td>
<td>-.085</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>-0.656 (.472)</td>
<td>-.149</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>-0.777 (.473)</td>
<td>-.147</td>
</tr>
<tr>
<td>Other (Scientist etc.)</td>
<td>-0.136 (.254)</td>
<td>-.018</td>
</tr>
<tr>
<td>Holder of medical (MD) degree</td>
<td>0.339 (.191)</td>
<td>.054†</td>
</tr>
<tr>
<td><strong>Seniority</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time since completion of highest degree</td>
<td>-0.002 (.009)</td>
<td>-.009</td>
</tr>
<tr>
<td><strong>Organizational Location</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>-0.042 (.188)</td>
<td>-.009</td>
</tr>
<tr>
<td>Other (Hospital, Hospital RI, University RI)</td>
<td>0.075 (.169)</td>
<td>.018</td>
</tr>
<tr>
<td><strong>Funding</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal</td>
<td>-0.169 (.119)</td>
<td>-.042</td>
</tr>
<tr>
<td>Federal councils</td>
<td>-0.266 (1.054)</td>
<td>-.007</td>
</tr>
<tr>
<td>Non-Canadian councils</td>
<td>0.009 (.147)</td>
<td>.002</td>
</tr>
<tr>
<td>Private foundations</td>
<td>0.151 (.115)</td>
<td>.037</td>
</tr>
<tr>
<td>Federal/Provincial departments and agencies</td>
<td>0.146 (.129)</td>
<td>.033</td>
</tr>
<tr>
<td>Private firms</td>
<td>1.492 (.136)</td>
<td>.326***</td>
</tr>
<tr>
<td>Public funding with commercialization design</td>
<td>0.636 (.146)</td>
<td>.130***</td>
</tr>
<tr>
<td><strong>Time Spent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage research</td>
<td>0.003 (.004)</td>
<td>.025</td>
</tr>
<tr>
<td>Percentage teaching</td>
<td>-0.006 (.006)</td>
<td>-.037</td>
</tr>
<tr>
<td><strong>Productivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of articles published (last 5 years)</td>
<td>0.022 (.005)</td>
<td>.172***</td>
</tr>
<tr>
<td>Number of research personnel</td>
<td>0.050 (.028)</td>
<td>.056†</td>
</tr>
<tr>
<td>Number of research trainees</td>
<td>0.056 (.020)</td>
<td>.089**</td>
</tr>
</tbody>
</table>
### Legitimacy of Academic Entrepreneurship

| Attitudes to entrepreneurial activities (scale) | 0.103 (.018) | .180*** |

### Credibility of Conflict of Interest Concerns

| Attitudes to conflict of interest implications (scale) | -0.056 (.021) | -.079** |

### Credibility of Incentives of Academic Entrepreneurship

| Attitudes to positive incentives (scale) | 0.004 (.030) | .005 |

**Constant (SE)**

|          | 5.783 (17.395) |

| N         | 732            |
| R²        | 0.484          |
| Adjusted R² | 0.466      |

* p<.10† p<.05* p<.01** p<.001***

Table 4.4: OLS Regression examining PI participation in entrepreneurial activities.

This analysis indicates that researchers’ funding sources, their academic productivity, their attitudes to entrepreneurial activities, and their attitudes to negative conflict of interest related outcomes are significantly correlated with participation in entrepreneurial activities. Those researchers receiving funds from private industry or firms, and who had received public funds designed to incent the commercialization of academic research were more likely to participate in entrepreneurial activities. As well, academic productivity in the form of scientific papers published and academic trainees supported were significantly positively associated with entrepreneurial participation. Examining the effects of attitudes to entrepreneurial activities, positive attitudes and a high degree of legitimacy granted to entrepreneurial activities were significantly positively associated with participation in activities, while agreement with conflict of interest concerns was significantly negatively associated with participation in these activities. Attitudes to positive implications or incentives of entrepreneurial activities had no effect on entrepreneurial participation in this model.

#### 4.4.3 Experiences with Academic Entrepreneurship

The following analyses draw from qualitative interviews with PIs and trainees, and examine their engagements with entrepreneurial activities in order to indicate how academic entrepreneurship is initially experienced. In interviews with entrepreneurial
PIs, participants often detailed their difficulties or uncertainties related to the practice of entrepreneurial activities, and described a learning process in their entrepreneurial pursuits. Entrepreneurial PIs described entrepreneurial science as a foreign set of activities that required a learning process, and expressed uncertainties about how to go about patenting their research, how to negotiate with their TTO, how to run a spin-off company, and how to negotiate industrial contracts. They often looked to their entrepreneurial or industrial colleagues for guidance on how to undertake these processes, and also spoke about a desire to be leaders in academic entrepreneurship, and to transfer the skills they had learned to other scientists.

PIs described entrepreneurial activities as a divergent mode of scientific practice that required a skillset different to that of academic activities. The difficulties of undertaking entrepreneurial activities were set against a backdrop of academic scientists’ lack of training in research commercialization or collaboration with industry. For example, this university-based professor described his lack of training in entrepreneurial science:

“And so most of my colleagues, we’re trained differently, though. You know, nowhere in any of my training or post-training life has there been an overt effort to inform me about commercialization or to even say let’s go through the list of discoveries or papers that you’ve published over the last ten years and let’s see which of those might actually be commercializable if we did this or did that. We’re not trained like that, what we’re trained to do is ask another basic science question.” [R11]

As this scientist was embarking on spin-off company development as a first time entrepreneur, he described a learning curve in undertaking this pursuit, and his lack of training in doing so as an academic.

“You know for me there’s a large curve, it’s a foreign business for me to get into this, you know I, we aren’t trained in this way as professors, it’s a whole new language and a set of conceptual details that we have to assimilate and assimilate and then be able to use appropriately and effectively in our language and in our writing and in our speaking, so I think you know I’ve made a lot of progress this year. I’m still a babe in the woods but I feel more comfortable than I did a year ago, and I also have had a year to talk with other colleagues who are in this field, in commercialization, and I understand more now about where they’re coming from, what they’re willing to do and not willing to do, so, and I also know how much time and energy it will take to develop one or two or three products and I
recognize that and so I have a very much better sense of what I’m trying to do than I did a year ago.” [R11]

Other scientists also described a learning process and negotiation of entrepreneurial activities. For example, in the first excerpt, a professor described himself as a savvier entrepreneur now that he had patented some of his research. In the second excerpt from a professor and Senior Scientist, the importance of leadership in entrepreneurial science is asserted. As an experienced entrepreneur, they characterized themselves as more knowledgeable, and note their perceived importance of taking ownership of these processes.

“The learning process is interesting, I mean if I was to go back and do this again, I would do it very differently, and I think we’d be a bit smarter, we’d get the right patents at the right time, and market them a little better.” [R27]

“Well, I mean one thing I should say is that doing it the way we’ve done it is an enormous learning experience. I mean, I’ve been through it several times now, so it gets easier with practice, and there are others who don’t have an interest or don’t have expertise or don’t have the time, who just want to sort of assign the rights to the university and say you go with it and call me if you need my help I guess.” [R14]

In the following excerpt, a junior level PI noted the importance of education about academic entrepreneurship, especially in terms of lost opportunities for academic researchers and for product development.

“So unless, without getting any kind of education about that, there’s probably a million things that will never be developed because, you know, the academics just don’t know. And the only reason that I know anything about it is because I was at that company for a while. But most of my colleagues don’t really think about it and so a lot of opportunities are missed.” [R12]

In these accounts, entrepreneurial PIs described their difficulties and uncertainties in conducting entrepreneurial activities, and their overall lack of training to do so as academic scientists. As such, the practices of academic entrepreneurship were experienced as significantly different and foreign modes of scientific practice, yet these academic entrepreneurs expressed concern about lost opportunities and mistakes due to these uncertainties. Despite these practical uncertainties, entrepreneurial PIs asserted the
importance of conducting these activities and taking a leadership role in teaching other scientists the practices of entrepreneurial science.

4.4.3.1 Trainee Experiences

Trainees occupied a largely different role in relation to entrepreneurial science, largely due to their lack of exposure to these pursuits, and lack of power and agency in their academic laboratories. As indicated, only four of the trainees interviewed could describe situations in which they had themselves participated in an entrepreneurial activity. Other trainee interview participants claimed some exposure to some activities of commercialization, including patenting and spin-off company formation through their peers or the labs around them, and at times had witnessed the patenting activities of their supervisors. Many, though not all, trainees were somewhat aware of entrepreneurial activities within academic settings, though this awareness was partial. For example, trainees were aware of the value of patenting, but less aware of certain institutional initiatives like TTOs or collaborations with industry from within the academy. Thus, their perceptions of these initiatives were primarily speculative and based on brief interactions with colleagues who had worked in these domains, or perceptions of entrepreneurial activities in their own or other labs.

The following accounts from trainee interview participants demonstrate their overall lack of exposure to entrepreneurial activities. In the first account, a PhD student responds to a question asking about the extent to which they were noticing research commercialization or industry collaboration around them. They characterized their research environment as being primarily academically-driven and cite a lack of exposure to commercialization activities. As well, they claimed a lack of organizational support for these activities, where trainees must be self-driven to gain exposure to them. In the second account, another PhD student discussed some knowledge of patenting activities, but also described how most trainees are shielded from these activities by their PI or supervisor.

“Around me? Not too much, my view might be pretty narrow, so not a whole lot. I would say it’s a lot more still like academic driven, like we have - I don’t think we’ve ever had anyone ever come in from the commercialization...oh maybe once, maybe once in the five years that I’ve been here, maybe once someone
came in from the commercialization centre to give a very quick chat. Whereas every week we have like 7 or 8 different professors or researchers coming in and giving a talk on their research, their academic research, so it’s very much academic focused, not so much exposure. I think if you want to get any exposure, you’re almost on your own.” [R32]

“I believe my Master’s PI has patents, I think, but he doesn’t really talk about it too much with us and only like people who are really close to him know things, so I believe they had patents but I’m not a hundred percent sure.” [R36]

In light of this overall lack of exposure and uncertainty about entrepreneurial activities, some trainees did express an interest in learning more about the workings of entrepreneurial science. For example, this third PhD student demonstrated some interest in pursuing an entrepreneurial project, if appropriate. However, they saw entrepreneurial science as one amongst many forms of science, and the appropriate role of publicly-funded science as prioritizing academic research.

“I think that if [the potential for commercialization] had have come up over my research, I think I would have been interested in doing it and just seeing how that process works. I mean in terms of the actual research, I think there’s room for all sorts of research and I think for a primarily government sponsored lab such as ourselves…it’s not really necessary for us to be going out and working with industry because we have all sorts of room for solely government-funded research and it’s important to have that. So again yeah, it would have been interesting in my work, but I don’t necessarily…I mean I would have learned stuff that way, but I’ve learned other things the other way, I don’t know” [R37]

Similarly in the following account, academic science was prioritized over entrepreneurial or applied science. This PhD student saw the entrepreneurial or development work to be best located in other scientific domains, or conducted by other professionals.

“I think that if you want to just learn about science then you just should put your mind right into it and focus on that and don’t worry too much about like what’s the application and all that, right. Because if you are doing basic science but think okay, what’s the application and all that, it’s also driving your project in that way and maybe that’s not the best way in terms of the idea of basic science. In the mean time, of course we want somebody…if there’s an application to it then of course there should be somebody seeing a potential application for it and then like have access to our data and experiments and all that and use it to translate into real applications. So I think that’s the hard job of people who go around and all of what basic science has produced and see the potential and all that, I think that’s a hard job but also people who’s very practical would be able to do that.” [R36]
Overall, the majority of trainees interviewed lacked direct exposure and experience with academic entrepreneurship, and tended to orient primarily as academic scientists. The four trainee interview participants who had participated in entrepreneurial activities expressed navigation strategies that involved the co-alignment of entrepreneurial and academic activities. An analysis of their experiences is examined in Chapter 6.

4.5 Analysis and Discussion

The data in this chapter provide an overview of the characteristics of academic biomedical scientists and the nature of their participation in entrepreneurial activities in Canada. As well, analyses aim to contribute to theoretical literatures by empirically examining an institutional logic of entrepreneurial science. These data indicate that entrepreneurial science is valued as a largely distinct institutional logic to academic science, though this logic is heterogeneous, and that concerns about conflict of interest that are divorced from the context of scientists’ work tend not to adequately capture concerns that arise from academic scientists’ engagement with entrepreneurial activities. Finally, these data indicate evidence of a mixing of logics amongst entrepreneurial scientists, who may draw from multiple logics concurrently.

Survey data on academic scientists’ participation in entrepreneurial activities indicates that despite policy concerns about the poor commercialization performance of Canada’s scientists (Jenkins et al., 2012; Conference Board of Canada, 2013), the majority (66%) of CIHR-funded academic biomedical scientists in Canada are participating in activities of entrepreneurial science. Amongst the entrepreneurial activities examined, most respondents had disclosed inventions to technology transfer offices and patented their research. These activities are closely connected to each other, and are academic ‘push’ activities associated with research commercialization. Spin-off company formation is a much more arduous pursuit, requiring significant effort and resources by academic scientists, but nearly 12% of PI respondents had still engaged in this pursuit. Connected activities of collaboration with industry were practiced by the minority, and only a very small minority of PIs had spent time working in the health products industry, despite the potential of these activities to enhance scientists’ network capacities and productivity.
As well, despite increasing attention to entrepreneurship training and capacity building amongst trainees and junior scientists from both governing bodies (AUCC 2010, 2011) and educational institutions themselves (Sa, Kretz, Sigurdson 2014), trainee participation in entrepreneurial activities was in the minority, indicating a lack of opportunity or willingness of these scholars to engage entrepreneurial activities. A larger proportion of trainee respondents had reported spending time in industry, potentially indicating that this is becoming a more acceptable and routine pursuit. As well, approximately one third of trainee respondents indicated that they would consider a career in industry, indicating movement from academic to industrial sectors.

Importantly, the findings presented in this chapter contribute to the theoretical literature on the institutional logics of academic and entrepreneurial science by empirically investigating these logics. With the exception of patenting activities, activities of entrepreneurial science were positively valued by only minorities of survey respondents. As agreement with normative appropriateness of these activities was taken to indicate their legitimacy within the academic research enterprise, most entrepreneurial pursuits were granted overall low legitimacy. This is indicative of institutional location of entrepreneurial activities as largely distinct or divergent activities to academic science.

As well, through low agreement to incentives of academic entrepreneurship, the credibility of proposals to align the logics of academic and entrepreneurial science, specifically by associating academic career and funding rewards with entrepreneurial activities, were strongly rejected by academic scientists. This indicates an overall orientation to academic entrepreneurship as a set of activities that are distinct from academic science, and a position amongst scientists that entrepreneurial activities ought to be undertaken autonomously and not be incented by academic funding and reward calculations. Even the positive implication of real-world applications from entrepreneurial activities, associated with research impact and Mode II science (Gibbons et al., 1994), and which is often cited as a primary goal in entrepreneurial activities, was met with some skepticism as a credible implication of academic entrepreneurship. Thus, despite arguments that entrepreneurial activities are increasingly becoming the norm in
academic science in Canada (Metcalfe, 2010), normative attitudes and values towards the legitimacy of academic entrepreneurship maintain its location as a largely distinct logic to academic science.

This location of a distinct institutional logic in entrepreneurial science is also corroborated by qualitative data on entrepreneurial scientists’ and trainees’ experiences with and exposure to entrepreneurial activities. Despite entrepreneurial PIs’ values related to the importance of academic entrepreneurship, they found these activities to be practically difficult and distinct from their academic training. Similar to findings from studies in other settings, entrepreneurial activities were undertaken with certain difficulties and uncertainties by academic scientists (Slaughter, Archerd, & Campbell, 2004). Entrepreneurial PIs had to learn the skills of entrepreneurial science, and often found these to be foreign or distinct from their native academic pursuits. These scientists acknowledged entrepreneurial activities as novel pursuits, acceded to their own difficulties and uncertainties in these pursuits, and yet also wished to act as leaders amongst their entrepreneurial peers and colleagues in introducing and normalizing these activities.

This divergence in logics in the practices of entrepreneurial science was also reflected in interviews with trainee participants, where they lacked exposure to entrepreneurial activities. Trainee experiences with entrepreneurial science were minimal, highly diverse, and dependent on their laboratory dynamics and organizational capacities. For the most part, they lacked knowledge of entrepreneurial activities, and their training environment thus far had been more academic than entrepreneurial. Though some trainees interviewed perceived benefits in exposure to entrepreneurial science, they tended to prioritize academic activities. The location of trainees as separate from entrepreneurial activities is likely indicative of a system in which scientists must establish their academic capacities before embarking on entrepreneurial activities. This lack of knowledge and exposure to entrepreneurial activities amongst trainees thus both indicates the divergence of entrepreneurial activities, especially in the training of emerging scientists, and also positions trainees as bystanders in the institutionalization of academic
entrepreneurship, as they hold little familiarity or agency with respect to entrepreneurial science.

Despite the assertion of entrepreneurial science as a distinct institutional logic, the analyses in this chapter also indicate that this logic is heterogeneous, contesting accounts claiming the monolithic nature of an entrepreneurial or industrial logic (Sauermann & Stephan, 2013). Indeed ‘entrepreneurial science’ is composed of a range of diverse activities that hold diverse meanings for academic scientists. The lines of legitimacy differentiating the activities of academic entrepreneurship tended to be drawn around entrepreneurial activities that were seen to be extensions of academic science, and which did not imply the industrial overtake of academic science. For example, a weak majority of the surveyed population granted positive normative value to patenting activities, indicating some legitimacy associated with these activities as routine and beneficial aspects or extensions of academic scientific practice, and as increasingly academic research practices (Popp Berman, 2008; Metlay, 2006). Though support was in the minority, there was also some degree of legitimacy granted to the practices of developing commercial products from the results of one’s research. Similar to patenting activities, these development activities may be experienced as extensions of academic research and thus more routine or academically aligned scientific practices.

