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The "Second Academic Revolution": Interpretations of Academic Entrepreneurship

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ABSTRACT

The number and scope of faculty and institutions involved in academic entrepreneurship continues to expand, and this has significant implications for universities, involving potentially wonderful opportunities but also dire risks. This paper looks beyond academic capitalism, a theory that currently dominates the study of higher education, by introducing several other theoretical frameworks for interpretation of academic entrepreneurship: resource dependence theory, the Triple Helix model, and Mode 2 knowledge production. Acknowledging the fact that academic capitalism significantly furthers our understanding of academic entrepreneurship, I argue that these other conceptual propositions are constructive in enlightening perspectives on the various aspects of academic entrepreneurship, although as of yet no single work completely explains all facets of this complicated issue.

RÉSUMÉ

Le nombre et la portée de professeurs et d'institutions impliqués dans l'entrepreneuriat universitaire continuent à augmenter, ce qui a des conséquences importantes pour les universités en impliquant des opportunités potentiellement fantastiques, mais aussi de sérieux risques. Ce document va au-delà du capitalisme académique, une théorie dominant présentement l'étude de l'enseignement supérieur, en introduisant plusieurs autres cadres théoriques pour l'interprétation de l'entrepreneuriat académique: théorie de la dépendance des ressources, le modèle Triple Helix et le mode 2 de production de connaissances. Tout en reconnaissant le fait que le capitalisme académique éclaircit de façon significative notre compréhension de l'entrepreneuriat universitaire, je soutiens que ces autres propositions conceptuelles révèlent de façon constructive les perspectives sur les différents aspects de l'entrepreneuriat académique, même si, pour l'instant, aucun travail a lui seul n'explique complètement toutes les facettes de cette question complexe.

INTRODUCTION

University campuses are seeing unprecedented growth of academic entrepreneurship in recent years. The tendency to capitalize knowledge is indicated by the dramatic increase in patent activity, which more than doubled during the 1990s, at American universities (OECD, 2000). Also, "An increasing number of academic scientists have taken some or all of the steps necessary to start a scientific firm by writing business plans, raising funds, leasing space, and recruiting staff" (Etzkowitz, 1998, p. 823).

Deemed as the "second academic revolution" (Etzkowitz & Webster, 1998, p. 39), academic entrepreneurship has significant implications for universities involving potentially superb opportunities but also dire risks. Academic entrepreneurship places newfound importance on economic and social development, thereby affecting established academic missions of teaching and research. There is a critical need to examine this phenomenon in order to harness and direct its development. At present, the understanding of academic entrepreneurship in the field of higher education is dominated by the theory of academic capitalism. While acknowledging the fact that academic capitalism is a powerful theory and significantly illuminates our understanding of academic entrepreneurship, I believe it is important to examine the issue from additional perspectives as well. This paper offers supplementary evidence and introduces several theoretical frameworks for interpretation of academic entrepreneurship: academic capitalism, resource dependence theory, the Triple Helix model, and Mode 2 knowledge production. I argue that each illuminates various aspects of academic entrepreneurship although as of yet no single work completely explains all facets of this complicated issue.

Dramatic Growth of Academic Entrepreneurship

The term academic entrepreneurship is used among a group of scholars who study the changing role of the university in the new economy. I adopted the expression to refer to faculty, staff, and student activities and behaviours that capitalize knowledge. Other researchers prefer different terms, such as academic capitalism and academic commercialization. These terms may vary connotatively, but they all give the impression of assuming the breaking down of the boundaries between the academia and other sectors of society, specifically industry and government.

