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The entrepreneurial society & the role of the University

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1 Introduction

Universities are now widely recognized by public policies throughout the leading developed countries as being crucial for contributing to economic growth, sustainable employment creation, and competitiveness in international markets. The policy mandate for universities as an engine of economic growth has only recently emerged. The purpose of this paper is to explain how and why the role of the university in the economy and society has evolved considerably, and why it has emerged as a key institution facilitating economic development and growth in the era of globalization.

In the second section of this paper, the role of the university during the era of what has been termed as the *managed economy* is explained. In the managed economy, the university seemed to be largely peripheral and tangential to economic goals. By contrast, the third section of this paper explains why the university emerged as a key source for knowledge in what has been termed as the knowledge economy. The fourth section explains why investment in research and the creation of knowledge does not automatically spill over to generate innovative activity and ultimately economic growth. Finally, in the last section of this paper a summary and conclusions are provided. In particular, the public policy mandate for the university in the entrepreneurial society is not just to generate new knowledge and ideas but also to facilitate their spill over from the universities and contribute to the formation of entrepreneurship capital.

2 The University in the Managed Economy

The managed economy characterizes a historical era when economic growth, employment creation and competitiveness were shaped by investments in physical capital such as factories, machinery and plants. According to the Nobel Prize winner, Solow (1956), the driving forces underlying economic growth in what became known as the Solow model consisted of two key factors of production ñphysical capital and (unskilled) labor. Solow did point out that most of economic growth remained unaccounted for in his model. In fact Solow attributed to the unobserved factor of technical change, which was characterized to “fall like manna from heaven”.

The neoclassical growth model was econometrically verified in a vast number of studies linking measures of economic growth to the factors of physical capital and labor. According to Nelson (1981, p. 1032), “Since the mid-1950s, considerable research has proceeded closely guided by the neoclassical formulation. Some of this work has been theoretical. Various forms of the production function have been invented. Models have been developed which assume that technological advance must be embodied in new capital. Much of the work has been empirical and guided by the growth accounting framework implicit in the neoclassical model”.

There did not seem to be much of an economic contribution that a university could make in a capital-driven economy. The major activities and focus of universities ñ research and education ñ did not seem to be relevant in either generating physical capital or increasing the availability of unskilled labor for industry.

Rather, it was in the social and political realms that the universities could contribute during the era of the managed economy. The university was an institution preparing young people to think freely and independently, and where the fundamental values of western civilization and culture were passed down from generation to generation.

American universities had evolved from being extensions of religious institutions to effective independent institutions of higher learning by the twentieth century. The earliest colleges founded in the United States, such as Harvard College, were burdened with explicit ties to the church. In fact, the church played a fundamental role in creating and sustaining institutions of higher education during the early years of the country. The sponsorship and support of universities by the church was more the norm than the exception, and had been established as the norm for higher education in Europe.

The historical and institutional linkage between the church and the university was disrupted by Alexander Humboldt in Berlin during the 1800s. In particular, Humboldt triggered a new tradition for universities centering on freedom of thought, learning, intellectual exchange, research and scholarship as the salient features of the university. As the Humboldt model for the university diffused through first Europe and subsequently to the other side of the Atlantic, universities became free from parochial constraints, leading instead to the non-secular university committed to independence of thinking, learning and research.

Thus, the Humboldt tradition for the university was reinforced during the managed economy, with the emphasis on physical capital and unskilled labor as the twin factors shaping economic performance. Despite the preeminent contributions to social and political values, the economic contribution of universities was modest.