Academic scientists strongly rejected the legitimacy of activities that might cause market or industrial forces or interests to take control of academic research, such as in the case of choosing research topics with commercial applications. As well, respondents strongly rejected activities that might undermine their own academic legitimacy or credibility, such as in the case of co-authorship with industry, likely due to the association between co-authorship with industry and ghost-authorship or management in biomedical publishing (Sismondo, 2007; Sismondo & Doucet, 2009). These differences in valuations afforded to different activities, and their differing degrees of legitimacy amongst academic scientists, indicate a heterogeneity in entrepreneurial activities, and a need to recognize these as a diverse set of practices that hold different implications for academic scientists.
Relatively high neutrality amongst responses to items assessing the legitimacy of entrepreneurial activities is also indicative of heterogeneity in the institutional logic of entrepreneurial science. This neutrality may be partially explained by findings from qualitative interviews, where scientists discriminate between different entrepreneurial arrangements and different scientists conducting these activities, as explored further in Chapter 6. Respondents thus may not have been willing to make broad claims or statements about the appropriateness of entrepreneurial activities outright, and instead make distinctions between different specific entrepreneurial arrangements or the practices of different scientists. Taken together, these analyses indicate that entrepreneurial science is not a monolithic entity, but instead a range of activities that are valued as being more or less aligned with academic science.

Related to scientists’ perceptions of a divergence in the logic of entrepreneurial science, academic scientists tended to grant some credibility to claims about the threats of these initiatives to upstream scientific practices. Specifically, through granting credibility to the problems of bias and secrecy when academic scientists engage with industry, respondents deemed these to be valid and credible concerns resulting from a divergence between academic and entrepreneurial logics. However, relatively low credibility was granted to the concern about threats to public trust as a result of these activities, and even less was granted to concerns about potential harms to participants in clinical trials. This lack of credibility granted to these downstream claims, often cited in the bioethics literature, may signify a decoupling of entrepreneurial pursuits with their potential downstream impacts, and a failure to recognize these specific harms as relevant to entrepreneurial activities in the basic biomedical sciences. As such, these downstream concerns were valued as distinct from the day-to-day realities of these scientists, and as such, granted low credibility (Brosnan and Cribb, 2014). Relatively high neutrality and uncertainty about these items (indicated in the Don’t Know responses) was also indicative of respondents’ skepticism in making broad statements about all interactions between academic researchers and industry collaborators. These themes of ethical
decoupling and ethical boundary-work between upstream scientific practices and downstream concerns related to conflicts of interest are further examined in Chapter 5.

While indicating that entrepreneurial science denotes a largely distinct yet also heterogeneous institutional logic, these analyses are also indicative of a mingling of institutional logics amongst entrepreneurial scientists who may concurrently draw from both academic and entrepreneurial logics. Evidence from the multivariate model examining factors associated with scientists’ participation in entrepreneurial activities indicates that entrepreneurial scientists tend to deploy both logics concurrently, as participation in entrepreneurial activities is significantly associated with certain academic characteristics. Similar to findings in other settings, the academic ‘resource’ of scientific publications is highly correlated with entrepreneurial activities (Lowe & Gonzalez-Brambila, 2007; Gulbrandsen & Smeby, 2005; Haeussler & Colyvas, 2011), and patenting activities and publishing activities often work in tandem (Breschi, et al., 2007; Coupe, 2003; Guena & Nesta, 2006). As well, academic scientists’ laboratory personnel, especially their trainees, were associated with participation in entrepreneurial activities, indicating that academic scientists with larger academic laboratories, and more resources to support these laboratories, are more likely to engage in entrepreneurial activities (Landry, Amara, & Ouimet, 2007; Landry, et al., 2006; Landry, Amara, & Saihi, 2007). Associations were also found between scientists holding funding relevant to academic entrepreneurship (i.e., funding from private firms and public funding aimed to incent commercialization) and their entrepreneurial activities, indicating that funding sources are highly determinative of research activities, and that scientists who receive these funds were facilitated in their entrepreneurial pursuits (Bozeman & Gaughan, 2007).

Scientists’ value orientations were also highly correlated with entrepreneurial participation (Benner & Sandstrom, 2000; Hoye & Pries, 2009; Lam, 2010; Rabino, 1998; Shinn & Lamy, 2006). High legitimacy granted to entrepreneurial activities and low credibility granted to claims about conflicts of interest were associated with participation in entrepreneurial activities. Though the direction of the relationship between these attitudinal items and scientists’ participation in entrepreneurial activities
cannot be determined, this does indicate that participation in entrepreneurial activities is highly linked with scientists’ normative values. As such, positive valuations of entrepreneurial activities, and a decoupling of the credibility of conflict of interest consequences are associated with increasingly entrepreneurial scientists. There are thus overlaps between scientists’ academic productivity, in the form of publishing, academic laboratory size, funding sources, and value orientations with participation in entrepreneurial activities, indicating that increasingly entrepreneurial scientists may draw from multiple logics, in both being academically productive and participating in entrepreneurial pursuits.

This simultaneous location in academic and entrepreneurial logics is also indicated in the characteristics of the entrepreneurial PIs interviewed for this study. Though these scientists were recruited for their entrepreneurial experiences, they were also highly accomplished and productive in their academic careers. These scientists were both entrepreneurs and high-powered academic scientists, and thus drew resources from both logics in asserting their institutional position. As academic scientists of high stature, these individuals possess a high degree of power and agency in promoting the legitimization of entrepreneurial science, and the ability to do institutional work to this end. The ways in which entrepreneurial scientists draw from multiple logics, and use these as a source of power and legitimacy in shaping new norms of scientific practice are examined in the following two chapters. The findings of this chapter thus establish the grounding for the following qualitative analyses examining how entrepreneurial scientists draw on multiple logics in legitimizing entrepreneurial pursuits.
Chapter 5
Valuing Entrepreneurial Science

5.1 Introduction

While the previous chapter established the legitimacy afforded to academic entrepreneurship amongst Canadian academic biomedical scientists, and provides some indication that academic entrepreneurs may draw on resources from multiple logics, this chapter examines how academic entrepreneurs generate positive value and legitimacy in entrepreneurial science through appeals to both academic and entrepreneurial logics. This chapter explores why entrepreneurial scientists claim to engage in entrepreneurial activities, and as such, how they legitimize the role of entrepreneurial activities in academic science. I examine how academic entrepreneurs, as institutional workers, express the value-added of entrepreneurial pursuits, and how this in turn interacts with the institutions of academic science to designate academic entrepreneurship as legitimate. I demonstrate that entrepreneurial scientists engage in processes of institutional change-through-maintenance, where they draw on the maintenance of academic norms as resources to legitimize entrepreneurial activities. Entrepreneurial scientists engage with narratives of scientific, societal and clinical translation benefits in justifying entrepreneurial science, yet through their simultaneous claims to adhere to the logics of academic science and to avoid conflicts of interest, they claim new zones of legitimate scientific conduct where entrepreneurial activities are valued and academic norms can be maintained.

Some scholarly analyses of academic entrepreneurship have examined the role of scientists’ values and motivations, yet have tended not to examine how these values and motivations may shape the institutions of academic and entrepreneurial science. For example, Lam’s (2011) UK-based, mixed-methods study of scientists across disciplines focuses on connections between scientists’ value orientations towards research
commercialization and their personal motivations for pursuing commercialization. This study categorizes types of academic scientists based on their value orientations, and found that scientists with ‘traditional’ or academic value orientations tended to be motivated by the career and reputational rewards of research commercialization, while those scientists who identify primarily as entrepreneurial scientists are primarily motivated by the intrinsic satisfaction of commercialization activities as well as the financial rewards associated with these activities (Lam, 2011). While Lam’s study identifies relevant motivations associated with academic entrepreneurship and makes important connections between these motivations and scientists’ overall value orientations, the analyses in this chapter extend beyond these individual accounts, and examine how entrepreneurial scientists generate institutional legitimacy and value in entrepreneurial activities through their motivational accounts.

Other studies of scientists’ motivations associated with entrepreneurial activities have tended to focus on one particular entrepreneurial activity. In a qualitative examination of faculty decisions to patent their research at two U.S. universities, comparing physical and life sciences faculty, Owen-Smith and Powell (2001) found that scientists patent their research because of their personal perceptions of benefit related to the protection of research and the importance of drug development, and that the perceived costs of interacting with TTOs mediate these perceptions. Owen-Smith and Powell thus note the importance of organizational and institutional environments in decisions to patent, but do not examine the wider range of entrepreneurial activities associated with patenting. As well, they do not theorize the connection between scientists’ entrepreneurial decisions and the ways in which the larger institutional environment is shaped by these decisions and claims of value in patenting activities.

Similarly, in a survey of academic scientists in Italy, Baldini and colleagues found that faculty tend to engage in patenting for the prestige associated with these activities, for novel research directions, and not for personal financial rewards, and that organizational patenting incentives are perceived as reducing obstacles for academic scientists (Baldini, Grimaldi, & Sobrero, 2007). Also in the Italian context, scientists’ motivations
associated with initiating start-up companies were examined, differentiating between environmental influences, university level support mechanisms and individual related factors (Fini, Grimaldi, & Sobrero, 2009). Fini et al’s study found the importance of academic status associated with spin-off company initiation for academic scientists, access to academic funding opportunities and research resources from the spin-off company, as well as their claimed importance of generating national economic and societal impacts. While these studies identify important motivational factors associated with academic entrepreneurship in the international context, they do little to theorize beyond motivational accounts to examine how entrepreneurial scientists’ claims about the value of entrepreneurial activities can legitimize entrepreneurial activities in the institutional context. This study adds to this literature by conceptualizing the connection between scientists’ motivational accounts about academic entrepreneurship with how these accounts can entail the institutional legitimization of entrepreneurial activities as a valuable aspect of academic practice.

Complicating accounts attentive to scientists’ motivations for participating in entrepreneurial activities, some studies have examined how ethical concerns can shape scientists’ justificatory accounts. For example, Hobson-West’s (2012) qualitative study of scientists engaged in animal research found that scientists claimed a necessity in the use of animal models to justify and legitimize their practices, despite some moral quandaries. As such, they relied on promisory discourses of medical advancement in describing the ends of their research, and used this to distinguish their scientific practices as ethical. Though these studies attend to the construction of ethical legitimacy in the work of scientists, they tend not to be explicit in their analyses to how scientists’ might strategically draw on multiple and potentially contradictory institutional logics to justify their activities, and how this serves to legitimize their pursuits.

The analyses that follow thus examine entrepreneurial scientists’ motivations associated with a range of entrepreneurial activities, and also take these motivational accounts to be strategic moments in the institutional legitimization of entrepreneurial activities in academic biomedical research. I examine the ways in which entrepreneurial scientists
claim value in entrepreneurial activities in (1) contributing to scientific practices through financial and intellectual resources; (2) generating societal and economic impacts; and (3) generating clinical impacts and health benefits. As well, I examine the ways in which scientists simultaneously claim adherence to the importance of academic institutions and values such as academic freedom and autonomy, and the importance of curiosity-driven research. I argue that claims of value in entrepreneurial activities, for scientific or downstream benefit, are coupled with seemingly contradictory claims of adherence to academic norms and the avoidance of conflicts of interest. However, these claims of adherence to academic norms work together with scientists’ claims of benefit and value in entrepreneurial science to serve as legitimizing constructs. The institutional work examined here is largely normative and discursive, as entrepreneurial scientists draw from both academic and entrepreneurial logics to re-shape the norms of academic science through the legitimization of entrepreneurial activities.

5.2 Data Sources

To examine how academic entrepreneurs justify the positive value of entrepreneurial activities and engage in institutional work to legitimize these pursuits, I draw from the twenty-four qualitative interviews with entrepreneurial PIs, described in the study methodology in Chapter 3. I analytically position these scientists as agentic institutional workers, who may draw from diverse institutional logics to initiate change or maintenance in institutional structures through the promulgation of legitimacy in their activities and pursuits. As well, as agents who are both of high academic stature and accomplishment, and who are actively engaged in entrepreneurial activities, I position these scientists as agents with institutional power and individual legitimacy, and thus the capacity to reshape domains of academic scientific practice.

These analyses draw from discussions of scientists’ motivations to participate in entrepreneurial activities and their overall attitudes towards associated conflict of interest concerns and related harms of academic entrepreneurship. In interviews with these scientists, they were asked what had motivated them to pursue their commercialization initiatives and collaborations with industry. Interviews were initially coded to
descriptively group these responses by domain of value scientists granted to their entrepreneurial activities. Complementary analyses drew from participants’ discussions around conflicts of interest, as well as the ways in which these scientists described the value of academic science, though these discussions were often not directly prompted in the interview guide. These analyses were grouped together to examine the often-conflicting nature of scientists’ value orientations towards entrepreneurial science, or their use of academic caveats in their discussions of the value of entrepreneurial activities.

By drawing from these motivating or justificatory accounts, I determine why academic scientists claim to undertake entrepreneurial activities, and as such, the value they describe in these activities as extensions or additions to academic scientific practice. I identify processes of institutional work from these valuations, and scientists’ deference to academic norms and activities, and to conflict of interest avoidance. By coupling these motivational claims with scientists’ assertions of the value of academic norms and activities, I take these motivational accounts as strategic legitimization pursuits in the institutionalization of entrepreneurial science.

5.3 The Value of Academic Entrepreneurship for Scientific Practice

Entrepreneurial scientists described positive value in entrepreneurial activities for their capacity to contribute resources to scientific practices, and to enhance scientific activities. Collaborations with industry, including conducting contract research and receiving research grants from industry, were valued both for their ability to enhance academic science by providing additional financial and material resources in the form of funds and equipment to academic science, as well as their ability to add enjoyment or intellectual resources to scientific practices.
5.3.1 Financial Resources

Scientists described a poorly funded research environment, and thus proposed a necessity in additional entrepreneurial resources to fund the activities of their academic laboratories. Usually, this appeal to the need for resources was fulfilled through accessing industry funding or engaging in fee for service activities. Through these activities, scientists claimed that they could gain monetary resources to fund their academic research without drastically changing the nature of the research conducted in their labs. These funds allowed them to take on high-risk projects, or to engage in research projects that they otherwise would not be able to. The following accounts from a clinician-scientist located in a hospital research institute and a university-based professor indicate their difficulties with securing public grant funding. In this poor funding environment, they proposed the value of entrepreneurial activities as additional funding sources.

“One of the main drivers of that is not just the commercialization, but to try to get more funding. One of the problems we have is, as researchers in general I think, is just the amount of funds from CIHR and other funding agencies. We never have enough money to do anything like really well. There are some people who are the stars who have lots of money, obviously are very productive and are great scientists, so we have quite a few in Canada. But by and large, the vast majority of people are struggling, and trying to cut corners, and the funders are getting good value for their money, but there’s not enough money around. So if you want to do something that’s exciting and a little bit more, it’s always difficult. So, if you have an angle with industry, an industrial angle that you see might benefit a pharmaceutical company or some other company, many people will go to them for funding for one reason or another.” [R1]

“One thing that I’ve learned is that it’s very difficult now getting grant funding, so if we have an idea that we can commercialize, or we license the technology to a company, then suddenly there’s a whole new series of grant applications that we can write and apply for to help fund these ideas, and even if it turns out that the product isn’t commercializable… we can publish these results …so it’s like a new source of funding for our laboratories, that’s actually one compelling reason for going this route.” [R11]

In the following accounts, entrepreneurial activities are described as having relatively few costs but great benefits for academic science. In the first account from a university professor, writing a business plan to acquire one million dollars was cast as procedurally
commensurate with writing an academic grant. In the second account from a hospital-based cell biologist, the amount of work required to consult for industry was described as being minimal, and thus non-disruptive to the activities of academic science.

“You can build up labs with much better funding from the private, and push your science along much quicker with much higher and better funding on a per year basis if you have private funding, and that was one thing. So that was very motivating because at some point we had the choice I think to either write another grant for $100,000 a year, or write a business plan and get a million dollars per year, and so we went for number two, because we just thought it would be great, and it worked right, and that was great too.” [R18]

“Generally speaking, these collaborations come with funds to help support the research, and again, in times like this where research funding is pretty grim at the moment - certainly in Canada it’s better than what’s going on in the U.S., but to have developed these relationships with a number of these big pharma, big biotech companies…Now I have a couple of them that essentially say to me we’ll give you X amount of dollars every year, and all we ask is that you come out once or twice a year and just update us on the state of the art, what’s going on in the field, you know meet with various folks to give us some ideas, so that’s very nice.” [R7]

In these justifications for the conduct of entrepreneurial activities to generate revenue for academic laboratories, scientists claimed minimal work to generate these revenues, but much gain in funding their scientific practices. Scientists claimed that entrepreneurial activities could facilitate or enhance the science of their labs, without drastically changing the nature of this science or types of activities in which they engaged. These justificatory strategies tended to rely on appeals to a poor funding environment in Canada, and thus located the resources drawn from entrepreneurial activities as necessary in enhancing the activities of their academic laboratories.

5.3.2 Intellectual Resources

Alongside these accounts of the positive value of entrepreneurial activities in enhancing scientific activities through the provision of financial resources, scientists also claimed positive value in the enjoyment and intellectual resources that entrepreneurial pursuits could add to their scientific practices. They valued the scientific insights and intellectual capital that could be accessed through collaborations with industry, as well as the challenges and research directions provided by industrial partners. The science
conducted in industry that could be accessed through entrepreneurial activities was viewed as being exciting, and scientists valued the possibility of research application or translation that they could achieve through these collaborations. The following accounts from a junior molecular biology professor at a university research institute, and a stem cell scientist at a hospital research institute indicate sources of value in industrial collaborators who can enhance academic research.

