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Government and Guanxi:
The Chinese Software Industry in Transiton

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Five years ago the Chinese software industry pretty much didn't exist. Today, in Beijing and Shanghai and some of the major cities, it is about 5 to 6 years behind; in the countryside its about 500 years behind.

Ya-Qin Zhang, Director, Microsoft Research Asia

Government policy is like the moon. It is different in the middle of the month than it is on the first day of the month. Government policy is also like the sun. When it shines on you, you flourish.

Chinese proverb

China's 10th Five-Year Plan (2001-2005) identifies software as a critical or "pillar" industry that is essential to economic progress and national security, hence deserving of government promotion, along with more established industries such as computer manufacturing, telecommunications, lasers, and aerospace. This targeting reflects the recognition that software remains a small and underdeveloped sector. It is an extremely fragmented industry that consists of thousands of small, undercapitalised firms with few competitive advantages relative to the foreign corporations that dominate the market. Its exports are negligible. At the same time, Chinese software output has grown an average annual rate of 30% since 1995 and is predicted to continue this rapid growth for several more years. And the industry appears a threat to more established producers like Japan and India because it is located in the world's fastest growing market alongside a dynamic IT manufacturing sector.

These contradictory trends in the Chinese software industry are best understood as products of the country's incomplete transition from a centrally planned to a more market -oriented economy. Chinese policymakers have accelerated the introduction of market mechanisms for over two decades, however the recent vintage of the reforms means that institutional change is uneven and fragmentary, and that the entrepreneurial, managerial and technical skills required for developing globally competitive firms remain scarce. And at the same time as government control over the economy is being reduced, there are few signs that China is creating a Western-style laissez faire market economy.

The Chinese leadership has repeatedly affirmed its deep commitment to national economic autonomy. Deng Xiaoping's often-repeated words: "Science and Technology are the Chief Productive Forces" reflect the significance of indigenous mastery of technology to their vision of a modern, powerful economy. This perspective is reinforced by military and strategic concerns. A 2000 editorial in the *People's Liberation Army Daily* on 'information colonialism' argued, for example, that China must develop its own software because "without information security there is no national security in economics, politics, or

military affairs." [1] Taking it one step further, one official argues: "maintaining independence and keeping the initiative over our own operating system will be the 'Two Bombs and One Satellite' [i.e. the intercontinental missile] of the new era."[2]

These commitments provide ideological justification for the "techno-nationalism" that characterizes contemporary Chinese policy toward software and other high technology industries.[3] The shift to market-coordination thus coexists with the aggressive promotion and preferential treatment--either explicit or implicit--of domestic producers or 'national champions.' One Chinese engineer concludes: "Most high tech promotion in China is just old wine in new bottles; an attempt to grow entrepreneurship using the tools of the planned economy." Moreover the identification and promotion of select producers, by providing government contracts, preferential access to capital, and regulatory priority, leaves open a multiplicity of opportunities for bureaucratic discretion and corruption.

These contending pressures contribute to the unpredictability of the business environment in China. A western lawyer practicing warns of "the apparent schizophrenia in the evolution of law and practice in the PRC technology sector over the past few years . . ." The impression of schizophrenia derives, in part, from the lack of transparency in regulation and policymaking: state agencies and actors can (and do) change the rules of the game with little warning. Moreover the actions of different agencies and different levels of government in China are often contradictory. The government is organized around a complicated inner network of personal relationships that do not correspond to a standard organizational chart or Western bureaucracy. In theory the Communist Party controls the government, yet no individual or committee rules in a predictable top-down fashion. Decisions are the product of continuous and complex two-way negotiations between individuals in different ministries (horizontally) and levels (vertically) of government. These internal debates remain inaccessible to all but select insiders.

