

Academic entrepreneurship: time for a rethink?

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ERC Research Paper No.32

June 2015

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ABSTRACT

Academic entrepreneurship, which refers to efforts undertaken by universities to promote commercialization on campus and in surrounding regions of the university, has changed dramatically in recent years. Two key consequences of this change are that more stakeholders have become involved in academic entrepreneurship and that universities have become more “strategic” in their approach to this activity. We assert that the time is ripe to rethink academic entrepreneurship. Specifically, theoretical and empirical research on academic entrepreneurship needs to take account of these changes, so as to improve the rigor and relevance of future studies on this topic. We outline such a framework and provide examples of key research questions that need to be addressed to broaden our understanding of academic entrepreneurship.

Key words: Academic entrepreneurship, open innovation, entrepreneurial universities, spillovers, development.

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INTRODUCTION

Since the enactment of the Bayh-Dole Act in the U.S. in 1980, there has been a substantial rise in the commercialization of science and other forms of university technology transfer (Siegel and Wright, 2015). An increase in university licensing, patenting and start-up creation in the U.S. has also been observed in many countries in Europe and Asia, as well as in Australia, Canada, and Israel (Grimaldi et al., 2011). These commercialization activities have come to be known in some circles as “academic entrepreneurship”. Academic entrepreneurship has certain distinctive features vis-à-vis more traditional forms of entrepreneurship, notably regarding the emergence of entrepreneurial ventures from traditionally non-commercial contexts where the academic usually continues to work for the university and the ownership of intellectual property which often lies, at least in part, with the university. As noted in Siegel, Waldman, and Link, (2003a), academics and others involved in the research enterprise at the university who engage in entrepreneurship have traditional scientific norms, standards, and values, unlike many conventional entrepreneurs.

Academic entrepreneurship has changed dramatically since the time universities first established technology transfer offices in the 1980s and 1990s (Lockett et al., 2014). When these activities were first developed on campuses, there was a strong emphasis on two key dimensions of university technology transfer: patenting and licensing. Little attention was paid to the start-up dimension, since this would divert attention from potentially lucrative “block-bluster” patent licensing deals. Also, there were very few entrepreneurship courses and programs on campus, so those involved in the research enterprise were not well-versed in entrepreneurship or well-connected to the entrepreneurial community. Also, many universities have only recently integrated academic entrepreneurship into their economic development mission.

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However, evidence regarding the effectiveness of the university sector and their technology transfer offices (TTOs) in promoting academic entrepreneurship is patchy at best (See Siegel and Wright, 2015 for a review). It is debatable how far models applied to elite universities relate to the broader sweep of universities (Wright et al., 2008) and indeed how effective universities are in promoting academic entrepreneurship. Thus, some have questioned whether universities should engage in academic entrepreneurship at all or, if they do, whether they need to focus on those areas where they can be effective.

The question of whether a university is effective in this arena is not just an empirical issue but also a policy issue regarding both the operations and the purposes of universities. Operationally, we conjecture that some universities will persist in efforts to promote this activity, even if their culture is not conducive to it or they do not possess complementary assets to be successful at academic entrepreneurship. They do so for several reasons. The first reason is competitive pressure, if rival institutions and aspirational peers (e.g., institutions such as Stanford and MIT) are effective in this arena. In the U.S. and Canada, for example, the collection of data on university patenting, licensing, and start-up activity, by the Association of University Technology Managers (see AUTM, 2013), has spurred benchmarking of academic entrepreneurship based on these metrics. These may not be the full set of true “outputs” of academic entrepreneurship, yet they can drive strategic decision making by university administrators.

The second operational reason for aggressive pursuit of academic entrepreneurship, even when it is not warranted, is increasing pressure on universities to generate money from private donors. This trend has been exacerbated by declining national support for universities in Europe and state-level support for U.S. universities. Many alumni donors have a strong interest in supporting entrepreneurship on campus, especially if it involves students. Indeed, many alumni commercialization funds for university-based technologies have been established at leading American public and

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private research universities (e.g., Columbia, the University of California at Berkeley, the University of California at San Diego, Cornell, Purdue, and the University of Maryland). Some of these are focused on student-based start-ups. A third operational reason for pursuing academic entrepreneurship, even when it is not effective, is the growth of funding from federal agencies to support academic entrepreneurship (e.g., the U.S. government's Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Programs).

More fundamentally, in this article, we argue that we have reached a juncture that requires us to rethink academic entrepreneurship, given the changing role and purpose of universities.¹ In a recent lucid and insightful essay, Martin (2012) neatly explodes the myth that academics are facing a new phenomenon of pressure to link their research work more directly economic needs and commercialization. He notes that leading research universities in Germany in the 19th century were closely linked to industry and that the German model was eventually adopted by many leading research universities in the U.S., U.K., and France in the 20th century. The establishment and growth of "polytechnics" and "land grant" universities in the U.S. and Europe, in both centuries, also strengthened connection between universities and industry. Martin makes the interesting point that it is the period of the second half of the twentieth century that is anomalous. For example, the establishment of institutions such as the National Science Foundation and the Cold War defence establishment, in the aftermath of World War II, and the concomitant rise of federally-funded basic research at U.S. universities, may be regarded as an aberration.

