University-Industry Collaboration for Technology Development: The Case of University Research Parks

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Abstract: What are the conditions for success of University Research Park and what should the Korean government and universities have to do for meeting the conditions? We found out the factors that impact on the success of University Research Park through literature review and, applied them for University of Illinois. Previous researches emphasized on university policies, intellectual eminence, characteristics of research, venture capital as the critical factors for success of University Research Park. As a promising case, University Research Park of Illinois has the favorable environments except for external venture capital. Although none could surely assert that University Research Park of Illinois will follow the previous success stories of Silicon Valley, Research Triangle, and Route 128, we could say that it has good conditions, and high possibilities for success. We analyzed critical success factors of University of Illinois compared with Stanford University, and drew some policy implications for improving Korean University Research Park: Government had better allocate more money in promoting excellent University Research Park, and universities rearrange university-industry collaboration polices such as incubator and licensing share, and foster supporting organization and internal venture capital.

Keywords: University Research Park, university-industry collaboration, factors for success

Is the research university a base for innovations stemming from scientific and technological advances that promote economic prosperity? Is the research park a truly effective mechanism for generating mutual benefits for the university and industry?

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Many studies have strongly suggested that research parks are phenomenally successful experiments in linking universities to industrial development and other mechanisms that facilitate university-industry collaborative research and development (R&D) (Griliches, 1986; Link, 1981; Link & Siegel, 2003; Mansfield, 1980; Porter, 2001; Swann, Provezer, & Stout, 1998).

However, substantial debate ensued soon after governments, especially in the United States, adopted strong policies to promote closer university-industry relations in the 1980s. These debates typically took the form of a rebuke in "picking winners" (Kash & Rycroft, 1995). According to these views, industrial policy does not always make industry more efficient and productive. Sometimes it backfires and actually promotes a misallocation of resources.

Why, then, are there so many research parks near prestigious American universities? What are the critical factors for the success of U.S. university research parks, such as those at Stanford University and Massachusetts Institute of Technology? What are promising universities-second-generation parks, such as the University of Illinois and the University of Wisconsin-are doing now? Furthermore, we need to consider what the Korean government can do to catch up to the American style of university-industry R&D collaboration.

We focus here on the critical success factors of the American university research park identified in the literature. We conduct a case study analyzing the research park at the University of Illinois, one of the most promising of the second-generation research parks, compared with that of Stanford University, the most successful of the first-generation parks. Based on this research, we will discuss the policy implications for transferring the American style of research park to Korea.

WHY DOES THE UNIVERSITY RESEARCH PARK MATTER?

A number of definitions of a research or science park have been proffered by various organizations (AURP, 1997; Link & Scott, 2006). In this paper, however, we use the definition provided by Link and Scott (2006):[1]

> A university research park is a cluster of technology-based organizations that locate on or near a university campus in order to benefit from the university's knowledge base and ongoing research. The university not only transfers knowl-

1. This is the definition that National Science Board uses in *Science and Engineering Indicators, 2006* (Link & Scott, 2006).

edge but expects to develop knowledge more effectively given the association with the tenants in the research park.

In the Western world, universities have been existed for more than 900 years. During most of that history, universities have been seen as inwardly focused institutions of knowledge and scholarship. Throughout the 20th century, the role of the university expanded to include more direct links with society, technology, and the economy. Big universities have tended to become research universities. Their primary missions emphasize the conduct of research and the training of graduate students to conduct research. The first research universities developed in Germany: The University of Gottingen was founded in 1737, and the University of Berlin was established in 1810.

In the United States, Johns Hopkins University, Clark University, Stanford University, and the University of Chicago were early cases, and now, several hundred universities consider themselves research universities. The flow of new technology from the university became apparent during and after World War II. Mansfield (1980, 1986) has demonstrated that more than half the economic growth of the United States in the decades since World War II can be directly attributed to advances in technology. It has been also shown that overall, research in the United States has produced a strikingly high annual return on investment: 20% to the organization that invests in the research, 50% to society and the nation at large, and a still greater rate of return for global society. These calculations do not include the direct contribution of universities through the production of highly trained scientific and engineering graduates who provide the workforce of industry. The flow of manpower is obviously another direct effect of universities on technological development and the economy.