In spite of the rapid pace of change in the Chinese economy since 1978 the creation of stable regulatory and legal institutions will likely take decades. In the interim the legacies of prior economic and political structures continue to affect most aspects of economic life. Personal relationships, or *guanxi,* have historically served as an important organizing principle for Chinese economic and political life; trusted friends and family often provide

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[1] Cited in Naughton and Segal (2001), p. 38

[2] Chinese policymakers have even suggested that Microsoft Windows has "backdoors" that allow either the company or the US to spy on users. *Ibid*

[3] Naughton and Segal (2001) define techno-nationalism as a policy orientation toward autonomy and independence from other states. The original techno-nationalist states, like Japan and Korea in the 1980s, were willing to bear the economic costs of a strong central government control alliance with domestic large corporations in order to insure technological and economic independence. They sought to create independent domestic capabilities in critical technologies as well as to develop institutions to diffuse these capabilities throughout the economy. China is pursuing a more laissez-faire variant of techno-nationalism, but remains equally committed to becoming "masters of our own fate." (President Zhiang Zemin, 1995)

the only reliable partners in uncertain and unpredictable environments. Scholars have noted a renewed role for such personal connections in China's transitional economy--particularly for entrepreneurs seeking to advance in its evolving market system (Gold et. al., 2002.) Reliance on social networks and trust appears to be a characteristic of shortage economies with weak legal infrastructures, like Russia and China, where powerful officials control access to resources. In such an environment the accumulation of *guanxi* is necessary to achieve most goals, from acquiring housing to starting a business. Entrepreneurs in China, for example, typically need official assistance to gain access to licenses, financial resources, facilities, protection, favourable interpretation of regulations, and other favours.[4]

If personal relationships are a mechanism for coping with institutional instability and the absence of a formal and reliable system of laws and regulations, the emergence of a market economy and rational law might be expected to diminish the importance of *guanxi*.[5] However the experience of the Chinese software industry suggests that the need to cultivate relationships with powerful state actors remains critical for businesses even in regions that have aggressively adopted market mechanisms (Wank, 1995, 1999.) Local officials in China control resources that are essential for entrepreneurs and businesses, including most notably land (which is owned by the state and controlled by local governments); and their administrative authority includes allocation of financing, infrastructure, access to licenses and permits, and the enforcement of contracts.

At the same time government officials in China depend upon local businesses to demonstrate their own capabilities. Political advancement in China's new reform economy is tied closely to growth, and the decentralization of state authority has fuelled intensifying competition between localities--particularly in the critical IT sectors. This creates powerful incentives for officials to favour local technology firms in the interest of stimulating growth; while local enterprises recognize the advantages associated with devoting time and energy to building these relationships. This is particularly the case for private entrepreneurs that typically have no official connections: they are rarely officials or members of the Communist Party and their firms are not part of the state. A manager of one of the leading US software companies in China notes: "The most important factor for business success in China is not technology, it is relationships."

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[4] *Guanxi* is loosely translated as "connection" or "relationship." The literature on the subject is extensive, with the main theoretical divide being between those who see the reciprocal obligations and indebtedness that characterizes *guanxi* as a cultural phenomenon, distinctive to Chinese society. The alternative view, adopted here, views the clientelistic relations associated with the as a result of particular institutional structure of Chinese society--but not a fundamentally Chinese phenomenon. See Gold et. al., 2002.

[5] For more on this view, see Guthrie, 1998. Legal scholar Stanley Lubman (1998) cautions, however, that while the Chinese are attempting to formalize a system of regulation and rule of law, business practice still treats such Western concepts as a contract as a cage that can be unlocked with appropriate *guanxi.*

These relationships are not necessarily limited the highly personalized *guanxi* of an earlier era--particularly given the aggressive efforts by the central government to combat corruption. Most observers concur that government officials are particularly vigilant in the new technology industries, insuring that software is among the sectors least affected by corruption. On the other hand, if overt corruption is minimized, it is clear that once a firm reaches a certain scale it is scrutinized, and often controlled by government agencies and bureaucrats in more subtle ways. In the new technology sectors, these relationships are likely to take the form of "reputational practices" such as hiring Party members or formerly prominent top officials for managerial positions and seats on the board of directors.

This paper begins with a brief history of the evolution of China's science and technology system, and its information technology sector in particular to highlight the widespread institutional changes underway in the transition from a planned to a more market oriented economy. It then focuses on the development of the Chinese software industry--the market, labour force, sources of capital, ownership and management, and its regional distribution. The analysis highlights the persistent role of non-market factors, the government and guanxi, alongside the ongoing reforms oriented toward introducing market mechanisms into the economy. The conclusion focuses on the effects on the software industry of China's entry into the WTO and on the emerging trends in an economy where the pace of change is unparalleled.

