Chinese Policy to Stimulate University-Industry Linkages in Nanjing †

De-Jin Su,* Dong-Won Sohn, & Sunwoo Sohn*****

Abstract

Rapid changes in the economic, social and academic environments often provide opportunities to develop new and advanced technologies. In China, recent literature on the role of universities suggests that university-industry linkages (UILs) play a substantial role in the development of high-tech industries. Since 1979 when the country became more open and underwent economic reform, Chinese central authorities, local governments, and universities have continued to set up various science and technology (S&T) policies to stimulate UILs, contributing to China's technological progress and economic growth. This study examines the role of S&T policies on UILs such as transfer of technology, joint research, and spin-off creation with a particular focus on Nanjing University (NJU) in Jiangsu Province. Nanjing has over 53 universities, ranking it behind Beijing and Shanghai in terms of S&T and higher education opportunities.

By adopting "institutional methodology," this study contends that UILs not only benefit universities and industry but also society in terms of job training, consulting activities, joint research, R&D results commercialization, patent licensing, new business creation, and other aspects. Finally, we suggest that the Chinese experience, though with some problems, might enhance our understanding of how to stimulate UILs through the arrangement of various S&T policies.

Keywords
UILs, S&T policies, Nanjing University, University, China

† Authors would like to thank Professor Shi-Chang Yan from Hohai University; Professor Li-Bo Xu from Nanjing University and Nanjing Audit University; and Professor Hui Jin from Nanjing University and Jiangsu University of Science and Technology for their excellent support.

* Assistant Professor, Nanjing Audit University, Nanjing, China, sudejin@nau.edu.cn.
** Professor, Inha University, Incheon, Korea, sohndw@inha.ac.kr.
*** Student, Myungduk Foreign Language High School, Seoul, Korea, swsnowlily12@gmail.com.

1. INTRODUCTION

Earlier research determined that the role of a college education is not only in the education of skilled personnel but also in R&D commercialization and new venture creation (Di Gregorio & Shane, 2003; Hashim, Alam, & Siraj, 2010; Sohn & Kenney, 2007; Su, Ali, & Sohn, 2011). University knowledge and research results are increasingly important in creating opportunities to facilitate the transfer of technology, academic-industrial cooperation, and new product development. Furthermore, as critical R&D performers, research-oriented universities facilitate UILs[1] through closed university-industry networks and their own intellectual property easier than do teaching-oriented universities. Emerging economies like China, Brazil, and Russia in particular require a wealth of knowledge-based resources to update their industrial structures, and are increasingly concentrating on stronger relationships among government, universities and industries.

Following the American model of academic entrepreneurship, China has realized some dramatic success in UILs since the 1980s when central authorities switched their emphasis from class struggle to economic development (Chen & Kenney, 2007; Wu & Zhou, 2012). Within the past three decades, universities in China have become the country's most important and innovative source for skilled labor, basic or applied R&D, new technology licenses, technological service for industrial partners, and even new spin-offs. The rise of UILs in China is attributed to several explanations: the openness and economic reform that started in 1979, the implementation of an array of technology transfer policies, the increasing rate of financial support by central or local governments, the change in focus and guidelines at universities, and changes in the restrictions on professors or researchers (Åstebro, Bazzazian, & Braguinsky, 2012 Chen & Kenney, 2007; Su & Sohn, 2012).

Many prior studies have significantly contributed to advancing our understanding of the mechanisms and importance of UILs. This paper focuses on the research-intensive universities of China that have had successful experiences with UILs. Encouraged by economic profit and effects on academic, these universities continue to launch numerous university spin-offs[2] (USOs), some of which have been critical to economic structure optimization and national competitiveness improvement (Table 1). It is important to note that unlike in the U.S. or South Korea, most Chinese universities belong to the state and are run by the government.[3] As a result, political and executive power dominates the entrepreneurial activities of universities. It is the role of science and technology (S&T)

[1] UILs are broadly characterized by several characteristics: labor force training, university-industry cooperation, technological licensing, knowledge dissemination, and new business creation, underlying factors found in high-tech clusters in research-heavy universities like those found in the Boston and San Francisco Bay areas in the U.S. (Kenney & Von Burg, 1999).

[2] A USO is an outcome of an entrepreneurial process that exploits new technology created at the affiliated parent university. In addition to Wu and Zhou's (2012) study, the number of university-affiliated technology firms dropped from 2,097 (a 10.4% R&D contribution to university) in 2000 to 1,933 (a 2.2% contribution to university) in 2006.

[3] These sectors mainly refer to the Ministry of Education (MOE), the Ministry of Industry and Information Technology (MIIT), and Chinese Academy of Science (CAS), provincial governments, and city governments.

policies[4] constituted by China's governments and universities that are evaluated in this study.

TABLE 1. The Most Successful Cases of USOs in China (Unit: RMB).

Year	Firms	Universities	Main business	Initial capital	Patent applications	Patent registration
1986	Founder Group	PKU	IT, pharmaceuticals	4.4 Million	N/A	N/A
1997	Tongfang	THU	IT, energy, environment	N/A	1388	791

Source: Each companies.
Note: PKU=Peking University; THU=Tsinghua University.

2. RESEARCH OBJECTIVES AND METHODOLOGY

This study is designed to encourage policymakers to foster entrepreneurial economic development through flexible S&T policies enacted by the central government, local government, and universities. Specifically, this study can help in answering the following research questions:

First, are UILs are influenced by political power? If so, how do political authorities affect the quality and speed of UILs? Second, can universities' S&T policies partially explain why some universities can be good at UILs than others? Third, why are some university researchers more willing to participate in UILs than others in China? Does that come from entrepreneurial incentives or the researchers' own intentions?

Accordingly, our study adopted a two-step approach to examine the role of S&T policies in UILs. First, beginning with the more open atmosphere and economic reform that started in 1979, we reviewed major S&T policies created by the central authorities and local governments and its role in UILs. This was followed by interviewing university technology transfer offices (UTTOs) and university-industry cooperators from NJU and Nanjing. The primary reason that this study chose NJU and Nanjing was because the existing research on UILs tends to focus on Beijing and Shanghai while ignoring the next university-concentrated city of Nanjing,[5] considered as another emerging high-tech urban cluster cooperating closely with local universities in China. The UTTOs were asked to explain the role of university's rules in UILs, and university-industry connectors were questioned as to whether they benefited from universities policies.

[4] Since China has implemented various S&T policies to support technological progress since 1985, we can classify these policies into three groups including: (1) supporting system regarding R&D funding, (2) improving management efficiency in S&T institutes, and (3) enhancing the academic-industry linkages.