Overwhelming evidence indicates that the university is now more than ever integrated with the economy (Etzkowitz, 1999; Slaughter & Rhoades, 2004), and is growing stronger as an entrepreneurial institution (Etzkowitz, 2003, 2004). An indication of this is the dramatic increase in patent activity at universities. United States universities more than doubled their patent productivity during the 1990s (OECD, 2000). University licensing also expanded. The Association of University Technology Managers (AUTM) reported that the 158 universities in their survey granted 3,000 licenses based on patents to industry in 1998, up from 1,000 in 1991 (Florida & Cohen, 1999). Gross licensing income from university technology transfer grew from $121 million to $1 billion in 2000, a 700 per cent increase (Powers & Campbell, 2003). In Canada, the distinct nature and scale of the integration of universities with the economy is reflected in the upward trend in industry's support for academic research. For example, whereas university research and development funded by industry was 4.2 per cent in 1985, it increased to 11.6 per cent in 1997 (Crespo & Dridi, 2007).

A special and relatively new form of such entrepreneurship is the creation of spin-off firms or start-up companies. About 3,376 university spin-offs were founded in the United States between 1980 and 2000 (Pressman, 2001). While small in number, these firms nonetheless yield important benefits to the academic institutions that spawn them as well as to the larger society. For example, a study conducted by BankBoston estimated that if the companies founded by MIT faculty and graduates formed a nation, the sales of these companies would rank that nation the 24th largest economy in the world (1997). Considered the institutional centre of the dynamic high-tech firm cluster of the Waterloo region, the University of Waterloo has initiated over 250 spin-offs, which has had a considerable impact on the local economy (Bramwell & Wolfe, 2008). Some of the most prominent companies, such as Genentech, Lycos, and Digital Equipment Corporation, started as university spin-offs. In frontier and technology-intensive industries, university spin-offs are often the dominant types of companies. These firms are generally highly successful and significantly more likely than other kinds of companies to go public (Shane, 2004).

Global Knowledge Economy

The revolutionary changes in academia's relationship with the market and economy should be understood in the context of global knowledge economy. Academia and business have come to work more closely together partly in response to the changing nature of the economy (Fairweather, 1989). Since the late 1980s, knowledge has emerged as the key ingredient in economic growth. The dynamic of economies has become increasingly related to the creation, distribution, and application of knowledge (OECD, 1996). In major OECD countries, knowledge-based production and service was reported to account for over half the gross domestic product (OECD, 1996).

A knowledge-based economy is characterized by a need for continuous innovation, which is in turn dependent on advances in science and technology. Partnerships between government, industry, and universities are indispensable to fostering innovation. Today, "the linkage between industry and science and diffusion of knowledge within national innovation systems are emerging as a primary focus for innovation policy" (OECD, 2004, p. 14). All OECD countries, and many others, are emphasizing collaboration between the science and the industrial sectors. In Canada, in an effort to more actively engage universities in innovation, the federal and provincial governments have developed a number of policies and programs to encourage collaboration between university and industry. For example, following the Bayh-Dole Act of 1980 in the United States, Canada published the Fortier Report which recommends that universities own the intellectual property rights generated from publicly funded research on the condition that every reasonable effort is made to convert their discoveries to useful products or services. Other initiatives include a program established by Prime Minister Mulroney in the early 1990s to promote industrial support for academic research and development and to strengthen partnerships between universities and the corporate sector.

Impacts of Academic Entrepreneurship on University and Faculty

Evidence indicates that academic entrepreneurship that aligns with the university's goals enhances the faculty's mission of research and teaching. For example, a survey

of over 1,200 biotechnology faculty members at 40 of the most research-intensive universities conducted by Blumenthal and his coauthors reveals that biotechnology faculty with a reasonable amount of industrial support published more, patented more, and were more actively involved in administrative and professional activities than their colleagues without industrial funding, even though there was no difference in their teaching load and other academic commitments (Blumenthal, Gluck, Louis, Stoto, & Wise, 1986). A survey conducted in 1994–95 of 2,052 life science faculty members found similar results (Blumenthal, Causino, Campbell, & Louis, 1996).

The Carnegie Mellon Survey (1994) suggests that partnerships with industry significantly contribute to academic research and development. The study reports that university-industry research centres spent a total of $4.12 billion in 1990 $2.53 billion of which went to research and development. To put this in perspective, the total research and development expenditures of the National Science Foundation in 1990 were $1.73 billion (National Science Foundation, 1993). The Carnegie Mellon Survey also provides evidence that a university's ties with industry help to support and train students, increase funding for academic research, and expose faculty to different intellectual perspectives (Cohen, Florida, & Goe, 1994).

