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ZHONGGUANCUN AND CHINA'S HIGH-TECH PARKS IN TRANSITION

"Growing Pains" or "Premature Senility"?

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Abstract

This essay examines the development of China's high-tech parks and, in particular, the challenges they have encountered. It concludes that lack of institutional support for innovation and the indigenous technological capabilities necessary to be competitive, unclear ownership, lack of venture capital, and the overwhelming role of government have impeded the efforts of China's high-tech parks to duplicate the success of role models such as Silicon Valley.

China has made great efforts to catch up with the worldwide new technology revolution. The State Council in 1988 approved setting up the Beijing Experimental Zone for New Technology and Industrial Development, the predecessor of the Zhongguancun Science Park, and subsequently permitted another 52 high-tech parks at the national level (see Table 1).[1] In the Chinese context, this institutional innovation is as important as the establishment in the 1980s of the Shenzhen Special Economic Zone (SEZ) and in the 1990s, the opening of Shanghai's Pudong New Development Zone. Just as

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1. China's first high-tech park was established in Shenzhen in July 1985 by the Shenzhen municipal government and the Chinese Academy of Sciences. See Ministry of Science and Technology, *Zhongguo Gaoxin Jishu Chanye Fazhan Baogao* [Report on the development of new- and high-tech industry in China] (Beijing: Kexue chubanshe, 1999), p. 199.

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TABLE 1 *China's High-Tech Parks*

Region	*Municipality/ Province*	*Name of High-Tech Park (Year Established)*
East	Beijing	Zhongguancun (1988)
	Tianjin	Tianjin (1991)
	Shanghai	Shanghai (1991)
	Liaoning	Shenyang, Dalian (1991), Anshan (1993)
	Hebei	Shijiazhuang (1991), Baoding (1993)
	Shandong	Jinan, Weihai (1991), Qingdao, Weifang, Zibo (1993)
	Jiangsu	Nanjing (1991), Suzhou, Wuxi, Changzhou (1993)
	Zhejiang	Hangzhou (1991)
	Guangdong	Guangzhou, Zhongshan, Shenzhen (1991), Foshan, Huizhou, Zhuhai (1993)
	Fujian	Fuzhou, Xiamen (1991)
	Guanxi	Guilin (1991), Nanning (1993)
	Hainan	Hainan (1991)
Middle	Heilongjiang	Haerbin (1991), Daqing (1993)
	Jilin	Changchun (1991), Jilin (1993)
	Neimenggu	Baotou (1993)
	Shanxi	Taiyuan (1993)
	Henan	Zhengzhou (1991), Luoyang (1993)
	Hubei	Wuhan Donghu, Xiangfan (1993)
	Hunan	Changsha (1991), Zhuzhou (1993)
	Anhui	Hefei (1991)
	Jiangxi	Nanchang (1993)
West	Shaanxi	Xi'an (1991), Baoji (1993), Yangling (1997)
	Gansu	Lanzhou (1993)
	Xinjiang	Ulumuqi (1993)
	Chongqing	Chongqing (1991)
	Sichuan	Chengdu (1991), Mianyang (1993)
	Yunnan	Kunming (1993)
	Guizhou	Guiyang (1993)

SOURCE: Gu Chaolin et. al., *Zhongguo Gao Jishu Chanye yu Yuanqu* [China's high-tech industry and zones] (Beijing: Zhongxin chubanshe, 1998), pp. 6–7.

Shenzhen, in that period, sparked development of industry in the Pearl River Delta, so did Pudong stimulate the Yangtze Delta's development into an industrial powerhouse. High technology is expected to become the new engine of growth for the Chinese economy.

If the 1988 founding of the Beijing Experimental Zone in Zhongguancun is used as the date of birth, China's high-tech parks should be entering a period

of "growing pains" in their "adolescent" transition. In the meantime, governments, academics, and entrepreneurs worry whether such parks will become "prematurely senile" before reaching "adulthood." One of the concerns that could lead to the latter possibility is the indecision of many high-tech enterprises in these parks over whether to fully transform themselves into operations driven by technology and innovation. These enterprises may be constrained by financial and human resources in undertaking serious research and development (R&D) activities. But more fundamentally, they seem unwilling to bet their long-term and sustainable growth on indigenous innovation at a time when imported technology, a large and growing domestic market, relatively low labor costs, and other advantages could bring them immediate and short-term benefits.

This article examines the development of China's high-tech parks, notably, the challenges they have encountered in their transition to being innovative clusters similar to Silicon Valley. Zhongguancun is used here as a case study, not only because it is China's first national high-tech park but also because the Zhongguancun case is a microcosm from which to explore China's high-tech development as a whole. To date, several barriers have impeded the efforts of China's high-tech parks to duplicate the success of role models such as Silicon Valley: lack of institutional support for innovation and the indigenous technological capabilities required to become competitive; low levels of R&D investment by enterprises; unclear property rights; lack of venture capital; and government restrictions on taking firms public, among other issues. Entrepreneurs have also raised questions about whether the government's role in high-tech development is currently overwhelming—both overly intrusive and omnipresent—because Zhongguancun initially operated very much on its own. Within the sector, there are concerns about whether the highly homogeneous development strategies adopted by many high-tech parks resemble the Maoist campaigns to "learn from Daqing and Dazhai." In the 1960s, Mao Zedong set up Daqing and Dazhai as "models" for Chinese industry and agriculture and, by extension, for the entire nation. While the Daqing and Dazhai operations showed some spirit of hard work, both were, in fact, singled out for political purposes as showcases.

Silicon Valley as the Model of High-Tech Development

The clustering of semiconductor, computer, and other high-tech firms in Silicon Valley is a unique phenomenon of the 20th century. With its origins as far back as the 1940s, Silicon Valley more recently has seen the rapid rise of high-tech startups premised around the utility or availability of 10 features: favorable business rules; knowledge intensity; a high-quality and mobile work force; result-

oriented meritocracy; a climate that rewards risk-taking and tolerates failure; an open business environment; universities and research institutes that interact with industry; collaborations among business, government, and nonprofit organizations; a high quality of life; and a specialized business infrastructure equipped with venture capital, lawyers, headhunters, accounting firms, and consultants.[2]

Silicon Valley developed on the "technology plus capital" model: Its technological advantage is realized through the support of financial markets by way of venture capital. In the U.S., the amount of venture capital invested increased from $610 million in 1980 to $24.3 billion at its peak during the fourth quarter of 2000. Much of this went to Silicon Valley firms. The distinctive feature of venture capital is not merely the provision of money; to maximize investment, venture capitalists—many of them technologists or seasoned entrepreneurs—have also helped startups formulate business strategy, assemble management teams, incubate promising projects, and even assist in daily operations.[3]

In addition, although Silicon Valley has developed under the mantra of free market, free enterprise, and laissez faire, one cannot ignore the visible hand of government. The early support of the U.S. government stemmed from demand for and procurement of high-tech products used in the defense industry. The government also nurtured the venture capital industry. For example, passage of the Small Business Investment Act of 1958 helped private markets function better by providing matching government funds at favorable interest rates. Lowering capital gains taxation and relaxation of rules for institutional investors in 1978 allowed insurance companies, pension funds, and corporations to invest in high-risk assets, including venture capital. The Bayh-Dole Act of 1980 further lifted restrictions on technology transfer, enabling firms generous access to federally sponsored research.[4]

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2. See, for example, AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass.: Harvard University Press, 1994); *The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship*, eds. Chong-Moon Lee, William F. Miller, Marguerite Gong Hancock, and Henry S. Rowen (Stanford, Calif.: Stanford University Press, 2000); *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region*, ed. Martin Kenney (Stanford, Calif.: Stanford University, 2000); and Junfu Zhang, *High-Tech Start-Ups and Industry Dynamics in Silicon Valley* (San Francisco, Calif.: Public Policy Institute of California, 2003).