[5] In September 2012, the government in Nanjing proposed new targets for S&T: by 2015, regional GDP to rise up to 100 billion RMB (13%), with high tech contributing up to 50% of industrial Gross Industrial Output Value, and with R&D expenditure increasing up to 4.5% of GDP.

3. STATE S&T POLICIES AND UILS

Recognizing the driving power of S&T in economic development and competitiveness, Chinese central authorities have recently shifted their political focus from "Made in China" to "Created in China." Universities assume a great deal of research tasks (in the forms of basic research, applied research, and process research) promoted by MOE or National Natural Science Foundation (NNSF) and industries (Chen & Kenney, 2007; Wu & Zhou, 2012). As a result, the fact that academic institutions have had some dramatic successes in innovation has raised new and interesting research possibilities for scholars. Of this transition period from a central economy to a more market-oriented economy, we believe that the development of academic entrepreneurship theory requires the consideration of state S&T policies of people making strategic decisions.

Through theoretical studies or empirical analysis, prior research concerning the role of Chinese universities in economic development have found that technology transfers from the academic environment to private industry is deeply affected by state S&T policies. First, state S&T policies are the basic and significant guidelines that direct higher education, R&D, technology transfer, result commercialization, and even the launch of new businesses in China (Wu & Zhou, 2012). In other words, universities that conduct state-funded research are more likely to stimulate UILs because they can make the cutting edge discoveries that have high commercial value. Second, according to state S&T policies, the central government to stimulate technological progress arranges financial funding or provides preferential treatment for universities. Third, universities and researchers often take the risk of failure when allocated by the state budget, despite the high pressure to publish.
To provide a clear map for scholars and policy-makers, this study divides state S&T policies into two categories: one, "general state S&T policies" that facilitate UILs, and the other, "special state S&T policies" that are only for universities.

3.1. General State S&T Policies

Since the economic reform that started in 1979, the emergence of a knowledge-based economy in China has changed policy-makers' understanding of the importance of knowledge and technology. Hence, central authorities enacted a slew of S&T policies aiming to develop high-tech industries and national competitiveness. Major general state S&T policies that influence UILs are listed in Table 2.

TABLE 2. General State S&T Policies or Programs with Impact on UILs

Year	S&T policies or programs	Agencies	Key Focus
1985	China Spark Program	MOST	Improve R&D capability of agricultural industries.
1986	Program 863	MOST	Enhance R&D intensity in biotech, aerospace, IT, laser technology, automatic technology, energy, new material, and marine technology.
1988	Torch Program	MOST	1) Building suitable environment for high-tech industries; 2) Building national high-tech zones; 3) Building service centers for high-tech start-ups; 4) Provide R&D fund for high-tech start-ups.

Year	S&T policies or programs	Agencies	Key Focus
1997	Program 973	MOST	Improve basic research capacity in agriculture, energy, IT, resource and environment, population and health, and new material.
2003	State Soft Science Research Program	MOST	Strengthen soft science capacity, such as social science and anthropology.
2006	National Medium and Long-term Program for Science and Technology Development	State Council	Enhance R&D expenditure investment in high-tech areas; educate world-class experts; attract returnees and overseas high-level talents, enhance technology transfer and commercialization.
2009	National Medium and Long-Term Talent Strategy from 2010-2020.	State Council /MOE	Strengthen R&D capacity in 11 major sectors; establish an intellectual property rights (IPR) system and protection laws; provide tax incentives and financial support for enterprises to innovate; boost S&T investment relative to GDP.

Source: MOE, MOST, State Council.

Particularly interesting are certain S&T policies or programs that have been identified as primary driving forces for stimulating UILs. These initiatives underpin university R&D activities by providing a wealth of resource support and direction for the commercialization of research results, thereby promoting innovations and the creation of high-tech zones such as Zhongguancun in Beijing (Chen & Kenney, 2007; Wu & Zhou, 2012).

3.1.1. Program 863

Starting in 1986, the importance of S&T in economic development and innovativeness gained significant attention in China. The central government launched a critical state high-tech R&D program named Program 863 that aims to improve China's competency for innovation and R&D capacity of frontier technologies. As a result of Program 863, 120,000 papers and books have been published, 8,000 thousand patents passed, and more than 1,800 national or industrial standards established over the past twenty years. By 2005, 33 billion RMB of the national budget was invested into Program 863, which benefited 150,000 researchers and scientists, more than 300 universities and research institutions, and more than 1,000 enterprises (Su et al., 2011). Encouraged by Program 863, an increasing number of research-intensive universities that play a critical role in Chinese economic growth and technological development (such as THU, PKU, Shandong University, University of Science and Technology of China, and NJU) are fervently implementing commercial research activities regarding high-tech industries, including IT, biotech, space technology, medical technology, and health. Furthermore, using these R&D results, some academic entrepreneurs from universities have successfully created a number of firms such as the Founder group from PKU, Tongfang from THU, Dongruan from Northeast University, and Softech from NJU.

Thanks to the advent of Program 863, other laws that aim to supplement the utilization efficiency of new technologies were also implemented. In 1990, the State Council enacted the Copyright Law,[6] regulating ownership and exploitation rights and contributing to the establishment of norms and resolving disputes with respect to copyright. While China had some dramatic successes in key state S&T development, its Ministry of Science and Technology (MOST) had enacted "S&T Secrecy

[6] http://www.863.gov.cn/1/4/index.htm

Regulation" in 1995 that enabled it to close itself from overseas influence and consequently to improving international technological competitiveness. With the development of the private economy in the 1990s the academic-industrial connection strengthened, but patent infringement was still prevalent because technology transfer from universities or research institutions to industry was still unsatisfactory. Consequently, the Patent Law was revised in 1992, 2001, and 2008.

3.1.2. Torch Program

In 1988, when Chinese leader Xiao-Ping Deng emphasized "science and technology is the primary productive force," MOST proposed another S&T policy called the "Torch Program" that contains the following eight characteristics:

(1) Investigate the development status and challenges under high-tech industrialization and the establishment of high-tech clusters, and provide insight for MOST's decision-making;
(2) Develop long-term plans for the Torch Program in order to enhance investment and raise capital in high-tech industries;
(3) Organize projects of the Torch Program to promote R&D commercialization, industrialization, and internationalization;
(4) Provide consulting service for high-tech clusters;
(5) Define high-tech products' lists;
(6) Collect and manage the base of high-tech SMEs innovation;
(7) Gather statistics for the Torch Program and high-tech clusters;
(8) Supervise the import-export mechanisms of universities, research institutes and high-tech enterprises.