From 1980 to 1999, American university spin-offs generated $33.5 billion in economic value added (Cohen, 2000). Individual case studies suggest the indirect effects of spin-offs on local economic development have been even larger. For example, Goldman found that 72 per cent of the high-tech companies in the Boston area in the early 1980s were based on technologies originated from MIT laboratories (1984).

Growing academic entrepreneurship has raised doubts and concerns; some academics now see the once deemed too-distant relationship between academia and government as too close (Cohen & Florida, 1998). Evidence appears to indicate that industrial sponsors are able to influence the direction of academic research agendas. Sixty-five per cent of university-industry research centres in the Carnegie Mellon Survey reported that industry exerts a "moderate to strong influence" over the direction of their research agenda (Florida & Cohen, 1999). Blumenthal et al. (1996) found that relationships between industry and universities tend to be short in duration and limited in size, which suggests that the research involved is generally applied rather than fundamental.

Even greater concerns revolve around the challenge to traditional academic values and norms posed by what Slaughter and other researchers called "academic capitalism," concurring with increased involvement with other sectors (Slaughter and Leslie, 1997; Slaughter and Rhoades, 2004). Traditionally, the social structure of the academic community was shaped by fundamental norms that expect unfettered and disinterested pursuit of truth, and free and open sharing of knowledge (Merton, 1942). Evidence suggests however, that these norms are being eroded as academic science moves closer to the commercial sector. According to Blumenthal and coauthors (1996), 82 per cent of the 306 life sciences companies in their survey sample require academic researchers to keep information confidential to allow filing of patent applications. More than half (56 per cent) indicated that their firms typically require academic partners to keep information confidential. Serious concerns over the threat to core academic missions and academic values have led prominent academic leaders and scholars to speak out. One of the most eloquent voices, former Harvard president Derek Bok, warns that academic commercialization can interfere with the basic cannons of scientific inquiry

in several important ways. For one, personal financial interest threatens to distract some researchers from exploring more intellectually challenging problems. Also, the practice of secrecy erodes trust among members of the academic community and is counter-productive to the advance of knowledge and science (2003).

The Theory of Academic Capitalism

The term academic capitalism was first adopted by Slaughter and Leslie in their 1997 book, *Academic Capitalism*. Slaughter and Rhoades developed the concept into a theory in their 2004 book, *Academic Capitalism and the New Economy*. By their definition, academic capitalism refers to "institutional and professional market or market-like efforts to secure external funds" (Slaughter & Leslie, 1997, p. 209). The external funds were usually under the name of research grants, contracts, and partnerships with industry and government (1997).

Although the definition of academic capitalism remained the same, there is a shift of conceptual focus in Slaughter and Rhoades' 2004 work. Previously, Slaughter and Leslie highlighted the "encroachment of for profit motive" into the academy (1997, p. 210). Slaughter and Rhoades emphasized the "internal embeddedness of profit-oriented activities" by higher education institutions and their faculty (2004, p. 11). The initial concept of academic capitalism derived its theoretical rationale mainly from the resource dependence theory. In this framework, colleges and universities as institutions distinct from state and corporations are "pushed and pulled" toward academic capitalism (1997, p. 211). Academic capitalism is a result of reaction to external pressure because organizations reflect and take on characteristics of their principle resource providers. Consequently, it is increasingly difficult for colleges and universities to maintain autonomy. In their 2004 book, however, Slaughter and Rhoades claimed that the academy is no longer a passive entity merely acted upon by corporations and other external market forces, but rather the state-subsidized entrepreneur that "initiate[s] capitalism" (Slaughter & Rhoades, 2004, p. 12). In this latter case, aggressiveness and embeddedness of profit-motivated behaviours and practices are emphasized. The drive to actively generate external resources comes from within. Slaughter and Rhoades claimed that, although resource dependence is still an important factor in the mix, it only reinforces academic capitalism and does not cause it.