3. Thomas F. Hellmann, "Venture Capitalists: The Coaches of Silicon Valley," in *The Silicon Valley Edge*, pp. 276–94; Dado P. Banatao and Kevin A. Fong, "The Valley of Deals: How Venture Capital Helped Shape the Region," in ibid., pp. 295–313; Martin Kenney and Richard Florida, "Venture Capital in Silicon Valley: Fueling New Firm Formation," in *Understanding Silicon Valley*, pp. 98–123; Nitin Nohria, "Information and Search in the Creation of New Business Venture: The Case of the 128 Venture Group," in *Network and Organizations: Structure, Form, and Action*, eds. Nitin Nohria and Robert G. Eccles (Boston, Mass.: Harvard Business School Press, 1992), pp. 240–61; John W. Wilson, *The New Ventures: Inside the High-Stakes World of Venture Capital* (Menlo Park, Calif.: Addison-Wesley, 1985), pp. 50–51; and *Asian Wall Street Journal*, January 5, 2003, p. M6.

4. Stuart W. Leslie, "The Biggest 'Angel' of Them All: The Military and the Making of Silicon Valley," in *Understanding Silicon Valley*, pp. 48–67; Hellmann, "Venture Capitalists"; and David G.

The success of Silicon Valley has drawn worldwide imitators whose ambitions are revealed in names like "Silicon Alley," "Silicon Island," "Silicon Stripe," and so on, although these venues may not be innovation-based, as Silicon Valley has been. In Taiwan, for example, the Hsinchu Science-Based Industrial Park was established in the 1980s, thanks to policy makers' vision, strong ties to Taiwanese in Silicon Valley, and the creation of social and physical infrastructure. The Singapore Science Park was set up in 1980 under a government initiative to attract investment from multinational corporations.[5] But as Simon Firth, writing in *Salon*, asks, "Does this self-styled Silicon Glen/Alley/Gulch/Fjord/Pampas/Polder/Fen have what it takes to match the success of the original[?]"[6] Examination of the Chinese case may provide the latest evidence.

Zhongguancun: "It Takes Ten Years to Sharpen a Sword"

Reform of China's Science and Technology System in the 1980s

Following the Soviet model, China's R&D activities up to the 1980s had largely been confined to institutions of learning, where scientists were more interested in producing academic publications than constructing prototypes. As such, most research did not benefit the nation's economic development but ended at the stage known in China as one of the "three *pins*"—*yangpin, zhanpin*, or *lipin* (samples, exhibits, or gifts, respectively)—without reaching the stage of marketable *shangpin* (commodities).[7]

The divergence of research and economy became a prominent problem in the late 1970s when China launched its reform and open-door program. In 1982, the Chinese Communist Party (CCP) called for science and technology (S&T) to underpin economic development. Then, in the mid-1980s, China started to restructure its S&T management system to better link research and

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Mowery, Richard R. Nelson, and Bhayen N. Sampat, "The Effects of the Bayh-Dole Act on U.S. University Research and Technology Transfer," in *Industrializing Knowledge: University-Industry Linkages in Japan and the United States*, eds. Lewis M. Branscomb, Fumio Kodama, and Richard Florida (Cambridge, Mass.: MIT Press, 1999), pp. 269–306.

5. For a discussion on the global approach of copying the Silicon Valley model and the problems encountered, see David Rosenberg, *Cloning Silicon Valley: The Next Generation High-Tech Hotspots* (London: Reuters, 2002); and *Building High-Tech Clusters: Silicon Valley and Beyond*, eds. Timothy Bresnahan and Alfonso Gambardella (Cambridge, U.K.: Cambridge University Press, 2004). For a discussion on the expensive disappointments in Asia's creation of high-tech centers, see "Is Silicon Asia Sprouting?" *Newsweek*, December 16, 2002, pp. 10–12.

6. Simon Firth, "Renaissance Geeks," *Salon*, March 26, 1998.

7. Qiwen Lu, *China's Leap into the Information Age: Innovation and Organization in the Computer Industry* (New York: Oxford University Press, 2000), p. 7.

the economy. In particular, the Chinese Academy of Sciences (CAS) implemented a "one academy, two systems" experiment, keeping a small number of its research personnel in basic research while leaving the rest to seek outside support for applied R&D work that would directly benefit the economy and meet market needs.[8]

In 1986, as the worldwide new technology revolution gained a foothold in China, four senior scientists who had contributed to China's strategic weapons program suggested to Deng Xiaoping, then China's paramount leader, that China follow the world trend and develop its own high-tech industry. The now well-known State High Technology Research and Development Program (863 Program) was thus initiated; two years later, the Torch Program was launched to implement high-tech industrialization.[9] Against this backdrop, Zhongguancun started to draw attention at home and abroad.

From "Electronics Street" to Experimental Zone

To some extent, Zhongguancun, located in the Haidian district in northwest Beijing, is in fact comparable to Silicon Valley. As China's most talent-intensive zone, Zhongguancun is home to Beijing University, Qinghua University, some 60 institutions of higher education, and more than 200 research institutes affiliated with the CAS, Beijing municipality, and various ministries. On October 23, 1980, Chen Chunxian, a nuclear fusion physicist from the CAS Institute of Physics, addressed a Beijing Plasma Society gathering about his two recent visits to the U.S. Instead of discussing American scientific research, he described what he saw in Silicon Valley and along Route 128 in Massachusetts. Chen's introduction fascinated the participants, who encouraged him to explore means of technology diffusion in China. Soon after, a now-defunct organization called Advanced Technology Development Services was founded as an embryo of S&T enterprise in Zhongguancun.[10]

Technological findings from the CAS eventually were transformed into marketable products by more than one-third of the firms along "Electronics Street" in Zhongguancun. These included four major enterprises—Kehai New

8. Tony Saich, *China's Science Policy in the 80s* (Atlantic Highlands, N.J.: Humanities Press International, 1989), ch. 1; Yao Shuping, Luo Wei, Li Peishan, and Zhang Wei, "Zhongguo Kexueyuan Fazhan Shi" [A developmental history of the Chinese Academy of Sciences], in *Zhongguo Kexueyuan* [The Chinese Academy of Sciences], eds. Qian Linzhao and Gu Yu, 3 volumes (Beijing: Dangdai Zhongguo chubanshe, 1994), vol. 1, pp. 218–19.