The Torch Program emphasized new materials, information technology, biotechnology, optical, mechanical and electronic integration, new energy, efficient energy, and environmental protection, areas universally acknowledged as new driving powers for economic development. In pace with the launch of the Torch Program, China realized dramatic successes in S&T through stimulating technology transfer, promoting R&D commercialization, applying intellectual patents and establishing high-tech enterprises. Furthermore, certain universities founded many high-tech business incubators that provide critical services (such as technology protection, business planning, venture-funding support, political incentives, and incubating offices) for transforming research results into business (Chen & Kenney, 2007). For instance, the top two universities in China, PKU and THU respectively, established incubators that have successfully launched high-tech spin-offs such as the Founder Group (affiliated with PKU), Tongfang (affiliated with THU), Ziguang (affiliated with THU), and many others.

3.1.3. Fifteen Years S&T Program

As one of the first initiatives of the new 21st century, China's central government established a fifteen-year S&T program called the "National Medium and Long-term Program for Science and Technology Development from 2006 to 2020" that declared R&D spending would rise from $24.6 billion in 2004 to $113 billion in 2020 as shown in Table 3.

TABLE 3. R&D Costs of the Fifteen-Year S&T program

Year	R&D expenditure ($ billions)	Percent of GDP (%)	Central government R&D	Appropriation (%)
2004	24.60	1.23	8.70	35
2010	45.00	2.00	18.00	40
2020	113.00	2.50	N/A	N/A

Source: http://www.sciencemag.org/.

According to this program, China's S&T policies will focus on (Wu, 2010):

(1) Giving priority to technological development in eleven major sectors such as energy, water resources, and environmental protection in the coming fifteen years

(2) Further improving the national intellectual property rights (IPR) system and strengthening the enforcement of IPR protection laws and regulations

(3) Encouraging enterprises to play key roles in innovation through involvement in state projects, and the provision of tax incentives and other financial support

(4) Boosting investment in science and technology: by 2020, China's research and development expenditures will account for about 2.5% of the country's gross domestic product (GDP)

(5) By 2020, deriving 60% or more of its economic growth from technological progress: the numbers of patents granted and total citations of journal articles by Chinese nationals are expected to be ranked among the top five in the world.

The aim of this S&T policy is to improve capacity for self-innovation and reduce dependence on foreign technologies, establishing a perfect national innovation system that enhances interaction between universities/research institutes and industrial sectors. Therefore, Chinese universities are required to strengthen cooperation with industry, thereby contributing to the foundation of dynamic, high-tech industrial clusters within the metropolitan regions. Some universities report that they were able to get more R&D funding in recent years from MOE, MOST, NNSF, and even the local government, thereby contributing to the further establishment of university R&D systems and platforms for UILs.

3.1.4. National Medium-and-Long-Term Talents Strategy

Despite prior state S&T policies that also made big contributions to high-tech industries, Chinese intellectual competitiveness still lags seriously behind developed and emerging countries. Meanwhile, accessibility to higher education remains very imbalanced. For example, people who live in regions with many universities have more opportunities to enter into higher education than those living in regions that have fewer choices. As a result, the distribution of national talent and S&T programs are also imbalanced.

Recognizing that high-quality talent is the most valuable resource in developing economic potential and national competitiveness in the 21st century, China's central government established a "National Medium-and-Long-Term Talent Strategy" in 2009 (Table 4) where selected universities can get more political and financial support for educating quality talent.

TABLE 4. National Medium-and-Long-Term Talent Strategy from 2010-2020

Typologies	2008	2015	2020
Total talent resources number (10 thousands)	11385	15625	18025
R&D personals (per 10 thousands)	24.8	33	43
High technical personnel / the skilled personnel personals (%)	24.4	27	28
Major labor age personnel with higher education (%)	9.2	15	20
Investment in human capital /GDP (%)	10.75	13	15
The contribution rate of talent capital (%)	18.9	32	35

Source: The Central People's Government of the People's Republic of China (2011)

In addition, this plan encourages talent born in China living overseas to return, most of whom have had an international education in S&T areas (Wright, Liu, & Filatotchev, 2012). By 2010, over one million Chinese students were studying in other countries, mostly in developed countries such as the US, the UK, Japan, Germany, and Korea, all of which are considered as major global creators of S&T.[7] China currently pays significant sums for foreign technologies, patents, and intellectual assets. Developing talent can mitigate those costs by creating specialized knowledge and technologies domestically. Over the past few decades, China has also lured returning students from overseas by establishing high-tech clusters such as the Tianjin High-Tech Industrial Park Overseas Chinese Students Pioneering Park, the Kunshan Business Incubator for Overseas Chinese Scholars, and the Beijing Daxing Business Incubators for Chinese Oversea Students. Seeing the dramatic effect of the first wave of S&T trained talents returning from overseas, central authorities have launched various policies to utilize foreign S&T resources. Since the early part of this century, many returning scientists and graduates have returned, attracted by China's economic growth as well as the various policies that encouraged high-tech activities not yet widespread in China. These scientists introduced critical technologies, creative knowledge, and rare processes to Chinese industries. Central authorities believe that returnees can make crucial contributions that will facilitate the transition from "Made in China" to "Created in China" by bringing with them critical resources such as advanced knowledge, cutting-edge technologies, international business networks, and advanced managerial experience (Dai & Liu, 2009).

3.2. Major Special State S&T Policies for University

Compared to the US, China's UILs are still in their infancy. Central authorities have designed several national projects aimed at providing political support and financial funding to certain research-intensive universities. These projects have partly improved the academic capacity and increased the innovative assets available to industries since the middle of 1990s (see Table 5).

[7] http://www.xjkunlun.cn/zzgz/rcgz/2010/2008107.htm

TABLE 5. Special State Projects That Impact University Research

Year	State Projects for universities	Agency	Key Focus
1995	Project 211[8]	MOE	Develop key disciplines, education, university faculties and campus infrastructure; strengthen research capacity; and establish the public service system of higher education.
1999	Project 985 [9]	MOE	Found world-class or high-level universities; strengthen the innovative capacity; stimulate technology transfer
2006	Program 111 [10]	MOE/SAFEA	Introduce 1000 foreign academic elites from the world's top 100 universities and found 100 world-class faculty research centers. In addition, send excellent domestic talents to world-class universities or research institutes to implement joint research or academic collaboration.