Thus, while early accounts of academic capitalism point to the difficulty academic institutions have in maintaining autonomy, more recent theories of academic capitalism stress the expanding power and boundaries of the academy through networking. Now, as Slaughter and Rhoades contend, instead of being encroached upon by external market forces, academic entrepreneurs invite the corporate sector inside. They argue that academic constituents aggressively engage in, and sometimes initiate, the capitalization of knowledge, exploiting a variety of state resources to take advantage of opportunities opened by the new economy.

The theory of academic capitalism argues that higher education institutions, through the process of integrating with the new economy, are displacing the knowledge regime of public good with that of academic capitalism, in which knowledge is treated as commodity (2004). The academic capitalism knowledge regime emphasizes knowledge privatization and economic interest, in which individual institutions, faculty, and firms have claims that come before those of the public.

Further, Slaughter and Rhoades noted that the entrepreneurial activities of faculty, administrators, students, and managerial professionals lead to the creation of new circuits of knowledge that integrate the university with the new economy; the emergence of network organizations that bring the industrial and governmental sector into the university; the establishment of intermediate organizations among public, non-profit, and for-profit organizations; and expanded managerial capacity, which facilitates new flows of external resources (2004). Under this theory of academic capitalism, knowledge is not communicated primarily within the intellectual community, but flows across other sectors of society. Organizations are created in niches within established colleges and universities. These entities link together different players with common interests to better capture opportunities created by the new economy.

Also, individuals and institutions involved in the academic capitalist knowledge regime operate in networks that serve as intermediates between public, non-profit, and private sectors (Metcalfe, 2004). These intermediating networks allow representatives of public, non-profit, and private institutions to collaborate on concrete problems, thus redefining the boundaries between the public and private sector. As knowledge capitalization expands, stronger managerial capacity in colleges and universities becomes necessary to facilitate university integration into the new economy; this commitment facilitates even further academic capitalism.

As Slaughter and Rhoades point out, several fault lines exist in academic capitalism. First, academic capitalism blurs the boundaries between the public and private realm, while individual faculty and institutions who engaging in academic capitalism receive a substantial level of public support. Also, academic capitalism reshapes the public arena in such a way that it gives special prominence to market logic and behaviour while using public monies for various for-profit activities. Moreover, academic institutions are often not successful capitalists. Undesirable outcomes of failed entrepreneurial initiatives affect students and the public who have to shoulder much of the cost. Finally, as higher education institutions move to intersect the global information network and market for increased revenue, their distinctive commitment to local communities declines.

The Resource Dependence Theory

One of the explanations of academic entrepreneurship is based on resource dependence theory (some prefer the term utility maximization). This conceptual framework assumes that academic entrepreneurial activities are motivated by the necessity of securing research dollars. According to this theory, organizations rely on key resources to support their continued operation. When critical resources are scarce, members of organizations engage in constant competition and often turn to alternative sources (Pfeffer, 1994).

Although absolute federal research and development spending for colleges and universities has increased since the 1980s (Hatakenaka, 2002), available federal funding per academic researcher has declined (Cohen & Florida, 1998). This coincides with the growing cost of conducting research and the increased competition for federal support. The shortfall in funding has led to the deterioration of research facilities and equipment, and threatens to compromise the quality of academic programs (Fairweather, 1989). In the resource-dependence line of reasoning, academic institutions are strongly motivated to seek alternative external sources of support. This is consid-

ered necessary to maintain and improve quality in teaching, and especially to further research. External research funding allows institutions to upgrade their research infrastructure and to give more support to junior faculty members' research (Lee, 1996). Opportunities for industrial funding, in this context, seem to represent the greatest hope for obtaining additional resources (Fairweather, 1989). In addition, the association between research and prestige is compelling. Many institutions now place increasing emphasis on research based on external funding (Brewer, Gates, & Goldman, 2002; Feller, 1990), which has become "a benchmark for measuring progress on the ladder of prestige" (Fairweather, 1989, p. 393). The need for research funds has also motivated some academics to start their own companies to create an independent financial base to fund their own research (Etzkowitz, 1999).

