Elite Universities in China & the Technology Sector:
A Policy Analysis Report

Maureen Downes
Y. Tina Wei
Aili Zhou
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Executive Summary

Over the past few decades, China’s high rate of economic growth can be attributed mainly to its manufacturing sector. Recognizing that this type of growth is unsustainable, and that a labor force is needed to jumpstart the science and technology sector, the Chinese central government has placed an increased emphasis on higher education. Likewise, while reforms across all levels of higher education have occurred since Deng Xiaoping’s economic reforms started in 1978 government directives have stressed the importance of establishing a group of “world-class universities” that are focused on building scientific and technological innovations.

The tradeoff between improving college quality and expanding access to college is typical for developing countries like China. Given that China has placed a disproportionate amount of resources towards elite universities, as defined by the central government’s directed “985 Project,” this policy analysis will explore these institution’s roles in meeting job market and research demands in the emerging technology sector. Utilizing the existing relationship of higher education institutions, state owned enterprises, research institutions, and the government, we identify the current strengths and weaknesses in the model. Drawing upon Tsinghua University as a case study, China’s most elite science and technology institution, we identify areas for potential policy interventions to improve the quality of applied research. We view the connection between research and the high-tech industry as an important factor in China’s economic development.
History of China’s Higher Education System

The different stages of reform in China’s higher education system, beginning with the founding of the People's Republic of China (PRC) in 1949, coincides with each of the major national policy shifts as directed by the central government. For the past three millennia, the traditional Chinese way of thinking and their education system has been overwhelmingly influenced by the ideals and teachings of Confucius. But with the first opening of China to the world during the First Opium War of 1840, which was a century prior to the Chinese Communist party’s rise to power, educational development became influenced by Western scientific and technological advances. Another wave of outside Western – and particularly US – influence came at the beginning of the twentieth century in the form of the Boxer Indemnity Scholarship Program, which led to the establishment of what is now known as Tsinghua University, China’s most renowned university (Yang and Welch 2011, p. 648). By the time the PRC was founded in 1949 there were 207 higher education institutions in China with 117,000 college students enrolled, but to put it into perspective, this constituted only 0.2 percent of the population (Qiang 1996, p. 17). Moreover, higher education resources were unevenly distributed during this time period, as only 41 percent of college students attended institutions in six major cities, and very few institutions were in underdeveloped regions (Qiang 1996, p. 17).

Inequality in education started to change under Chairman Mao Zedong’s regime as the government took over universities and reshaped them under the guidance of the Soviet Union model of higher education. Adopting a complex system of research institutions that was primarily focused on military advancement rather than industrial production, the relationship between research institution, universities, and enterprises was strictly separated from one another (Wang & Zhou 2011, p. 144). Chinese universities were governed by a highly centralized system under the central government, and each university was essentially a unit under the
Ministry of Education (MOE) (Xiong, Zhang & Liu 2011, p. 32). Under this system, the government became the sole entity that funded and controlled research. Institutions were divided into either comprehensive universities, which were focused on producing researchers for institutes or training teachers, or specialized universities, which prioritized science and technology training over all other disciplines (Wang & Zhou 2011, p. 144). As a result, the number of students in engineering soared and there was a sharp decline in the humanities and social sciences fields. By 1952, 14 comprehensive universities and five teacher colleges were revamped to fit the Soviet model (Qiang 1996, p. 17).

From 1967 to 1976, the Cultural Revolution devastated the higher education sector in China. All but a few higher education institutions were shut down during this period, and enrollment in postsecondary institutions dropped from 674,400 students to 47,800 students by 1976 (Qiang 1996, p. 17). Likewise, development of the economy and China’s science & technology (S&T) system came to a halt, and the “only mission of universities was to foster people with political ability” (Wang & Zhou 2011, p. 145). The centralized university system that was built under the Soviet model was completely dismantled. It is important to note that not only did academia essentially stopped teaching but research was also discontinued (Wang & Zhou 2011, p. 145).