3.2.1. Project 211

Though the private Chinese economy achieved dramatic growth in the 1990s, universities still had weak connections to the private sector as a result of an emphasis on labor-intensive industries rather than knowledge-based ones. Furthermore, the effects of universities on educating high-tech talent and technology research lagged behind developed countries (the US, UK, and Japan), and some emerging countries (Korea and Singapore). As a result, the Chinese central government proposed Project 211 in 1995, which aimed to improve R&D capacity at the university level and enhance university-industry cooperation, thereby harnessing intellectual resources to develop high-tech industries. During the first development phase from 1995 to 2005, the central government invested 36.826 billion RMB to these universities in order to strengthen key teaching staff (45%) and R&D capacity. According to a report published by MOE in 2005, Project 211 universities had over 80% of PhD students, 66.7% of graduate students, 50% of overseas students, and 33.3% of undergraduate students in China, while they kept 85% state principal faculties, 96% state chief laboratories, and received 70% of R&D funding. In addition, MOE[11] reported that Project 211 universities undertook half of the NNSF projects and Project 973 projects, one-third of those in Project 863, and one-third of the state S&T awards, making critical contributions to new technological developments.

3.2.2. Project 985

In May 1998, the central government proposed a new program called Project 985 towards establishing world-class universities. Project 958 selected thirty-nine universities from a pool already se-

[8] 'Project 211' means that China will establish about 100 universities in terms of faculty, research and management quality in the 21st century, reaching the level of a world-class university nation. Only 112 universities out of more than 2600 universities in China enter into Project 211 lists.

[9] The aim of Project 985 is to establish several world-class universities that bridge the gap between Chinese scholars and scholars from developed countries.

[10] Its official name is "The Program of Introducing Talents of Discipline to Universities." Program 111 members are selected from Project 211 and Project 985, both of whichare supervised by state ministries. With the goal of strengthening faculty capacity and enriching academic resources, MOE and SAFEA (State Administration of Foreign Experts Affairs) respectively invested 0.3 billion funds to Program 111 universities in the "eleventh five-year" period (2006-2010).

[11] http://baike.baidu.com/view/7085.htm

lected by Project 211. Compared to Project 211, these universities could get more state financial and political support that contribute to improving R&D capacity. For example, PKU got 0.125 million RMB from Project 211 and 1.8 million from Project 985 during the first phase. In addition, local governments also provided matching funding for these universities. However, the level of regional economic development was reflected in the magnitude of financial support to the universities. For example, Sun Yat-Sen University received 0.9 million from Guangdong province, while Lanzhou University got 0.15 million from Gansu Province per year.

3.2.3. Program 111

As an auxiliary policy of Project 211 and Project 985, the Ministry of Education (MOE) and the State Administration of Foreign Experts Affairs (SAFEA) launched Program 111 in 2006. This program aims to bridge the gap between Chinese universities and world-class universities in terms of research talent, research capacity, and industrial applications, and plans to eventually bring in 1,000 foreign academic elites from the world's top 100 universities and establish 100 world-class faculty research centers (by three steps: 25 in 2006, 40 in 2007, and 35 in 2008).

Since the above-mentioned S&T policies were implemented, an increasing number of universities have founded national university science parks (NUSPs) that contribute to transferring results from university research, nurturing high-tech firms, providing entrepreneurial bases for university researchers or students, and developing emerging strategic industries. By 2010, China founded eighty-six NUSPs that were affiliated with 134 universities, produced 6,617 high-tech USOs, and transferred 4,606 technologies to market. Furthermore, the incubating high-tech USOs submitted 5,603 patent applications including 2,333 invention patents. NUSPs made dramatic contributions to linking university research to industrial actors, thereby generating substantial interactions with economic potential. MOST's proposed targets include China founding 200 NUSPs that will produce 8,000 high-tech USOs, provide technological services for 100 thousand firms, transfer 10,000 technologies, train 100 thousand academic entrepreneurs or innovative talent, found eighty high-tech bases for students, and incubate 3,000 high-tech firms by students[12] by 2015.

4. REGIONAL S&T POLICIES AND UILS

In China, the existing evaluation system primarily focuses on economic achievement. Since the critical role of higher education in economic growth and industrial optimization emerged in the 1980s, more and more local governments have actively stimulated UILs through launching an array of S&T policies or providing various platforms, in spite of the fact that China's industry still depends on the importation of advanced technology in the forms of production equipment, processes,

[12] http://www.most.gov.cn/fggw/zcjd/201108/t20110819_89134.htm

and methodologies. Chen and Kenney (2007) found that as the two cities where leading universities are located, Beijing and Shanghai, enacted an array of S&T policies (such as founding NUSPs and joint industry-university innovation bases, providing funds, and creating incentive mechanisms) that supported universities in facilitating research that led to viable products and the development of technological processes. Furthermore, universities themselves benefit from these local S&T policies, stimulating cooperation with the private sector, evaluating the real effects of R&D, founding related offices of UILs, and generating economic income and enhancing academic position. Thus, many big global high-tech companies and domestic emerging high-tech firms tend to select both of those two cities as their business centers when entering the Chinese market because they believe that research-intensive universities might provide a wealth of skilled laborers, technological assets, joint research opportunities, and knowledge bases. As a result of the collaboration with local universities, these enterprises easily develop a competitive edge over their rivals.

Through interviewing several entrepreneurs who have been operating high-tech business for more than ten years in Nanjing, we discovered that UILs were comparatively weak before the 2000s. Although many universities and research institutes around Nanjing maintained a wealth of intellectual assets and innovative talent, local government still concentrated on labor-intensive industries up to as late as the 1990s. Due to the dramatic economic effect of high-tech (mainly in the areas of IT, biotech, and marine technology), the government in Nanjing continuously proposed S&T policies to stimulate economic development and improve competitive advantages. Encouraged by local S&T policies, some high-tech firms and universities jointly founded R&D platforms and laboratories towards strengthening academic-industrial interactions. While UILs have become more frequent, an increasing number of high-tech start-ups have also emerged in Nanjing.

The former capital of Chiang Kai-Shek's government, Nanjing contains fifty universities[13] and is ranked third in S&T and higher education behind Beijing and Shanghai. Industrial development cannot be separated from university support, especially as Nanjing tries to establish a knowledge-based innovative city.

In July of 2011, the Nanjing government launched a new S&T policy named "Eight Key Plans" aiming to establish high-level talent and a technologically innovative city (see Table 6).

TABLE 6. Eight Key Plans of Nanjing City

Name of Plan	Key Focus
Building S&T Ventures Cluster	This cluster will build an international-level incubator and provide political and financial support for academic entrepreneurs. By 2015, it will collect 10,000 S&T ventures.
Introducing S&T Entrepreneurial Talents	Actively introduces S&T entrepreneurial talents at home and abroad. By 2015, Nanjing will have 3,000 S&T entrepreneurial talents, including 1,000 returning with foreign academic degrees, 1,000 entrepreneurial foreigners, and 1,000 Chinese high-quality talents.