The Triple Helix Model

Etzkowitz and Ledesdorff (1998) put forward the Triple Helix model, in which the three major players in knowledge economy – government, industry, and the university – integrate while remaining independent from one another. In this model, the university is elevated from a subordinate role to a full partner with government and industry. In the course of interactions with the other two sectors, the university is transforming itself into an entrepreneurial organization. Etzkowitz calls this on-going process, the second academic revolution (Etzkowitz and Webster, 1998).

According to Etzkowitz and Leydesdorff, the Triple Helix model builds upon the traditional linear model by incorporating into it interactive and recursive factors (Etzkowitz and Leydesdorff, 1998). The linear model is premised upon separation of institutional spheres: this assumes a one-way flow of knowledge across distinctly defined boundaries from basic to applied research, and finally to product development. In contrast, the Triple Helix model postulates that knowledge flows in two ways. In this framework, the three strands – university, industry, and government – interact with one another recursively: each may relate to the other two. Thus, it denotes a knowledge infrastructure in terms of overlapping institutional spheres, with each assuming the functions that were formerly the province of the other, and hybrid entities formed at the interfaces (Etzkowitz & Leydesdorff, 2000).

The Triple Helix model "provides us with a heuristic method for studying the complex dynamics in relation to developments in the institutional networks among the carriers" (Leydesdorff & Meyer, 2006, p. 1441). While university, industry, and government are identified as the major institutions of the knowledge infrastructure, bilateral as well as trilateral relations are implicated (Leydesdorff & Meyer, 2006). Further, a dual-layered network is involved: one layer of institutional relations and another layer of functional relations. "When institutional differentiation is added to the functional differentiation in the exchange, the theoretical specification becomes one step more complex than before" (Leydesdorff, 2005, p. 10). The Triple Helix model reduces the complexity of the dynamics at play in the innovation systems of knowledge economy while providing a tool to relate the different perspectives.

As Leydesdoff and Meyer pointed out, the Triple Helix model has sometimes been regarded as "a plea for blurring the boundaries between universities, industry, and government" (2006, p. 1447). It is worth noting that the model equally emphasizes differentiation of functions among the institutions. It is the position of Leydesdorff that

the key institutions in innovation systems "do not have to be completely integrated nor completely differentiated" (Leydesdoff, 2005, p.10). Rather, the tension between integration and differentiation engenders new development.

Closely related to the thesis of structural integration and functional differentiation is the emphasis on changes at the interfaces between university, industry, and government, as well as internal transformations within each of the institutions. Under the Triple Helix model, the institutions involved are continuously reforming as they expand their functions. While some may see the transformations caused by the dynamics of emerging networks as the loss of traditional identity, Leydesdorff interprets it as "creative destruction which entails the option of increasing development" (Leydesdoff, 2005, p. 13).

Consistent with the notion of creative deconstruction, Etzkowitz contended that the entrepreneurial university is the latest phase in the progression of the higher education institution, in which the university takes on a new mission that represents a controversial departure from traditionally accepted functions of the institution. Capitalization of knowledge is the essence of the new mission that brings the university closer to users of knowledge and positions it as an economic player in its own right (1998). "The capitalization of knowledge becomes the basis for economic and social development and, thus, of an enhanced role for the university in society" (2004, p. 66). Under the entrepreneurial university model, knowledge is generated and communicated for practical applications as well as for advances of the theoretical disciplines. The effective entrepreneurial university carries on an interdependent relationship with the other social sectors while at the same time maintaining its independence. The necessity of maintaining a balance between interdependence and independence has led to the emergence of hybrid organizational formats that attend to the dual objectives. Along the blurring boundaries of university and the industrial sector, there exists two-way flow of influence. Meanwhile, as their relationships to government and industry changes, the internal structure of the entrepreneurial university also goes through renovation.