Our argument is that the debate regarding universities and academic entrepreneurship has relied too much on the research- third mission nexus with its narrow focus on university-industry links. This has arisen because of the undue narrow emphasis of academic entrepreneurship on the transfer of scientists' inventions from the laboratory to licenses and start-

¹ Our objective in this paper is not to review the burgeoning literature on academic entrepreneurship, given that comprehensive reviews have been published (e.g., Rothaermel, Agung and Jian, 2007; Wright et al., 2007; Siegel and Wright, 2015).

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ups, particularly in relation to formal intellectual property (IP), such as patents and licenses. However, many new opportunities for academic entrepreneurship arise from the development of informal IP, and the creation of new forms of entrepreneurial ventures.

Different stakeholders play varied roles in the missions of universities (Clark, 1983). More stakeholders have become involved in academic entrepreneurship, including students, a younger generation of faculty and post-doctoral fellows who are more comfortable working with industry than the previous generation, federal agencies that support entrepreneurship programs (e.g., the U.S. government's SBIR/STTR Programs), and alumni. In addition, the roles of other stakeholders such as technology managers at universities, economic development officials at the university and in the region and state, surrogate entrepreneurs, managers of incubators/accelerators and science/research/technology parks, state legislatures, and other bodies that govern universities also need to change. The need therefore arises for universities to perform the role of facilitating this development. In this context, there has been insufficient focus upon the teaching/education- third mission nexus informed by research. Consequently, arguments about whether there has been too much or too little academic entrepreneurship miss the point. There is a need to embrace greater variety in the extent and nature of academic entrepreneurship. We argue there is a need to evolve to a new model which will, in Martin's (2012) terms, see the emergence of new species of universities.

In light of the evolution in academic entrepreneurship, individual universities need to consider whether to pursue academic entrepreneurship and, if so, what aspects are most relevant to them. With such growing diversity, traditional methods of assessing university performance in academic entrepreneurship also need to evolve. That is, heterogeneity in university strategy may require broader notions of performance than those derived from AUTM data.

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As academic entrepreneurship has evolved, so too must scholarly analysis of academic entrepreneurship. There has been a rise in scholarly interest in academic entrepreneurship in the social sciences (e.g., economics, sociology, psychology, and political science) and several fields of business administration, especially management (see the literature reviewed in Rothaermel, Agung and Jian, 2007; Siegel and Wright, 2015). Within management, the two fields that have devoted the most attention to this topic are entrepreneurship and strategy. However, theoretical and empirical research on academic entrepreneurship needs to take account of these changes, so as to improve the rigor and relevance of research on this topic. In the remainder of this article, we outline such a framework and provide examples of key research questions that need to be addressed to broaden our understanding of academic entrepreneurship.

ACADEMIC ENTREPRENEURSHIP AND THE PURPOSE OF UNIVERSITIES

The evolution of academic entrepreneurship needs to be viewed in the context of the debate regarding the nature and purpose of universities, which has a long history (Martin, 2012). On one hand is the view that the purpose of universities is education for education's sake and that research conducted at universities should be basic in nature, or promoting knowledge for knowledge's sake. On the other hand, universities are viewed from a more utilitarian perspective involving aiding the material improvement of society.

Adopting an evolutionary perspective, Martin (2012) points out that the view that academics are facing a new phenomenon of pressures to link their work more closely to economic needs takes a short term view of the history of universities that ignores previous roles of universities, which has seen the evolution of a variety of university 'species' with different emphases. Martin argues that we are seeing a shift back towards a social contract for the university closer to the one in effect before the second half of the twentieth century when the so-called third mission had been in place

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for many centuries in some universities. Further, historically, Mode 2 research predates Mode 1 research, even in disciplines that would not now be regarded as serving practice. Moreover, there is evidence that the emphasis on third mission has not been accompanied by a decline in basic research (Siegel and Wright, 2015 for reviews). That is, a stronger emphasis on commercialization and academic entrepreneurship actually leads to an increase in basic research. This occurs because most of the “profits” from commercialization are ploughed back into basic research. Those who decry the rise of commercialization at research universities (see Bok, 2003; Slaughter and Rhoades, 2004) are misguided.

However, at the same time, evidence suggests that the benefits to society from third mission approaches, especially following the introduction of Bayh-Dole Act type regulation has not been as great as anticipated (Grimaldi, et al., 2011) and that there is a need to vest ownership of university technology with the researcher inventor and to adopt an open source strategy to make inventions publicly available (Kenney and Patton, 2009).