[13] According to a statistical bulletin published by the Nanjing statistical bureau, there were fifty-three universities (not including military colleges) that had 715.7 thousand undergraduates and 92.8 graduates in 2011 (http://www.nanjing.gov.cn/zwgk/xxgk/bmgx/201203/t20120330_1122337479.htm). Meanwhile, there were twenty university science parks (four at the state level).

Name of Plan	Key Focus
Training S&T entrepreneurs	Trains entrepreneurs for new S&T development, creating a new business model and new industries. By 2015, finish the training of 200 S&T entrepreneurs.
Mentoring program for S&T ventures to make list	Provide "green channel" and mentoring program for S&T ventures. By 2015, have 100 S&T ventures make list.
Building entrepreneurial platform for S&T ventures	Encourage districts, high-tech zones, Open Economic Zones, industrial parks, science parks to build entrepreneurial platforms for new S&T business with universities and research institutes. By 2015, build twenty university S&T parks and sixty strategic emerging industrial innovation centers.
Building investment fund and capital raising system for S&T ventures	Build financial service system across the initial stage, growing stage and maturation stage of new ventures. By 2015, provide financial investment and support for raising capital for 10,000 S&T ventures and primarily produce 1,000 S&T ventures.
Attracting high-level R&D institutes	Build international enterprise R&D parks to attract top global 500 and top 500 Chinese firms. By 2015, attract 100 high-level R&D institutes.
Establishing development plan for proprietary intellectual property rights	Build effective intellectual property rights management system and protection system. By 2015, achieve 10,000 authorized invention patents.

Source: http://www.most.gov.cn/dfkj/js/zxdt/201107/t20110707_88005.htm

To effectively implement the Eight Key Plans, Nanjing in 2012 proposed the 321 Talent Plan, which aims to introduce three types of entrepreneurial talent: academic leaders of outstanding achievement in a S&T area and can enact high-tech R&D results with high market potential, experts who have intellectual property rights or key technologies that can be applied to industrialization, and entrepreneurs who have new business creation experience abroad and can take technology, projects or funding to create new business in Nanjing (see Table 7). With consideration to how many new businesses die at the initial stage, the Nanjing government provides the initial funds, business space, administration, equity trading, and other services that ensure S&T ventures can have a healthy business environment in which to grow. To strengthen the linkage between these new S&T ventures and universities, the Nanjing government encourages 321 talented researchers to participate in university R&D activities to solve technological problems or find new commercial opportunities.

In addition, 321 researchers with strong academic abilities will be recommended to professorships or research positions at Nanjing universities (including NJU, Southeast University, Hohai University, NJU of Science and Technology, and NJU of Aeronautics and Astronautics, schools that have strong R&D departments and have established various incubators, science parks, and joint research bases for simulating UILs).

TABLE 7. 321 Talent Plan of Nanjing

Classifications	Key Focus
Key Support Projects	Disperse initial 2 million RMB startup fund; provide 3 million RMB venture fund and 3 million RMB financing guarantee if needed, a rent-free 100 square meter office and 100 square meter house for a term of three years.
Support Projects	Disperse 1 million RMB startup fund; provide a 1.5 million RMB venture fund and a 1.5 million RMB financing guarantee if needed; 100 square meter office and 100 square meter house without rent for three years.

In 2010, Nanjing proposed a "Twelfth Five Year" program to outline the major developmental targets for the next five years (2011-2015), in which it refers to the five key S&T policies (see Table 8)

TABLE 8. Five Key S&T Policies

Classifications	Key focus
Zijin Talent Plan	Starting in 2010 invest 0.1 billion RMB to support 10 top talents (or group), 100 leading talents (or group), and 10,000 urgently needed talents per three years, thereby fueling industrial modernization and economic growth.
Zhongshan Young Talent Project	Establish an exceptional S&T environment around universities and key enterprises in Nanjing, with over twenty young talent innovation and entrepreneurship bases to educate and support 500 young talents each year through financial funding or policies.
Jinling Famous Celebrities Project	Support 100 cultural and artistic talents; provide financial funding and international communication; educate and support 100 talents from every facility per year.
Modern Service Industry Gold-Collar Project	Introduce 5,000 modern service industrial talents who are good at finance, service outsourcing, software and information service, idea design, intellectual property, and modern logistics.
The Increasing Project of High-Skilled Talent	Establish five national high-tech talent-training bases; train 15-20 thousand skilled talents per year.

Source: http://www.nanjing.gov.cn/njgk/csgk/csgk16/

5. UNIVERSITY S&T POLICIES AND UILS

Research into why universities adopted particular S&T policies to stimulate UILs showed how those policies often involve incentives or various kinds of support for entrepreneurial activities (Di Gregorio & Shane, 2003). As the most successful benchmark of UILs, many US entrepreneurial universities (such as MIT, Stanford University, and the University of California) have enacted well-performing S&T policies to stimulate academic entrepreneurial activities. Chinese universities should also expect to expand and accelerate technology transfer and eventual commercial application through launching a series of S&T policies like those at American universities. In China, university S&T policies designed by its TTO often need to answer several questions: what are the incentives for R&D and entrepreneurial activity; what is financial support for entrepreneurial activity; the presence of nurturing conditions for startups; and issues relating to industry-university joint research. In looking to stimulate UILs, most Chinese universities set up various departments in the form of industrial-academic-research (Chan-Xue-Yan) committees, TTOs, university development, and university science parks that organize and provide support for developing academy-industry partnerships (Chen & Kenney, 2007; Su et al., 2011).

To help understand how university S&T policies might influence the UILs, NJU[14] is presented an

[14] By February 2012, NJU maintains 7 State Key Laboratories, 8 MOE Key Laboratories, 1 State Engineering Technology Research Center, 2 MOE Engineering Research Center, 6 Jiangsu Province Key Laboratories, 11 Jiangsu Province Engineering Technology Research Center, etc. In addition, NJU was ranked as the fourth best R&D environment for graduate students.

example of what is considered a successful entrepreneurial university that implements radical technologies with broad scope patents to cooperate with industrial firms.

5.1. Technology Transfer Center (TTC)

A TTC that identifies and manages university intellectual assets (including intellectual protection, technology licensing, introducing new research results to practice, and creating strong connections with industrial partners for products development) is critical for entrepreneurial universities (Comacchio et al., 2012). NJU implemented various R&D activities that made big contributions to improving its university faculty and its capacity for innovation since the 1980s, but commercial research was still in its infancy. To overcome such a challenge, NJU established its TTC as a separate university executive branch in 2004. Through providing opportunities related to research commercialization, industrial consulting, and commercial evaluation, the TTC at NJU created a cooperative bridge between university researchers and industrial sectors. In addition, the TTC at NJU enacted a series of S&T policies such as the "NJU Patent Strategy," "NJU Protection Regulation Regarding Intellectual Property Rights," "NJU Management Regulation Regarding Found Patents," and the "NJU Rules on Inventing and Licensing Patents," providing political guidelines for facilitating UILs, ranging from new R&D commercialization to USO creation. Owing to the dramatic success in UILs, this center was selected as the first batch of State TTCs[16] in 2008.