As Etzkowitz (2003) sees it, the incorporation of economic and social development into the academic mission calls into question the fundamental purpose of the university, just as the discovery of new knowledge, when first introduced, had challenged the tradition of the university being an institution to preserve and distribute knowledge. Although tension between research and teaching persists to this day, fulfilling both missions together has proven to be more beneficial overall. The debate we are currently involved in regarding the incorporation of economic and social development into the established academic functions somewhat reflects the first academic revolution. Various conflicts and problems arise from this new marriage, including restructuring the way traditional missions are carried out. It is Etzkowitz's position that new rules can be negotiated and conflicts can be managed much as they were during the first academic revolution, and that eventually the new mission of economic and social development will be "integrated into the university as research was integrated with teaching in an earlier era" (Etzkowitz, 2004, p. 76).

Mode 2 Knowledge Production

Michael Gibbons and his coauthors propose that a new form of knowledge production has emerged: they have named this Mode 2, as distinguished from the traditional

Mode 1. In contrast to Mode 1, in which the generation, application, and exploitation of knowledge are carried out separately, Mode 2 emphasizes the close integration of discovery, application, and use of knowledge.

According to Gibbons and his colleagues, the new mode produces knowledge in the context of the application, tackles problems that transcend disciplinary boundaries, and operates in non-hierarchical, heterogeneously organized structures. It involves an extended set of criteria in quality control and tends to be more socially accountable. Mode 2 is not projected to replace but rather to complement Mode 1. Some of the most important attributes of Mode 2 knowledge production include the following.

The Context of Application

In the traditional Mode 1, a practical goal is not necessarily an indispensable part of knowledge production. In Mode 2, by contrast, the imperative of being useful to someone is present from the beginning. Unlike Mode 1, in which research is guided mainly by the intellectual interests of a particular scientific community, problem solving in Mode 2 evolves around a particular application. As a result, "knowledge is always produced under an aspect of continuous negotiation and it will not be produced unless and until the interests of various actors are included" (Gibbons et al., 1994, p. 4).

Transdisciplinarity

The conduct of research in the context of application means that knowledge production can no longer be confined within the disciplinary framework. Operating in the context of application makes it necessary to draw upon knowledge resources from various disciplines and configure them in ways that best solve the problem in hand. "Transdisciplinarity is the privileged form of knowledge production in Mode 2" (Gibbons et. al., 1994, p. 27). In the traditional Mode 1, knowledge production is discipline-based, which implies a separation between fundamental theory construction and application of knowledge that already exists. In contrast, the solution to problems in Mode 2 integrates theoretical advances as well as practical progress: the assumption that fundamental discovery precedes practical application no longer applies. The guiding theoretical framework is generated and perfected in the context of application and crosscut through well-established disciplinary cores. Accordingly, research is organized, results diffused, and outcome evaluated all in such a manner that transcends the boundaries of disciplines.

Heterogeneity and Organizational Diversity

Flexibility and communication are crucial in the organization of problem solving. Consequently, low hierarchical structures are created to organize the production of knowledge. In Mode 2, research units are generally not as firmly institutionalized as in Mode 1. People with diverse expertise and experience are brought to work together on a problem in teams until the mission is accomplished.

Social Accountability and Reflexivity

Mode 2 is characterized by a considerable element of public influence in the definition and solution of problems, as well as the evaluation of performance. At the same

time, the scientific community exhibits a marked sensibility to the broad implications of their activities. As the public becomes increasingly educated about the potential impact of scientific advances and technological innovation, more people desire to have a voice on the knowledge production agenda. As a result, social accountability is embedded in the Mode 2 knowledge production process from defining the problem and setting the research agenda to interpreting and diffusing the results.

The context of application in Mode 2 nurtures reflection on the part of scientists and other participants involved; thus, the entire process is infused with sensitivity to the impact of the research. Problem solutions necessarily incorporate considerations for their implementation that "are bound to touch the values and preferences of different individuals and groups that have been seen as traditionally outside of the scientific and technological system" (Gibbons et al., 1994, p. 7).