TRADITIONAL AND EMERGING PERSPECTIVES ON ACADEMIC ENTREPRENEURSHIP

Table 1 presents a contrast between traditional and emerging perspectives on academic entrepreneurship. The traditional rationale for academic entrepreneurship was that it would enhance the commercialization of university research and also serve as a source of revenue for the university. The latter was viewed as both timely and important, since state and national support of universities had been declining for many years. Not surprisingly, early reviews of the academic entrepreneurship literature (see Rothaermel, Agung and Jian, 2007; Wright et al., 2007) showed that studies focused mainly on several well-defined metrics of university technology transfer activity, such as the establishment of technology transfer offices, patents, licenses, and start-ups/spin-offs. These studies identified significant variation in the performance of universities and TTOs,

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as well as their actions to mitigate the effects of attempts to measure such performance (Lockett et al., 2014). While some universities were highly effective, general conclusions were that many TTOs were inefficient, and lacking in resources and capabilities to be successful in this arena. Theoretical perspectives included the theory of the firm/productivity applied to analyses of the performance of TTOs (Siegel, et al., 2003a; Chapple, et al., 2005)); agency and contracting theories applied to the relationships between universities, technology transfer offices (TTOs) (e.g. Macho-Stadler, et al., 1996, 2007, 2008; Markman et al., 2005, 2006); and resource based and entrepreneurial orientation theories applied to the resources and capabilities required in both TTOs and spin-offs (e.g., Lockett and Wright, 2005; Mosey and Wright, 2007; O’Shea, Allen and Chevalier, 2005; Powers and McDougall, 2005; Rasmussen et al., 2011, 2014).

However, these previous approaches have largely not considered all dimensions of the new entrepreneurial eco-system, which has broadened out the rationale to reflect the wider social and economic benefits of academic entrepreneurship to the university ecosystem. Key elements of the university ecosystem facilitating entrepreneurship include: (1) the rise of property-based institutions, such as incubators/accelerators and science/technology/research parks, to support technology transfer and entrepreneurship (2) substantial growth in the number of entrepreneurship courses and programs on campus (in multiple colleges/schools), (3) the establishment and growth of entrepreneurship centres, (4) a rise in the number of “surrogate” entrepreneurs on campus to stimulate commercialization and start-up creation, and (5) a rapid increase in alumni support of various aspects of this entrepreneurial ecosystem, including alumni commercialization funds and student business plan competitions.

This shift reflects policy developments that focus on the need for universities’ knowledge transfer to make a wider contribution to society with a greater emphasis on teaching. This has induced a move to focus on more indirect aspects of academic entrepreneurship, such as social

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ventures and commercial start-ups, launched by students and alumni, as well as the transfer of knowledge to existing local businesses.

Table 1: Traditional and Emerging Perspectives on Academic Entrepreneurship

Theme	Traditional Perspective	Emerging Perspective
Why	To generate direct financial returns	To provide a wider social and economic benefit to the university ecosystem
What	Academic Spin-offs; licensing; patents	Student and Alumni start-ups; Entrepreneurially-equipped students; Job creation in the local region or state
Who	Academic faculty and post docs	Students; Alumni; on-campus industry collaborations; surrogate entrepreneurs
How	TTOs; science parks	Accelerators; Entrepreneurship garages; student business plan competitions; collaborative networks with industry and alumni; employee mobility; public-private 'incubators'

The emerging shift in focus of entrepreneurial activities is also affecting the roles of university TTOs and science parks catering to faculty and post-docs. In addition to these traditional modes of support we have witnessed the development of accelerator programs, entrepreneurship garages for students, collaborative networks with industry and alumni, faculty mobility (e.g., specific programs to lure “star scientists” with a strong commercial orientation) and new forms of public-private incubators (Zucker and Darby, 2001).

Understanding these shifts in practice provide the basis for new directions in theorizing and empirical analysis regarding academic entrepreneurship which may also have implications for the understanding of entrepreneurship more generally, as we develop in the next section.

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RETHINKING ACADEMIC ENTREPRENEURSHIP: AN EMERGING RESEARCH AGENDA

We adopt a multi-level framework for rethinking academic entrepreneurship research. This framework consists of four dimensions. First, we analyse changes in the reasons universities are adopting strategies to pursue academic entrepreneurship. Second, we examine issues relating to new, emerging forms of academic entrepreneurship. Third, we consider questions associated with the increasing scope of actors involved in academic entrepreneurship. Finally, we explore questions of new forms of how academic entrepreneurship can be facilitated. Suggested research questions relating to each of these dimensions are summarized in Table 2. We now consider each of these dimensions in turn.

Why: the rationale for academic entrepreneurship

As academic entrepreneurship has evolved, many universities are starting to adopt a *strategic approach* to this activity. This involves addressing formulation issues, including establishing institutional goals and priorities and resultant resource allocation decisions. Research is lacking that on one hand applies a strategic choice framework to the factors influencing university strategies, and on the other hand, examines the narratives adopted by different universities to rationalize and communicate the strategies they have adopted. We see the following as key issues.