According to Rogers, Yin, and Hoffman (2000), the Bayh-Dole Act of 1980 had a broad impact on the patenting and licensing activities of research universities. That legislation shifted the right of transferring technologies stemming from federally funded research from the federal government to the universities conducting the research. According to Sandelin (1994), at least 60% of all invention disclosures at universities arise from federally funded research, and university offices of technology transfer have defined their role on the basis of the Bayh-Dole Act. It has encouraged not only the disclosure and protection of innovation from publicly supported research but also the commercial development of products and processes derived from such innovation for public benefits (Mowery, Nelson, Sampat, & Ziedonis, 2001).

Regarding the effects of university research parks on local and regional economies, the arguments are also divided. One observation seems negative: Considering the huge subsidies that university research parks receive, their contribution to local economy is minimal to none. Proponents of this view basically disregard the positive effects of

government subsidies to economic activities. It is true that university research parks are sometimes separated from the rest of the local economy, and the people who work in university research parks often come from outside the region and live there as outsiders. Therefore, lower-level jobs such as restaurant work, cleanup, and logistics are the only jobs that local people can enjoy. These arguments can be found in the cases of enterprise zones and urban revitalization projects (Kash & Rycroft, 1995). Other arguments are based on the research done in the large research parks, such as Silicon Valley, Route 128, and the Research Triangle. According to one estimate, the average pay in Silicon Valley ($76,800 in 2001) is more than twice the nation's average pay ($35,300). In terms of revenues yielded during 1988-96, startups at Stanford accounted more than 50% of the region's total revenues (Joint Venture Silicon Valley Network, 2002).

MODELS OF UNIVERSITY RESEARCH PARKS: PULL AND PUSH MODELS

There are many ways of transferring university research results to the economy. One of the university's more aggressive roles in the commercialization process is the establishment of spin-off companies. Besides spin-offs, however, there are other types of technology transfer, such as the commercialization of university-based technology by an outside business entity, university technology centers, and so on. We explain them with push and pull models.

Push Model: Models of Spin-offs

The push model focuses on how universities send technology outside the organization. We have identified three spin-off models in the United States (Giannisis, Willis, & Maher, 1991) and one in Japan and Korea.

Above all, in the entrepreneurial model, faculty and students are integral to the founding of their own companies. They are the entrepreneurs. The formation and growth of newly established startups may be largely attributed to the combination of expertise and the independent motivation that the entrepreneurial faculty brings to the commercialization process. Second, in the traditional model, the commercialization potential of a university-based technology is pursued by an outside business entity. Through various avenues, that business entity approaches the university research center with a proposal for developing university-owned technology. Third, in the institutional model, the commercialization process is managed by university technology cen-

ters or not-for-profit subsidiaries of the university. A spin-off venture is created as a result of the university's formal process of technology identification, assessment, and development.

In addition to the models outlined above, we can add one more model, that is, the informal model of exchange between university and industry. The informal model is often found in Japan and Korea. The tie between the university and industry depends on an informal network structure of relationships. The defining principle of this model is the mobilization of knowledge through informal but well-articulated networks (Florida & Cohen, 1999). R&D-intensive firms sponsor academic research through donations, and the results of that research are transferred to the sponsors through intellectual property ownership and transfers of human capital (i.e. graduates).

Pull Model: Category of Firms

The pull model focuses on the characteristics of the firms helped by the university research park. Prospective firms that university wants to invite seem very limited. From the perspective of firms, the size of the company, its age, and the nature of the business are critical features that determine many of the specific needs and expectations. Each group of firms has different characteristics and needs from the university research park.