THE DEVELOPMENT OF INFORMATION TECHNOLOGY IN CHINA

1. The Evolution of China's Science and Technology System

1.1 Science and technology in the planned economy

China's leaders began to develop a science and technology base immediately after the formation of the People's Republic. From 1949 until 1977 all research, development, and engineering activities were controlled and coordinated by the State Development Planning Commission and the State Science and Technology Commission. The State Development Planning Commission controlled the detailed annual and five-year plans that allocated resources throughout the economy. Each administrative and productive unit made investment, production, pricing, distribution and other operational decisions according to these guidelines. The State Science and Technology Commission oversaw the funding and administration of science and technology activities in Chinese research institutes, firms, and universities.

Research and development was conducted by state-owned research institutes such as the giant Chinese Academy of Sciences, dedicated to basic research, and the hundreds of industrial and local institutes that conducted more applied R&D. The latter focused on the

needs of particular industries such as defence and other heavy industries like machinery, iron and steel, or mining. In most cases, the relevant ministries of the central government administratively governed the R&D institutes, controlling both funding and personnel, as well as the state-owned enterprises, or manufacturing firms, that were to implement and exploit the new technology.

Approximately fifty major state-owned research institutes were the driving engine for technological innovation and the development of heavy industry in China. Since civil use technologies accounted for only a very small portion of both research and production activities of the country before 1980s, it is not surprising that the most significant technological achievements of this era were in high priority strategic weapons such as guided missiles and artificial satellites. China's system of higher education was organized in the same period to both create and disseminate scientific and technological knowledge. By 1965, fifty-five universities had been established across the country but their focus was almost exclusively teaching rather than research.

The entire system of science and technology research came to a halt during the Cultural Revolution (1967-1976) with the exception of the development of military technologies such as nuclear weapons, guided missiles and satellites. This created an enduring gap in the age structure of China's technical community that has yet to be overcome. On one hand, three-quarters of "senior scientists" such as full professors and senior engineers were due to retire by early in the 21st c.; on the other, half of Chinese scientists were under 35 years of age in the late 1990s, and only a small percentage held ranks higher than "junior" (e.g. assistant professor.) In this decade China fell behind the advanced countries in development of its information technology industries.

1.2 Abandoning central planning, 1978-1992

China's policymakers initiated market-oriented economic reforms in the 1980s in order to address the shortcomings of the nation's science & technology system, which combined weak R&D, poor technical skills, a lack of efficiency, and a dated focus on defence and other heavy technologies. The new policy initiatives that were developed to enhance China's technological capabilities in this period fall into three categories:

1. Exploiting the international environment by acquiring foreign technology, attracting foreign investment, and sending students abroad for training.

2. Promoting university-based research, which was barely existent in the pre-reform era, and encouraging closer ties between research and production through horizontal, market-mediated ties linking research institutes, universities, and enterprises. This included providing greater managerial autonomy to new high tech enterprises without changing ownership.

3. Funding schemes and institutional innovations to improve the focus and coherence of R&D and technology diffusion efforts, including most famously the "863" Plan (named for its approval date of March 1986), which allocated approximately 5 billion RMB between 1986 and 2000 to projects designed to monitor the world's high technology frontier, train a new generation of researchers, and advance Chinese capabilities in fields such as biotechnology, information technology, energy, robotics, new materials, space, and lasers.

The proliferation of programs in this period reflected in part the competitive bureaucratic entrepreneurship among Chinese officials seeking to insure a continued role in a rapidly changing system, as well underlying frustration with the quality and efficiency of existing research and innovation practices.

These reforms significantly improved the infrastructure for domestic research in China and reduced the direct control by the central government over decisions made by firms and research units. Many decisions regarding administration and resource allocation were shifted to the provincial level, and reliance on market-based resource allocation decisions increasingly replaced administrative fiat at both central and local government levels. The "863" Plan, for example, introduced the concept of peer review for the first time in technology research, and focused primarily (but not entirely) on civilian objectives. In most state-supported organizations there were comparable attempts to shift evaluation criteria from political to economic goals.