“So the interest in collaborating with companies is number one, you tap into this incredible knowledge base that you just don’t get in your day to day interactions, or often you don’t get from working with expert collaborators in academia. Industry collaborations give you this view into a group of people who are all working really hard on one particular problem, and so it’s always a learning experience and an intense one in a field that I’m usually not that well versed in. So, you know it’s a challenge, you have to come up to speed very quickly, but again you’re usually addressing a problem at an extremely high level, because if a company’s going to succeed, they put a ton of resources and brainpower into this problem, they’re engaging you -us- because they have an unresolved problem and so you’re joining a conversation that’s already at a fairly sophisticated level. I mean, scientifically I find that very engaging” [R13]

“What’s fun about interacting with industry is that this ends up in a totally new direction, it’s taking a discovery that came out of one’s lab and moving it in a translational direction that it otherwise would not move. And so that’s really interesting to see how that’s done because it’s so different from what we do in the lab normally, and I’ve met some really bright and competent people in industry, so it’s fun to meet those people. And there’s the satisfaction of actually having something one did in the lab move forward and maybe get closer to being something that could help people.” [R17]

In these accounts, scientists described the value that entrepreneurial pursuits could add to academic research through interactions between academic researchers and industry. They claimed that these entrepreneurial activities provided valuable extensions to academic science through scientific excitement and novel research directions for academic researchers, often related to the translation of their research to clinical settings. Scientists also maintained their autonomy as independent investigators in these collaborations, and suggested a complementarity between academic researchers and industry, where entrepreneurial activities can extend academic research to new domains.
5.4 The Value of Academic Entrepreneurship for Social Impact

Moving beyond the value that scientists claimed in entrepreneurial activities for scientific practices, they also claimed normative value in entrepreneurial activities for their ability to generate downstream societal and economic impacts. Language of return on investment and the generation of impact from academic research were used to explain what was perceived as a new mission or mandate of academic research, in producing societal impact and directing academic research towards these ends. Scientists commented on a shifting academic research environment toward increased obligations to produce societal value, jobs, and economic impacts from academic research. For example, this university-based professor located in a biomedical engineering department described a new model of academic science, where downstream impact is part of the mission of academic science.

“The old the model of universities as centres of higher learning, separate from the economy, separate from the rest of the community, I think are old models. I think modern universities are getting to be integrated into the community with downtown buildings, parts of universities downtown in cities, in supporting city planning, supporting commercialization and job activity. So I think the role of universities is changing and now they have to undertake this kind of partnership with the rest of the economy, and that means that conversion of public money support into economic activity.” [R6]

In addition, the generation of downstream impact in academic science was characterized as a specific obligation of publicly-funded researchers, and especially of health researchers in Canada. The following accounts from a university-based Assistant Professor in neuroscience, and two hospital-based clinician-scientists valued aspects of return on investment for Canadian citizens as necessary and beneficial outcomes of entrepreneurial pursuits, and indeed as obligations of academic researchers towards the public.

“If you have something that could be of value- that’s the whole reason why the government funds us in the first place- to do research to hopefully find things that are of value to Canadians…and so if we don’t work with industry then you lose that in many cases. I think you lose the impact of the work, it doesn’t get translated.” [R12]
“I mean we have not been, in the health care sector have not historically been as successful in terms of spin-off companies, right, that have created jobs, but I definitely think that for Canada too. So we’re obviously not in the business of manufacturing anymore, right, that’s why Ontario is in trouble, and so if you’re going to look towards a future of what is Canada’s role in terms of global wealth, we’ve got to be creating knowledge and be innovative.” [R20]

“The public wants us to be generating jobs, high value information technology jobs here, and we’re not going to do that if we don’t start companies.” [R2]

In these accounts, scientists described beneficial societal and economic outcomes from entrepreneurial activities, and spoke to an expanded mission of academic biomedical research in generating downstream impacts. In these cases, this expanded mission derived from obligations to the public in generating research impact and jobs. Rather than locating entrepreneurial science as distinct resource for academic activities, these accounts included entrepreneurial, translational activities as necessary aspects of academic science.

5.4.1 Protecting Basic Research

Though these previous accounts placed value on entrepreneurial arrangements for their ability to create societal and economic impacts, some scientists also addressed the importance of protecting or maintaining public funds for basic or curiosity-driven research. In doing so, they challenged directives towards an overemphasis on the generation of impact in academic research. In the following account, a university professor described value in funding initiatives that incent entrepreneurial activities and returns on investment in academic research, while also claiming the value of basic research.

“We’re being encouraged now by our funding agencies, by our Ministry and by our Government…across the country, internationally, to show return on investment and it’s very important. I agree that we should return the investment made in research and while I’m a strong advocate for funding basic research for the sake of basic research, I’m also a deeply strong advocate of if you have a good idea, you should probably try to follow it through to it’s logical application to a human condition” [R11]

The following scientists took a stronger position on this issue, and questioned the effectiveness of governmental and funding initiatives that promote commercialization
overall. They still maintained the importance of societal impact in academic research, yet found basic science and serendipitous discovery to be the means to that end.

“I believe that scientists have responsibilities to society, to do something that helps society, it’s just that over the course of time we’ve learned that a lot of curiosity driven research is the right way to form that base. And then from that base, discoveries emerge that will have commercial value and practical value and biomedical value and everything else. So, in my own personal view, curiosity driven research is not a moral, ethical principle, it’s simply a tried and true method of creating the knowledge base that’s necessary to move forward. So, you have to know stuff before you can figure out how to be practical about it.” [R24]

“All the breakthroughs have come from science that you couldn’t have predicted, so I don’t quite understand it, but there is a concern about it. I mean the pressure, the public pressure is definitely going in that direction, and I’m not sure that it is a good way to do science.” [R18]

Entrepreneurial scientists thus both claimed the importance of directing research towards societal applications and producing impact, and also claimed the importance of serendipitous discovery and basic research. As such, they tended to resist organizational, governmental and policy directives that might enforce the generation of impact in academic biomedical research, and claimed the importance of protecting basic science.

5.5 The Value of Academic Entrepreneurship for Clinical Impact

Connected to rationales of downstream impact value for societal and economic benefit, entrepreneurial activities were valued for their ability to help patients and save lives, and to do so in a way that was superior to academic translation activities. For example, this university professor discussed how academic research translation mechanisms were insufficient to realize the health goals and imperatives of biomedical research, and instead the patenting and licensing of a technology were cast as guaranteeing patient benefit.

“The basic motivation is that if you develop a prototype of something in the lab and it looks like it would be useful and helpful to a number of patients, if you don’t [commercialize], it just remains a laboratory curiosity really, that may be the subject of a paper or two and then does nothing beyond that. If you patent it
and license it and make arrangements to sell it … then you can help thousands of people.” [R14]

In the following account, this hospital-based clinician-scientist cast achieving health goals and reaching patient populations as an ultimate goal for basic biomedical scientists. As such, they claimed a necessity in entrepreneurial activities, and specifically the ‘vested interests’ of industry in pushing research towards these ends.

“Ultimately what we’d like to do… is getting something for people that’s going to help them stay healthy and so on. The usual thing that we try to do is to translate the work, so it’s these translations that are very difficult to do because of lack of money and you need someone to believe in you and in the idea to push it, you know, and someone with a vested interest.” [R1]

As well, engaging in entrepreneurial activities to reach the clinic was valued as a mechanism for maintaining control over how research was translated. By controlling the mechanisms of research translation, in this case through a spin-off company, this genetics professor claimed that they could better reach their goals of curing sick patients and gain responsibility over the uptake of their innovation.

“Well the reason I got into medical research was to cure people that are sick, and the only way you can do it is actually to do the translational research. I could do the basic research and hope that somebody runs with the ball and does it properly and doesn’t screw it up, or I could do it myself, and that way there’s nobody to blame but myself if it gets screwed up. But I’d prefer to at least be the person that’s gonna give it a shot, and I think to me that was basically the major reason I got into the job to begin with, and did all the training that goes with this career, was to cure people that are sick.” [R21]

In these accounts, the goals of patient benefit and cure, and the ways in which entrepreneurial activities might guarantee this, generated necessity in engaging in entrepreneurial activities if researchers were to create clinical impacts. As clinical impacts and patient benefit were inscribed into the purpose and mission of biomedical science, entrepreneurial activities were positioned with the promise of guaranteeing these impacts.

5.5.1 Clinical Distance

Alongside the value proposed in clinical directedness and researcher interestedness in clinical applications and outcomes, academic entrepreneurs simultaneously distanced
from the clinic in the context of concerns about conflicts of interest. When discussing the concepts and management of conflict of interest, entrepreneurial scientists claimed a location as disinterested basic scientists, and associated situations of conflict of interest with clinical scientists, or researchers who were in close proximity to the clinic. They also distanced the field of upstream biomedical research as a whole from conflict of interest concerns, and in doing so avoided even the potential for encountering these situations. For this university-based neuroscience professor, distance from a clinical trial stage of research was used to dispel conflict of interest concerns. He described his research as just one of many ‘data points’ for an industry partner, and assigned little decision-making value for industry in his research work.

“I don’t feel as a basic researcher that I have any conflict of interest at all in terms of the outcome of the study, right… So, it seems to me you know patently absurd that anyone would think that a guy like me is in a conflict of interest position in terms of the outcome of the study, right? And I don’t feel in any way that the drug company cares one way or another whether the study succeeds or fails. If it succeeds, it’s just one more of a long list of data points that would get them closer to making a go decision on a clinical trial, and then if it fails its just one of a long list of experiments that would make them slightly less likely to make a go decision on a clinical trial.” [R5]

Similarly in the following account, this engineering professor distinguished her research from situations where individuals might benefit personally from their collaborations with industry. She instead located ‘legitimate’ conflict of interest concerns within the fields of clinical or pharmaceutical research, and distanced the field of basic biomedical research from these concerns.

“I think there’s many cases where it is a very legitimate concern, a lot of the pharmaceutical research, deep concerns, where the researchers stand to benefit personally from these collaborations. In our case, the personal gain is very very far from any of this and so there’s a much, at least in the case that I’ve experienced so far, there’s very few issues in terms of conflict of interest.” [R22]

Here, distinctions were made between industry ties in the space of upstream biomedical research, where outcomes are characterized as more abstract, and in the space of clinical research, where outcomes are characterized as more visible or evident.
These justifications for the pursuit of entrepreneurial activities to reach clinical populations, and yet distancing from clinical settings in the face of conflict of interest concerns is most evidently displayed in the following account. This cell biologist, who holds a high-powered position as a director of a research centre, described a health-centric and clinically oriented mission of basic biomedical research. As a means of meeting these health ends, or fulfilling this mission, collaborations with industry were valued as necessary mechanisms to resource and translate academic research to clinical settings.

“If you work in biomedical research, where the work has a mission, which is eventually to improve health, then it’s the rare academic lab that could actually get all the way to a patient without having a private sector partner somewhere along the way. You know, you don’t have the capacity to do a large, expensive Phase III trial, so therefore industry has its legitimate role in the continuum from a basic discovery to a product that is being sold as a drug or as a device, so it’s fundamental.” [R24]

However, when asked about the potential problem of conflicts of interest associated with entrepreneurial activities in the conduct of academic biomedical science, he distanced the field of basic biomedical research from this health-centric mission.

“Now [conflict of interest is] much less of a problem in a very basic science supported protocol that is years and years and years away from any patients being involved or clinical decisions being made, because then the company’s paying for some experiments, nobody has any idea where it’s going to go, you’re not asking a patient to try the drug or not try the drug.” [R24]

This contradictory characterization of the appropriate role of academic biomedical researchers with respect to the clinic is illustrative but not unique to the ways in which academic researchers positioned themselves. Though scientists demonstrated an awareness of the potential for conflicts of interest when industrial or proprietary interests become involved in research, they decoupled these concerns from the conduct of upstream, basic biomedical science. Conflict of interest concerns associated with doing health or clinical research were strategically removed from the conduct of basic science, and instead scientists emphasized the uncertainty or non-directionality involved in their scientific practices.
5.6 Analysis and Discussion

In the previous chapter, it was established that academic scientists tend to position entrepreneurial science as a largely distinct institutional logic to academic science, and that academic entrepreneurs might draw from multiple logics. It was also established that academic biomedical scientists tend to disassociate or decouple downstream conflict of interest concerns from the engagements of academic scientists with industry. From the accounts in this chapter, where scientists described their motivations for participating in entrepreneurial activities, I demonstrate how scientists draw from both academic and entrepreneurial logics to locate the normative importance and legitimacy of entrepreneurial activities in academic science, and use a decoupling from conflict of interest concerns to accomplish this.

In these accounts, the process of legitimization of entrepreneurial activities involved a reliance on claims of benefit in entrepreneurial activities for academic science, while simultaneously claiming to avoid the harms of academic entrepreneurship. Through asserting that academic entrepreneurship is a valuable extension of academic science, academic entrepreneurs draw from academic logics to justify and legitimate the role of entrepreneurial science within the academic biomedical research enterprise. Dominating scientists’ accounts of their motivations to engage in entrepreneurial activities were the value these pursuits could add to academic practices, as well as in generating societal and clinical impacts through an expanded mission of academic science. At the same time, they claimed an adherence to academic values, and claimed that these could co-occur with their entrepreneurial practices. As institutional workers, they legitimate entrepreneurial activities through claims that entrepreneurial activities can enhance academic science, while academic norms can be maintained.

Similar to findings in other settings (Lam, 2011; Baldini, et al., 2007; Fini, et al., 2009), academic entrepreneurs in this study found intrinsic satisfaction and novel research directions in the activities of academic entrepreneurship. However, these scientists did not draw motivations from personal financial gains or career recognition or rewards.
Instead, their motivational accounts were dominated by a proposed need to fund academic laboratories, and to translate academic science to downstream social, economic and clinical impacts. As such, these scientists drew more heavily from institutional constraints and the demands of research funding than from personal reward structures. This study thus adds to descriptive accounts of scientists’ motivations associated with their entrepreneurial behaviours by locating academic entrepreneurs as institutionally embedded agents who may strategically draw from diverse institutional logics in their motivational or justificatory accounts.

In claiming the value-added to scientific practices through entrepreneurial pursuits, the financial and intellectual resources of industrial collaborations and industry funds were valued for enhancing academic science through the provision of research resources and intellectual stimulation for scientists, usually related to pushing research in translational directions. These pursuits were considered to be minimally invasive activities that would generate great benefits for academic science. They were also cast as increasingly necessary pursuits in a poor funding environment. Notable in these accounts, scientists maintained a divide between academic and industrial science. Though entrepreneurial activities (usually in the form of collaborations with industry) were framed as adding to academic research practices, these activities still relied on engaging with distinct, non-academic practices, and the intellectual resources that could be captured from industry collaborations were valued for this distinctness. Entrepreneurial activities were thus constructed as legitimate for their abilities to enhance academic science in an environment that was described as scarce in resources, and where industrial research directions could augment academic activities.

Claims about the generation of societal impact through entrepreneurial activities diminished the divide between academic and entrepreneurial science. Through an expanded mission of academic science in generating social and economic impacts, entrepreneurial activities were cast as the mechanism under which these impacts could be achieved. In these mission-oriented claims, entrepreneurial scientists both made claims towards the value of entrepreneurial science itself, and made academic claims towards
entrepreneurship as an aspect of academic science. The logics of academic and entrepreneurial science were thus brought together by entrepreneurial scientists to locate entrepreneurial science as an aspect of academic science. As such, claims about impact value in entrepreneurial science were distinct from claims about the intellectual and material resource value of entrepreneurial pursuits. Claims about impact value in entrepreneurial activities deemed entrepreneurial science to be a beneficial and value-added aspect of academic science, rather than distinct scientific practice.

Alongside these claims about the generation of impact in entrepreneurial activities, scientists resisted directives that would force research in this direction, and spoke to the importance of basic research and serendipitous discovery. In doing so, they claimed to protect academic freedom and non-directed discovery while maintaining the value of impact and economic development as an aspect of academic research. Scientists thus constructed a boundary between directing science towards applied ends as a beneficial and mission-centric pursuit, yet also resisted the imposition of these applied ends, and protected the value of serendipitous discovery. They claimed that entrepreneurial activities could produce societal impacts, yet maintained simultaneous, and seemingly contradictory, adherence to the importance of basic research and serendipitous discovery.

Scientists’ claims about clinical benefit as a result of entrepreneurial activities most clearly denote the ways in which entrepreneurial activities were valued as increasingly legitimate extensions of academic biomedical science, as academic entrepreneurs invoked promises of curing patients and saving lives. In these accounts, health impacts were used to justify and valorize entrepreneurial engagements (Lehoux et al., 2014), and scientists used the promisory discourses of medical advancement to legitimize their scientific activities (Hobson-West, 2012). These scientists described, and indeed claimed to foresee and insure, that benefits to patients could be achieved through entrepreneurial activities. Indeed, translation to the clinic was positioned as a fundamental aspect of doing basic biomedical science, and inscribed into the mission of academic biomedical research. As such, participation in entrepreneurial activities that required the pursuit of patents, the creation of spin-off companies, and collaborations with private industry were
characterized as fundamental and necessary activities for basic biomedical researchers to engage in, with the intended ends of clinical impact.

However, claims about the problem of conflicts of interest also caused biomedical scientists to distance themselves from clinic impacts and claim a role as disinterested scientists. Conflicts of interest became an irrelevant concern for these scientists through their proposed distance from patient populations, both for individual scientists and for the field of basic biomedical science as a whole. In order to justify and legitimize entrepreneurial activities, scientists distanced from the clinic in the face of proposed harms, and removed the possibility of entrepreneurial activities joining the worlds of biomedical science and clinical impact. This strategy thus formed part of a legitimizing discourse, where entrepreneurial activities could achieve patient benefit, yet not be subject to the concerns of clinical research. Through the deflection of conflicts of interest to clinical spaces, scientists created legitimacy in their own pursuits (Brosnan & Cribb, 2014), and purposively decoupled (Smith-Doerr & Vardi, 2014) the potential for downstream impacts of their activities from their scientific practices.

Entrepreneurial scientists thus engaged in a seemingly contradictory set of positions, in both claiming the benefits of entrepreneurial science, and also claiming to insure against their harms and protect academic norms and values. Some scholarly accounts of academic entrepreneurship have also examined possible contradictory or conflicting accounts of participation in entrepreneurial activities, where scientists might claim both benefits and harms in entrepreneurial science. For example, Welsh and colleagues found conflicting attitudes to entrepreneurial activities amongst academic scientists, where these activities were both positively valued, but simultaneously found to be problematic (Welsh, Glenna, Lacy, & Biscotti, 2008). Similarly, Gelijns and Thier highlight potentially conflicting imperatives in the context of medical innovation. While on-going interactions between academia and industry are characterized as increasingly important for the development of medical innovations, they locate a need to attend to the potential ethical harms of these activities on academic research (Gelijns & Their, 2002).
Following these accounts, I find that scientists in this study demonstrate what appear to be conflicting values in their accounts of their entrepreneurial engagements, yet it is through this use of conflicting narratives that scientists legitimize their entrepreneurial pursuits. While they claim to value entrepreneurial activities for academic scientific practice and downstream impact, they simultaneously claim to attend to the harms of industrial overtake of academic research programs, an over-emphasis on commercially directed research, and the potential for conflicts of interest. I argue that academic entrepreneurs appeal to the maintenance of academic norms in order to legitimize the value of entrepreneurial science. It is through this attendance to academic norms and institutions where entrepreneurial activities are legitimized as academically-aligned and beneficial, and where scientists claim that they can accrue the described benefits of entrepreneurial science while simultaneously protecting the integrity of academic science though attention to academic institutions.