9. Evan A. Feigenbaum, *China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to the Information Age* (Stanford, Calif.: Stanford University Press, 2003), ch. 5; and *Zhongguo Gaoxin Jishu Chanye Fazhan Baogao*, pp. 32–49.

10. Liu Ren and Zhang Yongjie, *Zhishi Yingxiong: Yingxiang Zhongguancun de 50 ge Ren* [Knowledge hero: 50 persons who have influenced Zhongguancun] (Beijing: Zhongguo shehui kexue chubanshe, 1998), pp. 232–40.

Technology (1983), Jinghai Computer Room Facilities Technological Development (1983), Sitong (known as Stone, 1984), and Xintong Computer (1984). These were broadly termed the "two Hais" and the two "Tongs." Another CAS spin-off, the New Technology Company of the CAS Institute of Computing Technology and the forerunner of Legend, was founded in 1984.[11] These firms were quite successful. Stone made RMB 1.43 million (US$620,000) in its first year and saw profits soar at an annual rate of 300% to reach RMB 25 million ($6.7 million) in 1987. Sales at Xintong grew at an average annual rate of 330%, hitting RMB 77 million ($20.7 million) in 1987, with profits of RMB 4.4 million ($1.2 million). Kehai, established with a loan of RMB 100,000 ($50,000), achieved sales of RMB 210 million ($56.4 million) and profits of RMB 21 million ($5.6 million) within four years. Jinghai's turnover in four years totaled RMB 280 million ($75.2 million), and profit and taxes RMB 50 million ($13.4 million, including both profit and taxes).[12] As a whole, during its initial development Zhongguancun saw a wealth of S&T startups. But it should be also pointed out that many of these firms accumulated their primitive wealth through activities that would be considered illicit, if not illegal, so much so that "Electronics Street" became known as "Crook Street."

"Electronics Street" was given a further boost in 1986 when the State Science and Technology Commission (SSTC), renamed the Ministry of Science and Technology (MOST) in 1998, researched high-tech parks in other countries with the aim of replicating them in China. The General Office of the CCP Central Committee appraised "Electronics Street" positively, and in 1988 the State Council approved the establishment of the Beijing Experimental Zone for New Technology and Industrial Development, along with 18 preferential policies on taxes, loans, and personnel mobility and recruitment, for its development.[13]

The Zhongguancun enterprises have focused on meeting market needs and integrating three key areas: technological development (*ji*), industry (*gong*), and commerce (*mao*), collectively called "Ji Gong Mao." Operating on the "four-self" principle—self-chosen partnership, self-financing, self-operating, and self-responsibility for gains and losses—these businesses have promoted technology transfer from universities and research institutes and created a series of products with market potential and a competitive edge. Some of the firms have been listed on stock exchanges at home and abroad.

11. Although its Chinese name is still Liangxiang, Legend changed its English name into "Lenova" recently. But Legend is used here, as it will take time for "Lenova" to be recognized.

12. Beijing Science and Technology Consultation Association and the China Research Institute of Talent-Intensive Area, *Zhongguancun Shinian Zhilu: Beijing Shi Xin Jishu Chanye Fazhan Shiyanqu Huigu yu Zhanwang* [Ten years of Zhongguancun: Retrospect and prospect of the Beijing Experimental Zone for New Technology and Industrial Development] (Beijing: Gaige chubanshe, 1998), pp. 55–57.

13. Ibid., pp. 58–60.

Evolving into a Science Park

But it took Zhongguancun 10 years to evolve into a science park. In June 1999, in approving the document "On Implementing the Strategy of Revitalizing the Nation with Science, Technology, and Education, and Speeding up the Building of Zhongguancun Science Park," submitted by the Beijing municipal government and the MOST, the State Council called for a new round of growth driven by high-tech industrialization and a knowledge-based economy. This made Zhongguancun strategically important as a mechanism for resolving the separation between S&T and the economy, helping shift China's development focus in the 21st century from tangible to human resources, and achieving high-tech standards attained by developed countries. This also means that the development of Zhongguancun and China's high-tech sector will face new challenges.[14]

In December 2000, the Beijing People's Congress passed "Regulations on Zhongguancun Science Park," which went into effect on January 1, 2001. The regulations include articles on protecting enterprise assets, intellectual property rights, and individuals' wealth, as well as providing preferential policies, developing real estate, and setting up a venture capital system. Under the regulations, individuals or organizations are now permitted to undertake any kind of business not explicitly prohibited by law and are less restricted by the government pre-approval process. Foreign investors now can hold up to one-quarter of the equity in domestic high-tech enterprises without obtaining full foreign-invested enterprise approvals. The regulations also intend to increase the government's administrative transparency for investors and entrepreneurs, especially for foreigners.[15]

Illusion and Reality

Under the National and International Spotlight

The Zhongguancun Science Park now comprises a total area of 100 square kilometers; its industrial structure centers around information technology (IT), integrated optical-mechanical-electronic technology, biotechnology, pharmaceuticals, new materials, energy-saving technologies, and environment-friendly technologies. From a total of 11 firms in 1983, some 15,000 high-tech enterprises have mushroomed there. In 2003, total income from technological development, industry, and commerce reaped by Zhongguancun's enterprises hit

14. Lin Wenyi, ed., *Tuoqi Mingtian de Taiyang: Zhongguancun Keji Yuanqu Fazhan Guihua Yanjiu* [Tomorrow's sun: Development strategy of the Zhongguancun Science Park] (Beijing: Beijing kexue jishu chubanshe, 2000).

15. "The Regulations on Zhongguancun Science Park" (adopted on December 8, 2000, at the 23rd Session of the Standing Committee of the 11th People's Congress of Beijing Municipality).

RMB 284 billion ($34.3 billion), up 18.1% from 2002. These firms generated added value of RMB 60 billion ($7.2 billion), an upswing of 31.6%. Enterprises paid RMB 12.2 billion ($1.5 billion) in taxes, a 22.4% increase. To sustain growth, Zhongguancun's high-tech firms on average invest 3.9% of their revenue in R&D, with the proportion for small- and medium-size companies running as high as 8.6%. In return, technological development contributes to more than 50% of their profits; the respective figures are the highest among China's enterprises.[16]

Domestic enterprises that use Zhongguancun as their springboard include telecommunications giants Julong Electronics, Datang Telecom Technology, Zhongxing Telecommunications, and Huawei Technologies (collectively known by the first character of their Chinese names as JuDaZhongHua), as well as consumer electronics manufacturers Haier, TCL, and others. Returned students and scholars from overseas have set up more than 2,100 firms. High-tech multinational corporations (MNCs) such as Hewlett-Packard, IBM, and Microsoft have picked Zhongguancun as their nerve centers for Chinawide operations and some, including IBM, Microsoft, Intel, Motorola, Ericsson, and Mitsubishi, have also set up research centers in the area.[17] In a word, companies spun off from Chinese research institutes and universities and domestic high-tech startups have been competing with MNCs, or as Zhongguancun entrepreneurs put it, "dancing with wolves" (*yu lang gong wu*) and "walking beside giants" (*yu juren tongxing*).