5.2. Incentive Policies for UILs

According to the theory of entrepreneurial motivation, academic entrepreneurship is likely to be encouraged by incentive policies. Prior scholars have argued that the ambiguity of distributions might restrain the commercialization of R&D results and therefore negatively influence the enthusiasm of researchers who are the main actors in creating new knowledge and patents (Di Gregorio and Shane, 2003; Su & Sohn, 2012). As a result, an effective incentive mechanism must be built that can stimulate universities to create knowledge and diffuse technology to industries. For example, the NJU sets regulation where inventors get at most 70% of USO stocks created through exploiting their own inventions. Tsinghua University allows researchers to invest their R&D results for 20%-50% of USO stocks. Jiangsu University allows researchers 50%-70% of technology stocks. However, existing incentive policies at Chinese universities tend to focus on academic publications rather than commercial activities (Wu & Zhou, 2012).

5.3. University Financial Support

The commercial potential of academic research needs to be realized through financial support. At this moment, sources of university funds for UILs can be classified into four groups: (1) the university's budget, (2) industrial funding, (3) government funding, and (4) capital from venture capital-

[16] Among the top 9 Project 985 members, only the NJU TTC earned this laurel demonstrating the success of UILs.

ists. However, venture capital and the industrial sector are not easily accessible because UILs are likely to get financial funding only when they can benefit from commercializing academic research (Rothaermel & Thursby, 2005). In the context of China, financial support from universities has only a critical effect on UILs, because the venture firms do not readily approach venture capitalists (Su et al., 2011). As one of the top five universities in China, NJU also provides a wealth of funds for academic entrepreneurs to help commercialize their new discoveries with higher market potential. From 2005 to 2010, over fifty[17] new S&T projects involving environmental protection, 3D technology, medicine, IT, and precision instruments that were developed by professors or researchers[18] through R&D platforms got financial support from the Technology Innovation Fund at NJU. Furthermore, some of these S&T projects were developed at the NJU Science Park or transferred to industrial sectors for commercialization, thereby generating considerable economic value to their parent universities.

5.4. Industry-University Joint Research Bases

Prior studies argue that collaborations with established firms can help universities exploit student employment opportunities, access industrial facilities or materials, understand market needs, and improve the success rate of R&D (Chen & Kenney, 2007). An increasing number of Chinese universities have created various industry-university joint research bases to stimulate partnership with industries. By 2012, NJU had founded twenty-four industry-university joint bases (twenty-one with local government and three with big firms) around the Yangtze River Delta.[19] For example, the NJU-Wuxi industry-university joint research centers founded by NJU, the Wuxi government, and the Wuxi high-tech zone in 2007 mainly focus on nano materials, life sciences, environmental protection, and new resources development, all rising R&D fields at NJU. In addition, this base holds the scholars' workstations, a technology transfer center, a software research institution, and a human resource research institution as all part of this academic-industrial connection that ultimately generates economic value. Furthermore, the Wuxi high-tech zone set up a 25 million RMB venture-capital fund to encourage the entrepreneurial activities of NJU researchers, which has helped nearly 100 R&D projects implemented by NJU researchers and motivated original research. As a result of this base, major contributions were made in introducing high-quality research talent, strengthening the commercialization of academic research, developing high-tech clusters, and improving regional competitiveness.

5.5. University Science Park

Nurturing policies partially explain the factors that facilitate the commercialization of university

[17] http://ttc.nju.edu.cn/ttc/jijin.php

[18] They were from the School of Physics, the School of Chemistry & Chemical Engineering, the School of Environment, the School of Life Sciences, the School of Electronic Science & Engineering, the Department of Computer Science & Technology, and the School of Earth Sciences & Engineering.

[19] http://ttc.nju.edu.cn/ttc/xf.php

inventions (Mei, 2004). At the initial stage of a new business, USOs are isolated from the marketing and manufacturing aspects of established firms that keep cost advantages and strong market networks in order to drive out new competitors. In general, USOs often take one of two approaches to solving these challenges (Nerkar & Shane, 2003). First, USOs grow within university science parks, which might accelerate the growth and survival of USOs through providing a variety of business support and services that include physical space, financial capital, business coaching, industrial connections, and market information (Comacchio, Bonesso, & Pizzi, 2012). Second, USOs enhance the degree of cooperation with established players which might provide industrial networks and market information, thus improving their ability to survive. In the context of Nanjing, more and more universities overwhelmingly adopt the first option that creates various university science parks (university incubators) while launching new spin-offs based on intellectual properties. For instance, NJU founded a science park in 2009 (see Figure 1), which concentrates on high-tech cluster establishment, technology transfer, technological development, entrepreneurial education, and high-tech business service. The science park evaluates the commercial prospects of university research results, provides entrepreneurial coaching for new businesses, seeks industrial partners for university researchers, educates academic entrepreneurs, and establishes connections between the private sectors and university to stimulate economic collaboration.

FIGURE 1. NJU Science Park

Source: Homepage of Qixia District Government, Nanjing [20]
Note: NJU Science Park is outlined by red line

[20] (http://www.njqxq.gov.cn/www/njqx/2010/tzqx9-mb_a3910111717990.htm)

TABLE 9. Typologies of University S&T policies and Mission Statements

Typologies	Mission Statement
TTO	Identify and manage university's intellectual assets, including intellectual protection, technological licensing, introduce new research results to industry, and create strong connections with industrial partners for product development.
Incentive Policies for UILs	Stimulate motivation for research and entrepreneurial activities of researchers, including scholarly publications, joint research, and new business creation.
University Financial Support	Arrange financial funding to support R&D commercialization, particularly new USO creation.
Industry-University Joint Research Bases	Provide physical space for implementing industrial-academic research and experiments, thereby strengthening the commercial likelihood of research results. In addition, joint research bases can enrich the sources of R&D expenditure and reduce the burden of university budgets.
University Science Park (University Incubators)	Provide support for underwriting UILs, including physical space, business coaching, consulting services, industrial resources, talent transfers, and even financial loans, narrowing the gap between university researchers and the industrial adoption of research results.