Locating academic entrepreneurs as institutional workers, legitimacy is generated in entrepreneurial initiatives through claims of the benefits of entrepreneurial science as both complementary and mission-aligned, alongside claims to adhere to academic norms. As such, entrepreneurial scientists claim that entrepreneurial and academic practices can be aligned, and academic values can be protected alongside entrepreneurial activities. Drawing from Smith-Doerr’s (2005) study of scientists’ decisions to work in the biotechnology industry over the academy, and Popp Berman’s (2012) historical model of academic scientists’ strengthening of a market model in the U.S. described in Chapter 2, a comingling of institutional logics takes place. This involves the ongoing interaction of diverse logics, rather than the outright replacement of one set of values with another. While these two studies suggest that scientists experiment with different logics before one gains strength over the other and may reproduce already-institutionalized practices alongside emerging ones (Popp Berman 2012), I suggest here that the appeal to academic logics alongside the value of entrepreneurial science is a strategic legitimization strategy for academic entrepreneurs to validate and generate normative value in entrepreneurial activities. Similar to Hargrave and Van de Ven’s (2009) both/and strategy of managing institutional contradictions, where contradictory institutional elements are framed as
being complementary, academic entrepreneurs indicate that entrepreneurial activities can be compatible with the maintenance of academic institutions, norms and practices. Where entrepreneurial activities are seen to be novel and potentially contentious in academic research, these appeals to academic norms and institutions legitimize entrepreneurial activities for these scientists, and indeed for academic research practice at large.

Table 5.1 demonstrates how academic claims are utilized alongside entrepreneurial claims as instances of institutional work for entrepreneurial scientists.

<table>
<thead>
<tr>
<th>Domain of Value</th>
<th>Entrepreneurial Claims</th>
<th>Academic Claims</th>
<th>Institutional Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource value to scientific practices</td>
<td>- Entrepreneurial activities can resource academic activities</td>
<td>- Entrepreneurial activities enhance scientific activities through the provision of resources; generate an ability to do more science.</td>
<td>- Generating positive normative value in academic scientists’ pursuit of entrepreneurial activities</td>
</tr>
<tr>
<td></td>
<td>- Necessity in academic entrepreneurship</td>
<td>- Entrepreneurial activities are minimally invasive</td>
<td>- Including entrepreneurial activities into the mission of academic science</td>
</tr>
<tr>
<td></td>
<td>- Conditional on poor academic research funding environment</td>
<td></td>
<td>- Claims to adhere to academic norms alongside entrepreneurial practices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Claims to avoid harms of entrepreneurial activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Claims towards the maintenance of academic norms and institutions form part of institutional change strategies towards the legitimization of academic entrepreneurship</td>
</tr>
<tr>
<td>Enjoyment/intellectual value to</td>
<td>- Novel research directions</td>
<td>- Entrepreneurial interactions enhance academic science</td>
<td></td>
</tr>
<tr>
<td>scientific practices</td>
<td>- Enjoyment in collaboration with industry</td>
<td>- Industry science is a distinct form of scientific practice</td>
<td></td>
</tr>
<tr>
<td>Generating social impact</td>
<td>- Responsibility of academy to generate impact;</td>
<td>- New mission of academic science</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Responsibilities to Canada and the public</td>
<td>- Importance of protecting basic research</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- New mission of academic science</td>
<td>- Importance of serendipitous discovery</td>
<td></td>
</tr>
<tr>
<td>Generating clinical impact</td>
<td>- Entrepreneurial science can generate clinical impact and produce patient benefits</td>
<td>- New mission of academic biomedical science</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Avoidance of COI through distance</td>
<td></td>
</tr>
</tbody>
</table>
Clinical benefit is insured through entrepreneurial activities
- New mission of academic biomedical science to generate impact
from the clinic/clinical disinterestedness

<table>
<thead>
<tr>
<th>Table 5.1: Institutional work and the value of entrepreneurial science</th>
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</table>

Using the tools of academic legitimacy in their conduct of institutional work, entrepreneurial scientists legitimized entrepreneurial pursuits through claims that these could enhance academic science. Through a distancing and deflecting of the potential for the harmful effects of entrepreneurial science on academic research, scientists proposed an ability to protect academic freedom, autonomy, basic research, serendipitous discovery, and scientific disinterestedness alongside entrepreneurial initiatives. They thus claimed an ability to manage the potential harms of entrepreneurial activities related to conflicts of interest and the industrial overtake of academic science. Despite valuing and projecting towards the clinic in their justificatory accounts of entrepreneurial science, they maintained a boundary between their entrepreneurial activities and the harmful conflict of interest-inducing activities of industry engagements in the clinical sciences. Assertions of adherence to academic norms must thus be understood as claims of strategic harm avoidance and protective ethical boundary-work in the pursuit of entrepreneurial activities.

Entrepreneurial scientists thus engage in an institutional work process of *change-through-maintenance*, where they interact with appeals to the maintenance of institutions of academic science in order to re-shape new values and modes of conducting academic biomedical research. Their normative claims about the value of academic entrepreneurship introduce entrepreneurial activities as legitimate scientific practices through an adherence to, and extension of, academic norms. As scientists generate new domains of legitimate academic scientific practice in entrepreneurial activities through claims about the normative value of these activities, their strategic claims to adhere to the maintenance of academic norms and institutions serve as legitimizing forces. These claims of legitimacy both act to protect actors’ engagements in entrepreneurial activities,
as they may be controversial, and promote the benefits of these activities as normatively valuable for academic researchers at large.

As academic entrepreneurs are active agents in responding to and shaping academic research practice, they strategically legitimize entrepreneurial activities as necessary and beneficial extensions of academic science. To examine how these scientists manage these activities in their academic laboratories, the next chapter turns to the navigation and organization of entrepreneurial activities. Forwarding an analysis of institutional change-through-maintenance, I examine how scientists appeal to complementarities between academic and entrepreneurial activities in their labs to cast entrepreneurial activities as routine pursuits, and how they create spaces of legitimate conduct in their laboratory activities. These instances of institutional work in the strategic legitimization of entrepreneurial activities are examined critically in the final chapter.
Chapter 6
Navigating Entrepreneurial Science

6.1 Introduction

Following from the previous chapter examining the ways in which academic entrepreneurs normatively value entrepreneurial activities and legitimize these pursuits, this chapter examines the institutional work done to legitimize the conduct of entrepreneurial activities within academic laboratories. As such, this chapter examines how academic entrepreneurs navigate their entrepreneurial activities within academic research settings, and how conflicts of interest are understood and managed in this context. By analysing the strategic claims and decisions made by academic entrepreneurs in selecting entrepreneurial projects and organizing these within their academic laboratories, this chapter examines how institutional work occurs at the level of scientific practices. I argue that entrepreneurial scientists’ navigation of entrepreneurial activities within academic laboratories entails their assertion of agency and control in these pursuits, the routinization of academic entrepreneurship as academically aligned, as well as the maintenance of boundaries between academic and entrepreneurial activities. Entrepreneurial scientists thus engage in an institutional work process of change-through-maintenance, where the assertion of their abilities to manage entrepreneurial pursuits alongside academic activities and avoid conflicts of interest designate the legitimacy of entrepreneurial activities.

The academic laboratory has been the site of many social studies of scientific practice. While many of these studies have examined how scientists produce knowledge in their laboratories, and the ways in which this shapes scientific practices (e.g., Latour & Woolgar, 1979), some have also examined the encroachment of entrepreneurial practices into academic research life. For example, Kleinman’s (2003) ethnography of an academic plant biotechnology laboratory in the U.S examines the ‘blending’ of commercial and academic cultures. This study found the influences of commercial
culture on academic research to be subtle, where industry involvements in academic research indirectly shaped academic agendas through the control and limitation of academic science. Intellectual property arrangements related to research tools, and perceived reputations at stake influenced the everyday practices of academic science and scientists’ interactions with technical materials (Kleinman, 2003).

In the Canadian context, Atkinson-Grosjean’s ethnography of a genetics Network of Centres of Excellence (NCE) examines the shifting practices of academic laboratories towards commercial responsiveness. She examined the importance of visionary leadership in pushing entrepreneurial laboratories forward, areas of friction between academic scientists and administrative blocks by the university, and the difficulties of intellectual property management in academic labs. NCE scientists made strategic decisions to occupy both the worlds of commerce and the academy, and used several strategies to avoid the appearance of conflicts of interest in their academic practices. In fact, membership in the NCE itself legitimized scientists’ maintenance of multiple roles in academic and commercial science (Atkinson-Grosjean, 2005). In this study, I draw on these ethnographic examinations by attending to scientists’ managerial strategies associated with conducting entrepreneurial activities in academic laboratories, including their perceived areas of organizational friction and facilitation in their management of entrepreneurial pursuits. In examining a cross-section of entrepreneurial scientists from across organizational settings, this study explores a diversity of experiences in the management of entrepreneurship in academic settings, and examines how scientists might strategically draw from multiple roles and logics in their entrepreneurial engagements.

Studies by Tuunainen have offered a complementary analysis by contesting the intermingling of academic and entrepreneurial activities, and have claimed the maintenance of a boundary between academic and commercial activities in the Finnish context. His study of plant biotechnology and language laboratories identified a process of activity-specific boundary maintenance between academic and commercial science, where the creation of a business spin-off separate from the academy managed tensions between the two. However, despite these boundary maintenance efforts, conflicts arose
between the use of a professor’s working hours for entrepreneurial activities, the use of university equipment by private companies, and the management of intellectual property (Tuunainen & Knuutila, 2009). In a similar setting, Tuunainen found conflicts and contradictions between the initiation of a spin-off company and attention to publicly-funded research activities as well as undergraduate teaching commitments, where scientists’ attempts to engage in entrepreneurial activities were met with resistance from university administration (Tuunainen, 2005b). In the process of establishing a ‘hybrid-firm’, combining academic and commercial initiatives, spatial boundaries in the use of physical research spaces were maintained, yet this boundary was often perceived as fluctuating and strategic in its use of material and organizational arrangements (Tuunainen, 2005a). Drawing from Tuunainen’s work, I engage with the complexities of boundary maintenance and management at the level of research practices by examining how entrepreneurial scientists’ academic engagements and responsibilities are maintained alongside their engagements with entrepreneurial science. I attend to the spatial, temporal and personnel distinctions that might delineate a boundary between academic and entrepreneurial science.

Additionally, studies of “ethical boundary-work” have shown how scientists negotiate ethics in their everyday scientific practices. For example, qualitative studies of practices of neuroscientists in the UK found different groups of scientists to locate pressing ethical concerns in the activities of the other, and to place scientific practices on an ethical spectrum while drawing their own personal practice line at a particular point (Brosnan et al 2013). Indeed, these scientists tended to construct boundaries around relevant issues to their scientific practice, and moral concerns become demarcated by the day-to-day work and roles of scientists (Brosnan & Cribb, 2014). Additionally, in the case of stem cell science, Wainwright and colleagues found boundaries drawn between scientific fields, where embryonic stem cell scientists tended to deflect ethical concerns to other (less-regulated) scientific fields. As such, these scientists delineated positive ‘ethical spaces’ in their own practices, and differentiated themselves from less ethical positions (Wainwright et al, 2006). Drawing from these studies, the analysis that follows examines not only the practical boundaries drawn around entrepreneurial scientists’ work, but also
examines how ethical boundaries, especially those around conflicts of interest, are used to legitimize scientists’ activities.

In this chapter, I examine academic entrepreneurs’ laboratory organizational practices around entrepreneurial activities, situating entrepreneurial scientists as agents in shaping the norms and practices of academic science through their strategic management of entrepreneurial activities within academic labs. I examine the ways in which entrepreneurial scientists describe their selection of entrepreneurial pursuits, as well as the organization of these activities in their academic laboratories, including strategies to combine or separate entrepreneurial activities from academic research, and the spatial, temporal and personnel negotiations to accomplish this. These management strategies represent a diverse array of entrepreneurial selection and negotiation strategies wherein scientists demarcate their own entrepreneurial practices and management as legitimate. Through these diverse strategies, entrepreneurial scientists stressed their agency and control over their engagements, and negotiated boundaries between academic and entrepreneurial science to determine legitimate scientific practice. I demonstrate that entrepreneurial scientists assert compatibilities between academic and entrepreneurial activities, and do so through their ability to manage academic activities alongside entrepreneurial pursuits, while claiming to avoid conflicts of interest and other harms. As such, entrepreneurial activities are strategically cast as routine pursuits that do not raise novel concerns for academic research.

6.2 Data Sources

To examine how entrepreneurial scientists describe their experiences with the management of entrepreneurial activities in their academic laboratories, the data used in this chapter draws from 24 interviews with entrepreneurial PIs and 4 interviews with entrepreneurial trainees. As this analysis examines the practical negotiations of conducting entrepreneurial science, scientists were asked how they organize entrepreneurial activities within their academic laboratories. That is, participants were asked about how they selected and managed entrepreneurial activities within their academic laboratories, and the ways in which they fit entrepreneurial activities into labs,
as well as any reorganizations or concessions that were necessary. As well, they were probed about the potential for conflicts of interest in this context and how they organized their laboratories to manage and avoid these.

Data were descriptively coded to make distinctions between different types of research selection strategies and types of distinctions made within academic laboratories, including personnel, temporal, spatial or regulative distinctions. From there, coding attended to common themes in scientists’ managerial strategies and found similarities and differences between these. Analyses also attended to scientists’ appeals to academic norms and practices alongside entrepreneurial ones, and how these were used in tandem. Finally, scientists’ descriptions of their management of conflicts of interest were critically examined, and both explicit and implicit conflict of interest avoidance strategies were noted. These analyses thus examined how entrepreneurial scientists manage entrepreneurial activities in their academic laboratories, and critically attends to their appeals to academic norms and appeals to conflict of interest management.

### 6.3 Selecting Entrepreneurial Pursuits

As a primary organizational strategy around the conduct of entrepreneurial activities, scientists described processes wherein they made strategic decisions about the types of entrepreneurial projects they pursued, as well as the industrial collaborators they were willing to work with. They sought entrepreneurial arrangements that would cohere with their academic goals and negotiated these relationships in order to participate in projects that were characterized as academically and scientifically credible. For example, the following account from an Assistant Professor in neuroscience demonstrates negotiations made with industry collaborators before embarking on a research contract. She describes a situation where a contract with an industrial partner would only be acceptable as academic work if scientific goals could be met, resulting in a publication or patent.

“If I didn’t think that the experimental design was scientifically strong enough, then I don’t know if I would do the contract without trying to get that changed. Because then, I mean, I would still get the income but it would be a waste of time
because if it’s not done properly it can never be published, it can't go to support a patent.” [R12]

Similarly, in the following account from a university-based Associate Professor working on protein science, industry projects were only taken on if they are aligned with academic scientific goals.

“Even when I say we were collaborating with industry, it’s close enough to my research that it’s a project that I would be happy to take on even if there was no industry collaboration. I can’t say that I’ve - I’ve never done a project that was sort of at the request of industry where I wouldn’t be interested in doing it anyway.” [R3]

As well as defining the types of entrepreneurial activities that they were willing to undertake, scientists selected the industrial partners they were willing to collaborate with. Academic entrepreneurs sought collaborators who had aligned or compatible scientific goals, and scientists noted the importance of limiting industrial control over academic scientific practices. In the first account, an Associate Professor in a university engineering department sought compatibilities amongst collaborators, and avoided the imposition of industrial research demands on the research process. In the second, a university research institute based professor of genetics indicated the importance of defining expectations for their industrial collaborator in order to maintain control over research processes.

“We had very hands off partners, but in the second round, when we discussed things with partners, many of them had very specific views of what they wanted to get out of the project, and there was certainly the risk that those views would not be aligned with what we wanted to do in terms of the research. And so in some cases, we didn’t pursue the conversation because it seemed like there wasn’t much ground for coming to an agreement on this.” [R22]

“It would be very well defined exactly what they would be doing and what the expectations are. I wouldn’t want to give our reagents to some company for them to do anything they please, I’d rather have a say in what they do” [R28]

As well, the selection of entrepreneurial pursuits sometimes aligned directly with concerns about conflicts of interest, and scientists asserted an ability to select entrepreneurial activities so as to actively avoid conflicts of interest in their own practices. For example, this hospital-based cell biologist denied her involvement with
conflicts of interest by avoiding speaking engagements on behalf of a pharmaceutical company or conducting contract research. She defined these as scientifically illegitimate activities, and drew a line between these types of entrepreneurial activities and activities that are compatible with her scientific goals.

“I do not accept funds to go out and proselytize about a particular drug company, that’s not what I do, so there’s no conflict. If I’m asked, if I’m approached by a company and they say this is what we’re working on and we’re interested in some of your models, I say I’m not a contract lab…If I see an opportunity to use some of my research investigations with some of their tools and materials I might say however, this is what I’m interested in. I don’t do contract work, and I don’t tout companies for what they’ve made, so there’s no conflict” [R7]

In direct opposition to the practices advocated as being academically compatible in the previous account, the following account from a professor in an engineering department proposes that contract research is free from conflict of interest concerns. Instead, conflicts of interest were located in ownership of a spin-off company, and contracting from that spin-off. This account also demarcates a line between legitimate and illegitimate scientific conduct and this scientist designates his own practices as legitimate.

“I don’t think it’s as large a problem with people who are doing contract research for industrial partners. I think the real difficulty is particularly when a researcher is a principal in a company, and this company contracts with this individual to do the research. And then I think there’s a confusion arising between what is university, what is industrial and how the two interact.” [R4]

These accounts demonstrate that scientists sought scientific and academic credibility in their own entrepreneurial activities, and claimed to avoid conflicts of interest through their strategic navigation of types of entrepreneurial activities. These navigation strategies can thus be understood as self-directed and self-protective for academic entrepreneurs, where no cohesive set of standards for selecting specific types of entrepreneurial activities exists. Instead, scientists relied on their own references to appropriate scientific practice and conflict of interest avoidance in navigating these activities.