More importantly, Zhongguancun has shown a spillover effect in promoting high-tech development in China. New technology enterprises have spun off, and high-tech parks have been established from Heilongjiang Province in the north to Hainan Province in the south. In 2003, the 53 national high-tech parks tallied income from *ji, gong*, and *mao* at RMB 2 trillion ($240 billion), total industrial value at RMB 1.7 trillion ($205 billion), and exports at $57 billion (see Table 2).[18]

A High-Tech Myth

Backed by strong government support and because of their role in *kejiao xingguo* (revitalizing the nation through science, technology, and education), high-tech parks are highly regarded in China. However, the surprising fact is that even in Zhongguancun—with its prime location in Beijing's research and education district and the resulting concentration of talent—growth has not been technology-driven. Legend started with the development of Chinese-character computer cards but retreated to commerce and manufactur-

16. <http://www.zgc.gov.cn>, accessed May 18, 2004.
17. Ibid., accessed August 8, 2003.
18. See <http://www.sts.org.cn>, accessed May 17, 2004.

TABLE 2 *Major Economic Indicators of China's High-Tech Parks* (US$100 million)

Year	*Number of Firms (Units)*	*Number of Employees (10,000 Persons)*	*Income from Ji, Gong, and Mao*	*Total Industrial Value*	*Profits & Taxes*	*Exports Value*	*Exports as a Percentage of Income (%)*
1991	2,587	14	16.40	13.38	2.24	1.8	10.98
1992	5,569	34	41.87	33.87	6.11	4.1	9.79
1993	9,687	55	97.81	77.63	12.93	5.4	5.52
1994	11,748	80	109.37	98.94	12.77	12.7	11.61
1995	12,937	99	178.93	165.97	20.75	28.8	16.10
1996	13,722	129	276.67	257.67	28.64	43.0	15.54
1997	13,681	148	408.67	375.06	42.22	64.8	15.86
1998	15,935	180	557.84	523.44	53.81	78.5	14.07
1999	17,498	221	818.38	717.97	89.06	119.1	14.55
2000	20,796	251	1,112.41	959.36	127.72	186.0	16.72
2001	24,293	294	1,441.15	1,222.28	155.25	226.6	15.72
2002	28,338	349	1,851.69	1,567.60	189.38	329.2	17.78
2003	n.a.	n.a.	2,439.77	2,090.97	240.18	570.0	23.36

SOURCES: <http://www.sts.org.cn>, accessed May 17, 2004; <http://www.most.gov.cn/gxjscykfq/dtxx/t20040212_11521.htm>, accessed May 17, 2004.
NOTE: N.a. = not available; values are adjusted based on the US$–RMB exchange rates at particular years.

ing. Founder, which used to be highly technologically innovative, with products dominating the global Chinese publishing market, has achieved little in terms of innovation since the early 1990s.

Objectively, China's high-tech parks mainly serve as distribution, processing, and trading centers for foreign technology companies. The most advanced brand name computers and other IT products that have kept China in pace with the world contain only a tiny percentage of domestically created technology. Chinese enterprises, perched at the bottom of the value chain, face tough global competition. Thus, while income from *ji, gong*, and *mao* in Zhongguancun reached RMB 240.5 billion ($29 billion) in 2002, profits totaled only RMB 11.2 billion ($1.4 billion), 4.7% of income; upper-stream firms, most likely MNCs, grabbed most of the profits through proprietary technology. Zhongguancun is also susceptible to changes in the upper stream of the value chain. Founder, then a reseller of Digital Equipment Corporation (DEC) products, for instance, lost RMB 30–40 million ($3.6–4.8 million) when DEC

merged with Compaq in 1998.[19] In the words of Liu Chuanzhi, chairman of Legend, Zhongguancun merely plays the role of an importer, or even a "carrier" (*banyungong*) of foreign technology.[20]

Technology is easier to talk about than to develop. First, it needs money. Microsoft's R&D expenditure was $4.5 billion for the 12 months ending December 2002, while Sun Microsystems, despite its shrunken sales revenue and losses, has maintained an R&D investment of 10% to 17% of its revenue in the past two years.[21] In contrast, Legend spends about 3% of its sales on R&D, and its recent profit growth was achieved mainly through cost-cutting.[22] Perhaps one could say that if Legend had spent more on R&D, it would have achieved higher profits. But given its complex, uncertain, prolonged, and even risky nature, a boost in funding for R&D does not guarantee an immediate return on investment or an increase in a firm's competitiveness.[23] Back in 1996, then-CAS president Zhou Guangzhao challenged Liu Chuanzhi to set up a target that the company increases R&D investment in strategic and forward-looking projects so as to achieve $2 billion sales revenue and 10% profits by 2000.[24] (In the 1999–2000 fiscal year, although Legend's sales revenue reached $2.2 billion, its profits ran to only $62 million.)

Second, technological development needs capable researchers. China has lost a large proportion of its high-quality R&D personnel because they have moved overseas or to well-established MNCs in China. Lack of financial and human resources, plus the fact that imported technology can bring quick payoffs, means that few firms have an incentive to adapt and assimilate domestic technology and make incremental improvements, let alone develop their own innovative products.

Conflict between Entrepreneurs and Scientists

Since the success of China's S&T firms has been mainly entrepreneurial, as opposed to technological, scientists find themselves playing a supporting role,

19. *Sanlian Shenghuo Zhoukan* [Sanlian Life Weekly], September 2, 2002, pp. 20–29.

20. Fang Zhou, Guo Tianxiang, and Tian Yishan, *Jinggao Weiji: Zhongguo Jiaru Shijie Maoyi Zuzhi Qianxi* [Crisis warning: Self-examination of CEOs on the eve of China's WTO accession] (Kunming: Yunnan renmin chubanshe, 2001), p. 45.

21. See <http://finance.yahoo.com>, accessed January 21, 2003.

22. *Qiaobao-Zhongguo Kexue Zhoubao* [The China Press-Science Weekly] (New York), April 16, 2003.

23. Sanjaya Lall, "Technological Change and Industrialization in the Asian Newly Industrializing Economies: Achievements and Challenges," in *Technology, Learning, & Innovation*, eds. Linsu Kim and Richard R. Nelson (New York: Cambridge University Press, 2000), pp. 13–68. For a recent news report on the Japanese case, see *Science*, 296 (May 17, 2002), pp. 1230–31.