In the past decade, NJU has achieved dramatic success in UILs through launching various S&T policies. In addition to active collaboration with industry, NJU also established many firms that commercialize inventions developed by university researchers.

6. DISCUSSION

Industry collaboration with universities is considered to originate from in-house R&D, enriching innovative assets, changing the nature of research properties, and shortening the product life cycle (Park and Leydesdorff, 2010). The reasons that universities are willing to strengthen cooperation with industrial partners can be attributed to several explanations: (1) industry can be a new source of university R&D funds, reducing the pressure on the government's R&D budget, (2) the industry-university funds are not limited by the "red tape" associated with government money, (3) joint industrial-university research provides hands-on opportunities for students to understand the nature of the real world, and (4) joint industrial-university research pushes professors or researchers to develop practical technologies (Clarysse & Moray, 2004; Etzkowitz, Wester, Gebhart, & Terra, 2000; Liao, Fei, & Liu, 2008; Meyer, 2003). Accordingly, an increasing number of Chinese universities have set up various S&T policies or institutions that shape the nature and fruitfulness of UILs, making contributions to regional economic growth in the process. We reviewed three levels of S&T policies in order to evaluate policy performance during China's high-tech developmental period. Furthermore, in using Nanjing City in Jiangsu Province as a case study, particular emphasis was placed on how university S&T policies affected the development of UILs.

6.1. A Summary of Research Results

Over the past decades, UILs were affected by the Chinese central or local government through policies and programs such as Project 211, Project 985, Program 863, the Torch Program, and Program 973, all of which aimed at improving national technological competitiveness and developing knowledge-based economy. Owing to political impetus, certain universities in China have realized dramatic success of UILs, such as THU, PKU, and NJU, which have founded university science parks, incubators, UTTOs, and other similar organizations for stimulating collaboration with industries. In addition, awareness of the UILs' importance (enriching R&D funds, creating financial income, enhancing academic position, and other benefits) made an increasing number of universities proactively enact S&T policies to underpin cooperation with industries. Accordingly, such universities have presented stronger competitive advantages and vitality than others that seem to have no initiative or ability to support UILs (Zhou & Peng, 2008).

As the dominant actor of UILs, university researchers play a crucial role in knowledge spillover and technology transfer from laboratories to industries. In order to stimulate the role of university researchers in UILs, universities such as NJU enact attractive incentives. Moreover, university researchers also believe that entrepreneurial activity based on their intellectual property might generate economic profit and enhance academic prestige (Chen & Kenney, 2007; Di Gregorio & Shane, 2003; O'Shea, Allen, Chevalier, & Roche, 2005).

6.2. Implications

Although universities in China are encouraged to communicate with industry, UILs are still tentative compared to that of developed countries. The ability for S&T policies to stimulate UILs has become an emerging research topic for interested scholars and a political issue for policymakers.

6.2.1. S&T Policy-Decision Making and UILs

Encouraged by the economic benefits of UILs, central authorities, local policy-makers, and even the UTTOs have steadily drawn up various S&T policies that look into applying research results. However, the S&T policy-decision making process is still dominated by bureaucracy that frequently manipulates S&T policies for political success rather than economic growth. To maximize the effects of S&T policies on UILs, the adverse effect of political power plays must be weakened.

6.2.2. Changing Role of Universities and UILs

In this era of knowledge-based economies, universities have emerged as a central innovation sector that supports the transfer of academic findings into something of commercial value. As a result, more and more Chinese universities are trying to change their role, shifting emphasis from teaching to research. However, this transformation has undergone many setbacks that seriously hinder UILs due to how China's existing university structure lacks the necessary cooperation with industry. In addition, the complexity and difficulty of the existing university structure also hinders changing roles in enhancing UILs. Thus, recent entrepreneurial universities in China such as THU, PKU, and NJU tend to create technology transfer offices (TTO) and permit them to manage a university's intellectual assets, science parks, and incubators .

6.2.3. For USOs to Survive in China

Although entrepreneurial universities have launched many USOs through nurturing intellectual resources or financial support, only a small number of them have grown into larger firms when compared against the overall number of nurtured firms, the majority of which did not survive. Prior studies looked for evidence as to why USOs have such a small chance of survival compared to independent or corporate spin-offs within existing industry networks and market mechanisms (Wennberg, Wiklund, & Wright, 2011; Wu & Zhou, 2012). In a study of why some USOs based on affiliations with the Massachusetts Institute of Technology exhibit survival ability better than others of similar systems, Nerkar and Shane (2003) argued, “New firms must build an organization and acquire assets that will be used in conjunction with their radical technology.” Similarly, Bathelt, Fogler and Munro (2010) argued that USOs based on university intellectual property have less market legitimacy. In accordance with Su et al (2011)’s perspective, the higher failure rate of USOs in China can be explained by the lack of industrial networks, market information, or commercial knowledge, and an inability to respond to rapid environmental changes. USOs in order to improve the success rate of radical technology commercialization must coordinate with the private sector to establish stronger industrial ties that enrich marketing and manufacturing assets.

6.2.4. Changes in the University Management System

Unlike university presidents in the West who act as “leaders, innovators, educators, or communicators,” China’s university presidents are often defined as “politicians” who primarily maintain good relationships with their superiors, communicate with peers, and govern university students, staff, and even professors (Chen & Kenney, 2007). Although the role of the university in society and the economy has gradually changed over several decades, the university management system in China still maintains earlier framework that hinders technology transfer, research commercialization, and new venture creation within the academic environment. In order to realize more active, profitable UILs, policymakers need to find more effective ways that can contribute to building a more flexible university management system.

6.2.5. Economic Interactions and UILs

New technologies developed from internal R&D and outsourcing are vital to industrial competitiveness that contributes to the development of new products or services. China is still in the “labor-intensive” or “investment-driven” stage of industrial development, and the central government must pay more attention to upgrading its innovative capabilities in order to enter into the “knowledge-intensive” or “innovative-driven” stage. As an important sector of R&D, universities play an increasingly central role in making research results a reality. Industry should seek out university-industry cooperation, in particular regarding joint basic and applied research, which is critical to developing new products and processes, finding solutions of industrial problems, assisting in on-the-job education and training, and so on.

Through close collaboration with industry, universities are also likely to generate more financial income, and in the process enriching university R&D funds that can foster technological progress and make new discoveries in a financial climate wherein governments are looking to reduce R&D budgets. Furthermore, if stronger UILs continuously show good economic performance, the private sector might see this as an incentive to invest more into universities for high-tech development that can result in new products.