Chinese policymakers also led the development of the domestic information technology infrastructure. From 1988 to 1992 the State Economics Committee, the newly formed Ministry of Machine and Electronics, and the State Science Committee focused their joint efforts on developing EDI, CAD/CAM and MIS to propel the broader application of electronics and information technology. And in the early 1990s the State Informatisation Expert Group invested heavily in accelerating the adoption of IT in key sectors of the Chinese economy and infrastructure through large-scale projects such as the “Golden Card” (adoption of IT in banking), “Golden Bridge” (the construction of national telecommunications backbone and other networks) and “Golden Custom ” (computer networking for foreign trade and other related issues.)

The "Torch Plan" was proposed by the State Council in the 1980s as well to create a supportive environment for development of new technology enterprises. The plan, undertaken by the Ministry of Science and Technology, has focused most prominently on the establishment of national high tech industrial development zones that provide firms with first-rate infrastructure (including roads, buildings, electric facilities, etc.) and a variety of preferential taxes and collective services. The first of these zones was established in 1988 as a trial in Beijing's Zhongguancun area (sometimes referred to as China's Silicon Valley.)

The reforms of the 1980s, while far-reaching, failed to develop consistent technology policy or a coherent system of innovation in China. Progress was disjointed and uneven. Funding for R&D and education remained low by international standards, policy continued to reinforce the concentration of applied research in public research institutes rather than industry, and the weight of policy--hence the flow of resources--remained biased toward state-owned enterprises rather than the potentially more creative and innovative non-governmental technology enterprises.

The "863" Program, for example, trained thousands of new researchers and contributed to development of a network of research centres.[6] However it had little success in bringing new products to market, largely because the research institutes had few connections with commercial enterprises; and the enterprises had little incentive to look to these institutions for innovation. Resources were often spread too widely as well: for example, the average funding for every 863 researcher between 1988 and 1994 was only about US $5,000 because more than 1,000 programs received funding annually (Naughton & Segal, 2001.) Moreover the majority of students and scholars who had gone abroad to study (approximately 200,000) since the beginning of the reform period remained abroad, making it difficult to staff research facilities and university science and engineering departments with a new generation of well-trained personnel capable of providing scientific leadership.

1.3 Market reforms to accelerate science & technology development: 1992-2002

Chinese technology policy through the early 1990s privileged the large state-owned enterprises (SOEs) and government research institutes, following the model of Japan and Korea. However most Chinese ministers lacked understanding of both the technologies that they sought to develop and the needs of Chinese industry, and Chinese SOEs and research institutes were unable to abandon the practices and structures of the planned economy. China also faced a different international environment than Korea and Japan a decade or so earlier, one characterized by an accelerating pace of innovation and intensifying global

[6] The 863 program employed approximately 40,000 individuals in over 5,200 research projects between 1986 and 2000.

competition. As a result, the strategies of the 1980s and early 1990s produced very little success.

Policymakers began in the 1990s to experiment with more significant loosening of government control as well opening of the economy to new actors and new forms of ownership. The accelerated growth of Shenzhen (in Guangdong province), which had been given policy autonomy during the 1980s as a Special Economic Zone, demonstrated to the central government the economic benefits of market opening. Following Deng Xiaoping's famous "Southern Tour" in 1992, China liberalized market access and initiated more favourable policies toward foreign investment, recognizing that it could play an important role in developing technological leadership. These reforms triggered a dramatic inflow of foreign investment in all sectors of the economy, particularly from Taiwan and Hong Kong. By the late 1990s China was one of the world's leading recipients of FDI and MNCs had became a dominant mechanism of technology transfer as well as an important source of new management models and training in the technology sector.

Policymakers also took steps toward promotion of non-state technology enterprises and signalled a new willingness to embrace alternative forms of ownership. The 1993 "Decision on Several Problems Facing the Enthusiastic Promotion of Non-Governmental Technology Enterprises" recognized that non-state enterprises could play a role building a new, more market-oriented economy. Influenced by the successful growth of the small start-ups in the US technology industry based, Chinese policymakers began to encourage the formation of a "new" generation of technology firms--typically entrepreneurial spin-offs from universities or government research institutes. While the start-up capital for these ventures typically came from friends or personal savings, the initial technology and offices were from the university or research institutes. They were thus viewed as neither "private" nor "public" but rather "collectively-owned" enterprises. The Legend Group (a spin-off from the Chinese Academy of Sciences) and the Founder Group (a spin-off from Peking University) are two of the leading successes of this generation of "non-governmental" technology firms.