3 The University in the Knowledge Economy

The stagflation characterized by the twin problems of inflation and unemployment starting in the 1970s ushered in the demise of the managed economy. Both scholars and policy makers began to turn towards a new source of economic growth, employment creation and competitiveness – knowledge. The primacy of knowledge and innovation became the salient feature of the endogenous growth models (Romer, 1986, 1994; Lucas Jr, 1988). The main advancement of the endogenous growth models was that the factor of knowledge became explicit in the growth model. While knowledge, or technological change, entered the Solow model only as an undetermined residual, in the endogenous growth models knowledge was not only a key factor driving economic growth, but it was also explicitly included in the model. Not only did knowledge drive economic growth, it is particularly potent because of its inherent propensity to spill over from the firm or university creating that knowledge to other firms and individuals who could apply that knowledge.

In fact, some American colleges and universities were thrust in the role of directed research with specific and concrete commercial applications as the goal. In an effort to stem the tide and ultimately win the Second World War, the United States Government turned to a number of American colleges and universities to produce innovative technological based weapon systems. This partnership between the federal government and the universities was so fruitful that it contributed a significant role in the ultimate victory by the allies.

One of the engineers who had played a key role in the development of the nuclear bomb, Vannevar Bush, argued for an expanded role for universities once the peace had been won. In his book, *Science: The Endless Frontier*, Bush (1945) provided a mandate for sustained involvement and investment in science, technology and research by the United States federal government to ensure that the United States would not just win the war but also the peace.

In fact, the deviation from the traditional role afforded by the Humboldt model of the university that came about from the Second World War was supported by an even older tradition which oriented the land grant colleges and universities towards commercialization established by passage and implementation of the Morrill Act. The Morrill Act, which was more commonly known as the Land Grant Act, was signed into law by Abraham Lincoln in 1862, and granted land to each state that was to be used in perpetuity to fund agriculture and mechanical colleges benefiting the state. As they evolved, the land-grant universities developed an effective set of institutional mechanisms that enabled the commercialization of science and technology from the land grant universities that contributed to agriculture in the United States becoming the most productive in the world (Audretsch, 2007).

As the knowledge economy replaced the managed economy, or as the factor of knowledge became more important while the role of physical capital receded, the role of universities in the economy shifted from being tangential and marginal to playing a central role as a source of knowledge. Universities in the United States became not just viewed as institutions promoting social and cultural values but as key engines driving the growth of the economy. In the Solow economy, where economic growth was achieved by combining unskilled labor with physical capital, the economic contribution of universities was marginal. As the knowledge economy replaced the Solow economy, a new role for the university emerged, as an important source of economic knowledge.

4 The University in the Entrepreneurial Society

The assumption implicit in the endogenous growth models that investments in new knowledge, either by firms or universities, would automatically spill over for commercialization resulting in innovative activity and ultimately economic growth has not proven to be universally valid. In fact, new knowledge investments must penetrate what has been termed "*the knowledge filter*" in order to contribute to innovation, competitiveness and ultimately economic growth (Audretsch *et al.*, 2006; Braunerhjelm *et al.*, 2010). The knowledge filter is defined as the barrier or gap between the investment in new knowledge and its commercialization. The knowledge filter poses a barrier that impedes or preempts the commercialization of investments in research and knowledge. While he did not use the phrase "knowledge filter", Senator Birch Bayh was essentially concerned about the magnitude and impact of the knowledge filter when he admonished his colleagues in Congress to beware, "A wealth of scientific talent at American colleges and universities – talent responsible for the development of numerous innovative scientific breakthroughs each year – is going to waste as a result of bureaucratic red tape and illogical government regulation".[1]

The knowledge filter can be viewed as posing a barrier or impediment between investments in new knowledge and their commercialization, which leads to innovative activity and growth of the economy. The existence of a formidable knowledge filter can actually render investments in research and science impotent in terms of their spill overs for commercialization and innovative activity. As Senator Bayh wondered, "What sense does it make to spend billions of dollars each year on government-supported research and then prevent new developments from benefiting the American people because of dumb bureaucratic red tape?".[2]

The existence of the knowledge filter suggests that investments alone in research at universities will not suffice in facilitating the spill overs that are requisite to generate innovative activity and economic growth. In order to take advantage of the massive investments in research and

[1] Introductory statement of Birch Bayh, September 13, 1978, cited from the Association of University Technology Managers Report (Association of University Technology Managers, 2004, p.5).