Despite the significant drop in postsecondary institutions during the Cultural Revolution, Deng Xiaoping’s leadership in 1977 led to the next wave of educational reforms. Coinciding the “reform and opening-up” policy that was implemented to create a socialist market-oriented economy was an opening-up of knowledge. There was a shift from “government ruling” to “government guiding” of universities (Wang & Zhou 2011, p. 146). These educational reforms included the implementation of the National Higher Education Entrance Examination in 1977,
also known as the *Gaokao* in Mandarin. Furthermore, in 1985, the system was given much more autonomy and there was an emphasis on shifting education away from political functions and towards economic functions (Wang & Zhou 2011, p. 146).

Another significant change occurred in the 1990s, which overlapped with China’s major economic reforms. The central government followed the US and the European higher education models and began merging their segmented universities and colleges system to form comprehensive universities (Wang & Zhou 2011, p. 146). But the real surge in the number of students enrolled in higher education institutions occurred after 1998 when the higher education expansion policy was issued. Specifically, universities gained autonomy in enrollment expansion, curriculum development, faculty recruitment, and international exchanges (Wu 2010). A review of the numbers show that in 1998 there were only 3.41 million students enrolled by China’s higher education. This number increased to 20.21 million by 2008 (Gu 2008, pg. 514).

**Higher Education as part of China’s National Innovation System (NIS)**

In discussing the relationship between China’s higher education and the high-tech industry as it relates to China’s developing economy, it is important to understand how the Chinese National Innovation System (NIS) has evolved over time. This helps to explain how applied research, particularly in S&T, is currently organized and produced in China today. NIS, a term that was coined in the late 1980s by Christopher Freeman and Bengt-Ake Lundval, is a concept in which its premise rests on “understanding the linkages among the actors involved [as it] is key to improving technology performances” (OECD 1997, p. 11). It is defined by Freeman (1987) as “the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies.” As increasing attention is
given to the “economic role of knowledge,” the study of national innovation system focuses on the “flows of knowledge” and the theory that “knowledge-based economies” are “directly based on the production, distribution and use of knowledge and information” (OECD, 1997, p. 11).

In the context of China, Wang and Zhou (2011) explain the evolution of China’s National Innovation System (NIS) in relation to China’s university system in the following four phases. Under the Soviet model, and as discussed earlier, research institutions, universities, and enterprises were completely separated from one another with the central government as the intermediary, or perhaps interfering entity, between them. The university system remained parallel to the research system, which was a completely separate arm of the government. The large growth of research institutes weakened the research function of universities, and education became the single aim and mission of universities (Wang & Zhou 2011, p. 145).

During the Cultural Revolution, the NIS and the higher education system was essentially nonexistent, and political movements replaced economic and technological development. During economic reform phase of 1978 to 1990, research institutions started offering graduate degrees, while universities began to take on research projects (Wang & Zhou 2011, p. 145). As the government expanded the mission of universities to include both education and research, university established research institutes and university-run enterprises began to emerge. Although still no relationship existed between enterprises and the university system or the
research system, there was a slowly growing coordination between universities and research institutes. The government still remained as the central link between all three sectors.

The last phase came in 1992, the same year that the Chinese government pushed for the development of a market-oriented economy. The government encouraged greater cooperation between research institutes, the higher education system, and enterprises. Also, as enterprises became more involved and played a more active role in technological innovation, they became a greater focus of China’s NIS (Wang & Zhou 2011, p. 147). Furthermore, as the government emphasized on this “enterprise-university-institution cooperation” project they also initiated the S&T system reform that promoted research as the key to economic development. The interactions between the three became closer than it ever had been and hence, this led to a more “free” flow of knowledge and information than before.
Later in 1998, when the central government gave local governments more authority over universities within their provinces, there was a “profound” shift in the development of higher education as they gained more local investment and the links between universities and regional economic and social development tightened (Swindall 2007). Through the government’s “Vitalizing the Nation through Science and Education (CNSE) Strategy”, universities were now specifically charged to “serve economic development and promote the advancement of S&T” (Wang & Zhou 2011, p. 148). Under the government’s continued guidance, the current Chinese NIS is still evolving from a government-dominated system to a more market-dominated one, and universities are playing a larger role in R&D. Currently, though the relationship between the research sectors and enterprise systems are closer than before and while enterprises are becoming more and more important in S&T research input and output with the support of the government, enterprises are still not major actors in the advancement of S&T for economic development.