Quality Control

In Mode 1, quality control is affected by a select group of peer reviewers who decide by consensus what problems are important, what methods are preferred, and who is qualified to pursue the solutions. Selection criteria for problems to solve primarily reflect the intellectual interests and major concerns of a particular discipline and its leaders: problems chosen are usually judged to be of crucial importance to the advance of the discipline. In Mode 2, however, the disciplinary criterion of scientific excellence is not sufficient in setting the research priorities. The transdisciplinary nature of the model dictates that additional criteria be applied, incorporating the interests of the intellectual community as well as those of the broader society. Unlike Mode 1, in which the definition of success is based on the standard of a few disciplinary gatekeepers, the meaning of success in Mode 2 satisfies a broader set of criteria and is determined not only by the contribution made to the overall solution of transdisciplinary problems, but also by efficiency and usefulness.

Mode 2 is significant since it renders new meaning to technology transfer, which heretofore had been assumed to be a linear process in which knowledge flowed one way from the university to the other sectors. As the problem-based context makes distinctions between science and technology and basic and applied science less relevant, technology transfer becomes a more integrated and interactive activity in which knowledge flows in two ways. As Gibbons and his co-authors illustrated, Mode 1 is like a relay race in which knowledge is transferred from university to industry the way one runner passes the baton cleanly to the next. In contrast, Mode 2 resembles a soccer game in which the ball is passed back and forth repeatedly among the players: to score requires co-operation of all teammates. In a similar fashion, scientists, engineers, and other professionals from diverse institutions and disciplines are organized to solve particular problems that involve both theoretical ideas and practical procedures. Different institutions, be it academic, industrial, or governmental, are members of the team. The focus is on the problem, and collaborative endeavour rather than individual performance is emphasized (Gibbons et al., 1994).

Contributions of Different Theories

Based on my knowledge of the literature, I conclude that each of the theories described above brings to the table a distinct perspective on the phenomenon of aca-

demic entrepreneurship. The combination of these theoretical propositions illuminates our understanding of the subject more than any one particular theory by itself, and therefore enables us to achieve a more comprehensive view of the various aspects of academic entrepreneurship.

Compared to other theories, the theory of academic capitalism adopts a more individualistic approach. Instead of treating the university as a single and bounded entity, the basis of this theory devotes more attention to subunits and various groups within the institution. Also, the bulk of literature related to the subject focuses mainly on research functions and research universities that increasingly develop partnerships with industry and government. With a focus on revenue generation from marketing educational products and services, the works of academic capitalism make an effort to address undergraduate education as well as other aspects of academic commercialization.

Perhaps more than other theories, academic capitalism brings to our attention the negative impacts of academic commercialization. In particular, it points out that market orientation has led universities and faculty to put institutional, group, and individual interests before those of the public. As a result, the nature of higher education as a public arena is undermined.

Resource dependence theory recognizes the challenges facing higher education institutions caused by the decline of available federal funding and the increased cost of research. The theory helps us understand why an increasing number of universities and faculty have turned to industry for alternative resources and why more academics are motivated to start their own companies to cultivate an independent base of financial resources for their research enterprises (Etzkowitz, 1999).

Research dependence theory also highlights the element of competition for prestige. From this perspective, universities compete with their peer institutions for research dollars, prominent faculty, and high-quality students to achieve academic excellence (Powers, 2003). Such competition is especially intense among institutions that are ambitious for higher prestige. Scholars of this view believe that annual rankings by high profile newsmagazines such as *U.S. News & World Report* have contributed to this culture of competition (McDonough, Antonio, Walpole, & Perez, 1998). As the environment becomes increasingly competitive and market-like (Zemsky, Shaman, & Iannozzi, 1997), research universities are developing a cultural environment in which securing external funding is an ongoing responsibility (Mendoza & Berger, 2003). They realize that state and federal funding are insufficient to pursue the margin of excellence and that "the institutions themselves had to take ownership of their own revenue stream. They had to raise money, and they had to push their grants and contracts to the outside limit and they had to make relationships with industry and business" (Buchholz, 2002, p. A1).