First, university spin-offs are generally small firms that focus almost exclusively on the development and marketing of a new high-tech product. These firms, whose founders may be university professors or related persons, want to establish close and personal relationships with university researchers. The firm's business may hinge on one enabling technology created by the university. The firms try to interact with the university through a business incubator, business assistance program, or R&D partnership. They sometimes suffer form a lack of capital or lack of time that a professor can provide. They may expect that the university will take an equity share in the startup instead of a large up-front payment on a university license.

Second, medium to large high-tech companies have a strong internal R&D component. They want to stay on the leading edge of the innovation curve, and they try to use university R&D partnering to add capacity to their already strong internal R&D component. To accomplish this, they engage in various forms of interaction with universities. They generally employ their own internal technology transfer liaison personnel who work full-time on establishing and monitoring university R&D relationships and sponsor university research, willingly paying university overhead rates. They take advantage of federal programs, such as the ATP(Advanced Technoloy Program), that have a university-firm collaboration requirement. These firms employ university

researchers as consultants and endow chairs.

Third, medium to large high-tech companies with scaled-down internal R&D capacity view R&D partnering with universities as an opportunity to fill gaps created as a result of downsizing or restructuring. Should they identify a professor of interest, they attempt to create a partnering relationship. They selectively engage in sponsored research and pay standard overhead rates, but generally only if the intellectual property rights are negotiated in advance in terms that are quite favorable to the company. They expect a tangible product or process as a result of their R&D partnership.

Fourth, small to medium-sized stable but growth-oriented companies with minimal R&D needs look to university for growth opportunities rather than survival. Having already established a market niche, their expectations of university R&D partnering are minimal. These companies may interact with a university through the vehicle of state grants, which require university-firm partnerships, or federal grants, such as the Small Business Innovation Research Program. These companies are extremely sensitive to security issues. In a similar manner, these companies expect that the university will understand their need for exclusive proprietary rights to any licensed technologies (Rahm, Kirkland, & Bozeman, 2000).

WHAT MAKES UNIVERSITY RESEARCH PARKS SUCCESSFUL?

Many scholars have studied the factors that make university research parks successful (Di Gregorio & Shane, 2003; Link & Scott, 2005; Miyata, 2000). Gregorio and Shane (2003) and Link and Scott (2005) base their studies on the number of start-ups and spin-off companies as a result[2] of university research parks, while Miyata (2000) uses the number of inventions obtained from the Association of University Technology Managers. Based on this research, we propose five important factors.

University Policies

The most important determinant for a successful university research park is university policy related to technology transfer. Of course, this policy must be subject to government regulations, such as the Bayh-Dole Act and the Copyright Act. Under government policy, however, universities differ in their policies toward technology transfer and new startups.

In particular, previous research has emphasized three different policies. First, the

2. Results refer to the dependent variable in macroeconomic analysis.

distribution of royalty rates between inventors and the university could influence the propensity of entrepreneurs to found firms to exploit university inventions. The greater the inventor's share of the royalties, the lower are the incentives to seek profits from an invention by founding a firm. This means that the share of royalties is the opportunity cost of starting a firm to exploit the technology. Second, the use of incubation should increase the startup rate. Most university technologies are embryonic and development is necessary before they can be sold in the marketplace (Jensen & Thursby, 2002). University incubators allow entrepreneurs to ripen technology and reduce the cost of development. Third, the presence of internal venture capital funds could make the acquisition of capital easier for startups and should increase the startup rate. Contrary to general venture capitalists, the administrators of university venture capital funds have direct or indirect connections with potential university entrepreneurs, and this is very useful for solving information asymmetry problems. Di Gregorio & Shane (2003), for example, empirically explored university technology transfer policies, such as policies regarding the distribution of royalties and whether the university is permitted to take an equity stake in licensees, that appear to influence startup activity.[3]