**The 985 Project: Higher Education Reform of Elite Universities**

One of the main features of higher education reform in China is the promotion of elite universities as a means to promote S&T advancement and economic development. In his speech regarding the “Mobilization of Rejuvenating the Nation Through Science and Education,” at Peking University’s centennial on May 4, 1998, President Jiang Zemin stated that “China must have a number of first-rate universities of international advanced level” (MEC 2000b, p. 17). The 985 Project, “The Project for Founding World-Class Universities”, was named to commemorate Jiang’s speech and illustrates the government’s goal and efforts to develop a tertiary education system of international stature. In response to Jiang’s speech, the Ministry of Education (MOE) issued “The Action Plan for Education Revitalization for the Twenty-First Century” and through the 985 Project, they pursued a goal of establishing a number of world-class universities as well
as a number of key research centers of excellence (Wang 2011). This project is focused on exploring new systems for higher education governance, improving Chinese universities’ global competitiveness, and finally, creating a path for building world-class universities. Thus far, Project 985 has been implemented in two phases, 1999 to 2001 and 2004 to 2007. Since 2009, it has been undergoing its third phase.

Peking University and Tsinghua University, known as China’s “Harvard” and “Yale”, were the only two universities specifically referred to by President Jiang. Though thirty-nine universities are affiliated with the “985 Project,” only nine universities have been identified to develop into world-class universities. These nine universities are jointly supported by the central government and local governments as well as other organizations such as the Chinese Academy of Sciences, Commission of Science Technology and the Industry of National Defense. The remaining universities are expected to reach “world-known university status,” which according to the MOE project policy document will be slightly lower in stature, but still recognized on the international scale (Ching 2011, p.20).

The government plays a dominant role in the organization and management of Project 985. The universities participating in this project are handpicked by the government. Both the MOE and Ministry of Finance (MOF) were central in its original implementation in 1998. The MOE and the MOF at the central government level, the local governments of the provinces in which these selected universities are located, and other governmental organizations collaborate to provide financial resources. The total amount of funding received by a selected university depends on various factors, such as the university’s position and goals, the status it is expected to achieve in the world system, and the local government’s financial situation. While these are broad guiding principles, some critics have noted that the funding system under the 985 Project
lacks guidance and any rationale on how to determine the amount to be invested in each institution (Cheng 2011). Figure 1 below shows the allocation of funding from the central government for the top nine universities in 2004. Universities at the Level 2 primarily appeared in only the second phase of the “985 Project.”

**Figure 1: Education Funding for Elite Universities in China (2004)**

<table>
<thead>
<tr>
<th>Funding Size (per university)</th>
<th>Number of Universities</th>
<th>Total Funding for Universities in the Same Level</th>
<th>Elite Universities</th>
<th>Funding of top Elite Universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Top Elite Universities --- More than 1000 million RMB</td>
<td>9</td>
<td>153.39</td>
<td>Tsinghua University, Peking University, Zhejiang University, Shanghai Jiao Tong University, Harbin Institute of Technology, Fudan University, Huazhong University of Science &amp; Technology, Xi'an JiaoTong University, Nanjing University</td>
<td>35.91, 24.08, 18.74, 14.61, 14.43, 13.12, 11.51, 10.53, 10.46</td>
</tr>
<tr>
<td>Level 2: 500-1000 million RMB</td>
<td>23</td>
<td>166.97</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Level 3: 500-1000 million RMB</td>
<td>38</td>
<td>143.31</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Level 4: 500-1000 million RMB</td>
<td>53</td>
<td>126.75</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: China’s Ministry of Education (2006d) & Li, Whalley, Zhang, Zhao 2008