Given that universities are heterogeneous, in terms of their resource endowments and scientific base (Mustar et al., 2006), these choices should reflect such configurations. In other words, it may be an inappropriate and inefficient strategy for some less research intensive universities to attempt to pursue forms of academic entrepreneurship aimed at creating high growth spin-offs based on faculty's world-leading research and formal IP. Rather, their priorities may need to focus on other dimensions such as start-ups by students, the development of entrepreneurial garages to facilitate such ventures and equipping students to be entrepreneurial even if they are employed by corporations.

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Table 2: An Emerging Research Agenda on Academic Entrepreneurship

Theme	Sample Research Questions	Conceptual Perspective
Why	<ul style="list-style-type: none"> • What factors influence the kinds of strategies for academic entrepreneurship adopted by universities? • What instruments are required to measure the wider impact of academic entrepreneurship, including spillover effects? • What conflicts arise between the traditional and emerging perspectives on academic entrepreneurship and how might they be addressed? 	<p>Strategic choice Narrative theory</p> <p>Institutional theory</p>
What	<ul style="list-style-type: none"> • What are the new forms of academic entrepreneurship that are emerging and to what extent do they complement traditional forms? • What are the implications for the redesign of curricula to facilitate emerging forms of academic entrepreneurship? • What are the implications for the configuration of social versus commercial versus hybrid ventures created by student entrepreneurs? 	Social entrepreneurship
Who	<ul style="list-style-type: none"> • How can faculty, TTO, alumni and on-campus industry collaborations best be incentivized and facilitated? What are the implications for ownership of IP? • What are the implications for recruitment of new staff and for changes to existing staff/faculty? • What challenges are raised for developing university strategies toward academic entrepreneurship involving a wider array of stakeholders? • What are some ethical concerns regarding academic entrepreneurship? • How does academic entrepreneurship relate to the social responsibility of universities? • What challenges are raised for configuring appropriate entrepreneurial teams beyond the university phase? • What cognitive diversity is present among student, alumni entrepreneurs? • To what extent can international academic networks be leveraged to facilitate international academic entrepreneurship? 	<p>Multiple agency theory</p> <p>Organizational justice</p> <p>Team dynamics/ conflicts</p> <p>Ethics/Social Responsibility</p> <p>Knowledge spillovers</p>
How	<ul style="list-style-type: none"> • What is the appropriate configuration of organizational arrangements for promoting academic entrepreneurship in different university ecosystems- beyond the entrepreneurial university? • How do universities organize 'multidextrous' (ie social & commercial start-ups, licensing, etc.) academic entrepreneurship activities? • What are the benefits and challenges in incentivizing academics/students/alumni to move to more favourable ecosystems for academic entrepreneurship? • What roles do university boards/councils play in facilitating academic entrepreneurship? • What are the antecedents and consequences of mobility of academic entrepreneurs? • How does academic entrepreneurship affect efforts on the part of the university to promote economic development? 	<p>Organizational Design</p> <p>Entrepreneurial ecosystems</p> <p>Public-private governance</p> <p>Geography of Innovation</p>

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Establishing priorities also relates to choices regarding technological emphasis for the generation of licensing opportunities, relating to *stage of development*. For instance, proof-of-concept technologies are likely to be more attractive than other technologies if the strategic objective is licensing for cash, since it is relatively easy to compute economic value under this scenario. Furthermore, such technologies can be codified for efficient arms-length transfer and they are more likely than other technologies to result in a commercial product, without substantial additional research expense.

Resource allocation decisions must also be driven by increasing recognition that universities need to make strategic choices regarding the *mode of commercialization* they wish to emphasize, i.e., licensing, start-ups, sponsored research and consulting, and other mechanisms of technology transfer that are focused more indirectly promoting entrepreneurial ventures through stimulating economic and regional development, such as incubators and science parks, and entrepreneurship programs.

University administrators, backed by regional policymakers, may also need to make a strategic choice regarding *technology field of emphasis*. Opportunities for technology commercialization and the propensity of faculty members to engage in technology transfer vary substantially across fields both between and within the life sciences and physical sciences (Wright, Birley and Mosey, 2004). There is also substantial variation in research quality across departments and college within a given university. If a university does not have a critical mass of research excellence or sufficient TTO expertise, that institution may need to establish a regional *collaboration*. We lack systematic analysis of the appropriate types of such collaborations that can generate local knowledge spillover benefits (Zucker et al., 1998). For example, the resources, capabilities, and configurations of universities within a region may vary considerably from elite to local universities. This raises important questions regarding potential tensions between complementarities and incompatibilities across these institutions.

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To be effective from a macro-perspective there may be a need for collaborations across regions.