Intellectual Eminence

University research parks that have leading researchers and intellectual eminence tend to create more startups. Two different variants of this explanation have been suggested in the literature (Di Gregorio & Shane, 2003; Miyata, 2000). First, most intellectual capital is tacit and belongs to a small set of leading researchers who work at eminent universities. The best way to commercialize this tacit knowledge is for researchers to become entrepreneurs. Second, the university's prestige or reputation makes it easier for researchers from eminent universities to start companies in order to exploit their inventions. This means that the university's intellectual reputation can be used for investors to solve the information asymmetry problem between investors and researchers. Di Gregorio & Shane (2003) examined empirically whether university eminence increases the startup rate using the overall academic rating score of graduate schools published in the Gourman Reports and found that a university's intellectual eminence significantly predicts startup activity. Link and Scott (2005) found that R&D spending among the top 100 universities and the age of the park both significantly influenced university spin-off activities.

3. Specifically, they examine the number of companies founded to exploit university-assigned intellectual property across 101 U.S. universities over the 1994-98 period.

Characteristics of Research

Above all, the success of a university research parks depends on the research that the university conducts. Universities differ in the degree to which their research focuses on industrial problems. Some universities focus their research on the needs of industry more than other universities. Commercially oriented universities receive a greater share of their research budget from industry than do other universities (Rosenberg & Nelson, 1994).

Di Gregorio & Shane (2003) offer three reasons that a university's tendency to conduct industry-funded research and development should increase its startup activities. First, industry tends to fund more commercially oriented research than the government, and a commercial orientation should increase the likelihood of discovering technologies that have sufficient commercial value. Second, industry tends to fund less risky research than government funds. More risky research is problematic for firm formation because single-technology new companies cannot exploit the economies of scope in technology development that allow large firms to diversify these risks (Arrow, 1962; Nelson, 1959). Third, being more basic, government-funded research tends to suffer from greater information asymmetry problems than industry-funded research. Information asymmetry problems result in failures in venture finance markets, and industry-funded research is less exposed to failure. Based on these arguments, ceteris paribus, the greater amount of commercially oriented research activity the university engages in, the more startups it will create.

In an empirical study, Di Gregorio & Shane (2003) examined whether characteristics of the research that universities conduct influence startup activity through industry/total sponsored research funds and industry-sponsored funding. The results, however, are separate. On one hand, there is little support for the contention that universities that conduct more commercially oriented research experience greater startup activity. On the other hand, the dollar amount of industry funding is significant.

Venture Capital

Venture capitalists play an important role in the innovation process by providing risk capital and operating assistance to new high-tech firms (Florida & Kenney, 1988). Venture capital investments tend to be made locally because firms want to solve a moral hazard problem with geographic proximity (Gompers and Lerner, 1999; Sahlman, 1990). Sorenson and Stuart (2001) found that the probability that a venture capital firm will invest in a startup decreased with the geographic distance between the headquarters of the venture capital firm and the startup firm. Lerner (1995) found that

geographic proximity influenced the composition of the boards of directors of venture capital-backed startups: and venture capital firms headquartered within 5 miles of a startup's location were twice as likely to be on the company's board of directors as venture capital firms headquartered 500 miles away.

Other Determinants

In addition to the factors mentioned above, there are many other determinants that may influence the success of a university research park, such as the specific technology focus, the proximity between the university and the research park, and the ownership of the university. In empirical studies, the percentage of startup companies related to biotechnology and information technology is greater in research parks (Link & Scott, 2005, 2006). Universities with research parks closer to campus have a greater percentage of university spin-off companies. Adams and Jaffe (1996) have suggested that communication costs related to collaborative R&D activity increase with distance. Wallsten (2001) has shown that geographic proximity to other successful innovating firms is associated with a firm's own success. Distance has been verified as an important factor in many empirical studies (Link & Scott, 2005, 2006). In the United States, private universities have developed by emphasizing academic research and liberal arts education. On the other hand, public (state) universities often emphasize practical research fields, such as agriculture and engineering (Miyata, 2000). Therefore, we can expect that a university with a close relationship with state government will tend to generate more startups. In empirical studies, however, the ownership of university is not a statistically significant determinant (Miyata, 2000; Link & Scott, 2005, 2006).