The Founder Group: A "non-governmental" enterprise

Peking University Founder Group Corp. was one of China's early "collective enterprises." Professor Wang Xuan, a mathematician at Peking University, started the firm with university support to develop Chinese-language electronic publishing software. Founder now controls over 80% of China's desktop publishing system market and it a dominant supplier to Overseas Chinese newspapers. While top government officials are not involved in allocating funding or corporate investment decisions as in a traditional SOE, it is typical for the university to maintain ownership and control in university spin-offs. Founder's seven-person Board of Directors, for example, includes three Peking University professors and five graduates of the university. Professor Wang Xuan, who remained Chairman of the Board until 2002, is Communist Party secretary for the university and a member of the Standing Committee of the 9th National People's Congress. The close connection to the university and to the Party gives the company an advantage in competing for contracts from state-owned businesses--Founder's leading customers include state-owned newspapers, banks, the tax bureau, and television stations. And the strong university and Party ties also create pressure to make decisions based on political rather than purely economic/ efficiency considerations. In short, despite its apparently innovative ownership, Founder appears to be a new variant of state enterprise.

The original business, Founder Holdings Ltd, was listed on the Hong Kong stock exchange in 1992 but Peking University remains the largest, and majority, investor, through a diversified holding company called Beijing Founder. The Founder Group is now a highly diversified business, like most leading Chinese IT companies. It includes three other listed companies (including not only software development but also IT equipment and new materials) along with 17 wholly owned businesses and joint ventures in businesses ranging from manufacturing its own brand of PC hardware and developing broadcast and TV systems to network security and mobile Internet communications. Founder is also one of China's leading systems integration firm. In 2000 it had 5,000 employees and 10.1 billion RMB ($1.2 billion) in revenues.

By the late 1990s, the Chinese government was supporting private firms as well as university or research institute spin-offs, instead of directing resources for science and technology solely to state-owned enterprises.[7] All domestic enterprises designated by the government as technologically advanced began to receive the same preferential treatment (including preference in procurement decisions, access to low interest credit, etc.) regardless of ownership status. The expansion of the types of technology enterprises receiving preferential treatment was accompanied by during the 1990s by establishment of 52 more national high-tech industrial development zones, which were designed to provide an environment conducive to technological innovation and entrepreneurship.

The opening of the technology sector to private and other forms of ownership was paralleled by substantial reductions in the manpower and mandates of government ministries. A major restructuring of the Chinese Academy of Sciences (CAS) and its research institutes, for example, included dramatic reductions in the workforce and the introduction of competition in hiring decisions. The Institute of Software, which performs research on fundamental software theory and applications, reduced its workforce from over

[7] This was reflected in the ideological shift made at the 15th Party Congress in 1997 where the legitimacy and contribution of private enterprise were fully acknowledged.

500 to 125 between 1999 and 2001. Many individuals whose jobs were eliminated found jobs in private enterprises with the training they had received at the Institute. Salaries were increased from an average of 2,800 RMB to 5,000 RMB per month, with top salaries around 15,000 RMB per month. This insured that programmers and technicians at the Software Institute were paid more than their counterparts at private firms such as Legend. These salary increases reduced turnover from 30% in the late 1990s to around 10% in 2001.

By the end of the 1990s the Chinese government had abandoned most of its control over the process of selecting or importing technology. Private firms and venture capital were increasingly identified as keys to domestic technology development in this period. A 1999 decision summarized a wide range of policies developed to foster new technology enterprises, including a fund to support S&T innovation in SMEs, preference for domestic products and equipment in government and enterprise procurement, partial tax deduction for R&D expenditures, tax exemption for all income from the transfer or development of new technologies, a preferential 6% value added tax rate for software products developed and produced in China, the deductibility of payroll expenditures for software development and manufacturing firms, VAT exemption and subsidized credit for high-tech exports, preferential tax treatment for imports of cutting-edge technologies and equipment, the listing of new technology companies on Shanghai and Shenzhen stock exchanges, and interest subsidies for technological restructuring projects of strategic scientific importance by large and medium-sized SOEs deemed as profitable.