Universities also need to formulate *IP and patent strategies*. University technology transfer offices must ensure that IP is well-defined and protected before trying to attract commercial interest. This entails costs, in terms of recruiting sufficient expertise or paying for external advice. The ownership of IP also needs to be resolved. Thus, the IP and patent strategy should consider whether a technology is proprietary to the department, can be licensed on an exclusive base, or can be licensed on a non-exclusive basis. Relatedly, there is an emerging debate about universities becoming patent trolls through their retrospective attempts to generate income from inventions emanating from scientific activity. Rather than discovering new inventions or manufacturing the inventions covered by patents, patent trolls impose costs on the market by manipulating patents to extract financial gain for inventions they did not create. While universities enforcing their patents may have characteristics of trolls as they are not engaged in manufacture, they are distinct from trolls in that they provide benefits from the new inventions they create (Lemley, 2008).

Evidence that few TTOs generate positive net income (Abrams, Leung, and Stevens, 2009) has led to a questioning of their role at the university and in society. This is somewhat ludicrous because it has never been the stated objective of any TTO that we are aware of to maximize profit. Some have suggested that legal ownership of inventions by universities is sub-optimal, from an economic efficiency standpoint, and in terms of reducing the social benefits from the more rapid dissemination and commercialization of university-based research. According to this view, the TTO impedes commercialization and academic entrepreneurship, since it leads to delays in licensing, misalignment of incentives among parties, and delays in the flow of scientific information and the materials necessary for scientific progress (Kenney and Patton, 2009).

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An alternative approach is to vest ownership with the inventor, freeing them up to contract with whomever they see most able to assist in commercialization. The importance of ownership rights in enabling entrepreneurs to take decisions about the coordination of resources and obtain the returns from the bearing of risk has a long, but oftentimes neglected, history (e.g. Hawley, 1927; Fama and Jensen, 1983). However, academic entrepreneurship seems distinctive in that unless supplemented with support policies that enable these individuals and teams to extract value from the ventures they create, it is doubtful whether vesting ownership will lead to greater value creation. Another course of action is to adopt an open source strategy (Perkmann and West, 2015) to make inventions publicly available or to be more selective in the use of exclusive licensing (Lemley, 2008). At present, we lack comparative analysis of which approach is most effective and under what conditions.

As universities evolve and implement strategies for the broadening range of academic entrepreneurship, they also need to develop mechanisms to assess whether such strategies have been successful. While measures have been developed to measure the effectiveness of universities and TTOs in terms of patenting, licensing and spin-off activity based on formal IP (see Siegel and Wright, 2015 for a review), there is a need to develop convincing measures of success for these new forms of academic entrepreneurship activity. As the evolution of academic entrepreneurship has shown, *developing* such measures poses technical and institutional challenges. That is because the various actors involved in academic entrepreneurship seek to shape this activity, in order to meet their own goals, which may be at variance with those of policymakers and senior university management (Lockett, Wright and Wild, 2014). Such issues highlight opportunities to analyse the interactions between the actors involved in developing and implementing academic entrepreneurship using the lenses of institutional theory and institutional entrepreneurship (Battilana, Leca and Boxenbaum, 2009).

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What: emerging forms of academic entrepreneurship

Some have argued that we need to integrate technology and knowledge transfer into the curriculum and other university activities (Martin, 2012; Wright, 2013). This involves going beyond direct technology and knowledge transfer to encompass indirect aspects. University education and research may lead indirectly to entrepreneurial activity, such as subsequent start-ups and corporate spin-offs, once graduates have gained industrial experience. There is some evidence that the performance of these ventures exceeds those of university spin-offs, which suggests that they yield greater societal benefits (Wennberg et al., 2011, Siegel and Wessner, 2012).

Further, a notable shift beyond spin-offs based on formal IP, is an increased diversity of start-ups at universities (Shah and Pahnke, 2014), especially the rapid growth in student start-ups. These start-ups are typically less demanding, in terms of financing needs, but may require support to enable them to grow and create financial, economic and social value. An increasing trend among students is the breadth of venture beyond traditional commercial start-ups to include social ventures. There is increasing demand for specialized Masters Degrees for graduates from non-management disciplines who want to gain practical skills to shape and realize entrepreneurial opportunities they have identified. For example, a major component of the MSc in Innovation, Entrepreneurship and Management at Imperial College is the 'entrepreneurial journey' undertaken by students. Many universities (e.g., the University at Albany) now have a full-time MBA program in entrepreneurship, which is linked to the university TTO.

TTOs may have a role to play in supporting entrepreneurial skills development and industry interactions for faculty and student start-ups. In the traditional model of academic entrepreneurship, TTOs have focused mainly on patents and licenses and placed little emphasis on the entrepreneurial dimension of university technology transfer, including social

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entrepreneurship. Some preliminary evidence from the U.S. and Europe suggests that business schools can play an important role in accelerating technology commercialization and entrepreneurship when they integrate the business education curriculum with working with a university TTO (Wright et al., 2009).