24. Pei Jingsong et al., *Hafo Shiye zhong de Lianxiang Jituan* [The Legend Group from the perspective of Harvard Business School] (Beijing: Guoji wenhua chuban gongshi, 2001), p. 141.

although they were initially important in integrating technology with market, knowledge, and capital. In fact, most cooperation between scientists and businesspersons has proved unsuccessful, according to Chen Chunxian, the Zhongguancun pioneer.[25] Three pairs of entrepreneurs and scientists—Liu Chuanzhi and Ni Guangnan, Zhang Yufeng and Wang Xuan, and Wan Runnan and Wang Jizhi, who respectively made Legend, Founder, and Stone the most famous IT companies in China—all ended with a breakdown in collaboration.

The predecessor of Founder was the Beijing University New Technology Company, established in 1986. Zhang Yufeng, a physicist-turned-entrepreneur, and Wang Xuan, a computer scientist—both professors at Beijing University—teamed up to make Founder a successful high-tech enterprise whose core technologies were Chinese electronic publishing systems. But when the company's financial situation deteriorated in early 1999, the conflict intensified between Wang at Founder (Hong Kong) and Zhang at the parent company Founder Group. Both resigned from the Founder Group board, and Wang left his position as president of the Founder Academy of Technology.[26]

At Legend, there had been tension for some time between Ni Guangnan and Liu Chuanzhi before Ni was relieved of his chief engineer position in 1995. Four years later, Legend, under Liu, went through ownership reform (see below). It fired Ni, the scientist whose contributions had fueled Legend's takeoff, without stock options.[27] Stone's Wang Jizhi, who had helped make the company at one point the most successful in Zhongguancun, had been its chief engineer only briefly before resigning. The most recent case involved Wang Zhidong, the software-engineer-turned-chief-executive of the leading Chinese-language portal Sina, who in 2001 was dismissed by the company's board, backed by venture capitalists.[28]

High turnover because of personal conflicts and performance issues is common in the high-tech sector and often leads to the formation of new startups. But the Chinese cases described above are different in that not all who left the S&T firms have continued in entrepreneurial activities. Moreover, in the case of Liu Chuanzhi and Ni Guangnan, the breaking point came after internal rifts surfaced

25. Liu Ren and Zhang Yongjie, *Zhishi Yingxiong*, p. 239.

26. But shortly afterward, as requested by employees, Wang Xuan, the so-called "spiritual leader" of Founder, returned to the Founder Group board. See Wang Hongjia, *Zhihui Fengbao: Zhongguancun, Beida, he Beida Fangzheng* [Intellectual storm: Zhongguancun, Beijing University, and Founder] (Beijing: Xinhua chubanshe, 2000); *Sanlian Shenghuo Zhoukan*, September 2, 2002.

27. When Legend was granted dividend distribution rights by the CAS in 1994, Ni Guangnan had not yet broken with Liu Chuanzhi and was awarded an equal amount of dividends. See Liu Ren, *Zhishi Yingxiong 2.0* [Knowledge hero 2.0] (Chongqing: Chongqing chubanshe, 2002), pp. 62–63.

28. For a discussion on Wang Zhidong and the early development of Sina, see David Sheff, *China Dawn: The Story of a Technology and Business Revolution* (New York: HarperBusiness, 2002).

over the role of technology in Legend's development, as Liu admitted recently; Ni's initiatives on computer chips and telecommunications gear were rejected.[29] Broadly seen, a chief engineer would be expected to focus more on technological development than on corporate finance. If technological plans or projects are perceived as a threat to the company's leadership, technical personnel and the knowledge they represent are more likely to come into conflict with market and capital, and the latter two usually have the final say. From this perspective, it is also understandable why Legend's takeover of the CAS Institute of Computing Technology, from which the firm spun off 14 years ago, ended in a 1999 divorce.[30]

Institutionally and legally, because of delay in the ownership reform and lack of an incentive mechanism, technologists did not own the companies to which they had made significant contributions.[31] As such, their interests were more likely to be viewed as personal than professional. Without a normative corporate governance structure, they could not successfully voice their grievances to boards of directors.

Finally, examining the issue from another angle, one may wonder if the crux of the problem also lies in the lack of trust between the parties. By contrast, throughout Silicon Valley, people admire the unique six-decade partnership and friendship between David Packard and William Hewlett at Hewlett-Packard. Regardless of times hard or great, there was no major dust-up between the two. Packard, the philosopher of the "Hewlett-Packard Way"—the enlightened model of doing business—trusted Hewlett, the engineer and soul of the company, with his reputation, fortune, and life.[32]

What Do China's High-Tech Parks Lack?

Although China's high-tech parks have changed enormously in recent years by trying to focus more on innovation, attract more foreign investment, and produce more high-tech gadgets, the question remains as to whether this transformation has addressed the fundamental problems of how to churn out the next Hewlett-Packard or Intel and how to make Zhongguancun truly "China's

29. See <http://www.itsway.com/web/articleview.asp?id=2411>, accessed February 18, 2003; and *Jishuanji Shijie* [China Computerworld], November 30, 2002, pp. A24–29.

30. Ibid., January 3, 2000, pp. A17–24. The takeover was one of the measures by the CAS Knowledge Innovation Program in 1998 to build the academy into the nation's center in basic research and high-tech development. One year later, the alliance dissolved.

31. Corinna-Barbara Francis, "Bargained Property Rights: The Case of China's High-Technology Sector," in *Property Rights and Economic Reform in China*, eds. Jean C. Oi and Andrew G. Walder (Stanford, Calif.: Stanford University Press, 1999), pp. 224–67; and Bennis Wai-Yip So, "Evolution of *Minying* High-tech Enterprises in China: Legitimizing Private Ownership," *Issues and Studies* 37:5 (September/October 2001), pp. 76–99.

32. Michael S. Malone, *The Valley of Heart's Delight: A Silicon Valley Notebook 1963–2001* (New York: John Wiley & Sons, 2002), pp. 19–22 and 241–52.

Silicon Valley." According to early entrepreneur Duan Yongji, chairman of Stone, Zhongguancun differs from a first-rate high-tech park because it lacks products that are internationally competitive and technologies with high market dominance. Neither does it have products and technologies that could make an impact on economic development of the region, nation, and beyond, and its enterprises do not stand at the forefront of the global high-tech industry.[33]

Therefore, although Zhongguancun was dubbed "China's Silicon Valley" when it was established, doubts have always existed about the appropriateness of the label. Development of China's high-tech parks lags far behind not only Silicon Valley but also Taiwan's Hsinchu, just a few years older than its mainland counterpart. According to China's renowned economist Wu Jinglian, Zhongguancun, in following the example of Silicon Valley instead of mirroring its success, is but a poor shadow of its role model.[34] Elevating Zhongguancun's status to a science park in 1999 in fact showed that the government was tactfully acknowledging its failure to create a comparable high-tech hub.

Among other factors, rising business costs, a dearth of high-quality technologists and skillful managers, and a tendency to copy technology rather than invent it have frustrated the development of China's high-tech enterprises as well as high-tech parks. In Duan Yongji's view, two problems—lack of a mechanism for valuing technology and for generating venture capital—put Zhongguancun and China's high-tech parks behind Silicon Valley.