Overall, scientists’ discretion over the appropriate types of collaborators and types of activities were thus positioned as necessary conditions for these relationships to take
place, and sufficient conditions to protect the integrity and credibility of the science being conducted. Through appeals to the importance of alignment between entrepreneurial and academic activities, academic control over research, and the active avoidance of conflicts of interest through the selection of entrepreneurial projects, academic entrepreneurs claimed an ability to manage and incorporate entrepreneurial activities into academic scientific practice.

6.4 Organizing Entrepreneurial Activities in Academic Laboratories

As well as scientists’ discussions of selecting appropriate entrepreneurial activities, they discussed a strategic organization of the academic laboratory around entrepreneurial pursuits. These discussions also took several forms: certain scientists described processes where they actively separated entrepreneurial activities from academic activities, while other scientists stressed the importance of both of these activities occurring within the same laboratory times and spaces. Across these accounts, partitions of the laboratory were made around laboratory space, time and personnel to strategically accommodate entrepreneurial activities in various ways, and boundary strategies were used to either include or exclude entrepreneurial practices from academic practices. Throughout, scientists claimed to prioritize academic practices, norms and rewards, and that their managerial strategies could accomplish this, and thereby avoid potential conflicts of interest.

6.4.1 Combining Academic and Entrepreneurial Laboratory Activities

Where scientists denied a need to reorganize the academic laboratory to accommodate entrepreneurial activities, entrepreneurial activities were cast as routine aspects of academic laboratory work, not requiring novel modes of practice. For example, this university research institute based Assistant Professor working in molecular biology refused to take on entrepreneurial activities that would cause them to reorganize their laboratories or separate industry from academic projects.
“[Separating entrepreneurial activities] would be antithetical to the way we operate, you know. We don’t have any technicians in the lab, and as a consequence everyone helps with everyone’s project whether they like it or not. So having sort of self-contained circumscribed industry projects would just - it doesn’t fit that model.” [R13]

In the following two excerpts, entrepreneurial activities were cast as minimal, thus not requiring significant laboratory reorganization. In the first, a university-based neuroscience professor claimed to avoid any accommodations that would be required for entrepreneurial work by only taking on limited industry projects and also viewing these as relatively simple to pursue. In the second account, a physiology professor distinguished themselves from highly active academic entrepreneurs, and characterized his own entrepreneurship as minimal and manageable.

“There’s no need [to separate the research], because the industry funded research is so simple, and such a small percentage of our overall testing, that there’s really no practical requirement for any sort of firewall or any sort of separation. You know, it ends up being just a tiny fraction of what we do every day, and it doesn’t really compete for resources in any realistic way, because it’s so limited. So you know, there’s really no…there’s nothing required to accommodate it.” [R5]

“The kind of research that I do just wouldn’t lend itself to that, and there’d be no need [to separate activities], and I’m not a big time rogue company guy in that sense, I’m not continually working with people that we would need to demarcate areas or have individuals who are doing stuff that they can’t talk about to others or that kind of thing. It’s much more relaxed how it’s organized. We’re completely transparent with everyone, you know, and the secrecy agreements and whatever I sign, we always work with the technical staff in my lab to make sure they’re allowed to see whatever and they sign things themselves so that they can talk about it amongst each other if necessary, that type of thing. So I make certain that the working environment is not compromised from what has been very effective for me over the years.” [R8]

As well, entrepreneurial scientists combined academic and entrepreneurial practices in a way that allowed them to actively pursue both academic and entrepreneurial rewards concurrently. Specifically, publication planning was used, where scientists managed the accrual of both academic (publishing) and entrepreneurial (patenting) rewards. Here, academic activities and rewards were positioned as primary goals, while entrepreneurial activities and rewards were characterized as complementary, minimal pursuits. These
two hospital-research institute based scientists discussed their use of publication planning strategies.

“If it’s a collaboration, then we of course always have clauses that we’re allowed to publish after giving [the collaborator] suitable time to file patents if that’s something that they own.” [R24]

“Well publications and patents are not mutually exclusive…we actually have a paper out for review right now and we sent a big disclosure to the science and technology office and they’re looking through it…the paper’s not accepted yet, it hasn’t been presented to the public, so it’s not disclosed…you can write a patent overnight” [R2]

In these accounts of scientists’ refusals to reorganize their academic laboratories or practices to accommodate entrepreneurial activities, entrepreneurial pursuits were cast as routine and manageable aspects of academic science. This was especially true in the case of patenting, which was recognized as an increasingly routine and acceptable entrepreneurial activity, compatible if not commensurate with academic rewards. As entrepreneurial activities were characterized as aligned aspects of academic science, any accommodations or problems associated with these activities were denied, as scientists claimed an ability to maintain their academic activities alongside their participation in entrepreneurial activities.

6.4.2 Separating Academic and Entrepreneurial Laboratory Activities

Alongside these accounts that refused a demarcation or separation of academic and entrepreneurial activities, some academic scientists used similar justificatory strategies around the maintenance and prioritization of academic norms and practices to suggest the necessity of a separation between academic and entrepreneurial activities. For example, this university biochemistry professor used physical laboratory separations to manage their entrepreneurial and academic projects and to maintain a distinction between them.

“We’re in these very large multi-user labs, you know, many many benches, and so there are specific benches, and the people working on that are in one section, the people doing the other are in another section, now they talk to each other, they may share a lot of stuff, we have you know our weekly lab meetings, we interact with both, and so you know they hear what’s going on, but there is a little bit of a physical separation, and for example we have meetings where we talk just about the commercializable stuff where all the basic people don’t come.” [R19]
Temporal distinctions were another site of limiting or constraining entrepreneurial activities, and creating distinctions between academic and entrepreneurial activities. By limiting the amount of time spent on entrepreneurial activities, scientists claimed to manage the encroachment of entrepreneurial activities into academic life. For example, the first excerpt describes an imagined—and problematic—situation where an academic researcher might devote a disproportionate amount of time to entrepreneurial work, to the detriment of their academic obligations. In the second account from another university professor, a surplus of time spent on entrepreneurial activities in a way that might detract from academic obligations was cited as a potential site of conflict of interest. In these two accounts, these scientists located the potential for misconduct in the activities of other entrepreneurial arrangements that might override academic time with entrepreneurial activities.

“I can imagine where a professor devotes an abnormally large amount of time to the welfare of the company and this detracts from his ability to work as a university professor and to justify the salary that he takes from the university for that work. And if that were true, then I think there has to be some adjustment made. If the company is successful, then the professor should quit the university or go for a time and be paid by the company, then that’s a solution.” [R11]

“The only conceivable conflict of interest I can imagine is if I was doing so much contract work that I wasn’t doing my grant-funded studies, right? I mean if I was so consumed with running contract studies that studies that I, you know, was funded by the public to do didn’t get done, well that would be a real conflict of interest, I suppose, but of course you know it doesn’t even come close to happening” [R5]

Avoidance of conflict of interest was also present in other accounts of the separation of academic from entrepreneurial activities. In the following account, a junior professor of pharmacology described her separation of research spaces and resources or equipment, thereby avoiding any potential ‘conflict’.

“Well I think about it in terms of different projects, and some projects are funded by a company and are fee for service, and some projects are funded by grants and are purely academic. But I don’t really see a conflict because you know for the, we don’t have a lot of materials that go back and forth between one project and another, you know the animals or the drugs that are for the company project don’t tend to get used in the other projects, so it, we haven’t really had a problem keeping them separate.” [R12]
In these strategies to separate or demarcate entrepreneurial activities from academic pursuits, scientists expressed a confidence in their own ability to manage entrepreneurial activities and avoid industrial encroachment within their academic laboratories. They acknowledged the potential for conflicts of interest, and located these in other entrepreneurial arrangements, but also positioned these as manageable through their laboratory navigation activities.

6.4.3 Personnel Distinctions: Shielding Academic Trainees

As well as these laboratory-partitioning strategies, personnel distinctions played a particularly prominent role in the organization of the entrepreneurial laboratory. Notable here was the shielding of academic research trainees from most entrepreneurial activities, and the use of research technicians in their place. In the following accounts, entrepreneurial PIs maintained that trainees ought to be protected or separated from most entrepreneurial pursuits, as these were seen to be incompatible with or antithetical to academic training benchmarks and rewards.

Entrepreneurial science was described a having stricter and shorter timelines than those in academic science, uncertain funding trajectories, less scope for academic freedom, and problematized for placing limits on trainees’ abilities to speak publicly about their research or publish. In the first account below, a cancer geneticist in a hospital research institute discussed the importance of trainees’ academic freedom, and how entrepreneurial activities might constrain this. The second account from a stem cell scientist at a hospital research institute indicates the problem of secrecy and the duration of entrepreneurial projects for trainee progression.

“You want a PhD student or a Masters student to have complete freedom as to what to follow and what not to follow. Usually if you get involved in one of these [entrepreneurial] projects, it’s very narrow; the definition of what this project is about is very narrow. Sometimes you’ve got to follow your curiosity if something unpredictable happens or any unexpected results, you are much more restrained, you know, and therefore I would not put a student working on any of these projects, no.” [R25]

“To alleviate a potential problem, not necessarily an actual problem, that if [a student’s] thesis was 100% a company project, it’s conceivable that they could
have trouble writing their, submitting their thesis if the company claims that it’s confidential information let’s say. You know what I mean, it’s a potential problem so it’s prudent to let a student have their own project which is not the research agreement. Also frankly, research agreements are short duration, typically a year, six months or a year, maybe 18 months and you know easy come easy go … It’s not wise for a graduate student or PhD student that’s going to be in the lab for 5 years to find out after a year that he has no funding for this particular project.” [R17]

To shield or separate trainees and their work from industrial timeline demands and publication or presentation limitations, research assistants or technicians were used in their place. These members of the academic laboratory were not seen to be subject to the same intellectual constraints and timelines as academic trainees. Technicians were used as substitutes to undertake entrepreneurial work, where it was thought that their primary role was not academic, but indeed technical. These two PIs relegated industrial collaborations to research technicians because of the detriments of entrepreneurial activities on trainee progression and development. As well, in the second account, the activities of other scientists are problematized for asking their graduate students to hold both academic and entrepreneurial roles.

“In terms of students, if the aspect of the research is specifically focused on a relationship with industry, then I will try to have a research assistant or somebody like that do that portion of the research so it doesn’t affect students so much…Because students have to, you know, submit abstracts and publish and so on, and they’re time limited in their PhDs or their Masters degrees. They want to finish and get out so they don’t want to be there forever waiting for some specific result, and we can’t publish anything, so I try not to have that impact the training to an extent” [R1]

“Some of my colleagues have had researchers sort of wearing two hats or graduate students who end up wearing two hats, one at the university and one private, but I’ve tried to keep them separate and the way I do that is by having employees that do the development work and graduate students do the research and testing.” [R14]

Similarly, this junior genetics professor avoided the blurring of boundaries between trainee and technician activities where this would limit trainees’ publications.

“So again, that’s another reason why we wouldn’t sign up for a collaboration that would limit publication, because then the student is transformed into a technician.” [R13]
While still maintaining a distinction between the scholarly work of academic trainees and industrial projects, some PIs used strategies to separate or limit the time commitments of their trainees on these projects, yet still allowed them to participate in them. The first professor allowed trainee participation in entrepreneurial activities where there were no limits on trainee publications or other interruptions to their thesis work, and in doing so, they claimed to avoid potential conflicts of interest. They also suggested that trainees might be able to participate in entrepreneurial activities so long as they were not detracting from their scholarly activities. The second account from a junior professor recounted using a trainee in an entrepreneurial pursuit out of necessity, and questioned the ethical appropriateness of this.

“But our number one job with our graduate students is to make sure that the work that they perform can be published in their thesis and in the peer-reviewed literature and they focus their major activity on doing that. But if you want to hire them to do work in your company and that work can either be published or put in their thesis, then there’s no conflict there, or if you’re not taking so many hours, maybe you could hire them on a Saturday afternoon to work for you, that would be time that they would probably not be working in the lab on their own thesis research, and not depriving them of getting their thesis done in a timely fashion, I think that would be appropriate as well.” [R11]

“So, just one example is the company work is almost always done by the technician and a research associate, but we had one project where we needed a third person involved to apply the drug, because it was just a really complicated exam, so we needed a third person, so one of the students did it, and it ended up taking a couple weeks out of their time for their own research. But at the time, you know, I was struggling to support them, so I felt it was acceptable, and they agreed. So I don’t know if that’s like a ethical grey area or not?” [R12]

For a minority of PI’s, however, and in the case of some entrepreneurial activities, trainee participation was encouraged rather than avoided. These PIs spoke of the importance of trainee participation in certain entrepreneurial activities, especially where the trainee might benefit intellectually, or generate academic rewards from participating in entrepreneurial activities. The first account from a cell biologist demarcates entrepreneurial activities that would enhance trainee development from those that would detract from it. In the second excerpt from a physiology professor, patents were cast not only as entrepreneurial activities, but also as academic activities that were commensurate with publications for trainees that would positively benefit trainees.
“So there’s sort of two extremes there, one where it’s an intellectual exercise, it’s part of the student’s thesis and another where it’s really a dumb thing to do that it’s assembly line, process, and therefore I would get a technician to do it.” [R27]

“If the student gets her or his name on a patent, in the appropriate position, and I think that’s very good. It’s equal to a publication in our field, or the credit can be.” [R11]

PIs thus asserted that trainees ought to be shielded from the majority of entrepreneurial activities, except where this might benefit the trainee. These PIs thus recognized the potential for conflicts of interest or commitment in their trainees, and prioritized trainees’ academic pursuits, while technicians did the entrepreneurial work.

6.4.4: Trainee Experiences

This shielding of trainees from entrepreneurial activities was echoed by most trainee interview respondents, where they had little knowledge of entrepreneurial pursuits and little exposure to these activities, as discussed in Chapter 4. A few trainee accounts were notable: in these cases, academic trainees had participated in entrepreneurial science, and discussed the organization of their academic training with entrepreneurial activities. Of particular interest was one trainee studying stem cell science based in a hospital research institute, who managed both entrepreneurial and academic activities in the course of their PhD. He was influenced by the demands of an academic system, while maintaining an interest and involvement in entrepreneurial activities. Here, he described managing an entrepreneurial project, including constraints on disclosure, alongside his roles and responsibilities as a PhD student.

“So I have a main project which I use for my committee meetings and I can go to conferences and give presentations and I’ll be publishing. But I have a side project where we’re working on something that no one really knows about. We bring in collaborators confidentially to help us out with things when we get stuck, but we realize that once we disclose we lose - so for example if I publish an abstract at a conference with this other project, then the clock starts ticking right at that moment, that’s essentially disclosure, so I’ve got a year to patent it in North America, and I essentially give up the right to patent it in many other countries. So, that’s why if we want to be able to have world wide patents on this type of thing, I can’t tell you anything about it, I can’t disclose it at a conference, I
can’t even show my committee …So it’s not easy as a PhD student to work on this type of project because you could be delaying your own graduation.” [R16]

He demonstrates a strategic balancing and management of both meeting academic benchmarks, like disclosure, publications and committee meetings, while also participating in entrepreneurial work, and was confident in his ability to control these dual demands. He went on to discuss how his time was allotted between academic and industrial projects. He thus demonstrates an awareness of the academic metrics that he must meet or reach; yet had managed his work so that he could accomplish these ends and still work towards pursuing an entrepreneurial project.

“I would just say over the last couple of years, it’s worked out to fifty-fifty, but I might work for a month or two steady on one and then let someone else handle the next part of that project and then go back to working on mine. So the main thing is as a PhD student, you’ve gotta have committee meetings regularly, so within a six month period of time, I’ve got to make sure that I spend at least three solid months working on my primary project, so I can’t work too long on that other project regardless of how exciting things are getting, because I still need to continue to show progress.” [R16]

Overall, these accounts demonstrate that trainees occupy a precarious role with respect to entrepreneurial activities, where they were shielded from most entrepreneurial activities by their PIs, occasionally encouraged to participate in patenting activities, and often uncertain about how to manage these activities amongst their academic obligations. For the most part, PIs claimed to avoid placing their trainees into entrepreneurial scientific roles that might compromise their academic activities, and entrepreneurial trainees themselves echoed this requirement of prioritizing academic activities.

6.5 Analysis and Discussion

This chapter examines the ways in which academic scientists explain the organization and division of their academic laboratories around entrepreneurial practices. Through their descriptions of the types of entrepreneurial projects to pursue, and decisions around the organization of these activities within academic laboratories, entrepreneurial PIs asserted their agency and control over the practices of entrepreneurial science, and the alignment of academic and entrepreneurial activities. This alignment was established
either through the routinization and convergence of academic and entrepreneurial activities in academic laboratories, or the maintenance of a boundary between the two, where academic values could be protected alongside the practices of entrepreneurial science. As academic entrepreneurs asserted that entrepreneurial activities could be adequately managed in academic laboratories, and conflicts of interest could be avoided, they claimed the legitimacy of these activities as academically-aligned and manageable pursuits. As a site of institutional work, the academic laboratory was actively negotiated, where scientists drew on academic norms and logics in their entrepreneurial activities, and claimed an ability to avoid conflicts of interest in their own practices in order to legitimate entrepreneurial initiatives. While the previous chapter demonstrated where entrepreneurial scientists legitimate the value of entrepreneurial activities through claims about the maintenance of academic norms, this chapter examines how scientists cast these activities as routine, manageable and legitimate scientific pursuits through claims of academic alignment and conflict of interest avoidance.

Primary in these diverse strategies to manage entrepreneurial activities within academic laboratories was PIs’ assertion of their agency and control over these activities. Through their descriptions of selecting appropriate and scientifically compatible entrepreneurial activities and collaborators, as well as their claimed ability to discern and manage entrepreneurial activities in their laboratories, PIs asserted their capacity to control these activities, and differentiate appropriate or legitimate arrangements from inappropriate ones. Through these assertions of control, scientists claimed discretion over the practice and oversight of entrepreneurial activities, and claimed to do so in a way that would not negatively impact their laboratory operations. In doing so, entrepreneurial scientists defended their ability to determine the directions of entrepreneurial research, and determine the operations of these activities in their academic laboratories. As such, even the subtle effects of commerce in the academic laboratory (Kleinman, 2003) were deemed to be manageable through these exercises of control and discretion.