THE COMPARTIVE CASE STUDY: THE UNIVERSITY OF ILLINOIS VERSUS STANFORD UNIVERSITY

Based on the literature review, we analyze the success factors of the research parks at the University of Illinois at Urbana-Champaign and at Stanford University.

Historical Background

The University of Illinois was established in 1868 as one of 37 public land-grant institutions created within 10 years of the signing of the Morrill Act by President Abraham Lincoln in 1862. In 2004, the University of Illinois was ranked 18th among all universities in the nation in terms of spending on R&D ($506 million) (NSF, 2006).

The Research Park at the University Illinois was founded based on a vision of a "silicon prairie" in the late 1990s. There are three research parks that have been very active in the region: the Chicago Technology Park, the Northwestern University/ Evanston Research Park, and the DuPage Research Park (Office of Naval Research, NASA). The University of Illinois research park was founded in 2000 but is still under development.

The State and Regional Development Strategy Act (1999), signed into law on August 11, 1999, established a multiyear strategic plan for economic development in Illinois. Governor George Ryan's administration placed a particular emphasis on economic development in Illinois: to meet the challenges of the new economy by making a transition from agriculture to industry. While Illinois's resource-based and manufacturing industries remain important, the major source of new economic growth are believed by many experts to be in the technology and service sector, whose products require a different mix of inputs. Illinois needs its own new economy based on knowledge and innovation-that is, intellectual capital. It requires high-performance, globally competitive firms that rely on a quality workforce, state-of-the-art technologies and processes, and better information about customers' needs in order to stay competitive.

The state identified key industrial sectors, including resource-based industries, service-based industries, capital-intensive industries, and innovation-based industries. Among them, innovation-based industries, in which university-industry collaboration makes a difference, have experienced superior growth in the last 10 years. In particular, information and electronics, software, and biotechnology and life sciences have shown some promise. In order to realize the potential of Illinois's new economy, diverse efforts have been already been started, including various laws, assistance programs, new institutions, events, and budget allocations. Among them, major efforts in the area of innovative or venture-oriented business are listed in the appendix.

Stanford University was established in 1891 after six years of planning and building. Stanford University was ranked eighth among all universities in the United States in terms of spending on R&D in 2004 ($671 million) (NSF, 2006).

The Stanford Research Park was authorized in 1951 when 209 acres of Stanford land was set aside for light industrial use. In the 1950s, Fredrick Terman, who helped guide Stanford from a financially struggling regional university to an internationally recognized world-class research university, led the development of the research park in Silicon Valley. By the late 1980s, the park had grown to 100 companies in residence. Today, the Stanford Research Park has a world-class reputation as one of the largest and best-known parks of its kind in the world.

Compared with Stanford Research Park, Research Park at the University of Illinois has a short history (just 10 years) and lesser reputation, even though the University of

Illinois has a much longer history. For decades, however, visions of a "silicon prairie" that would rival the best high-tech spots on the East and West Coasts have floated just out of reach of the Champaign-Urbana campus. A state university known worldwide for its computer and engineering programs, it has watched as many of its best minds have headed elsewhere after graduation. Champaign-Urbana was ranked sixth in the nation (among 343 metropolitan areas in North America) for transportation and in the top 15 for high-tech growth opportunity. While excellent highway access and the availability of Willard Airport are major factors in this outstanding ranking, the importance of rail access should not be overlooked.