One of the institutions in the vanguard of this movement is Johns Hopkins University (Phan, 2014). At Hopkins, students in the Carey Business School requires MBA students to take a Discovery to Market course, which involves a partnership with the Hopkins Tech Transfer Office to conduct a market analysis and commercialization plan for a university-based innovation. Other institutions in the U.S. where business schools work closely with the TTO include Oregon State University, Rensselaer, the University at Albany, University of Montana, and the University of Wisconsin-Madison. Universities in the U.S. and elsewhere are also developing 'entrepreneurial garages' providing space, resources and mentoring to facilitate student and alumni start-ups, in some cases integrated with curricula.

Evolution of these initiatives underscores the importance of analyzing the effectiveness of different configurations across universities and would add a new dimension to the landscape of incubators traditionally associated with entrepreneurship (Siegel, Westhead and Wright, 2003b, Barbero et al., 2014). Also, development of university support for different types of start-ups and the entrepreneurs involved in them requires appreciation of the different needs of commercial and social ventures. While recognition of the heterogeneity of these ventures is emerging (Mair, Battilana and Cardenas, 2012), understanding of the support needed for their emergence and sustainability lags behind especially in a university context.

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Who: broader range of actors involved in academic entrepreneurship

There are high opportunity costs of commercialization for academic entrepreneurs. Thus, there is a strong need for universities to adapt *promotion and tenure and remuneration systems* for academics so that commercialization activities are valued. The first major US university to explicitly reward commercialization in promotion and tenure was Texas A&M in 2006. Based on a survey of North American institutions, Stevens, Johnson, and Sanberg (2011) reported that the following 16 universities in the U.S. and Canada consider patents and commercialization in tenure and promotion decisions: Thompson Rivers University, University of Moncton, Northern Arizona University, Brigham Young University, Ohio University, University of North Carolina at Greensboro, George Mason University, University of Nebraska-UNeMed Corporation, Medical College of Wisconsin, Wake Forest University Health Sciences, Utah State, University of Texas Health Science Center Houston, Oregon State University, University of Saskatchewan, New York University, University of Illinois at Urbana-Champaign. Since 2011, the University of Arizona and the University of Maryland have also instituted such policies. At present, we lack systematic analysis of the effects of these changes to promotion and tenure mechanisms on both recruitment and performance. However, common sense dictates that having commercialization activities matrixed into the university's reward systems is likely to induce higher levels of academic entrepreneurship.

Another set of individuals who are important to attract and remunerate are TTO personnel with the appropriate *skills* to support emerging commercialization strategies. Traditionally, many TTO personnel have had a strong legal background, but are not well versed in the realm of entrepreneurship. Now that university's commercialization interests are being steered into the creation and development of start-ups by faculty and students, along with the presence of alumni and other industry partners on campus, TTO staff must know more than simply how to identify and protect

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intellectual property. Specifically, TTO employees need to understand key entrepreneurial concepts, such as opportunity recognition and exploitation, and must also possess additional commercialization and entrepreneurial skills.

In recruiting, incentivizing and assessing the performance of TTO employees the challenges posed by their dual agency nature in relation to the university and the academic entrepreneurs they serve has been recognized (Siegel, et al., 2003c). A wider set of dual or multiple agency issues also arise in relation to academics who take lead roles in spin-offs funded by venture capital firms or who engage in university-industry entrepreneurial collaborations while retaining their university role. In addition, the emergence of student start-ups also introduces new agency issues between students, the university and academics. While there are vertical principal-agent relationships between the academic and the university, the relationship between the TTO and the faculty is more of a horizontal agency relationship. Universities, TTOs and academics have different and conflicting objectives and cultures, but the involvement of venture capitalists and corporations adds a further layer of potential agency conflicts. In these contexts, further analysis is needed on how faculty, TTO, student and industry entrepreneurial collaborations can best be incentivized and facilitated.

Another unexplored dimension of individual involvement in academic entrepreneurship concerns the role of international collaborations among academics. Such collaborations may arise when doctoral students or visiting professors return to their home countries. While Murakami (2014) has highlighted the importance of returnee academics and the maintenance of international collaborative ties, this has not been extended to academic entrepreneurship. We know from the entrepreneurial mobility literature that returnee entrepreneurs can create a significant spillover effect that promotes innovation in other local high-tech firms in the home country of the returnee (Filatotchev et al., 2011) and that there may be some benefits from location of returnee entrepreneurs on university

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science parks (Wright et al., 2008). Returnee academic entrepreneurship adds a further dimension to entrepreneurial mobility but there is a lack of evidence on the benefits to host country universities that may arise from collaborations with entrepreneurs who return home after having graduated or completed a post-doc assignment. This is an important omission, given that many universities are attempting to increase their international profiles. For example, to what extent do host country universities and faculty promote and take stakes in returnee entrepreneurs' ventures? To what extent would such involvement both raise the profile of the university and help attract subsequent students and endowments from successful return entrepreneurs?