[2] Statement by Birch Bayh, April 13, 1980, on the approval of S. 414 (Bayh-Dole) by the U.S. Senate on a 91-4 vote, cited from (Association of University Technology Managers, 2004, p. 16).

education, additional entrepreneurial activity was required by the universities. In particular, the universities needed to become more entrepreneurial in that they pro-actively developed mechanisms, incentives and even change their culture from that of a Humboldt University to facilitate knowledge spillovers for commercialization out of the universities.

In order to spur innovative activity to re-ignite American economic growth, employment creation and competitiveness, the United States Congress enacted the Bayh-Dole Act in 1980. The Bayh-Dole Act represented an explicit policy attempt to facilitate knowledge spillovers from universities for commercialization and ultimately economic growth (Kenney and Patton, 2009; Link and Siegel, 2005; Link *et al.*, 2007).

Part of the response to creating the entrepreneurial university was the development of academic fields and areas of research that were not just focused on "knowledge for its own sake", which is the gold standard of scholarly inquiry under the model of the Humboldt University, but rather oriented towards knowledge for the sake of solving specific and compelling problems and challenges confronting society. Thus, relevance and applicability emerged as the key guiding values in these new, external oriented fields and areas of research, such as biochemistry, informatics, and bioengineering.

In his highly influential book on higher education in the United States, A Larger Sense of Purpose: Higher Education and Society, the former Princeton University president Harold Shapiro (Shapiro, 2005) laments that American universities do not actually seem to possess a larger sense of purpose. Shapiroís concern echoes a recent assessment condemning what is characterized as the selling out of American universities in the *New York Times*, which chides higher education in the United States because "colleges prostitute themselves to improve their *U.S. News & World Report* rankings and keep up a healthy supply of tuition-paying students, while wrapping their craven commercialism in high-minded sounding academic blather . . . I would keep coming up with what I thought were pretty outrageous burlesques of this stuff and then run them by one of my professor friends and heí'd say, 'Oh yea, we're doing that"'.[3]

Similarly, Steve Lohr of the New York Times warns that "the entrepreneurial zeal of academics also raises concerns, like whether the direction of research is being overly influenced by the marketplace".[4] Toby E. Stuart wonders whether "basic scientific questions are being neglected because there isnít a quick path to commercialization? No one really knows the answer to that question".[5]

There has been wide acclaim for the impact of the Bayh-Dole Act on the innovative performance. According to the *Economist*, "Possibly the most inspired piece of legislation to be enacted in America over the past half-century was the Bayh-Dole Act of 1980. Together with amendments in 1984 and augmentation in 1986, this unlocked all the inventions and discoveries that had been made in laboratories through the United States with the help of taxpayer's money. More than anything, this single policy measure helped to reverse America's precipitous slide into industrial irrelevance. Before Bayh-Dole, the fruits of research supported by government agencies had gone strictly to the federal government. Nobody could exploit such research without tedious negotiations with a federal agency concerned. Worse, companies found it nearly impossible to acquire exclusive rights to a government owned patent. And without that, few firms were willing to invest millions more of their own money to turn a basic research idea into a marketable product".[6]

[3] Budiansky (2006, p. A23).
[4] Lohr (2006)
[5] Quoted from Lohr (2006).
[6] The Economist (2002)

Similarly *Business Week* concludes that, "Since 1980 the Bayh-Dole Act has effectively leveraged the tremendous value of academic research to create American jobs, economic growth, and public benefit. The Act has resulted in a powerful system of knowledge transfer unrivaled in the world. One would think that the combination of public benefit and the productive, job-creating effects of the Bayh-Dole Act would be a winner in every sense".[7]

The mechanism or instrument attributed to facilitating the spillover of knowledge from university scientist research to commercialization and innovative activity is the university Technology Transfer Office (TTO). The TTO was not explicitly created or mandated by the Bayh-Dole Act, but subsequent to passage of the Act in 1980 most universities created a TTO dedicated to commercializing university based research. Virtually every research university has a TTO or similar office today.