As Leydesdoff pointed out, although the phenomenon of a triple helix interaction can be found as early as the second half of the 19th century, "the codification of network mode as a regime of university-industry-government communications is of rather recent date" (2000, p. 252). The Triple Helix model provides a macroscopic view of university relations with industry and government, allowing us to perceive the evolvement of academic entrepreneurship in historical as well as current political and economic contexts. The model offers a framework that vertically interprets the evolving intertwined relationship between the university, industry, and government; and horizontally interprets the change at the interfaces between the three sectors as

well as the transformation within each of them, especially the university. In contrast to the theory of academic capitalism, the Triple Helix model regards the university as an equal partner with government and industry. This premise leads to the assertion that university relations with other sectors are both interdependent and dependent, and, therefore, not only do industry and government have influence on the university, but the reverse is true as well.

The Triple Helix model yields an optimistic and novel perspective of the tensions caused by the rise of academic entrepreneurship. The basis of this theory contends that tensions along the boundaries of different sectors are necessary conditions for further development. The three spheres (university, industry, government) neither have to completely integrate, nor fully differentiate. Also, the tensions caused by the addition of the mission of economic and social development are growing pains and can be managed.

Mode 2 underscores change in the nature of science and research enterprise. The notion that knowledge production is changing "struck a chord of recognition" among academic researchers as well as policy makers and other professionals (Nowotny, Scott, & Gibbons, 2003, p. 179). The expression "Mode 2" is popular and widely cited among researchers and people of other backgrounds illustrating the influence of this concept.

While Mode 2 does not directly address academic entrepreneurship, it sheds light on the internal mechanism underpinning the phenomenon. Academic capitalism emphasizes the internal embeddedness of profit-seeking orientation within the academic community. It suggests that academia's aggressive involvement in academic capitalism is driven by the inner motive to pursue economic interest. Resource dependence theory, on the other hand, highlights the need to secure support, which dictates academia's interactions and integration with other sectors of society, especially industry and government. Mode 2 offers a new way to approach the issue, implying that, to a certain extent, academic entrepreneurship is endogenous to the new way knowledge is produced.

Mode 2 endows technology transfer with new meaning. Characterized by integration and interaction, the new mode of technology transfer constitutes the internal mechanism inherent in the new mode of knowledge production that fosters academic entrepreneurship. As the boundaries between different disciplines break down and distinctions between fundamental and applied science diminish, academic scientists collaborate more closely with each other and with their industrial or governmental partners as necessary for the definition as well as the solution of problems. The interdependence of academia, industry, and government in this respect are exemplified in such fields as electronics, computers, life sciences, and molecular biology. In three decades, for example, under the auspices of the federal government, the collaborations between university and industry have given rise to a brand new discipline as well as an entire new industry of biotechnology (Powers & Campbell, 2003).

CONCLUSION

The high stakes in academic entrepreneurship and the tremendous challenges it poses to the academic community is powerfully illustrated in Harvard's well-known policy reversal to pursue research profit. In 1982, weighing the benefits and risks of university partnership with industry, and struggling with the decision about whether the university should assist faculty in their formation of spin-offs firms, Derek Bok, President of Harvard University, concluded that the financial returns, being largely

uncertain, were not worthy of risking the dangers to academic science (1982). On 15 September 1988, however, the *New York Times* reported that "in an important policy reversal, Harvard University has decided to raise money for investments aimed at bringing faculty members' research to the marketplace and making a profit for the school" (42, p. A21).

In spite of the assertion that academic entrepreneurship is not inexorable, in reality the number of academics involved in entrepreneurial activities continues to increase. Academic entrepreneurship redefines the purpose of the university through taking on the new mission of economic development. It involves both wonderful opportunities and dire risk. The effort to have more control over the future of higher education begins with understanding of the phenomenon. This paper represents a small step in this direction.

As the ship of academia sails into an uncharted domain, it is the obligation of all of us who care about higher education to offer what we see from our standpoint, experience, and knowledge to help with the navigation. What is at stake is colossal, and we cannot afford to voluntarily limit our views to one or two perspectives without taking into consideration the perspectives of others. Rather, it is imperative that we find as much information as we can and seek as many insights as possible to safeguard a smooth sailing and a sound trip.

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