Facts and Figures

The plans for the Research Park at the University of Illinois included two sites for a research park. One is the north research park, located next to the engineering campus in Urbana. The other is the south research park, located in the campus's southwestern corner in Champaign. The proposals for these sites were quite different: The north research park was meant to be an urban park in an urban setting. The strategy was to market the park to prospects and not to put capital into construction until a tenant could be found. For these reasons, the north research park has not yet been developed, and no immediate activity is planned. The south research park began development in 2000. Fox/Atkins, a private developer, invested capital in the park's building and infrastructure because of its rural surrounding. Besides the private funds of Fox/Atkins, the park has been financed by the University of Illinois and Governor Ryan's VentureTECH program, which was designed to develop infrastructure and high-tech businesses.

According to several Web sites,[4] the Research Park at the University of Illinois provides an environment in which technology-based businesses can work with the research faculty and students at the university to take advantage of opportunities for collaborative research and easy access to university labs, equipment, and services. Located minutes from the central campus, the research park is now home to 50 companies, including Motorola, and it is growing, employing almost 1,000 people in high-tech careers. At any given time, more than 200 student interns with leading-edge technical skills are working in these companies, gaining valuable work experience while making real contributions to internal corporate R&D and product development programs. The research park offers companies high-quality multi-tenant facilities that are outfitted to tenant specifications. Whether a company's research goals are short term or long term, flexible leasing programs are available to meet individual needs.

4. See http://www.tech.com and http://www.provost.uiuc.edu.

The research park's master plan envisions an ultimate buildup of the park covering more than 200 acres in the southwest corner of the central campus, only minutes away from the student union and core academic departments. Planned future amenities include a four-star hotel with restaurant and conference facilities, a day care facility, a retail village, and a championship 18-hole golf course. As an incubating institution, EnterpriseWorks (EW) is a 43,000 square foot startup business incubator in the Research Park at the University of Illinois in Urbana-Champaign. Since opening in 2003, EW has become the launching pad for more than 30 startup companies. EW provides an environment for starting a high-growth technology venture with 24 full wet-chemistry labs, furnished office space, an extensive array of shared equipment, and conference rooms with complete presentation facilities and high-speed wireless Internet access.

The Stanford Research Park resides on a 700-acre campus, has 10 million square feet of developed building and facilities, and employs 23,000 workers in 150 companies occupying 162 buildings. Companies are scientific, technical, and research oriented in the fields of electronics, space, biotechnology, computer hardware, and software, as well as law office and consulting firms. Today, the Stanford Research Park is known as one of the world's best research parks (Sandelin, 2004).

Comparative Analysis of the Critical Success Factors of University Research Parks

In the previous section, we proposed five determinants for a successful university research park. In this section, we apply those factors to the Research Park at the University of Illinois and review whether it is well equipped by comparison with the Stanford Research Park.

First, the Research Park at the University of Illinois has a good environment in terms of university policies. The university has the right to own inventions created by university faculty, staff, and anyone using university facilities and resources. The Bayh-Dole Act of 1980 determined that the university retains the title to intellectual property created using federal funds. If a technology is licensed, the inventor receives 40%, the inventor's department receives 20%, and the Office of the Vice Chancellor for Research receives 40% of the revenues (after expenses). At Stanford, inventors receive one-third of the net royalties earned by their invention. Thus, inventors at the Research Park at the University of Illinois have strong incentives to license their technology in the light of the university's licensing policy. If the Office of Technology Management at the University of Illinois decides not to pursue patenting and commercialization of an invention, it will release the university's ownership rights back to

inventor. If the invention was created using federal funding, the inventor must obtain the approval of the federal agency.

Second, the Research Park at the University of Illinois has a higher reputation in terms of intellectual eminence. The Department of Commerce's United States Patent and Trademark Office announced the top 10 U.S. universities receiving the most patents during calendar year 2004. Among the 10 universities receiving the most patents for inventions, the University of Illinois was ranked ninth with 58 patents, and Stanford University was ranked sixth with 75 patents in 2004. According to the 2006 rankings published in U.S. News & World Report, both the undergraduate and graduate programs in engineering were tied for fourth in the country, and Stanford University was at the top. Therefore, the Research Park at the University of Illinois in strong in intellectual eminence.