The TTO not only oversees and directs the commercialization efforts of a university. In addition, the TTO is charged with the painstaking collection of the intellectual property disclosed by scientists to the university along with the commercialization activities achieved by the TTO. A national association of offices of technology transfer, The Association of University Technology Managers (AUTM), collects and reports a number of measures reflecting the intellectual property and commercialization of its member universities.

The databases collected and assembled by AUTM have been subjected to considerable empirical scrutiny, resulting in the emergence of a large and growing body of research. These studies have been large concerned with analyzing the impact of the Bayh-Dole Act in general and the TTOs on generating innovative activity from the research and scientific activities at universities (Lockett *et al.*, 2003, 2005; Breznitz *et al.*, 2008; Phan *et al.*, 2005; Siegel *et al.*, 2007a,b). It is important to recognize that the bulk of these studies analyze and reach conclusions about the inputs and outputs of the TTOs at universities (Mustar *et al.*, 2006; Mosey and Wright, 2007; Shane, 2004; Powers and McDougall, 2005; Phan and Siegel, 2006; Di Gregorio and Shane, 2003; Mowery, 2004). As Phan and Siegel (2006) point out, most of this literature concludes that the commercialization efforts of the TTOs have been strikingly positive.

However, most of these studies analyze the outputs of the TTO in terms of patents and/or licensed technology (Phan and Siegel, 2006). While the conclusions based on these studies are generally remarkably positive, considerably less attention has been given to startups emanating from universities.

In fact, scientist entrepreneurship, as measured by new firms started by university scientists, is seemingly remarkably modest. The data reported by university TTOs and collected by AUTM suggests a paucity of commercialization spilling over from universities in the form of scientist entrepreneurship. For example, the number of university based startups in the United States reported by Association of University Technology Managers (2004) averaged 426 per year for the entire country from 1998 to 2004. When compared to the number of research universities and the dollar amount investment in scientific research at universities, this amount of university entrepreneurship does not seem to be particularly encouraging or in any sense an endorsement of a robust system of knowledge spillovers from universities.

Similarly, an examination of entrepreneurial performance of particular universities also points to a paucity of university entrepreneurship. For example, one study found that the TTO of the Massachusetts Institute of Technology (MIT) generated only 29 startups in 2001 Breznitz *et al.* (2008). At the same time, there were only six startups facilitated by and registered at

[7] Business Week (2010)

the TTO at Stanford University. Thus, however successful universities have been at generating patents and licenses, entrepreneurial activity seems to be considerably more meager and modest, leading perhaps at least some to infer that based on the TTO data measuring scientist entrepreneurship at universities compiled by AUTM, universities have not been particularly successful in commercializing research and science.

Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) point out that there may be limitations inherent in the inferences made about university entrepreneurship and knowledge spillovers based solely upon data collected by the TTOs. In particular, using data generated and compiled by the TTOs and collected and made available by AUTM could lead to underestimating the extent to which entrepreneurial activity is being generated by universities. Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) point out that the main task of the TTO is not to measure and document all of the intellectual property created by university research along with the subsequent commercialization. While the TTO does measure and document the creation and commercialization of intellectual property, its commercialization activities are typically a subset of the broader and more pervasive intellectual property being generated by university research and its commercialization. In fact, as Thursby and Thursby (2002), Thursby and Thursby (2005) and Mosey and Wright (2007) point out, there are considerably more commercialization activities undertaken at universities which may not interface or fall within the TTO's activities. Similarly, Shane (2004, p.4) finds that, "Sometimes patents, copyrights and other legal mechanisms are used to protect the intellectual property that leads to spinoffs, while at other times the intellectual property that leads to a spinoff company formation takes the form of know how or trade secrets. Moreover, sometimes entrepreneurs create university spinoffs by licensing university inventions, while at other times the spinoffs are created without the intellectual property being formally licensed from the institution in which it was created. These distinctions are important for two reasons. First it is harder for researchers to measure the formation of spinoff companies created to exploit intellectual property that is not protected by legal mechanisms or that has not been disclosed by inventors to university administrators. As a result, this book likely underestimates the spin-off activity that occurs to exploit inventions that are neither patented nor protected by copyrights. This book also underestimates the spin-off activity that occurs "through the back door", that is companies founded to exploit technologies that investors fail to disclose to university administrators".