There has been some research comparing academic entrepreneurship between countries (e.g. Clarysse et al., 2005, 2007), but there has been limited analysis of internationalization and academic entrepreneurship. While entrepreneurial opportunities generated by innovative science may potentially have global markets, is the lack of commercial expertise among academic entrepreneurs particularly telling in international markets? Alternatively, are academics with worldwide research reputations better able to attract interest from global venture capital firms and multi-nationals? From the firm's perspective, this has important implications for whether there are different challenges faced by spin-offs from universities that seek to internationalize compared to regular commercial start-ups. By the same token, exploring the tension between a lack of international commercial expertise and an international research reputation opens up possibilities for improving our understanding of the drivers of internationalizing new ventures or newly-created global ventures.

Broadening of the stakeholders involved increases the complexity of formulating and implementing strategies for academic entrepreneurship. There are a variety of theories and concepts in organizational behaviour, organizational theory, human resource management, and ethics and social responsibility that have become salient as academic entrepreneurship has matured. As reviews of the literature have shown, most analysis of

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academic entrepreneurship has been based on a “macro” (institutional or firm) perspective (Rothaermel, Agung and Jian, 2007; Siegel and Wright, 2015).

A key implication of the evolution of this field is the need to apply more “micro” theories and concepts to this phenomenon, including theories of organizational commitment, organizational culture, and organizational justice (Greenberg, 1987). For instance, perceptions of justice held by academic entrepreneurs, with respect to their academic departments, colleges, and universities may influence their propensity to engage in this activity. This could include all conceptualizations of justice, including distributive, procedural, interactional, and deontic justice (Cropanzano, Goldman, and Folger, 2003). For example, procedural justice refers to the extent to which an individual perceives consistency, lack of bias, and fairness in the determination of his or her attained outcomes from the organization. The importance of procedural justice in relationships between entrepreneurs and their investors has been studied (e.g., Sapienza and Korsgaard, 1996; Sapienza, Korsgaard, Goulet, and Hoogendam, 2000), but the application of such an approach to academic entrepreneurship would present an opportunity to extend the theoretical boundaries to individuals operating in a traditionally non-commercial context.

Theories of organizational design and structure are also likely to be relevant in this context. For example, there have been several qualitative studies of the importance of organizational structure of university TTOs (e.g., Bercovitz, Feldman, Feller, and Burton, 2001) for academic entrepreneurship. However, there needs to be more research on the impact of differences in reporting relationships, “decentralization” of university TTOs, and other types of managerial practices within the university on academic entrepreneurship. To the best of our knowledge, theories of organizational commitment and organizational culture have not been applied in this context, except in the context of the importance of academic department chairs in stimulating this activity (e.g., Bercovitz and Feldman, 2008).

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Although the importance of pecuniary incentives for faculty members has been examined (e.g., royalty distribution formulas-see Lach and Schankerman, 2004); Link and Siegel, 2005), there has been no systematic analysis of the role of changes in promotion and tenure policies on the propensity of academics to engage in this activity. We also need additional research on the role of non-pecuniary incentives and specific human resource management practices in the TTO and on campus. For example, some universities have adopted incentive compensation for TTO personnel and have varied other key human resource management policies in the TTO. It might also be useful to examine specific human resource management practices and policies of property-based institutions, such as incubators and accelerators.

The lens of ethics and social responsibility has also become more important as commercialization and entrepreneurship expand on campus. A good example of this has been the university response to concerns regarding commercialization and global public health. Working through their TTOs, many universities have developed blockbuster drugs that are prohibitively expensive for consumers in developing countries. Richard Levin, the former President of Yale University, which was involved in a controversy surrounding an expensive drug it had helped develop, had this to say about the Bayh-Dole Act: “Congress did not intend to give us the right to maximize profits...it gave us private-property rights for a public purpose: to ensure that the benefits of research are widely shared.” Some universities have responded to this concern by developing socially responsible licensing programs (see Stevens and Effort, 2008), such as policies adopted by the University of California at Berkeley (see <http://ipira.berkeley.edu/socially-responsible-licensing-ip-management>).

Both micro and macro theories of ethics and social responsibility would seem to be applicable to all aspects of aspects of academic entrepreneurship beyond licensing (e.g., conflicts of interest that arise between academic entrepreneurs and their corporate or entrepreneurial partners and other obligations they have in their role as faculty members).

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How: modes for facilitating academic entrepreneurship

We noted earlier the dimensions associated with the development of university based entrepreneurial ecosystems to facilitate academic entrepreneurship. As new forms of academic entrepreneurship emerge, this ecosystem also needs to evolve. However, while there may be broad commonality of the principal elements, the configuration of these elements likely varies between universities and their contexts that are as yet not well-explored. Such contingencies are dependent upon factors such as the research strength of a particular university and spatial factors relating to the local environment (Autio et al., 2014). For example, the scope of the entrepreneurial ecosystem may differ for a university in a less-industrialized region, as compared to the ecosystem associated with a comparable university in a major metropolitan area.