Along with receiving funding from the central government, elite universities in China have established university-run enterprises. During the early 1980s these enterprises were more service oriented, including printing and publishing services, but have now evolved into fully-operational science and technology (S&T) enterprises. These university-run enterprises receive
funding from the government, and in recent years have been held up as model examples for how higher education can receive financial support from the high-tech industry while promoting the role of universities in developing a “knowledge based economy” (Wang & Zhou 2011, p. 166).

Lastly, beyond the formal definition of elite universities as defined by the 985 Project, K. Morham has proposed eight characteristics of the Emerging Global Market (EGM) research institution that has been embraced by the Chinese central government (Yang & Welch 2011). Characteristics of EGM research institution include a mission of transcending the boundaries of the nation-state, research-intensive, new roles for faculty members, diversified funding, build new relationships with stakeholders, worldwide recruitment, greater internal complexity, and global cooperation with similar institutions. This framework helps guide the evaluation of the research and high-tech industry.

**Higher Education & Economic Growth**

The relationship between the economy and higher education has been inextricably linked since the Cultural Revolution. In 1978, the Chinese government made a significant shift to focus on economic growth, implementing a policy of reform and opening-up to the outside world. The educational philosophy set by Deng Xiaoping during this period of economic growth, stated that education should serve the purpose of modernization, and in particular economic development by “turning the heavy population burden into advantages in human resources” (Wang & Shi 2009). Despite Deng Xiaoping’s recognition that economic growth must work in tandem with higher education development, in 1999, among all the employed of China, only 3.8 percent of graduates had a two-year degree in higher education (Wang & Shi 2009).

Not much different from today, each new student is still tracked into a specific field within the one university they are matched to, but what is now different is that prior to the
employment policy shifts of 1990s, each gradate was considered as states cadres and thus, their employment was assigned officially by the state (Chen 2004, p. 4). The significant increase in the number of students graduating from elite universities during the 1990s also caused a dramatic shift in the relationship between state owned enterprises and higher education. Mirroring the Central governments shift from control to guidance over higher education, the government loosened student employment policy and encouraged graduates to find jobs in the market but with the help from the government and universities. According to Professor David Yunchao Chen, who is on the Chongqing Municipal Education Committee, this employment policy shift has been gradually received by students and their parents over the last decade, and “the job-hunting markets at various levels have been installed nationwide” (2004, p. 4). The continuous improvement of employment services at universities, as explained by Chen, has further promoted the “rapid mass expansion of higher education.”

**Research and Development (R&D) at Elite Universities**

A major directive of the 985 Project is to “build platforms for technological innovation” in China (Cheng 2011). A framework by which to understand if elite universities are meeting this objective is through R&D.

Though the relationship between elite universities, R&D, corporate R&D, and enterprises are cooperating more, they are not tightly integrated with one another. Funding for R&D comes through the central government, and is disseminated across various institutions. In recent years, research funding between the central government and elite universities has grown rapidly, much of it from different government departments for very large research projects (Cheng 2011). As mentioned earlier, enterprises are also starting to play a bigger rule in research development and the relationship between these universities and enterprises are growing much closer.
In 2007, enterprises accounted for 35.5% of universities’ total R&D funds, which was only 26.5% in the previous year (Wang & Zhou 2011, p. 154). Between 2006 and 2007, the enterprise sector funded more than half of the total R&D funds while the government funding of university R&D funding is starting to decrease (Wang & Zhou 2011, p. 150). But the government is still playing a significant role in dictating further development of S&T in the public R&D sector. During this same period, the public R&D sector, which is made up primarily of research institutions and universities, received more than 95% of the government’s total R&D fund and of that, the research institutions received 64% of funding and universities received just over 19% (Wang & Zhou 2011, p. 150). This is attributed to the lingering effects of the Soviet higher education system when universities had no role in R&D activities, which was earlier explained as the first phase of the Chinese NIS model.