Unclear Ownership and Its Reform

Though lack of scientific innovation is a major factor for the slow growth of many high-tech enterprises in China, unclear ownership may be blamed as well. Many S&T firms, spinoffs from state-owned institutions of research and learning, used those institutions' funding, staff, facilities, and most important, research achievements, thus avoiding the need to bear the full range of entrepreneurial risks for startups.[35] Liu Chuanzhi of Legend acknowledged that being a CAS spinoff made it easy to get loans from state-owned banks and approval for a branch in Hong Kong and eventually to go public there.[36] For this reason, research institutions and universities are on solid ground to claim profits and part ownership from their spinoffs. In the meantime, those enterprises have become interested in using ownership to reward entrepreneurship and

33. *Beijing Qingnian Bao* [Beijing Youth Daily], August 25,1999, p. 15.

34. Wu Jinglian, *Fazhan Zhongguo Gao Xin Jishu Chanye: Zhidu Zhongyu Jishu* [Developing high- and new-technology industry in China: Institutions are more important than technology] (Beijing: Zhongguo fazhan chubanshe, 2002), p. 23.

35. Lu, *China's Leap into the Information Age*.

36. Pei et al., *Hafo Shiye zhong de Lianxiang Jituan*, pp. 43–44.

pioneers, mobilize existing employees, and attract talent and further investment. But real ownership reform would have to surmount at least three barriers. The first is policy—how the ownership of spinoffs is distributed to different parties. The second is historical—how internal employees are defined within a firm and what that firm should do about employees who have contributed but left. The third is practical—how to quantify employee contributions and avoid conflict among employees. Therefore, the reform at Stone and Legend in the late 1990s represents an important institutional innovation.

Stone, set up in May 1984 by several scientists from the CAS Computing Center with RMB 20,000 ($8,620) in borrowed funds but not a penny from the state, is a truly non-governmental enterprise (*minying qiye*). Promoting the "four-self" principle and ambitious to become "China's IBM," Stone accumulated total assets of RMB 4.8 billion ($580 million) and had 52 subunits by 1999.[37] But unclear ownership, along with the lack of core products and a fraud that cost it several hundred million RMB, led to setbacks for the company that was once No. 1 in Zhongguancun.[38] In the mid-1980s, Stone started to consider clarifying its ownership, but that was delayed in 1989 when Wan Runnan, Stone's president, fled abroad for fear of prosecution for his involvement in the Tiananmen Square incident.[39] In 1999, when it celebrated its 15th anniversary, Stone determined to solve the ownership problem through a management buy-out (MBO) scheme.[40] However, the company's subsequent path has been neither simple nor smooth, and its ownership has yet to be resolved.[41]

Legend took a different approach. Soon after it spun off from the CAS Institute of Computing Technology, the company was granted permission to operate as a business, hire employees, and distribute income. In return, it would remit part of its profits to the institute, as research funding. In 1993, Liu Chuanzhi asked the CAS for the right to distribute 35% of profits as dividends among employees, which was approved the following year. Of that portion, 35% would go to key founding members and 20% to veteran employees, while the remainder would be reserved for those who had joined the company after 1988. Each employee was entitled to a dividend according to his or her seniority and contributions. For example, 15 key founding members were to share 18 parts of the 35% percent portion, with Liu Chuanzhi getting three parts, and an executive deputy president, two. As a result, veterans retired happily, while young managers emerged to take the initiative. Five years later,

37. Scott Kennedy, "The Stone Group: State Client or Market Pathbreaker?" *China Quarterly* 152 (December 1997), pp. 747–77; and Lu, *China's Leap into the Information Age*, pp. 19–62.

38. *Jinghua Shibao* [Beijing Times], February 18, 2003, p. B27.

39. Wu Jinglian, *Fazhan Zhongguo Gao Xin Jishu Chanye*, pp. 20–23 and 36–37.

40. *Beijing Qingnian Bao*, July 7, 1999, p. 6.

41. *Jinghua Shibao*, September 17, 2002, p. B27 and *Zhonghua Gongshang Shibao* [China Business Times], November 27, 2002.

when Zhongguancun formally became a science park and ownership reform became imminent, Legend converted its dividend distribution rights into stock options and implemented an employee stock-option scheme.[42]

However, ownership reform at Founder, which started in 1999 under the Legend model, is unfinished. Founder was initially registered as a Beijing University-run enterprise (*xiaoban gongchang*), an enterprise category dating back to the late 1950s. In fact, the name of the university is still part of the company's formal and full name—Beida (Beijing University) Founder.[43] Direct control by Chinese universities over their spinoffs is understandable because of their close ties, and also because many Chinese view professors' dual roles as faculty members and company employees as an apparent conflict of interest. In addition, Founder's management did not stabilize until its "spiritual leader," Wang Xuan, retired recently.[44] Ownership clarification at Founder also includes the issue of whether those who departed, especially Zhang Yufeng, the loser in the conflict with Wang Xuan, should be granted stock options in recognition of their contributions to the establishment and early success of the company.[45]

Immature Venture Capital Investment

Some of China's high-tech firms have started to rely on financial markets—share listing or private investment—to raise funds or reorganize existing assets. As of April 2004, Zhongguancun had 61 companies listed at home or abroad.[46] Compared with Silicon Valley, however, venture capital investment is still in its formative years, as it did not begin to appear in China until 1993.[47] The problem of introducing the practice of venture capitalization does not lie in money; China had total savings of RMB 10.6 trillion ($1.3 trillion) by July 2003.[48] Interest rates have dropped and investment by ordinary Chinese

42. Pei et al., *Hafo Shiye zhong de Lianxiang Jituan*, pp. 164–67, 260–61.

43. Lu, *China's Leap into the Information Age*, pp. 125–26. This *xiaoban gongchang* mentality exists in all university spinoffs, whose ownership reform has yet to be finalized. For the case at Qinghua University, see *Jingji Guancha Bao* [Economic Observer], December 9, 2002, p. A24.

44. *Sanlian Shenghuo Zhoukan*, September 2, 2002. Wang Xuan is said to be involved in Founder's management, down to decisions about who should get which apartments. See Adam Segal, *Digital Dragon: High-Technology Enterprises in China* (Ithaca, N.Y.: Cornell University Press, 2003), fn. 87, p. 74.

45. *Jingji Guancha Bao*, December 9, 2002, pp. A9, A11; *Ershiyi Shiji Rencai Bao* [21st Century Talent News], February 19, 2003.

46. *Beijing Ribao* [Beijing Daily], May 20, 2004.

47. Francis Bassolino, "In Search of Growth: China Turns to High Tech Venture Capital Funds," *Harvard China Review* 2:1 (Spring/Summer 2000), pp. 48–51; and Allan K. A. Marson, Matthew J. McGain, and Flora Huang, "New Ways out for Venture Capital Investors in China," *China Business Review* 29:4 (July/August 2002), pp. 30–34.