Third, the rate of industry-sponsored funding of total R&D expenditures at the Research Park at the University of Illinois was 8% in 2002. This rate was greater than 6% of all universities and colleges in same year; therefore, we can say that the Research Park at the University of Illinois conducts more commercially oriented research compared to other universities. The main research area that the University of Illinois park focuses on is applied engineering, such as information technology, internet infrastructure, telecommunications, electronics, and life science. These facts imply that the Research Park at the University of Illinois is strong in the characteristics of its research.

Fourth, the Research Park at the University of Illinois has an internal venture capital fund, IllinoisVenture, as well as the VentureTECH program supported by the governor, to develop infrastructure and high-tech business. There are, however, few external venture capital companies in the area because it is located far away from the metropolitan Chicago area. This is the biggest difference between the Illinois and Stanford research parks. In all, 26% of U.S. venture capital was invested in Silicon Valley in 2005, and the share of venture capital funding for biotechnology, medical devices, and equipment was 20% over 2000-05 (Joint Venture Silicon Valley Network, 2006). Compared with the Stanford Research Park, therefore, the Research Park at the University of Illinois is weak in external venture capital investment.

Fifth, in terms of other determinants, such as proximity and ownership issues, it seems that the Research Park at the University of Illinois has comparatively favorable conditions. In terms of proximity, the park is located just five minutes away from the main campus, and the state has the ownership of the university, so its research emphasizes solving practical problems. However, the Illinois park is located comparatively far away from any large metropolitan market.

Overall, compared with Stanford University, the Research Park at the University of

Illinois has a favorable environment for success in most of aspects except for external venture capital and proximity from metropolitan. None, however, could assert that Research Park at the University of Illinois approaches the success story of Stanford University in Silicon Valley as a "silicon prairie." But we can expect that the possibility of success is very high because it has at least some prerequisites. To succeed as a silicon prairie, however, the University of Illinois, the local government, and other participants have to make an effort to pull in external venture capital from other areas.

CONCLUSION

Why are so many state-owned universities trying to build university research parks in the United States? The answer is apparent. State governments suffer from economic difficulty,[5] and creating startup ventures is the best solution to unemployment driven by economic recession. It is difficult, however, for an ordinary second-rate university to become an innovative university even if research funding from industry or local government increases. Government should be patient instead of expecting quick results from funding to university research.

There are hundreds of universities in Korea, but research universities that have the necessary factors for success are few. From the review of the critical success factors of U.S. university research parks and the comparative case study of the parks at the University of Illinois and Stanford University, we can propose some policy recommendations to promote the successful development of university research parks in Korea.

First, the Korean government should allocate more funding to promote excellent university research parks.[6] Some of the funds for excellence-oriented R&D and human resource development have to be allocated for improving the university research park. When a university research park booms in provincial area, the genuine balanced national development that the government pursues could be accomplished through regional economic development. In this respect, the Connect Program, which was started in 2005 and is now managed by the Ministry of Education and Ministry of

5. The top class private universities such as Stanford, and MIT already established URP before 1990s.

6. The Korean government must decide how to allocate funds between excellence-oriented and redistribution-oriented R&D and human resource development projects. To reach the best proportion between the two goals, we recommend the Korean government conduct pre-research and survey researchers and the general public as part of a policy demand investigation.

Commerce, Industry and Energy, must be expanded. In addition, central and local governments need to develop programs to build strong relationships between universities and industry.

Second, universities which that to be research-oriented institutions must reconsider their polices on incubation, license sharing, and organizational support. Because most universities suffer from financial deficit, universities must make an effort to attract external venture capital investment and to foster internal venture capital with the help local government and alumni.

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