While the research institutes heavily depend on government funding, the growing integration of research between universities and enterprises is bringing universities closer to the market. Yet, the market and universities are still disconnected. Many scholars have noted that the Chinese industry “operates at a low-tech level in a labor-intensive economy” thus leaving a gap in R&D (Wang & Zhou 2011, 168). The relationship between universities, research institutes, and enterprises, are growing closer and the transfer of knowledge and information is flowing more freely than before, but the effects of the government’s past and current interventions are still causing segmented research.

Another outcome of the 985 Project directives can be seen through patent invention and platform technology development. Specifically, platform technology is defined as capacity building for technological innovation to emerge, while patent development serves as a proxy for technological innovation. Since the implementation of the 985 Project in the late 1990’s, elite
universities have increased the number of patent inventions from 400 patents in 1999 to 6,000 in 2008 (Cheng 2011). Upon first glance, this tenfold increase in patent development, along with an increased number of technology platforms and major long-term research projects indicate that technological innovation is occurring at elite universities. However, other statistics show that these patents are still at very low levels of commercialization, meaning that although the number of patents granted in universities in increasing every year, the number of contract deals in domestic technical markets are not increasing as rapidly (Wang & Zhou 2011, 166).

The rapid increase in research funding for elite universities has arguably created a skewed incentive structure for researchers. Government officials in charge of funding research projects have great influence over the targets of the funding. Therefore according to Cheng, some critics have therefore pointed out that China’s scientists are well aware that the projects obtained by a few powerful officials and scientists, using their personal relationships, are deemed the most important. This has resulted in researchers investing much of their energy in management and relationships with those in control of the resources and not in academic work. This unhealthy culture has not only caused a waste of research resources but also spawned abnormal academic competition, impeding innovation and the output of high-level research. (Cheng 2011, p. 28)

Academic competition also occurs when research quotas must be met by researchers, often cited by critics as leading to replication and even copying of work. Furthermore, given that research questions are directed from the central government, university researchers are not given the environment to truly foster innovation (Yang and Welch 2012, p. 654).
Tsinghua University: A Case Study of Elite Higher Education & Economic Development

Through Project 985 the Chinese government has tasked elite university with developing human capital and improving the talent pool in the technology and science sectors. There is some evidence that elite universities have been successful in generating science and technology majors, and responding to the government’s directive for more advance research in the S&T sector.

Along with Peking University, Tsinghua University is viewed as one of the top two most elite universities in China. It admits many of the top undergraduate students nationally; every year, half of the top 10 students nationwide choose to study at Tsinghua (Wu 2002). In 2007, 16 of 19 disciplines were ranked in the top five, eight were ranked number one (Yang and Welch 2012, p. 652). It is also the school with the best professors; in 2007, three were named as national master teachers, 19 post graduate courses were named “national treasures,” and 11 doctoral theses were ranked amongst the best nationwide (Yang and Welch 2012, p. 652). As China’s leading technology focused university it receives a disproportionate amount of financial support from the central government as compared to the other Project 985 universities.

By using Tsinghua University as a case study, an analysis can be made on whether the university receiving the largest share of the government’s funding resources, educating the top ranked students in the country, and is getting the best instructors and researchers in the country has also successfully led the charge in the government’s third mission for higher education – research and development. Though Tsinghua University is not a typical Chinese university in terms of funding, resources and prestige – it is if using Harvard University to assess all institutions in the United States – generally speaking, hard data and assessment results on China’s universities are still in the early stages. But by looking at Tsinghua’s progress, we will
be able to extrapolate a bigger picture of elite higher education in China and better understand the role they play in economic development via research and development.