Shane (2004)'s concern that relying upon data collected by the TTO could result in a systematic underestimation of the entrepreneurial activity emanating from universities has been echoed by other scholars (Thursby *et al.*, 2009; Aldridge and Audretsch, 2010, 2011). Placing an undervalued estimate on the extent to which university research and science is commercialized may also lead to underestimating the extent to which knowledge spills over for commercialization and innovative activity from universities.

The economic performance of the United States depends crucially upon the capacity to generate knowledge spillovers from universities. Such knowledge spillovers are essential for generating economic growth, the creation of jobs and competitiveness in global markets. Underestimating the extent to which knowledge actually spills over from the universities, and the impact of university science and research, can lead policy makers to undervalue the economic and social impact of investments in research and science.

In order to mitigate such policy distortions, Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) proposed an alternative method for measuring and analyzing scientist entrepreneurship. Rather than asking universities what they do in terms of commercialization activities, Aldridge and Audretsch (2010 and 2011) instead went directly to university scientists and asked the scientists what they do in terms of commercialization.

Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) surveyed university scientists who had been awarded the largest grants from the National Institute of Cancer at the National Institutes of Health. Thus, their database consists of commercialization activities identified by the scientists themselves rather than the standard method prevalent throughout the literature of turning to the OTTs and the commercialization activities they report, which are ultimate compiled and made public by AUTM. In particular, Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) developed alternative measures of scientist entrepreneurship and other commercialization activities on the basis of the scientists reporting their own commercialization and entrepreneurial efforts.

With these studies, Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) were able to create a measure of scientist commercialization of university research and identify which factors are conducive to scientist entrepreneurship and which factors inhibit scientist entrepreneurship. A key finding of the Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) studies was that, of the patenting scientists, approximately one in four had started a new firm to commercialize their research. A second key finding of the Aldridge and Audretsch (2010) and Aldridge and Audretsch (2011) studies emerged from subjecting their new university scientist-based data set to empirical scrutiny to ascertain which factors influence the propensity for scientists to become entrepreneurs. This enabled a comparison of the factors conducive to scientist entrepreneurship to what has already been solidly established in the literature for the more general population. In fact, the empirical results suggested that scientist entrepreneurship does not simply mirror what has been found in the more general entrepreneurship literature (Aldrich and Martinez, 2010), for the entrepreneurial activities of the general population. By comparison the likelihood of becoming an entrepreneur was found to be less influenced by certain personal characteristics, such as age, gender and experience, as well as by human capital. Social capital seems to play a particularly important role in influencing which scientist becomes an entrepreneur and which scientist abstains from entrepreneurial activities.

5 Conclusions

The entrepreneurial society refers to a society where entrepreneurship serves as the critical force driving economic growth, employment creation and competitiveness in global markets, and where institutions and policy have a focus on facilitating and generating entrepreneurial activity. The role of the university is considerably different and more central in the entrepreneurial society than its rather peripheral and marginal role in the managed economy, and its important but specialized role as a source for key inputs and resources in the knowledge economy. Rather, in the entrepreneurial society the university has emerged as a key institution not only generating new knowledge but also facilitating spill overs that spur innovation, economic growth, job creation and competitiveness in global markets.

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