6.3. Research Limitations

In China, commercial activities of universities are still very much in the developing stages so statistical data of UILs is relatively incomplete and outdated. Therefore, this study cannot provide more analysis on the role of various S&T policies in UILs despite the accepted notion of its importance. A second important limitation concerns the scope of the investigation. Our sample, in our attempt to illuminate the role of university S&T policies in UILs, consisted only of the particular firms created through the exploitation of intellectual property created by NJU, even if NJU can be considered as a common case of successful cooperation with industry.

In addition, while our study only provides insight into one small way in which the three levels of that S&T policies impact the UILs, we hope that it will encourage scholars to examine this question in depth rather than simply supposing that existing S&T policies might influence the outcome of UILs.

6.4. Future Research

In spite of having realized some dramatic changes in UILs, Chinese universities have still not achieved the market effects of technology transfer compared to their Western counterparts, which generate financial income and even enhance academic position of researchers or universities (Chen & Kenney, 2007; Su et al., 2011; Wu & Zhou, 2012). Future research on the UILs of Chinese universities needs to look into how the commercialization of academic R&D is effectively stimulated and spin-offs created. This might require policymakers to enact more flexible and effective S&T policies.

7. CONCLUDING REMARKS

In recent years, the role of the university in R&D commercialization has become more important as partnership with industrial sectors increased (Zhang, 2009). To provide a roadmap for scholars interested in the UILs of Chinese universities, this study discussed the three levels of S&T policies associated with the academic entrepreneurial process as well as provided an outline of the major factors that stimulate new venture creation.

In conclusion, we believe that this study might open up a new avenue of research into the ways where industry interacts with university through skilled labor training, technology transfer, R&D commercialization, and even spin-off creation.

REFERENCES

Åstebro, T., Bazzazian, N., & Braguinsky, S. (2012). Startups by Recent University Graduates and their Faculty — Implications for University Entrepreneurship Policy. *Research Policy, 41*, 663–677.

Bathelt, H., Fogler. D.F., & Munro, P. (2010). A knowledge-based typology of university spin-offs in the context of regional economic development. *Technovation, 30*, 519-532.

Chen. K., & Kenney, M. (2005). *The role of university/research institute-industry linkages in the technological development of Beijing and Shanghai.* (BRIE Working Paper 168). Retrieved from http://brie.berkeley.edu/publications/wp168.pdf.

Chen. K., & Kenney, M. (2007). Universities/research institutes and regional innovation systems: The Cases of Beijing and Shenzhen. *World Development, 35*(6), 1057–1024.

Clarysse, B., & Moray, N. (2004). A process study of entrepreneurial team formation: The case of a research-based spin-off. *Journal of Business Venturing, 19*(1), 55-79.

Comacchio, A., Bonesso, S., & Pizzi, C. (2012). Boundary spanning between industry and university: the role of technology transfer centers. *Journal of Technology Transfer, 37*, 943-966.

Dai, O., & Liu, X.H. (2009).Returnee entrepreneurs and firm performance in Chinese high-technology industries. *International Business Review, 18*(4), 373–386.

Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others? *Research Policy, 32*, 209-227.

Etzkowitz, H., Wester, A., Gebhart, C., & Terra, B. (2000). The future of the university and the university of the future: Evolution of the Ivory Tower to entrepreneurial paradigm. *Research Policy, 29*, 313-330.

Hashim, F., Alam, G.M., & Siraj, S. (2010). Information and communication technology for participatory based decision-making-E-management for administrative efficiency in Higher Education. *International Journal of Physical Science, 5*(4), 383-392.

Kenney, M., & Von Burg, U. (1999). Technology and path dependence: The divergence between silicon valley and route 128. *Industrial and Corporate Change, 8*(1), 67-103.

Liao, S.H., Fei, W.C., & Liu, C.T. (2008). Relationships between knowledge inertia, organizational learning and organization innovation. *Technovation, 28*, 183-195.

Mei, M. (2004). Innovation feedback: Interactive development in research universities and their science parks. Retrieved from http://iis-db.stanford.edu/evnts/4097/MMeng_Innovation_Feedback.pdf.

Meyer, M. (2003). Academic entrepreneurs or entrepreneurial academic? Research-based ventures and public support mechanism. *R&D Management, 33,* 107-115.

Nerkar, A., & Shane, S. (2003). When do start-ups that exploit patented academic knowledge survive? *International Journal of Industrial Organization, 21*, 1391-1410.

O'Shea, R.P., Allen, T.J., Chevalier, A., & Roche, F. (2005). Entrepreneurial orientation, technology transfer and spin-off performance of U.S. universities. *Research Policy, 34,* 994-1009.

Park, H.W., & Leydesdorff, L. (2010). Longitudinal trends in networks of university-industry-government relations in South Korea: The role of programmatic incentives. *Research Policy, 39,* 994-1009.

Rothaermel, F.T., & Thursby, M. (2005). Incubator firm failure or graduation? The role of university linkages. *Research Policy, 34,* 1076-1090..

Sohn, D.W., & Kenney, M. (2007). Universities, clusters, and innovation systems: The case of Seoul, Korea. *World Development, 35*(6), 991-1004.

Su, D.J., Ali, M., & Sohn, D.W. (2011). A Model to create high tech startups from the academic environment: The case of PKU and THU. *African Journal of Business Management, 5*(26), 10821-10833.

Su, D.J., & Sohn, D.W. (2012). Why do Beijing universities play important roles in regional innovation systems? Based on resource-based view. *African Journal of Business Management, 5*(14), 4768-4783.

Wennberg. K., Wiklund, J., & Wright, M. (2011). The effectiveness of university knowledge spillovers: Performance differences between university spinoffs and corporate spinoffs. *Research Policy, 40*, 1128-1143.

Wright, M., Liu, X.J., & Filatotchev, I. (2012). Returnee entrepreneurs: Resource orchestration, context and knowledge spillovers, In Wang, C.L., Ketchen, D.J., & Bergh, D.D., (Eds.)Research methodology in strategy and managment. (243-263). Bingley, UK: Emrald.

Wu, W.P., & Zhou, Y. (2012). The third mission stalled? Universities in China's technological progress. *Journal of Technology Transfer, 37*, 812-827.

Zhang, J. (2009). The performance of university spin-offs: An exploratory analysis using venture capital data. *Journal of Technology Transfer, 34,* 255-285.

Zhou, C.Y., & Peng, X.M. (2008). The entrepreneurial university in China: nonlinear paths. *Science and Public Policy, 35*(9), 637-646.

Zweig, D. (2009, June). *Returnees, technology transfer, and China's economic development.* Paper presented at the 4th international Symposium for oversea talents and China's development. Retrieved from http://www.cctr.ust.hk/materials/working_papers/WorkingPaper 28-DZ- Returnees_and_Tech_Transfer.pdf.