**Transformation**

After the creation of the People’s Republic of China, Tsinghua University was disassembled; it lost its schools of law, agriculture, sciences and humanities, and was transformed into a specialized polytechnic engineering university. In the aftermath of the Cultural Revolution (1966-1976), China’s higher education system quickly resumed and Tsinghua began to rebuild itself into a multidisciplinary research university. One of the central themes of the disciplinary construction was to establish and rebuild the schools in social sciences and the humanities. Tsinghua University then added academic programs in science, engineering, arts, law, and management. By 2002, Tsinghua’s schools and departments added economics management, arts and design, and medicine to its curriculum and completed its transformation from a polytechnic program into a comprehensive university (Gu 2008a).

**Governance**

Another notable distinction about Tsinghua University is that though the autonomy of other elite universities has greatly increased, the state still holds a strong control of Tsinghua University. As an example of the close monitoring of Tsinghua’s political performance, the State Council appoints Tsinghua’s President and the CPC’s Central Committee has the final approval; other high level university administrators are also appointed by the central government (Pan 2006, p. 257). Except for Peking University, no other university in China has its president appointed by such high level state authority. These presidents are politically affiliated with the CPC, members of the CPC, and held government positions prior to their presidency (Pan 2006, p. 257). Nationality, ruling party membership and the affiliation between scholars and officials are
key factors that affect the appointment of the senior university administrators.

**Research & Development**

Tsinghua University has played an integral part in the development of China’s National Innovation System (NIS). Contributing to the research and development (R&D) of science and technology (S&T), in 1994 it became the first university in China to establish a Science Park. The prestige of the University and its close relationship with the government guarantees easier access to central government funding along with other resources in S&T research. Given these favorable conditions, Tsinghua University has made giant strides in promoting R&D (Yang 2011).

Unlike most Western universities where researchers choose their own topics interest and then apply for funding, in China, meeting national strategic needs and contributing to the rejuvenation of the Chinese nation by building world-class universities is first priority. Chinese researchers are usually guided by specific topic areas. Topics are specified at every level of the government. From institutional to ministerial and to the national level, topics are arranged around expressed national developmental needs (Yang & Welch 2011, p.654). This is especially the case in Tsinghua University, particularly given its status in the Chinese higher education system as well as its close connection with the government. For instance, on February 15, 2008, the State Council discussed and approved a project for a nuclear energy station for Tsinghua University and defined it as “one of the symbolic projects to build an innovative country” (Yang 2008, p. 1). Projects at the institutional level are always based on national economic and social development needs. For years, Tsinghua has been completing various leading projects with great practical significance for China’s national construction. Especially at elite universities and in the case of Tsinghua, R&D is still directed more so by government guidance rather than responding
to the markets demands.

The transfer of technology information and development, which according to the study of NIS is an important factor in economic development, is also another major concern. Elite universities like Tsinghua have increasingly assumed commercial roles and are important players in many science research parks. Top university professors in particular, are finding commercial applications for their research projects. The diffusion effect of university-based innovation and entrepreneurship, however, should not be overstated. In 2001, only about 40 percent of university enterprises were involved in S&T related activities (Ma 2004). Their sales revenue made up only 3.7 percent of all high-tech enterprises nationwide, and nearly half of such revenue was contributed by enterprises affiliated with Peking University and Tsinghua University (Xue et al 2005).

China’s national estimate shows that only approximately 10 percent of university research and innovation has been commercialized (Science & Technology Industry of China March 2000, p. 52). This is not surprising given that the ties between university-based research and the industry are still in the process of building closer partnership, which has been more recently guided and encouraged by the government’s third mission of universities to drive economic development through R&D (Wang & Zhou 2011, p.164). Many of the early university research spinoffs simply provided technology services to other firms and skilled personnel were more significant than research results. Furthermore, nearly none of the transferred technology is what would be considered “world-class” in relations to universities in the United States, such as MIT or Stanford, yet it is considered adequate given the current Chinese market (Chen and Kenney 2005).
Employment & Applied Research