A recent development of the ecosystem that complements but also challenges TTOs and traditional university incubators is the emergence of accelerator programs. Accelerators select promising entrepreneurial teams and provide them with pre-seed investment and time-limited support comprising programmed events and intensive mentoring (Clarysse, Wright and Van Hove, 2015). As the newest generation of incubators, the focus is less on space and more on assisting the ventures through their entrepreneurial journey. These accelerators typically operate early in the life cycle of a new venture. Some accelerators are focused on preparing the venture for the next round of venture capital. Others are focused on creating a local entrepreneurial ecosystem of new ventures, while some adopt a match-making model by facilitating links with lead users to create high growth ventures. While some university students and faculty have obtained places on accelerator programs, systematic integration of academic entrepreneurs with accelerators appears to be missing. At present, there is limited analysis of the extent to which the above new forms of accelerating technology commercialization by faculty and students are successful in enabling early stage ventures to emerge and grow (see Winston Smith and Hannigan, 2014). Further, we know little about the

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variety of accelerators and the nature and effectiveness of their links with universities.

There are also important questions regarding the governance of academic entrepreneurship activity. While there has been much attention to the links between university leadership, TTOs, departments and individuals regarding the drivers and constraints on academic entrepreneurship, there has been little attention to the role of university-level governance mechanisms. Specifically, the role of university boards (or University Councils in the U.K.) in developing the strategic direction of universities regarding academic entrepreneurship has not been examined. For example, in the U.K. system, University Councils are responsible for all financial matters and typically comprise senior university management and lay members, oftentimes with business experience and appointed by government. Academic affairs are the business of the university senate.

In the U.S., many state university systems have a Board of Regents or Board of Trustees. What role do members of these boards have in overseeing strategies and building university-industry links that facilitate academic entrepreneurship? How do variations in these governance structures, their compositions and the processes involved across different types of universities influence strategies for academic entrepreneurship? More fundamentally, to what extent does the development of academic entrepreneurship challenge the appropriateness of traditional governance structures and processes in universities? In public universities, especially, we know little about the role of public-private governance structures in overseeing and addressing potential conflicting objectives between academic entrepreneurship and more traditional university activities (Kivleniece and Quélin, 2012).

Much of the existing research has focused on the drivers of academic entrepreneurship based upon the characteristics of particular universities and their faculty. However, another feature of university entrepreneurial ecosystems concerns the mobility of academics to universities that may be

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more conducive to academic entrepreneurship. We know that hiring decisions mean that there is extensive faculty mobility between universities but there has been little research on the relationship between this movement and academic entrepreneurship. Research is needed on the benefits and challenges in incentivizing academics to move to more favourable ecosystems for academic entrepreneurship. Such research would augment existing studies of entrepreneurial mobility, which have traditionally focused on migration of entrepreneurs across countries (Aliaga-Isla and Rialp, 2013) or on organizational entrepreneurial mobility in the form of employee spin-offs (Agarwal, et al., 2004).

Taking a wider perspective of academic entrepreneurship that includes the indirect effects of universities in terms of start-ups by alumni, there is also a need to examine the extent to which graduates remain in the locality or move to another region to start a business. Evidence from studies of graduate employment shows that graduates having graduated in a weak region move to a strong region to get work and that graduates from better universities are more mobile (Faggian and McCann, 2009). At present, more fine-grained evidence on this employment-entrepreneurship choice, as well as on the comparative success of ventures created by graduates who do or do not move locality, is lacking.

CONCLUSIONS

We have argued that a juncture has been reached that requires us to rethink academic entrepreneurship. In our view, the debate regarding universities and academic entrepreneurship has relied too much on the research- third mission nexus and insufficient focus upon the teaching/education- third mission nexus informed by research. Consequently, there is a need to embrace greater variety in the extent and nature of academic entrepreneurship in the context of the changing role and purpose of universities.

Major questions remain regarding whether all universities should be

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involved in academic entrepreneurship and if so, how to be effective at this complex activity. This raises a series of issues related to strategy formulation and implementation at the university level and policy formulation and assessment at government level. It also opens up new areas of research in organizational behaviour, organizational theory, human resource management, ethics and social responsibility, as well as suggesting the greater importance of research on social networks in academic entrepreneurship. The psychological phenomenon of groupthink may also be relevant, as universities jump on the bandwagon to demonstrate to key stakeholders that they are earnest in their efforts to promote this activity. We have also shown that rethinking academic entrepreneurship has implications for entrepreneurship research at multiple levels of analysis. Specifically, we have identified the roles of ownership rights and incentives, the nature of incubators, entrepreneurial mobility and international entrepreneurship, and the use of procedural justice as a lens in academic entrepreneurship in opening up opportunities for theory development and new empirical analyses that will help enhance wider understanding of entrepreneurship.

In sum, we have shown that these developments introduce new questions that call forth a need for the incorporation of new theoretical perspectives in order to extend the research agenda on academic entrepreneurship.

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