The protection of academic trainees from most entrepreneurial activities reinforced the importance of agency and control, where entrepreneurial activities were seen to be out of
the control of academic trainees as junior scholars with little power and agency in the academic research enterprise. As such, trainees were shielded from entrepreneurial activities out of concern that these would interfere with their academic demands, and only allowed or encouraged to participate in them when they could enhance their academic careers. This separation or boundary between the academic activities of trainees and entrepreneurial activities reinforced the distinction of an entrepreneurial logic, and maintained that academic pursuits ought to be prioritized over entrepreneurial ones. As well, entrepreneurial activities were positioned as pursuits to be undertaken by experienced scientists who are presumed to be in control of their research environments, while those with little control over their research laboratory were required to prioritize academic pursuits. Entrepreneurial PIs’ accounts of the shielding of their trainees thus position entrepreneurial activities as pursuits that only agents who could control their academic research worlds ought to pursue, and as such, PIs recognized the potential for conflicts of interest in placing their trainees into entrepreneurial positions (MacDonald & Williams-Jones, 2009).

Through this assertion of control in the management of entrepreneurial activities, entrepreneurial PIs claimed an ability to discern and select entrepreneurial arrangements that were aligned with their academic goals and practices, and thus claimed a compatibility between academic and entrepreneurial activities. For example, their selection of entrepreneurial projects was guided by an alignment between the demands of industrial collaborators and PIs’ scientific interests, as well an alignment of academic and entrepreneurial rewards. As well, entrepreneurial activities were sometimes cast as minimal and routine aspects of laboratory practice, where these did not require any specific accommodations within academic labs. Through the use of strategies like publication planning, scientists claimed an ability to reap both academic and entrepreneurial rewards concurrently, and found compatibilities in these activities.

This alignment between academic science and entrepreneurial science was most prominent in their descriptions of the role of patenting. As patenting becomes increasingly academically recognized and routine, patents were viewed as commensurate
with academic rewards, both in PIs own practices and in that of their trainees. This corroborates survey data indicating patents are the most normatively acceptable entrepreneurial activity, where they are understood as an extension of academic science. Overall, through assertions of alignment with academic activities, entrepreneurial activities were cast as routine laboratory practices that were compatible with academic science. The casting of entrepreneurial science as routine and aligned with academic science thus served to legitimize entrepreneurial activities as academically-compatible pursuits.

Similar to Atkinson-Grosjean’s study (2005), entrepreneurial scientists in this study simultaneously occupied the worlds of commerce and the academy, and claimed an ability to manage conflicts of interest. Entrepreneurial PIs tended to adopt an ‘entrepreneurial ethos’, and sought compatibilities between academic and entrepreneurial values when undertaking entrepreneurial activities (Crespo & Dridi, 2007). Academic entrepreneurs thus aligned the worlds and practices of academic and entrepreneurial science and claimed these to be commensurate or convergent (Colyvas & Powell, 2006). As such, entrepreneurial activities were cast as academically aligned, routine, pursuits, and academic entrepreneurs asserted that they could arbitrate between legitimate and illegitimate activities based on these alignments. Understood as strategic mechanisms to legitimize entrepreneurial activities, these compatibilities and convergences were proposed to allow the co-occurrence of academic and entrepreneurial practices without a need for significant reorganization of the academic laboratory.

A connected laboratory management strategy relied on scientists’ proposed ability to maintain a boundary between academic and entrepreneurial activities. Through the assertion and maintenance of this boundary, they claimed that academic and entrepreneurial activities could co-occur in laboratory spaces without interrupting the practices of the academic lab. These boundary maintenance strategies were prominent in entrepreneurial PIs discussions of the maintenance of temporal boundaries around entrepreneurial activities, where the use of an excess of academic time on entrepreneurial activities was associated with conflicts of interest and improper academic conduct. These
boundaries were also prominent in PIs’ shielding of academic trainees from entrepreneurial activities. In the place of trainees, laboratory technicians were often used to do entrepreneurial work. Historically, lab technicians were considered the physical labour of the scientific lab, and as distinct to knowledgeable and technically skilled academic agents (Shapin, 1989). To maintain the boundary between academic and entrepreneurial practice, technicians undertook the labour of entrepreneurial activities, while trainees were encouraged to adhere to academic pursuits.

Corroborating the boundary-maintenance suggested in Tuunainen’s work, entrepreneurial scientists created and enforced boundaries to protect domains of academic practice. These boundary-strategies delimited what academic entrepreneurs determined to be legitimate entrepreneurial practices, and allowed entrepreneurial PIs to be the arbiters of these boundaries. This maintenance of boundaries spoke to concerns about the overtake of academic science with entrepreneurial activities, and as such, maintained a distinction between these types of activities. However, the boundaries between academic and entrepreneurial science were positioned as being sufficiently discernable and manageable by entrepreneurial PIs. Through the maintenance of these boundaries, entrepreneurial activities were legitimised as activities that could occur within academic laboratories, so long as they were adequately managed and did not encroach upon academic activities.

Assertions of agency and control, claims of alignment between academic and entrepreneurial goals, and claims of the maintenance of a boundary between academic and entrepreneurial activities also acted as conflict of interest avoidance strategies in scientists’ managerial accounts. Through scientists’ proposed ability to maintain the priority of academic science, either through alignment initiatives with academic activities or through the maintenance of the boundary between the two, they asserted their own ability to avoid conflicts of interest. Through entrepreneurial PIs’ proposed ability to select the nature and conduct of their entrepreneurial activities, they claimed an ability to foresee and avoid any potential harms deriving from these activities. Entrepreneurial scientists thus recognized that entrepreneurial activities had the potential to entail certain harms, yet deflected these to other scientific practices and other scientists.
Entrepreneurial scientists’ laboratory organization strategies thus cast the potential harms of entrepreneurial science, usually related to conflicts of interest, as knowable, manageable and avoidable through the discretion of individual academic scientists.

The accounts in this chapter indicate a range of practice variation in claiming the avoidance of conflicts of interest. As such, entrepreneurial scientists drew ethical boundaries around their own conduct, yet located the potential for conflicts of interest in the entrepreneurial arrangements of others. In doing so, they designated their own activities as legitimate through the designation of a series of inappropriate activities in less-ethical others (Brosnan et al, 2013; Wainwright et al, 2006). Conflict of interest avoidance thus became an organizing and legitimizing principle for entrepreneurial scientists, as they noted the potential for this problem in the activities of others and legitimized their own entrepreneurial pursuits through claims to avoid these situations.

This conflict of interest avoidance also served as a tool in the institutional work to cast entrepreneurial science as routine and manageable. By claiming that conflicts of interest were avoidable, and that entrepreneurial scientists were the appropriate arbiters of managing this avoidance, they designated their entrepreneurial activities as legitimate. Through claims that the line between academic and entrepreneurial institutional logics was manageable, and that discerning academic scientists were the appropriate arbiters of this line, PIs’ engagements with entrepreneurial science were legitimized. As such, conflict of interest avoidance strategies were not only self-protective mechanisms for entrepreneurial scientists in their own practices, but also legitimized scientists’ exercises of discretion and management in conducting entrepreneurial activities.

From these accounts of the strategic organization of the academic laboratory to select and negotiate entrepreneurial activities, I demonstrate how scientists generate legitimacy in entrepreneurial pursuits through appeals to academic norms. Through claims that academic activities and rewards can be aligned with entrepreneurial activities, and that potential conflicts of interest can be foreseen and avoided, legitimacy is asserted in the practices of entrepreneurial science. This was accomplished through casting
entrepreneurial activities as routine and non-invasive aspects of doing academic science, as well as scientists’ claims to maintain a boundary between the two to prioritize academic activities and avoid potential conflicts of interest. Table 6.1 demonstrates the ways in which academic claims are maintained alongside entrepreneurial claims in scientists’ descriptions of the organization of the entrepreneurial laboratory, and how these appeals to academic norms act as an instance of institutional work to legitimize the practice of entrepreneurial science.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Entrepreneurial Claims</th>
<th>Academic Claims</th>
<th>Institutional Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selecting Entrepreneurial Pursuits</td>
<td>- Entrepreneurial rewards (patents, lab income)</td>
<td>- Alignment between academic and entrepreneurial goals and rewards</td>
<td>- Establishment of agency and control over entrepreneurial activities and directions</td>
</tr>
<tr>
<td></td>
<td>- Shared goals (trust relationships)</td>
<td>- Academic control over activities</td>
<td>- Assertion of alignment between academic and entrepreneurial activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Avoiding COI</td>
<td></td>
</tr>
<tr>
<td>Combining academic and entrepreneurial activities</td>
<td>- Entrepreneurial work is routine scientific practice</td>
<td>- Entrepreneurial activities are routine or minimal</td>
<td>- Assertion that the boundary between academic and entrepreneurial activities can be managed</td>
</tr>
<tr>
<td></td>
<td>- Academic and entrepreneurial goals can be reached</td>
<td>- Similarities/convergence between academic and entrepreneurial activities</td>
<td></td>
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<tr>
<td></td>
<td>simultaneously</td>
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<td></td>
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<tr>
<td>Separating academic and entrepreneurial laboratory activities</td>
<td>- Co-occurrence of industrial and academic activity, but separation is required</td>
<td>- Prioritizing academic activities</td>
<td>- Conflicts of interest can be foreseen and avoided</td>
</tr>
<tr>
<td></td>
<td>- Harms are knowable, manageable, and avoided</td>
<td>- Setting limits on industry</td>
<td>- Institutional change through the inclusion of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- COI avoidance</td>
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</table>
Trainee Distinctions

- Trainee involvement in patenting as reward/experience/fairness
- Protect academic freedom, freedom to publish
- Facilitate academic control over research
- Trainees as academic agents
- Patenting as academic reward

entrepreneurial activities as routine and manageable lab practice, alongside maintenance of academic norms and perceived control and management of entrepreneurial practices

Table 6.1: Institutional work and the organization of academic laboratories

Through claims of the maintenance of academic norms alongside entrepreneurial practices, and entrepreneurial scientists’ ability to manage and avoid potential conflicts of interest, they engage in a process of institutional change-through-maintenance through their conduct of entrepreneurial activities. Through the recalling of academic norms, entrepreneurial activities are cast as routine, manageable aspects of academic scientific practice, where harms are knowable and avoidable. These legitimizing strategies thus cast entrepreneurial activities at large as manageable and legitimate scientific activities, and cast entrepreneurial scientists as the appropriate arbiters of controlling and managing these activities.

Taken together with the findings in the previous two chapters, I have argued here that academic entrepreneurs assert their agency and ability to reap the benefits of entrepreneurial activities, manage these as routine scientific activities in their academic labs, and claim to protect against potential harms through appeals to the maintenance of academic norms. These academic norms sustain and legitimize entrepreneurial conduct, and facilitate the inclusion of entrepreneurial practices into academic science by way of assurance that entrepreneurial activities can be managed by academic scientists, and as such do not pose novel concerns for the academic research enterprise. Through claims that entrepreneurial scientists are in control of and are appropriate arbiters of ethical and legitimate entrepreneurial practice, they designate entrepreneurial activities as academically aligned and manageable. Through the boundary they impose between trainees and most entrepreneurial activities, they maintain that legitimate entrepreneurial practice requires experienced, agentic actors to navigate these pursuits and prioritize the
maintenance of academic activities when actors cannot. As institutional workers with influence over the academic research enterprise, entrepreneurial PIs engage in activities to generate legitimacy and credibility in entrepreneurial activities as both self-justifying mechanisms, and as instances of normative change in academic research practice at large.
Chapter 7

Conclusion

7.1 Summary

Academic biomedical scientists’ participation in entrepreneurial activities has been increasing, and a large, diverse body of scholarship has addressed factors, attitudes, and norms associated with these initiatives (Grimaldi, Kenney, Siegel, & Wright, 2011; Landstrom, Harirchi, & Astrom, 2012; Rothaermel, Agung, & Jiang, 2007). While this scholarship has addressed the actions and participation of academic scientists in entrepreneurial activities and usually used the case of biomedicine or the life sciences, little of this scholarship has directly addressed the health-research orientations and implications of academic entrepreneurship in the biomedical sciences by linking this literature with scholarship on conflicts of interest. As policy initiatives incent entrepreneurial activities in the biomedical sciences in Canada (Brimacombe, 2005; Industry Canada, 2007; CIHR, 2009; Jenkins et al., 2012; Metcalfe, 2010; Rasmussen, 2008), this study provides an empirical analysis into the values and practices of academic biomedical scientists, and examines how academic entrepreneurs engage in normative processes to re-shape domains of academic scientific practice, and work to legitimize entrepreneurial activities.

This study thus both links together interrelated but largely independent bodies of literature on the facilitators, processes and proposed health-related harms of academic entrepreneurship, and examines how scientists interact with the potentially conflicting norms and logics of academic and entrepreneurial science. In particular, this study is attentive to the context of health innovation in the biomedical sciences, the role of individual norms, values and practices in responding to and transforming institutions, and provides insights into the state of academic entrepreneurship in Canada. Through a detailed mixed-methods study of academic biomedical scientists in Canada, this study provides unique insights into the values of academic scientists in relation to
entrepreneurial activities and related conflicts of interest, and examines how it is that academic entrepreneurs initiate the legitimization of entrepreneurial initiatives through their normative values and activities, in an environment where multiple logics prevail, and the direction of change is in flux.

Using an institutional work approach, I examine how entrepreneurial scientists navigate the institutional logics of academic and entrepreneurial science in order to designate legitimate scientific conduct. The findings of this study suggest that entrepreneurial scientists initiate an institutional work process of change-through-maintenance, where appeals to the alignment and maintenance of academic norms and practices serve to legitimize entrepreneurial activities, and where entrepreneurial scientists claim that these two institutions, norms, and sets of practices can co-exist. As entrepreneurial scientists actively create legitimacy in academic entrepreneurship, and deflect concerns about conflicts of interest, this study also assesses how conflicts of interest shape the legitimacy of entrepreneurial science in the context of biomedicine, and are embedded into scientists’ norms and practices.

The three analytic chapters of this dissertation examine three distinct but interrelated domains. Chapter 4 provides the grounding for this study by empirically examining the institutional logic of entrepreneurial science, the credibility of related conflict of interest concerns, and factors associated with Canadian academic biomedical scientists’ participation in entrepreneurial activities. These analyses attend to emerging calls for empirical evidence on the institutional logics of entrepreneurial science (Sauermann & Stephan, 2013), and indicate that academic entrepreneurship remains as a largely distinct logic for academic scientists. Following Sauermann and Stephen, this study indicates that academic and entrepreneurial logics are also heterogeneous and both differ and overlap across many axes. As well, the survey data indicate that scientists are somewhat concerned about the effects of industry engagements in scientific practice, but decouple these concerns from their downstream impacts. Finally, an analysis of factors associated with scientists’ participation in entrepreneurial activities indicates that academic entrepreneurship is associated with scientists’ value orientations as well as their academic
laboratory features and resources. This demonstrates a mixing or overlap between the logics of academic and entrepreneurial science for increasingly entrepreneurial scientists. These findings thus locate an institutional environment where there is some overall skepticism about academic entrepreneurship, as this remains a largely distinct institutional logic to academic science. In this environment, academic entrepreneurs are positioned as active agents in shaping their research environments and designating new domains of legitimate scientific practice.

Chapter 5 draws on this normative distinction between academic and entrepreneurial science and focuses on the qualitative sample of entrepreneurial PIs as agentic institutional workers in generating normative value and legitimacy in entrepreneurial science. Drawing on studies of scientists’ motivations for engaging in entrepreneurial activities (Baldini, Grimaldi, & Sobrero, 2007; Fini, Grimaldi, & Sobrero, 2009; Lam, 2011; Owen-Smith & Powell, 2001), this chapter examines why academic entrepreneurs engage in entrepreneurial activities, and in turn, how they generate positive normative value and legitimacy in these pursuits. Entrepreneurial PIs claimed positive value in entrepreneurial activities for their ability to contribute to scientific practices through the provision of financial resources and intellectual research directions. They also positively valued entrepreneurial activities for their ability to generate downstream benefits to society, and to contribute to translational research agendas through the generation of clinical and health impacts. They simultaneously claimed the importance of academic norms such as academic freedom, curiosity-driven research, and academic disinterestedness in the products or outcomes of research. Despite valuing proximity to the clinic in their valuations of academic entrepreneurship, they claimed a distance from the clinic in the face of concerns about conflicts of interest. Entrepreneurial scientists thus work to generate scientific legitimacy in entrepreneurial activities as an expansion of legitimate academic scientific practice and do so through appeals to the maintenance of academic norms and logics, and the distance of basic biomedical scientists from conflict of interest concerns. These appeals to the comingling of academic norms with entrepreneurial logics serve to legitimize entrepreneurial science as an increasingly academic pursuit.
Chapter 6 draws on the findings of the previous two chapters by qualitatively examining how academic entrepreneurs generate legitimacy in entrepreneurial activities through the organization of their laboratory practices. The institutional work here is demonstrated in scientists’ strategic organization of entrepreneurial activities in academic laboratories, and how they manage conflicts of interest. Entrepreneurial scientists engaged in a diverse array of spatial, temporal and personnel distinctions to navigate entrepreneurial activities in their labs. Through these managerial strategies, they claimed their agency in controlling these activities, and also claimed both compatibilities between entrepreneurial and academic activities, as well as the maintenance of boundaries between these domains, and as such, an ability to avoid conflicts of interest in their practices. Through this routinization and co-occurrence of academic and entrepreneurial activities in academic laboratories, entrepreneurial pursuits were cast as legitimate and manageable aspects of doing academic science, where conflicts of interest could be foreseen and avoided. The importance afforded to the shielding of trainees from many entrepreneurial activities reinforced findings from Chapter 4 that entrepreneurial science remains a largely distinct logic to academic science, and establishes the importance of assertions of control and agency over entrepreneurial activities. As such, this chapter adds to studies of the organization of academic laboratories around entrepreneurial activities (Atkinson-Grosjean, 2005; Kleinman, 2003; Tuunainen, 2005a, 2005b; Tuunainen & Knuutila, 2009), and indicates entrepreneurial scientists’ active pursuits of the legitimacy of entrepreneurial activities in their day-to-day laboratory practices. Similar to how valuative claims about the benefits of academic entrepreneurship are used to legitimate these pursuits, the institutional work done here involves the recalling and maintenance of academic norms and practices for the purpose of legitimizing entrepreneurial activities.