According to the official statistics released by Tsinghua University in 2010, the employment rate of graduates was at a high of 98.3 percent, which tops all the other university employment rates in China. Of the 98.3 percent, 69.1 percent chose careers in government agencies or state owned enterprises (SOE), which is 38.8% higher than in 2003 (Beijing Daily 2011). But Tsinghua University and other elite institutions are anomalies in China; graduate employment numbers nationwide do not look so optimistic. According to the MOE, the number of unemployed college graduates was only 340,000 in 2001; by 2007, this number skyrocketed to 1,590,000 (Zhou and Lin 2009). Despite the government’s push for universities to focus on addressing economic development needs, “it may take a while before an increased supply of graduates can be effectively utilized by the economy” (Wang & Liu 2011, p. 222). The increasing number of unemployed graduates reflects a market that is not ready to absorb them.

On the other hand, the other arm of the national innovation system – Chinese SOEs – have shown very low independent innovation capacity, which is largely due to the lack of motivation since SOEs often dominate the market and have few competitors within the industry. According to Ji Xiaonan, chairman of the Council of Large Enterprises of the State-owned Assets Supervision and Administration Commission, China’s large SOEs spent 5.67 billion yuan (US$700 million) in introducing technology, but has only spent 360 million yuan in absorbing technology in 2003 (Xinhua News 2005). But on the other hand, in comparison to enterprises and the government, higher education in China only contributes an overall of 10.5 percent of R&D performance according to the Asian Development Bank in 2007 (2008, p. 122). In developed nations, the average contribution to R&D by higher education institutions is 27

As for private enterprises, which are seen as the engine of innovation in developed countries, they face an unfavorable development environment in China. Since 2008, the adjustment of China’s macro-control policies due to the global slowdown has turned out to be a huge boost for SOEs, but it has come at the expense of private enterprises, which have been crowded out of the market (Zhang et al. 2009). Therefore, private companies are much less preferred as an ideal employer for elite university graduates. Moreover, even though some of the enterprises are promoting innovations and a small number of them like telecommunications company Hua Wei are approaching the international technological frontier, most leading Chinese enterprises remain manufacturers and assemblers of products; they do not possess the core technologies (Zhang et al. 2009). In an informal survey of 299,995 Chinese industrial enterprises from the period of 2004 to 2006, the National Bureau of Statistics found that 53 percent of the large enterprises, 86 percent of the medium-sized ones, and 96 percent of small ones did not engage in continuous R&D activities (Zhang et al. 2009).

This evidences speaks to the reality that even though China’s elite universities like Tsinghua University are poised to produce talents and research to enrich the country’s overall national innovation system and drive economic development, the current labor market does not provide a favorable environment to attract these talents and initiate innovative minds. This reality is strengthened by another phenomenal fact: there will be over 6000 graduates this year in Tsinghua University, and out of which only 4000 are willing to enter into the current job market (Tsinghua Graduate Employment Brief 2011). Among the 4000 students, only 800 are undergraduates even though the overall number of undergraduates is 3000, which reveals the fact that 75 percent undergraduates are delaying their plans to join the workforce and instead, they
are pursuing continued education (Tsinghua Graduate Employment Brief 2011). Amongst current undergraduates, over half of them choose to pursue higher degrees and 25 percent choose to go abroad for additional education (Tsinghua Graduate Employment Brief 2011).

The main reason for pursuing graduate education for most of the undergraduates is to simply gain access to government agencies and SOEs positions where their employees have a very high educational degree threshold. Thus, the additional years of education for these elite university students have very low returns to the development of technological innovation. In elite universities there is a very high percentage of admitting outstanding undergraduates for postgraduate degrees from within the university. By the year 2009, the percentage for Tsinghua University and Peking University was over 40 percent (Beijing Daily 2011). To some extent, there seems to be evidence that the expansion of post-graduate education is not just to further promote research and innovation, but students are making this choice instead of trying to enter into an “unprepared” job market.