48. *Beijing Xiandai Shangbao* [Beijing Business News], August 14, 2003.

in the domestic stock market has not performed well. Venture capital, as a steady source of investment, therefore, will certainly grow if other opportunities are available for it. The main concerns for a firm seeking venture capital are first, clear ownership, and second, whether its governance structure is defined and transparent enough to engender trust in its management from venture capitalists. Domestic technologists have been neither mature nor rich enough to be venture investors themselves. Institutionally, limited partnerships are taxed as either individuals or corporations, which in fact discourages venture investment. Without an exit mechanism such as public listing, venture capitalists have to rely on over-the-counter property-rights exchanges to conduct mergers and acquisitions, which in most cases would not maximize their return on investment.

Under these circumstances, the government has played the role of venture capitalist. Between 1998 and 2001, some 170 government-sponsored venture capital companies managed a total of about RMB 20 billion ($2.4 billion). But the money was either used to support risk-averse projects or put into the stock market, rather than being invested in technology startups hungry for funding. For example, of the RMB 1.6 billion ($190 million) managed by Shenzhen Venture Capital, only RMB 200 million ($26.8 million) was invested in some sort of high-tech firm.[49] The bankruptcy of China New Technology Venture Investment in 1998 signaled the failure of government-backed venture capital investment.

In March 1998, the first proposal made to the Ninth Chinese People's Political Consultative Conference (CPPCC) was to introduce venture capital and establish a growth enterprise market (the so-called second board) in China. Chinese venture capitalists saw the second board as an opportunity to cash in on their investments. However, since that option was out of reach until very recently, when the government finalized the establishment of a stock exchange for small- and medium-size firms, private money was gradually withdrawn. In the meantime, high-tech companies preparing for listing on NASDAQ, Hong Kong's Growth Enterprise Market (GEM), or elsewhere could do so only after undergoing tedious and troublesome approval processes, as required by China's securities management authority.[50]

Almost all of China's best-known Internet companies were initially funded in part by venture capital from outside China. By 2002, the top venture capital funds invested in China included Warburg Pincus (no. 1, U.S.); Walden (2, U.S.); IDG (3, U.S.); JAFCO (4, Japan); Vertex (5, Singapore); Acer (8, Taiwan); and Softbank (10, Japan), clearly showing this dominance, while the combined investment of three domestic firms—Legend Capital (6), Shenzhen

49. Wu Jinglian, *Fazhan Zhongguo Gao Xin Jishu Chanye*, p. 46; Zhang Shuxin, "Zhongguo Xin Jingji Zhiyuan" [The source of China's new economy], in *CEO yu Beida Duihua: Qiye de Hexin Jingzhengli* [Dialogue between CEOs and Beijing University: Core competence of enterprises], ed. Zhang Weiying (Shenyang: Liaoning renmin chubanshe, 2002), pp. 145–80.

50. Sheff, *China Dawn*.

Venture Capital (7), and Beijing Venture Capital (9)—constituted only 12% of the total.[51] Nevertheless, as Zhang Shuxin, one of the earliest Internet entrepreneurs in Zhongguancun concluded, thus far, all venture investment in China has failed in that hardly any truly innovative technology has been turned into a long-term moneymaking proposition. Moreover, many venture capitalists are either foreigners who do not quite understand the Chinese situation, or they are sponsored by the Chinese government.[52] With delays in the maturing of the domestic venture capital sector, Chinese high-tech enterprises risk losing their growth potential; the most innovative ones are being purchased by foreign investors.

In spite of this situation, the good news is that by following Silicon Valley practice and trying to open a window on the new technologies that are remaking China's industrial landscape, some of China's earliest S&T firms have managed to set up venture-investment subsidiaries. For example, after retiring from the active management of Legend, Liu Chuanzhi now runs Legend Capital, the company's investment arm, which has invested some $35 million of its own money in companies that may sustain the fund's growth and become potential winners for Legend profitability. Legend Capital has raised some $70 million in its second round fund-raising.[53] More broadly, China—with the prospects of clarification on the ownership problem; improvement in corporate governance, accounting, and auditing; and, most important, a stable legal infrastructure—is expected to attract domestic venture capitalists whose head start and due diligence will pay off.

The "Silicon Valley Complex" and the "Zhongguancun Syndrome"

Despite having a strong "Silicon Valley complex" that is, all high-tech parks in China want to become a "Silicon Valley," Zhongguancun and China's high-tech parks have failed to replicate Silicon Valley in China. Moreover, most of them seem to be infected with a "Zhongguancun syndrome." The essay has pointed out some of the signs and symptoms that collectively can lead to this abnormal condition, characterized by lack of both indigenous innovative capability and the capacity to turn discoveries into profitable products, as well as unclear ownership rights, and other issues (discussed below).

Intolerance of Criticism

Zhongguancun has been much ballyhooed as the "crown jewel" of China's high-tech development, so criticism of the science park is not tolerated by

51. *Shuzhi Caifu* [Digital Fortune], no. 12, December 2002.
52. *Beijing Qingnian Zhoukan* [Beijing Youth Weekly], December 5, 2001.
53. *Ershiyi Shiji Jingji Baodao* [21st Century Business News], October 18, 2003.

commission administrators and, in some cases, company officers. For example, when news of the "divorce" between Legend and the CAS Institute of Computing Technology was announced in early 2000, media that carried the story faced possible advertising sanctions by Legend.[54] In 2002, *Newsweek* named Zhongguancun one of the eight "most creative cities in the world." However, the circumstances under which Zhongguancun was selected and the problems it faced were omitted. For one thing, the *Newsweek* article points out that "many local residents worry that the government may be ruining Zhongguancun's creative chaos and boosting property values to levels that price out struggling young talent."[55] This diagnosis of the "Zhongguancun syndrome" is very serious. The uneasiness of Zhongguancun officials toward dissenting views is quite similar to the hypersensitivity of Chinese leaders in the 1960s during the campaign to "learn from Daqing and Dazhai"—except that this time, Zhongguancun has become the new national icon. As a result, even Zhongguancun entrepreneurs were forced to go to Pudong, Shanghai's high-tech industrial zone, to hold a forum to criticize the Beijing municipal government for "not behaving well" in advancing high-tech in Zhongguancun.[56]

The Role of Government

Some criticisms also concern what role government should play in China's high-tech development. In the early period, when a company's entrepreneurs and researchers worked together to decide on strategy and direction, Zhongguancun was more spontaneous than today. The "four-self" principle was an indicator of considerable autonomy in business operations. At that time, government support came mainly through granting the district a preferential policy regime. The government used taxes to finance several new skyscrapers to house high-tech companies, adopted preferential financial measures to attract talent and startups, and even certified high-tech firms so they could obtain preferential treatment. It was only later, in 1998, that the government became decisively involved.[57] Now, the government may be running the risk of stifling innovation by approaching high-tech parks in the way it organized its nuclear weapons, missile, and satellite programs—believing that the mobility of human, financial, and material resources could turn Zhongguancun into "Sili-

54. See <http://www.pcdigest.com/passquery/wzxxxx/wz200004/wz200004006.html>, accessed February 18, 2003.

55. "How to Build a Creative City," *Newsweek*, September 2, 2002, pp. 50–60. The eight cities selected include Austin (USA), Tijuana (Mexico), Cape Town (South Africa), Zhongguancun (China), Antwerp (Belgium), Newcastle Gateshead (U.K.), Kabul (Afghanistan), and Marseilles (France).