Policy in this period also focused on accelerating development of the venture capital industry as a means to finance new technology enterprises as well as increasing investments in R&D. Total R&D spending in China increased steadily during the 1990s, reaching a total of 89.6 billion RMB (US $10 billion) in 2000, or 1.01% of GDP compared to only 0.60% in 1995. The 10th Five-Year Plan sets the goal of raising R&D spending to 1.5% of GDP by 2005. If achieved this would be very high for a developing economy: India in 1999 was 0.86%, Mexico was 0.40%, and the ratio in most advanced economies is 2-3% range (US Embassy Beijing, 2002.) The available data does not allow us to disaggregate by sector, funding for software research is primarily through initiatives such as the 863 Program, which allocated 15 billion RMB ($1.8 billion) for 2001-2005, and the Informatisation Programs. While R&D expenditure has increased significantly, China's companies, universities and research institutes still remain relatively isolated from the market. As Frank He, president of a Dallas-based software company, puts it, “In China, research is too far from being applied to real life. For example, we can barely find one out of five hundred Ph.D. dissertations (e.g. in Computer Science) with research findings useful for commercialisation. While in the United States, one dissertation out of one hundred can be turned into a real product.”

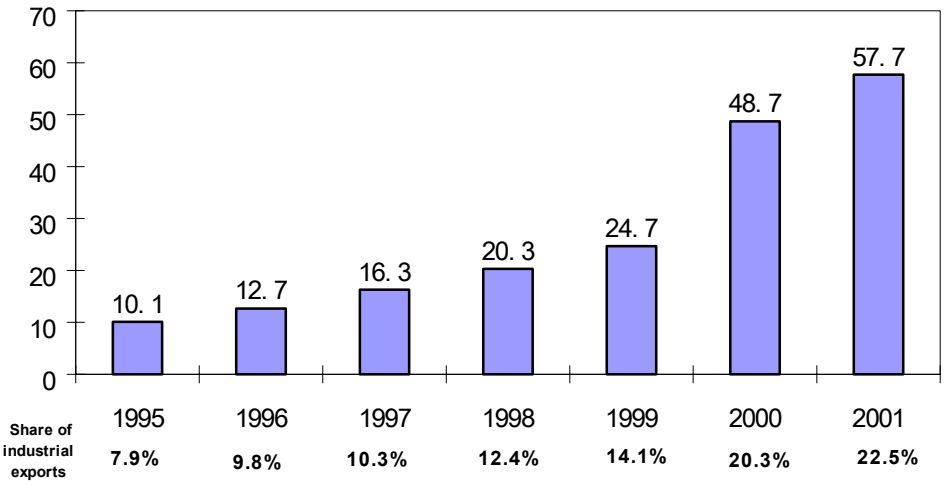
Two decades of change in China's science and technology system have been both disruptive and remarkable at the same time. The Chinese economy is stronger today than most would have predicted in 1980s, with impressive achievements in building a national telecommunications infrastructure and widespread adoption of IT, particularly wireless phones and related telecommunications products (Table 1.) The new technology regime has been extremely successful in the development of IT manufacturing capabilities, where relationships between domestic firms and foreign investors--particularly from Taiwan and Hong Kong--have contributed to rapid development of the domestic capacity for low-cost manufacture of computers, consumer electronics, and communications equipment. While initially these ventures were restricted to lower tech, intensive-intensive processes, over time their technical capabilities have increased. China is now manufacturing laptop computers and sophisticated electronic components for export. In 2002 the country was received $59 billion in FDI and was ranked the third largest IT manufacturing centre in the world, following only the US and Japan (Figure 1.)