Taken together, this study of publicly-funded academic biomedical scientists in Canada demonstrates institutional work processes of change-through-maintenance, where norms and practices of academic research are recalled and used to legitimate domains of entrepreneurial science. Similar to findings from other settings, actors make strategic calls to multiple and often competing logics, and engage in a comingling of diverse institutional logics (Popp Berman, 2012; Smith-Doerr, 2005). In doing so, the proposed
competing elements of the institutional logics of academic and entrepreneurial science are framed as being complementary (Hargrave & Van de Ven, 2009), and multiple and potentially contradictory institutional logics are exploited to both maintain and change institutions (Bjerregaard & Lauring, 2012). This comingling of logics is understood as strategic, and aimed at carving out scientific legitimacy for entrepreneurial science, both in the value these pursuits add to academic science, and also in demarcating legitimate forms of scientific activities through the management of the academic laboratory. This study also brings forward the importance of health claims in scientists’ normative valuations of their entrepreneurial pursuits (Lehoux et al., 2014), and is attentive to how ethical concerns, especially those about conflicts of interest, can shape laboratory practices (Brosnan et al., 2013; Hobson-West, 2012; Wainwright et al., 2006). Yet this study also indicates a precarious relationship between these health claims and claims about conflicts of interest, where entrepreneurial scientists both value and forecast the health implications of their research, and also distance from clinical settings in the context of conflict of interest concerns.

Though scientists engaged in institutional work processes to generate legitimacy in entrepreneurial pursuits, entrepreneurial activities were not generally taken for granted within the academic research enterprise, and as such have not been fully institutionalized (Colyvas & Powell, 2006; DiMaggio & Powell, 1983). As entrepreneurial science is maintained as a mostly distinct institutional logic to academic science amongst researchers at large, entrepreneurial scientists make strategic ongoing appeals to the maintenance of academic norms and practices to justify and legitimize entrepreneurial activities. This is indicative of a time of institutional uncertainty, where the overall direction of institutional change is not confirmed, and agentic entrepreneurial scientists interact with institutional contradictions to legitimate action (Seo & Creed, 2002). As entrepreneurial scientists make ongoing efforts to legitimize these pursuits in an environment of institutional uncertainty, and as academic biomedical research moves towards clinical and health applications, this study provides unique insights into how these legitimization processes are unfolding, and how the potential consequences and impacts of these processes are being managed and understood.
7.2 Theoretical and Methodological Contributions

This social scientific examination of how academic biomedical scientists in Canada value entrepreneurial activities and how academic entrepreneurs create legitimacy in these initiatives demonstrates several theoretical and methodological contributions. Firstly, as an interdisciplinary piece of scholarship, this study uses social scientific methods to examine a domain of health and research policy and ethics. As the study of academic entrepreneurship, and its multivariate benefits and harms, has spanned many disciplines, this study brings these diverse perspectives into conversation. As such, this study highlights a complex series of phenomena where innovation and policy studies, bioethics, and science and technology studies contribute diverse and meaningful aspects to understandings of academic entrepreneurship.

As well, this study empirically examines many of the assumptions upon which much of this diverse literature is predicated. Specifically, this study examines the assumption that entrepreneurial science constitutes a distinct institutional logic to academic science by examining Canadian academic biomedical scientists’ normative attitudes towards these activities. Also, through examining agreement to commonly cited implications of conflicts of interest in biomedical research, this study examines their credibility and resonance with scientists who themselves may face these situations. These constructs were not taken for granted in the design of this study, but instead treated as objects of inquiry that inform an overall examination of academic scientists’ interactions with entrepreneurial science and conflict of interest concerns.

Conceptually, through the use of theories of institutional work, this study advances scholarship in a relatively new and emerging domain of neo-institutional theory. As institutional work examines the workings of institutions on the ground, as actors create, maintain, and disrupt institutions (Lawrence, Suddaby & Leca, 2009), this study provides an empirical investigation of these initiatives at the normative level, in an institutional environment of divergence, heterogeneity and uncertainty. By studying micro-level processes that occur in the values and activities of academic entrepreneurs, this study
examines institutional change as a dynamic and on-going process that is often without a clear direction (Lawrence, Suddaby, & Leca, 2011). This study thus combines an institutional work analysis of the generation of institutional legitimacy in the re-shaping of norms of scientific practice, with an examination of understandings of academic and entrepreneurial logics, and how these interact with and reshape each other. This answers calls to bring together theories of institutional logics with theories of institutional work, while also demarcating a boundary of each conceptual approach in order to provide a more complex view of institutional processes (Zilber, 2013). In doing so, this study empirically establishes the varied and divergent nature of entrepreneurial science, and also examines the institutional labour of normative navigation between the logics of academic and entrepreneurial science. Though this research is speculative of the direction of institutional change towards the legitimization of academic entrepreneurship, it does not establish institutional change or institutionalization. Instead, I examine how agents can participate in institutional change processes through values, norms, and the recalling of multiple logics in the active legitimization of their pursuits.

Relatedly, this study makes a significant methodological contribution to studies of academic entrepreneurship, and demonstrates the importance of a mixed-methods and cross-sectional design. In utilizing both a survey instrument and qualitative analyses of semi-structured interviews with academic entrepreneurs as key informants, this study was able to capture a cross-section of attitudes towards academic entrepreneurship, as well as provide an in-depth picture of how entrepreneurial scientists describe and act to legitimize the conduct of their entrepreneurial activities. In interviewing individuals across organizational settings, I was able to examine commonalities as well as differences in these individuals and their legitimization strategies and valutative claims about academic entrepreneurship. Finally, the iterative nature of qualitative research allowed for further sampling of populations of interest, and in this case allowed for additional interviews with academic trainees in light of PI’s claims about the shielding of trainees from entrepreneurial activities.
7.3 Implications for Health Research Policy and Ethics

This use of social scientific theories and methodologies in the examination of the legitimization of entrepreneurial activities in academic biomedical science provides an empirical examination of an issue of bioethics and health policy concern and debate. In providing an in-depth understanding of how collaborations between industry and academic scientists and the commercialization of academic research are proceeding in upstream biomedical spaces, and how conflicts of interest are understood and managed in this context, this study provides the foundation for normative analyses and regulatory interventions that are attentive to how scientists navigate these research worlds.

To date, the processes of basic biomedical science have been relatively under-regulated and underexplored in the bioethics literature. While much attention has been afforded to biomedical innovations or technologies themselves, much less has examined the upstream processes of innovation, and how entanglements with private and proprietary interests might affect academic, publicly-funded science in upstream biomedical spaces. Despite much attention being granted to industrial and commercial engagements and interactions in the clinical domain, little ethics and regulatory attention has been given to these in basic biomedical research. This study thus highlights a need for bioethics scholarship to engage with issues in health research and innovation in upstream scientific practice, where the foundations of medical innovations are being discovered and promoted. Given increased attention to closer linkages between developers, innovators, and researchers in upstream biomedical science and downstream clinical practice (Dzau et al., 2010; Dzau, Yoediono, ElLaissi, & Cho, 2013), interactions between academic scientists and industry in these upstream spaces hold important conflict of interest implications. As such, this study calls for examination of the governance of financial conflicts of interest in upstream basic biomedical research as entrepreneurial arrangements legitimize connections between basic biomedical scientists and the clinic.

To begin an ethical and policy conversation about the understandings and management of entrepreneurial activities and their associated potential for harms in academic biomedical
science, this study examines how entrepreneurial scientists can catalyze change in their academic research environments through the legitimization of entrepreneurial activities. An aspect of this institutional work was the assertion of scientists’ location as arbiters of what makes for good scientific practice and what makes for conflict of interest avoidance. Conflicts of interest were actively denied by academic scientists, both in their applicability to spaces of biomedical science, and also through their laboratory organizational practices. Yet conflicts of interest also served as an organizing principle in the navigation of entrepreneurial activities in academic laboratories as scientists actively negotiated their practices to avoid potential conflict of interest, but recognized these conflicts in the activities of others. Though entrepreneurial scientists tended to deny and offload conflict of interest concerns, conflicts of interest are inherently embedded into their entrepreneurial practices through concurrent commitments to commercial, industrial and academic science (Emanuel, 2007; Lemmens & Luther, 2008; Porter, 1992).

Similar findings of scientists’ denial or avoidance of conflicts of interest have been found in other settings and amongst other groups of scientists. As examined in the review of relevant studies in Chapter 2, academic scientists or clinicians who hold ties to industry, tend not to recognize the potential for conflicts of interest in their own research, and tend not to disclose these ties (Campbell, Moy, Feibelmann, Weissman, & Blumenthal, 2004; Choudhry, Stelfox, & Detsky, 2002; Okike, Kocher, Wei, Mehlman, & Bhandari, 2009). Indeed, scientists engage in a decoupling of their research practices with ethical concerns, where these are found to be divorced from their everyday scientific practices (Smith-Doerr, 2008). Instead, they tend to rely on their own discretion and self-regulation in managing these relationships (Boyd, Cho, & Bero, 2003), and delineate their own scientific practices as ethical and manageable (Wainwright et al, 2006). Rather than relying on this self-regulation and discretion, these studies call for a need to develop and institute policies that recognize scientists’ positionality as agents who may indeed exercise discretion in their research engagements, but also to recognize the multivariate ways that entrepreneurial influences can shape research practices, often without recognition of the researcher.
The distancing of scientists from a belief in the validity of conflicts of interest in their scientific practices, and their belief in their own ability to self-manage these relationships may however undermine the efficacy of traditional conflict of interest policies and regulations. This study indicates that conflicts of interest are not understood just as practical and managerial situations that academic scientists with financial or proprietary interests in their research might face, but also as potentially pejorative constructs that might stifle their discussion and recognition, and also stigmatize scientists who hold industrial ties (Williams-Jones, 2011). This decoupling of scientists from recognitions of potential harms in their research processes, and the stigmatizing implications of conflict of interest accusations may thus undermine discussion and recognition of these activities amongst academic biomedical scientists themselves. Scientists’ decoupling from conflicts of interest may cause interventions such as disclosure of these interests to not hold any power in governing these arrangements. This calls for regulations that are grounded in scientists’ daily routines and understandings (Smith-Doerr, 2009). As such, regulators may need new terminologies and ways of thinking about the harms of industry engagements and entrepreneurial science in the basic biomedical sciences.

Many recent examinations of entrepreneurial scientific practice have called for a recognition and management of potential harms alongside fostering and allowing for the productive benefits of entrepreneurial activities (Gelijns & Thier, 2002; Nelson & Bierer, 2011; Taylor, 2013). The findings of this study indicate that entrepreneurial scientists believe that they themselves can be the arbiters of balancing the benefits of entrepreneurial science, while controlling and avoiding relevant harms. While there are undoubtedly benefits of academic entrepreneurship, related to health product development and productive collaborations between academic and industrial scientists that can generate resources and research ideas for academic scientists, the ability of scientists themselves to manage the potential harms of these relationships must be questioned. While entrepreneurial scientists claim that the practices and norms of academic science can exist alongside entrepreneurial activities, and that curiosity-driven and open-ended research can exist alongside entrepreneurial and directed research, the
potential for an entrepreneurial or industrial ethos to overtake academic science is an increasingly legitimate threat (Vallas & Kleinman, 2007). This calls for not just the actions of scientists themselves in managing this boundary, but also support from academic structures and funding bodies in prioritizing academic science (Vestergaard, 2007).

However, conflicts of interest may also exist beyond the domain of individual scientists and their entrepreneurial engagements. Indeed, as governments and academic organizations hold interests in revenue generation from academic science, the more systemic or institutional conflicts of interest must be recognized in this context (Barnes & Florencio, 2002). As these institutions and organizations hold interests in their economic development, they will continue to put systems in place to forward their economic interests (Liang & Mackey, 2010). As such, the self-management strategies of entrepreneurial scientists will not only be insufficient in the tendency for actors to be blind to their own conflicts of interest, but these strategies will also be insufficient in an organizational environment that is in itself inherently involved in a potential conflict of interest. There is thus a need to carefully attend to this organizational and institutional environment and its interests in profit and revenue generation.

This study attends to the health context and implications of academic entrepreneurship in the basic biomedical sciences by linking the literature on entrepreneurial science to the literature on conflicts of interest. In doing so, this study calls for the need to recognize the health implications of upstream research practices in the context of the biomedical or life sciences. As public policies and funding bodies deploy promises of health and social benefit as a rationale for and impact of academic research commercialization, this study calls for a need to also examine both the efficacy of entrepreneurial initiatives in achieving these goals at all, as well as a need to take seriously the deleterious implications they may imply.
7.4 Limitations

Though this study contributes to diverse scholarly literatures and illuminates a generally underexplored area of policy attention and concern, it also faces several limitations. Examining methodological limitations, the survey instrument relied on researcher self-report, where demographic and activity participation measures were subject to recall biases. As well, in measuring attitudes to entrepreneurial activities and to conflict of interest concerns and incentives, respondents were constrained in their choices to these initiatives and could not indicate additional areas of concern to them, and this may not be representative of the true nature of their attitudes. As detailed in the study methodology in Chapter 3, these survey items aimed to measure three overarching constructs: the legitimacy of academic entrepreneurship, the credibility of conflict of interest concerns, and the credibility of positive incentives of academic entrepreneurship. However, this survey instrument was not validated, and offered only approximate measures of these constructs, based on reviews of relevant literatures, and as such may have not adequately captured these constructs. However, no existing validated instruments could capture normative values towards academic entrepreneurship in the basic biomedical sciences and also test the credibility of commonly cited conflicts of interest. This instrument was nonetheless used, and through its adherence to the literature aimed to capture these constructs adequately. As well, as the use of this survey data was largely exploratory and interpretive, no causal relationships were attempted through analysis of this data, and it was instead used to explore general theories about academic entrepreneurship and conflicts of interest amongst academic biomedical scientists in Canada.

Qualitative interviews also relied largely on researcher self report and asked scientists to recall their motivations and organizational strategies related to entrepreneurial activities. Without an ethnographic study design examining the organization of the laboratory, scientists were asked only to recall their organizational choices around the management of entrepreneurial activities, while their actual organization of these activities may have been significantly different than what was reported. An ethnographic approach may have revealed the nuances of individual PIs or trainees engagements in entrepreneurial
activities, and extended beyond their discursive representations of these activities. However, the interpretive work to analyse these interviews took scientists’ responses to be strategic representations of research worlds and they were understood and analysed as such. As well, in recalling their organizational decisions they were able to recount past organizational decisions and speculate on their lessons learned, rather than only their current laboratory practices.

In addition, as academic entrepreneurship may be a novel and contentious activity, scientists may have been prompted to respond with what they perceived to be socially desirable responses. In using the language of conflict of interest in the interview guide, this may have constrained or restrained conversation in important ways, and the association of conflicts of interest with situations of research misconduct may have encouraged interview participants to avoid even the appearance of these situations. As early interviews indicated that the use of this terminology was constraining discussions, modifications of the interview guide introduced this term as a construct to be tested, and also asked about potential conflicts of interest more broadly in the form of trade-offs or risks of entrepreneurial science. As a goal of this study was to uncover understandings of conflicts of interest, the use of this language was necessary to uncover scientists’ understandings of these situations, while any accusations of these situations were avoided.

Finally, this research may have benefitted from a more comparative element, either in comparing types of scientists, or in a more longitudinal comparison to examine the evolution of scientific values with respect to activities of academic entrepreneurship. While this study pointed at institutional change or the institutionalization of entrepreneurial activities in academic science, in following theories of institutional work, it did not confirm this institutionalization process. As such, this study was inconclusive on institutional change in academic entrepreneurship in Canada. However, this study does point towards ongoing processes of change and the difficulties and nuances of this when pursuing activities that are perceived as inherently divergent. This study also benefitted from providing a singular picture of academic and entrepreneurial science
amongst publicly-funded academic biomedical scientists at a particular point in time that likely represents a key moment in the transformations of academic research cultures.

This study also faced certain analytic limitations. Firstly, I have relied on the terms “academic entrepreneurship” or “entrepreneurial science” throughout to denote activities in which academic scientists engage with industrial collaborators or pursue the commercialization of their research. Though these terms are used extensively in the academic literature in this domain and derive from the prolific work of Etzkowitz and colleagues, there are notable concerns with this phrase. The findings of this study indicate that “academic entrepreneurship” does indeed entail a diversity of types of engagements and activities that hold diverse meanings, efforts and rewards for academic scientists. This study thus calls for a need to disaggregate the meanings and practices of entrepreneurial science, by both highlighting the heterogeneity in values related to different types of entrepreneurial engagements, and also highlighting the ways in which academic entrepreneurs rely on their own discretion in determining legitimate entrepreneurial engagements. Though the term “academic entrepreneurship” may be useful as an analytic category, the analyses in this study may have relied too heavily on this category. This may require a rethinking of the use of this term in future work to account of the range of types of ‘entrepreneurial’ activities and their associated values, and how these may hold a multitude of meanings and implications.

As well, the term, descriptor, and concept of “conflict of interest” as a signifier for the detrimental implications arising from relationships between academic researchers and commercial or industrial interests may have limited the analysis of this study. Methodologically, testing or assessing conflicts of interest is a particularly difficult task, largely due to the pejorative meanings associated with this term, as it is often cognitively linked to situations of research misconduct (Williams-Jones, 2011). As well, the conflict of interest literature itself is largely theoretical or speculative rather than empirical, and so to take this body of literature as a fixed construct to be examined may itself have limited this study. While the survey instrument avoided the use of this term, it drew potential harms or implications of academic-industry relationships from this body of
literature and took these to stand in for this construct. In interviews, the suggested problem of conflict of interest was taken as an implication to be tested or measured, rather than assumed. Thus, while this study did some work to uncover the ways in which scientists make sense of this situation, reliance on these concepts may have limited analysis of this complex issue, which may signify diverse meanings for scientists. This study does, however, attempt to reflect critically both on the concept of conflict of interest itself, and also to examine the range of meanings associated with the harms or implications of entrepreneurial science for biomedical scientists themselves. Through both problematizing this term, and examining the ways it is navigated and negotiated by academic entrepreneurs, this study calls for broader understandings associated with the potential implications of academic research commercialization and collaborations with industry, as well as critical reflection on this term.