**Policy Implications**

Though the Chinese government has an objective for their elite universities to foster technology and science innovation, these universities – including the very top end of the rankings – do not have the capacity to adequately respond to market demands. Due to strong government interventions, universities at both at the research level and in the high-tech sector are not driving economic development as one would expect from universities in a developed country.

China is at a crossroad; S&T research and innovation at higher education institutions needs more resources and financial support, particularly from the government, but yet, it also needs more freedom from “government guidance” in order to promote more creativity and thus,
allow more innovation. Less stringent research quotas and government directives may also allow for higher quality research, and it may also counter unethical research behaviors amongst scholars. Thus, improvement can be made in the grant-making and funding process for research conducted by university institutions. It is doubtful though, due to the close proximately between elite universities and the government – both in the geographical and political sense – that the Chinese government would allow schools full reign on research questions and topics. But a mechanism to allow schools more opportunities to apply for funding to conduct their own research projects in the area of S&T could greatly enhance university ability to innovate and create. Furthermore, an improved structure for research could improve accountability through this funding process. Instead of ad hoc funding programs, institutionalized funding structures could promote valid research results and deter corruption. As the NIS model would suggest, a more freely flowing stream of knowledge and information would be most optimal for economic development.

In addition to creating a two-way street between the central government and the university institutions, creating an environment that allows for more collaboration between SOEs and private enterprises with higher education research would further enhance S&T development. Though the Chinese government called for more partnerships between each sector, there are government policy barriers that prevent better use of resources and human capital. The central government’s policies de-incentivize private enterprises to flourish, and SOEs are also crowding these private enterprises out the market. Furthermore, the government’s heavy guidance over SOEs does not allow for creative and rapid response to market changes or demands. As monopolies, SOEs do not have the incentive structure to spur innovation. Private enterprises could allow universities more opportunity to fund research that is not merely dictated by the
government, but this would also require that the central government to continue to free up its oversight on private industries. Though there is more knowledge and information moving between each sector, continued government intervention may actually be causing less collaboration and development.

On the other hand, though SOEs are starting to become a shrinking portion of the total economy, it would be in the government’s best interest to allow for more communication and consulting relationship between the SOEs and the universities. There is evidence to show that the link between universities research and enterprises have only been for job placement purposes rather than also for research and development. Research and development without real application or implementation does not spur economic development. China’s 1950s NIS model where research was completely isolated from the marketplace or industry is no longer the current reality. More and more research is being conducted in the labs of universities (and public research institutions). As suggested in the Tsinghua University case study, there are a growing number of graduate students, which will likely result in more research and innovation within master and doctorate programs. But in order for university research in S&T to lead the growth and development of the economy as they have been charged to do, the government needs to encourage more technology transfer from universities to the industries.

Lastly, recognizing the short-term versus long-term issues surrounding job placements for recent graduates, the government should focus on preparing the market for these graduates when they begin to look for job prospects in the government or SOEs – or the government should allow universities more freedom to respond to market demands. The closer between universities and the provincial and local governments that they are located in is already proving to be helpful to the local economic development. As this relationship continues to improve and
grow, and provincial government is given more authority from the central government over universities, higher education could then better match the job demands in the local science and technology sector. If the success of a knowledge-based economy is directly linked to the production, distribution and use of knowledge and information – then China needs to continue to allow for a more open flow of knowledge between the university institutions, research institutions, and both private and public enterprises.

**Conclusion**

We view the connection between research and the high-tech industry as an important factor in China’s economic development. However, the relationship between the central government, elite universities, state owned enterprises, and the economy are currently in flux. The case study example of Tsinghua University shows that although the elite university is generating the “best and the brightest” students, they are not entering a labor market that has the capacity for technological innovation. Furthermore, while the government has an objective for universities to foster technology and science innovation, these universities do not have the capacity to quickly respond to market demands, both at the research level and in the high-tech sector because of strong government interventions. Therefore, a series of policy implications and recommendations have been discussed in this report in an attempt to address these disparities.
References