Table 1. Adoption of IT in China and comparison countries, 2000/2001

	Personal computers (per 1000 people) 2000	**Internet Users (thousands), 2000**	**Internet secure servers, 2001**	**ICT expenditures % of GDP, 2000**	**Telephone Mainlines (per 1000 people), 2000**	**Mobile Phones (per 1000 people), 2000**
China	15.9	22,500	184	5.4	112	66
India	4.5	5,000	122	3.8	32	4
Brazil	44.1	5,000	1,028	8.4	182	136
Israel	253.6	1,270	301	7.4	482	702
United States	585.2	95,354	78,126	8.1	700	398

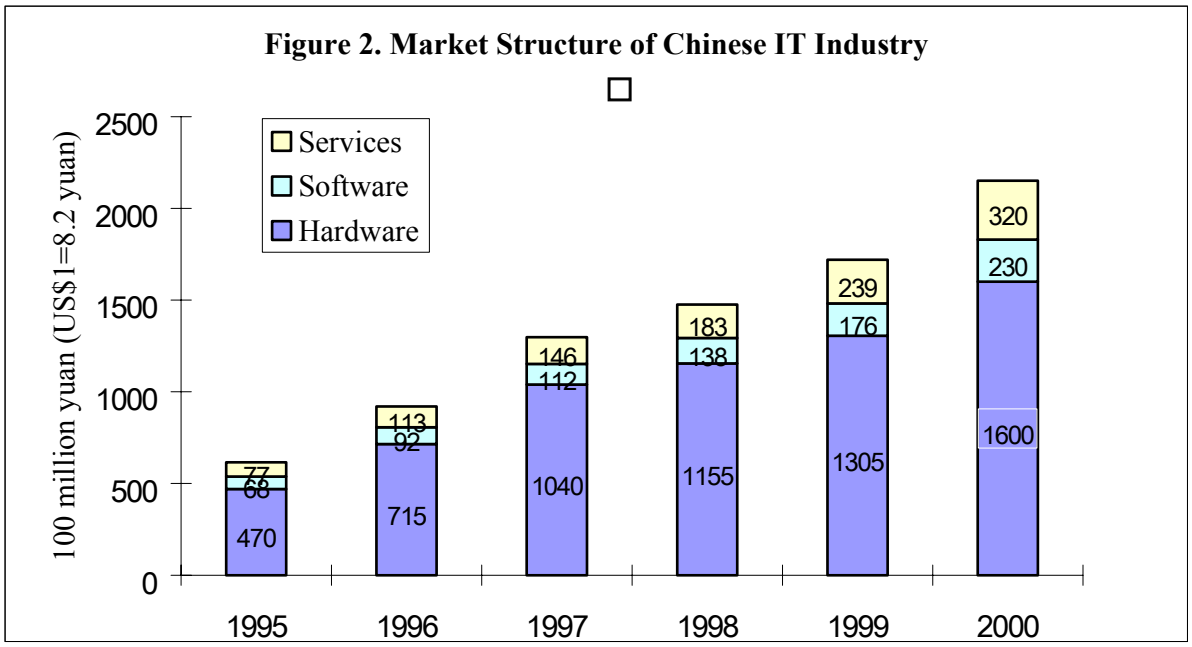
Source: The World Bank, *2002 World Development Indicators*, 5.9 and 5.10

Figure 1. China's High Technology Exports ($ billions): 1995-2001



Source: China Science & Technology Statistics Data Book, 2000. Ministry of Science and Technology of The People's Republic of China; Liu, Xielin. "The Achievement and Challenge of Industrial Innovation in China". Proceeding of 3rd International Symposium on Management of Innovation and Technology. Conference Hangzhou, China. Oct.2002.

Software remains the weakest link in China's IT sector. In 1995 software products accounted for only 10% of total Chinese IT output, or 68 million RMB (only $8.2 million) and the share barely increased by 2000. Software services outpaced the growth of products somewhat, increasing from 10% in 1995 to about 15% of the total by 2000 (See Figure 2.) The development of a dynamic software industry, unlike computer or even semiconductor manufacturing, requires more than the ability to mobilize resources quickly; it requires soft and intangible skills such as creativity, technical experience and managerial know-how as well as the capacity for commercialisation that are scarce in China. Moreover the technology transfers achieved in IT manufacturing through large-scale Taiwanese investments are not likely to be repeated in software, as Taiwan lacks software capabilities as well.