56. *Ershiyi Shiji Jingji Baodao*, September 21, 2002.

57. Segal, *Digital Dragon*, pp. 77–85.

con Valley." Entrepreneurs are envisioning an environment in which they serve as the engine for growth and the creation of wealth while the government nurtures market conditions and facilitates capital flows to sustain entrepreneurial competitiveness, rather than picking winners.

How Many "Zhongguancuns" Does China Need?

The "Zhongguancun syndrome" is also evident throughout high-tech parks in China. Many—in major cities like Guangzhou, Shenzhen, Hefei, Shanghai, Wuhan, and Xi'an—hold Silicon Valley as their growth model. Only three poor and remote areas, Qinghai, Ningxia, and Tibet, do not have a national high-tech park. Then, the question becomes: Does China need so many "Silicon Valleys"?

The answer is probably no. The 53 high-tech parks can be classified into three types. The first is set up in a region with strong infrastructure and human resources, such as Zhongguancun in Beijing and Donghu in Wuhan. The second type is set up in places like Shanghai and Nanjing, where a concentration of high-tech firms is planned. The third type is established inside economic development zones like Shenzhen. In the early 1990s, the state relaxed procedures for approving high-tech parks, so that many of them were established to take advantage of the preferential policies.[58] In many cases, a high-tech park may be used to showcase the political correctness of the local leadership, as with the 1960s focus on Daqing and Dazhai. Under these circumstances, high-tech parks, as well as firms in the parks, tend to adopt homogeneous strategies by attracting foreign investment and MNCs and focusing on quantity, not quality, of growth. Out of the 3,990 products made in Chinese high-tech parks, for example, 1,288, about one-third, are in the microelectronics and IT sectors. Around 30 high-tech parks have PC manufacturing businesses, 20 produce television sets, and more than 10 make mobile handsets and beepers.[59] Many of these commodities are based on foreign technology or even foreign products. Instead of attracting domestic high-tech startups with indigenous technologies, the parks compete with each other for foreign investment. Far from what their names suggest, many of these high-tech parks play only a role as manufacturing or export processing centers.

Since high-tech park mania is unlikely to stop, one rational choice is for high-tech parks to find niches through their respective comparative advantages

58. Ma Hong, "Guanyu Kaifa Gaoxin Jishu Chanye de Ruogan Wenti" [On the development of high- and new-technology industry], in *Keji Fengxian Touzi Lunwen Ji* [Science and Technology and Venture Capital], ed. Cheng Siwei (Beijing: Minzu yu jianshe chubanshe, 1997), pp. 3–13. For a discussion on the differences between technology parks, high-tech complexes, and science cities, see Manuel Castells and Peter Hall, *Technopoles of the World: The Making of Twenty-First Century Industrial Complexes* (London: Routledge, 1994).

59. *Kexue Shibao* [Science Times], July 30, 2002.

and competitive strategies. In this regard, China's high-tech parks could learn from the experiences of Hsinchu in Taiwan, with its concentration in semiconductor foundries, and the experiences of Bangalore in India, where software development is the major priority. Whether Zhongguancun should be a government priority is also debatable: Some observers claim that S&T personnel and resources are more concentrated there than elsewhere and point out that the Zhongguancun Science Park has won central government support; others prefer to see the growth of Zhongguancun and other high-tech parks as being driven significantly by the market rather than by government.

Conclusion and Discussion

In spite of their short history, Zhongguancun and other high-tech parks have not only provided China with the newest and most advanced technology but also have gradually established operational and management mechanisms with market orientations and great vitality as conduits to the knowledge-based economy. Of course, emphasis on the role of high-tech parks does not mean we should neglect the significance of international technology transfer and foreign direct investment in China's high-tech development, as frequently evidenced in the parks. Nor does the focus indicate that China's high technology is confined to such parks—high-tech firms have mushroomed elsewhere and some companies have relocated outside the parks. Nevertheless, high-tech parks are significant because of their bestowed responsibilities for integrating technology and the economy, developing human resources, and contributing to China's long-term and sustainable economic growth.

However, China's high-tech parks, arguably the most dynamic areas for innovative activities, have not yet been driven by indigenous innovation and technology development, and their prosperity is heavily reliant on the introduction of technology from Silicon Valley or other developed regions, or worse, on subordination to MNCs. On the one hand, it is difficult, if not impossible, for China's high-tech firms, even those in Zhongguancun, to challenge their international counterparts technologically, given their current position within the competitive global economic arena. On the other hand, working for technological giants makes it easier for these firms to achieve immediate, short-term gains. But there is concern over whether most of the firms have become so path dependent as to ignore long-term prospects of innovation-based endogenous growth. More problematic is the fact that although the Chinese government has emphasized the importance of innovation in high-tech development, in practice, it has been more interested in conspicuous statistics for parks—such as the growth rate of *ji*, *gong*, and *mao*; the number of firms; and the value of exports—rather than the genuine quality of the growth, such as outputs deriving from indigenous technology or patents per capita. Consequently, the government's roles have been mainly "custodial" (i.e., regulating the

firms) and "demiurgic" (i.e., preserving the status quo), far from being "midwifery" (stimulating the emergence of the entrepreneurship) and husbandry (supporting public R&D and exposing enterprises to globalization).[60] That situation has confused key players in high-tech firms and parks as to which course they should take.

While China's high-tech parks as a whole may continue to develop based on foreign technology companies, some—at least leading firms such as Legend in Zhongguancun—should and could depend on the path of becoming truly innovative. Given their close ties with universities and research institutes and especially, their previous experiences, the Zhongguancun firms should evolve toward more technology transfer and collaborative R&D activities involving academics, who may in turn share intellectual property rights in the existing firms or new spinoffs. These firms also should form inter-firm alliances to utilize high-tech clustering advantages, such as synergy, complementarities, trust, cooperation, and flow of information. In the meantime, the Administrative Committee of Zhongguancun Science Park should coordinate and facilitate such activities, organize firms and institutions of learning to tackle common technology issues, and campaign for policy changes as needed. As long as it is more realistic for China to produce only a couple of world-class high-tech parks comparable to Silicon Valley and Hsinchu, other high-tech parks should also clarify and adjust their development strategies—that is, instead of all being "high-tech parks," those focusing on manufacturing and those that are export-oriented might reposition themselves as "industrial sites" or "export-processing zones."

60. For a discussion on roles that states can play in the promotion of industrial development, see Peter Evans, *Embedded Autonomy: States and Industrial Transformation* (Princeton, N.J.: Princeton University Press, 1995).