7.5 Future Research

The findings of this study indicate the need for future research in this domain and highlight certain areas of particular interest. Firstly, to examine changes over time in the academic research enterprise and institutional change towards the inclusion of entrepreneurial activities as legitimate and taken for granted, a longitudinal or repeat study of this sort would add important insights. A repetition of the survey instrument at a five- or ten-year increment following its initial use would be able to examine changes in attitudes and practices over time. As well, a follow-up series of interviews, perhaps with the same or different scientists would also illuminate changes in attitudes or an increased legitimacy and credibility of entrepreneurial activities. Findings from the survey instrument indicate that in 2011, CIHR-funded academic biomedical scientists in Canada found low legitimacy in most entrepreneurial activities and that entrepreneurial scientists interviewed were involved in ongoing efforts to legitimize these pursuits. A follow-up study would allow for the comparison of these findings in order to examine the institutionalization or increasing legitimization or delegimization of entrepreneurial activities over time, as well as any differences in the valuative and managerial efforts of academic entrepreneurs. While this study indicates that scientists engage in an ongoing
institutional work process of change-through-maintenance, a repetition of this study would indicate the extent to which this change has indeed been accomplished.

Important amongst the results of this study was the proposal by scientists that entrepreneurial activities can facilitate clinical benefit and promote patient health, and do so in a more efficient way than academic translation pathways. Academic entrepreneurs asserted certainty in this ability to generate patient benefit and valued entrepreneurial activities to this end, yet these pathways of clinical benefit require further questioning as scientists tended to ignore uncertainties related to market and clinical uptake of new technologies. While the scientists in this sample valued entrepreneurial activities specifically for their ability to insure these benefits where academic translation activities could not, research is needed to track the superiority of entrepreneurial translation methods in generating patient impacts, as well as the ways in which scientists value these ends despite clinical, market and regulatory uncertainties. As well, these beliefs amongst study participants that entrepreneurial translation will insure access to health products tend to overlook how intellectual property and patents may constrain access and affordability, rather than facilitate patient benefit. A study of academic biomedical entrepreneurs’ attitudes towards these pathways of clinical benefit and the tradeoffs they were willing to make in terms of access to health products and research priorities would add important insights to this domain. As well, important questions could be raised about the commitments of a publicly-funded health research system in the context of Canada’s publicly-funded health care system.

Finally, this study highlights the uncertain place of trainees in the conduct of entrepreneurial science. These analyses indicate that trainee scientists are shielded from entrepreneurial activities, both through the actions of their supervisors or PIs and through their own primary orientations as academic scientists. Despite trainees’ desires to know more about entrepreneurial scientific practice, they had little access to the workings of entrepreneurial science. From an institutional work perspective, trainees have little power in academic laboratories and little agency in shaping new scientific norms or constructing legitimate scientific practice. As entrepreneurial activities become
increasingly institutionalized and legitimized, the role of academic trainees is worthy of future investigation, as they will likely face novel research environments as they progress to PI stages of their careers. As the future agents of academic science, these individuals ought to be studied in the context of these shifting institutions and their role in the academic laboratory with regards to entrepreneurial science.

7.6 Conclusion

Since the initiation of this study in 2010, entrepreneurial activities have proliferated within the academy. While these initiatives undoubtedly hold certain benefits, they ought not proceed without criticism. Attention to conflicts of interest is one way of regulating these initiatives, yet this study demonstrates a need for attention to the effects of entrepreneurial science at the level of individual scientists, universities, hospitals, research institutes, and public funding bodies. As entrepreneurial interests hold the potential to shape all phases of academic science, this study calls for a need for increased policy, ethical and regulatory reform that is meaningfully situated in the experiences and realities of academic scientific practice.
Bibliography


Chimonas, S., Frosch, Z., & Rothman, D. J. (2011). From disclosure to transparency: The use of company payment data. *Archives of Internal Medicine, 171*(1), 81-86.


Tereskerz, P. M. (2003). Research accountability and financial conflicts of interest in industry-sponsored clinical research: A review. *Accountability in Research, 10*, 137-158.


Appendix A: Survey Instrument

**SECTION C: Commercial applications of academic biomedical research/ Researcher involvement with the health products industry** (e.g. drug companies, medical device companies)

Remember: There are no right or wrong answers

C1. In your opinion, should academic biomedical researchers participate in the following activities, when the type of research they are doing makes this possible? For each statement, please indicate how much you agree or disagree: *(Please select only one response per question)*

<table>
<thead>
<tr>
<th>a. When academic biomedical researchers start to plan their studies, they should make efforts to choose research topics that are likely to have commercial applications.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strongly Agree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b. Academic biomedical researchers should make efforts to develop commercial products from the results of their research (e.g., do further development, collaborate with industry, create 'start up' companies).</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strongly Agree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c. Academic biomedical researchers should make efforts to consult for the health products industry (e.g., sit on business advisory boards).</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strongly Agree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d. When academic biomedical researchers publish in scientific or medical journals, they should make efforts to publish jointly with employees of the health products industry.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strongly Agree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>e. Academic biomedical researchers should make efforts to patent their research.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strongly Agree</td>
</tr>
</tbody>
</table>
SECTION D: Relationships between academic biomedical researchers and the health products industry (e.g., drug companies, medical device companies)

Remember: There are no right or wrong answers

D1. The following are some statements that have been made about academic relationships with the health products industry (e.g., drug companies, medical device companies). For each statement, please indicate how much you agree or disagree: (Please select only one response per question)

a. “Academic biomedical research that involves collaboration with the health products industry is more likely to be inappropriately biased in favour of industry in its design, analysis or the presentation of results.”
   - Strongly Agree
   - Agree
   - Neither Agree nor Disagree
   - Disagree
   - Strongly Disagree
   - Don’t know

b. “Academic biomedical researchers who collaborate with the health products industry should be more highly rewarded in their academic careers than those who do not collaborate with industry.”
   - Strongly Agree
   - Agree
   - Neither Agree nor Disagree
   - Disagree
   - Strongly Disagree
   - Don’t know

c. “Collaboration with the health products industry fosters secrecy and discourages exchange and cooperation between academic researchers.”
   - Strongly Agree
   - Agree
   - Neither Agree nor Disagree
   - Disagree
   - Strongly Disagree
   - Don’t know

d. “More public funds should be invested in academic biomedical research that involves collaboration with the health products industry than in academic biomedical research that does not.”
   - Strongly Agree
   - Agree
   - Neither Agree nor Disagree
   - Disagree
   - Strongly Disagree
   - Don’t know

e. “When the health products industry sponsors academic biomedical research, there is increased risk of harm to research participants.”
   - Strongly Agree
   - Agree
   - Neither Agree nor Disagree
   - Disagree
   - Strongly Disagree
   - Don’t know
I. “The results of research developed from collaborations between academic biomedical researchers and the health products industry will better address real-world problems.”
- Strongly Agree
- Agree
- Neither Agree nor Disagree
- Disagree
- Strongly Disagree
- Don’t know

If you have any comments about these issues please share them here:

If you have any comments about these issues please share them here:

If you have any comments about these issues please share them here:

If you have any comments about these issues please share them here:
### SECTION E: About you

**E1. Your gender:**
- Female
- Male

**E2. Your primary field of research: (Please select only one)**
- Basic biomedical research (CIHR Theme 1)
- Clinical research (CIHR Theme 2)
- Health services or policy research, including health economics (CIHR Theme 3)
- Population health or socio-cultural research (CIHR Theme 4)
- None of the above are applicable to my research

**E3. Your professional qualifications: (Please select all that apply)**
- Doctoral degree (e.g., PhD, DPhil)
- Master’s degree (e.g., MSc, MA, MBA)
- Bachelor’s degree (e.g., BSc, BA)
- Medical degree (e.g., MD, MBCh)
- Other clinical qualification (e.g., RN, PT/OT, etc.) Please specify

**E4. In the last five years, what is the approximate number of peer-reviewed journal articles you have published? (Please enter the number in the box)**

**E5. The year you completed your highest degree: (Please enter the year in the box)**

**E6. In the last five years, have you participated in the following activities related to the commercial application of your research, or involvement with health products industry (e.g., drug companies, medical device companies)? (Please select one response per row)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes</th>
<th>No/Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. I have co-authored academic paper(s) with employees of the health products industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. I have disclosed inventions to the office at my institution that supports technology transfer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. I have been named on patents (received or applied for) as a result of my research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. I have helped to create spin off company(ies) as a result of my research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. I have sat on the business advisory boards of health product firms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. I have worked in the health products industry (e.g., as a trainee, on sabbatical, as an employee)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. I have acted as a paid consultant for the health products industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. I have conducted contract research for the health products industry</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
E7. Your current academic rank. (Please select all that apply)

- □ Full professor
- □ Associate professor
- □ Assistant professor
- □ Senior clinician scientist
- □ Clinician scientist
- □ Senior scientist
- □ Scientist
- □ Trainee – Postdoctoral fellow
- □ Trainee – PhD student

E8. [Skip if trainee] How many fulltime equivalent (FTE) research personnel and trainees (i.e., graduate students and postdoctoral fellows) do you support from your research grants? (Please enter the numbers in the boxes)

<table>
<thead>
<tr>
<th>FTE personnel</th>
<th>Trainees</th>
</tr>
</thead>
</table>

E8. [Trainee only] What are your career goals? (Please select only one response per question)

a. Do you want to have a career as an academic researcher (i.e., in a university, hospital or academic research institute)?
- □ Yes, definitely
- □ Yes, probably
- □ No, probably not
- □ No, definitely not
- □ Don’t know

b. Do you want to have a career in the health products industry (i.e., as a researcher, administrator, business person in a drug company, medical device company, etc.)?
- □ Yes, definitely
- □ Yes, probably
- □ No, probably not
- □ No, definitely not
- □ Don’t know

E9. Your primary work affiliation. (Please select all that apply)

- □ University
- □ Hospital/ Health Care Facility
- □ Hospital Research Institute
- □ University Research Institute
- □ Other – Please specify:

E10. What is the approximate percentage of time you spend doing research, teaching or clinical practice? (Please enter the percentages in the boxes; NB. This need not add to 100%)

<table>
<thead>
<tr>
<th>%</th>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Teaching</td>
<td>Clinical Practice</td>
</tr>
</tbody>
</table>
Appendix B: Letter of Information and Consent Form

Commercialization, Collaboration and Conflict of Interest:
A Study of Academic Biomedical Researchers in Canada
Letter of Information/ Consent for Interviews

Investigator: Ms. Renata Axler
(PhD Candidate) Institute of Health Policy, Management and Evaluation
University of Toronto
Toronto, Ontario, Canada
(647) 330-6301
renata.axler@utoronto.ca

Research Sponsor: CIHR Canadian Institutes of Health Research

Purpose of the Study:
The goal of the project is to understand the views of individuals involved in the commercialization of their research and collaborations with industry. This project will explore the ways in which you have collaborated with the health products industry, your motivations for participation in these activities, the ways in which you organize your commercial and academic research activities, and the ways in which you understand conflicts of interest within the research enterprise.

Procedures involved in the Research:
I would like you to participate in an in-depth interview, either face-to-face, over the telephone, or via videconference, at a place and time convenient to you. I invite your open-ended responses to several questions about your research work and your involvement in the activities of research commercialization and collaboration with industry. With your consent this interview session will be tape recorded for transcription and analysis. The interview will last approximately one hour.

Potential Harms, Risks or Discomforts:
There are no physical risks to participation in this study. However, while we will keep your identity and information confidential, because of the small size of the Canadian medical and biotechnology research community there is a minimal risk that informed observers might surmise your identity or involvement from our final reports or publications. This could have negative peer or professional consequences.

All identifying material will be kept separate from your data, and will be kept in a safe in a locked office, with data stored on a password protected computer accessible only to core members of the research team. All data and identifying information will be kept for ten years after completion of the study (i.e., data collection) and will then be destroyed.

Potential Benefits:
This study is unlikely to provide direct benefit to participants. The benefits will be mainly to society as the proposed project will advance research in an understudied area while

...
producing knowledge that is highly relevant to public policy makers and to diverse public and private sector interests.

**Payment or Reimbursement:**
Receipted expenses directly related to participation in study will be reimbursed (e.g., long distance phone charges, postage, transportation, etc.)

**Confidentiality:**
Interview data will be audio taped and transcribed for later analysis by the investigator. Data from interviews and questionnaire will be kept confidential by removing identifying information from data, maintaining data in a locked location and in a password protected electronic database, with access limited to core members of the research team. Anonymity will be maintained for research participants through anonymous quotation in the final report and in all presentations and publications.

**Participation:**
Participation in this research study is entirely voluntary. You are free to withdraw at any time **prior to the completion of data analysis** and without prejudice. If you decide to withdraw before the interview is conducted, the interview will be cancelled. If you withdraw during the interview, the interview will stop and the recording and questionnaire will be destroyed. If you decide to withdraw after the interview, but before final data analysis and before the final study report is written, you may contact the investigator to do so. All your data will then be destroyed unless you specify otherwise. **Once data is analysed, and final reports and papers have been written, you will not be able to withdraw your participation from this study. Therefore, your right to withdraw is effective before and during your interview, and up until the point of final data analysis. After this point, all data will be retained.** You will receive a copy of this consent form for your records.

**Rights of Research Participants:**
If you have questions or require more information about the study itself, please contact:

Ms. Renata Axler  
PhD Candidate  
Institute of Health Policy, Management and Evaluation  
University of Toronto, 155 College Street, 4th Floor  
Toronto, Ontario, Canada  
(647) 330-6301 (phone)  
renata.axler@utoronto.ca

This study has been reviewed and approved by the University of Toronto Research Ethics Board. If you have questions about your rights as a research participant, please contact The Office of Research Ethics, University of Toronto, 416-946-3273 or ethics.review@utoronto.ca
<table>
<thead>
<tr>
<th>Consent and Privacy Options</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I understand and agree to participate in the research, I am willing to participate in an in-person or telephone interview to be scheduled/conducted at my convenience.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I agree to the interview being tape-recorded.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I am willing to allow the researchers to cite information offered in my interview (cited anonymously, not ascribed directly to me).</td>
<td></td>
<td></td>
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<tr>
<td>4. I would agree to be re-contacted if necessary.</td>
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</table>

I have read the information presented in the information letter about a study being conducted by Renata Axler, of the University of Toronto. I have had the opportunity to ask questions about my involvement in this study, and to receive any additional details I wanted to know about the study. I understand that I may withdraw from the study at any time, if I choose to do so, and I agree to participate in this study. I have been given a copy of this form.

____________________________________
Name of Participant

_____________________
Signature of Participant

In my opinion, the person who has signed above is agreeing to participate in this study voluntarily, and understands the nature of the study and the consequences of participation in it.

____________________________________
Signature of Researcher or Witness
Appendix C: Principal Investigators Interview Guide

In the ‘Impacts of Health Research’ survey you participated in earlier this year, you indicated that you have collaborated with the health products industry or attempted to commercialize your research in various ways. I hope that we can discuss how you fit these practices into the other activities of your academic life and why you understand these practices the way that you do.

1) Can you describe the type of research that you do?

2) In what ways have you collaborated with the health products industry or gone about the commercialization of your research?
   i. Can you describe these collaborations?
   ii. How did these collaborations/initiatives come to be?

3) Why have you decided to participate in these activities?
   i. What motivated participation in these activities?
      a. Were you influenced by university policies? Your colleagues? Funding or equipment opportunities?
   ii. How have you liked doing this work? If given the opportunity, would you participate in these activities again?

4) How do you organize your research practice in light of these activities and your other responsibilities as an academic researcher?
   i. Do you attempt to separate commercial/collaborative duties from your academic responsibilities?
      a. How do you do this? Why do you do this?
   ii. Are you inclined to keep these separate (or not) because of any specific university/funding policies? Your peers? Your attitudes toward science?
   iii. How do you manage/direct your trainees in their activities of commercialization and collaboration with industry?

5) Are there any compromises or trade-offs do you need to make for industry science? What tensions exist?
   i. Were there any challenges you faced with these activities? What were these?
   ii. How did you manage these challenges?
   iii. Were there any policies or procedures in place to help you manage these challenges?

6) Ties to industry and financial interests in research are sometimes said to initiate conflicts of interest, what do you make of this characterization?
   i. How do you manage your own research around this? Why is that important?
   ii. Is this an adequate characterization?
Appendix D: Trainee Interview Guide

1) Can you tell me about the type of research that you do?

2) Can you tell be about your career path?
   i. Where are you in your degree now, what do you plan to do next?
   ii. Have you always been on an academic career path?
   iii. Have you thought about working in industry, or conducting industry or commercial activities in academic settings?

3) Have you yourself collaborated with the health products industry or gone about the commercialization of your research? Or do you see this happening in your lab/ with your supervisor?
   i. Can you describe these collaborations? How did these collaborations/ initiatives come to be?
   ii. What motivated you to get involved in these activities?
   iii. Do you like working in a lab that works on collaborations with industry and commercialization of research? Is this something you might want to do?
   iv. What other commercialization initiatives are you seeing around you? How do you feel about these?

4) Can you see yourself getting involved in industry collaborations in your future career?
   i. Why/ why not?
   ii. How do you envision conducting this research in your own lab in future?

5) Do you think there are any compromises or tradeoffs that need to be made in the conduct of commercialization activities or collaborations with industry?
   i. Are you concerned about secrecy in science?
   ii. Are you concerned about bias in science?
   iii. Are you concerned about downstream effects- trust, harm, etc.?
   iv. Are there policies at your institution to address these tensions? How do you respond to these?

6) These tensions have sometimes been termed ‘conflicts of interest’- what do you make of that?
   i. Is this a concern for you?
   ii. How do you/ will you manage this concern?