Source: Tsao, "Chinese Labour Market in the Era of Information Technology"

2. The Origins of the Chinese Software Industry

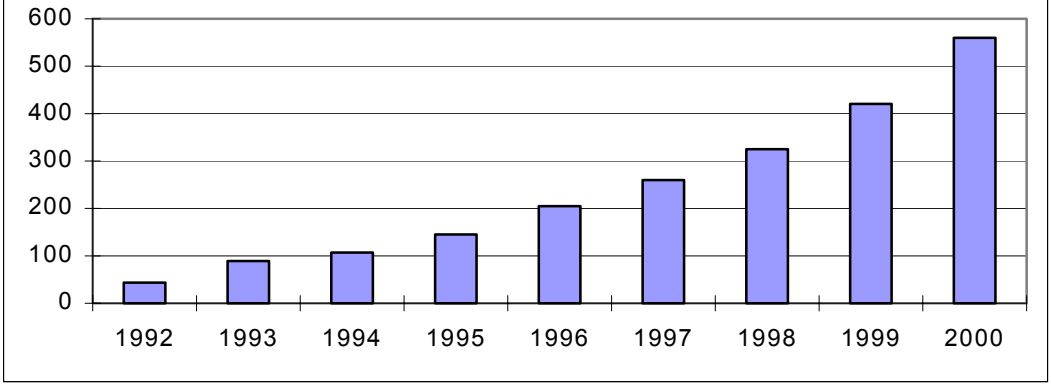
The Chinese software industry barely existed before the 1990s. The Institute of Computing Technology (ICT) at the Chinese Academy of Sciences built China's first computer in 1958. However the government devoted most of its financial resources and limited pool of skilled labour to reverse engineering key hardware such as integrated circuits and technologies with mixed military and civilian importance. There were, to be sure, scattered software development projects in state-owned research institutes, but commercial R&D was largely non-existent because of the organizational and institutional barriers separating these research institutes from the market.

In the late 1980s a couple of Chinese computer firms, including Founder and Legend, were authorized to commercialise software products. This allowed Founder to establish its early dominance of the market for Chinese language publishing systems. Chinese programmers at the Institute of Software at the Chinese Academy of Sciences and other research institutes also began to develop simple information systems, typically by directly manipulating a database for a limited set of functions such as searching and reporting, or the ability to update information interactively. These systems were developed separately for particular end-users and little attention was given to integration or overall design.

The Internet bubble, as elsewhere in the world, brought both hype and money to China's emerging software industry. It appears that the effects of the bubble were more severe than on the software industries in developed economies because of its immaturity. The inflated salaries and funding as well as the impractical expectations for growth distracted Chinese software developers from the necessary focus on mastering the process and techniques needed for mature software design and integration--including systems thinking, component-based design, and object-oriented design and development capabilities. The attitudes of customers, financiers and policymakers were also distorted by the experience. In short, the bust left all of the actors in China's fledgling software sector with a limited capabilities and superficial understandings of software processes and technologies (Brizendine, 2002.)

These weaknesses were masked, however, by the industry's growth: an average annual growth rate of over 30% from 1992 to 2000, albeit from a very small base. (Figure 3.) The International Data Corporation (IDC) forecasts the Chinese software market will continue to grow at a compound annual growth rate of over 30% between 2000 and 2005. Nevertheless, industry output of $7.2 billion in 2000 remains small relative to the booming IT hardware manufacturing industry, and China lags behind countries like India, Ireland, and Korea in software output. (Table 2.)

Figure 3. China's Software Market (100 million RMB)



Source: China Software Industry Association, p4.

Table 2: Software output: China and other countries, US$ billion

	China	U.S.	Japan	Ireland	India	S. Korea	Global
1999 sales	5.3	220	54	8.4	6.8	5.9	527.4
% of world market	1.0	42	10.2	1.6	1.3	1.1	100
2000 sales	7.2	240	57.2	8.9	8.9	8.3	596
% of world market	1.2	40.2	9.6	1.5	1.5	1.4	100

Source: China Software Industry Association, p3.

The Chinese government, recognizing these weaknesses, has targeted software, along with integrated circuits, in the 10th Five-Year Plan. The Plan anticipates continued 30% annual growth rates for software and projects sales of US $20 billion by 2005. It specifies two main goals: (1.) increasing domestic companies' share of the Chinese software market to 63%, almost double the current share; and (2.) growing software exports to $1 billion, a ten-fold increase, by 2005. These goals will be achieved, according to the Plan, by building 20 domestic firms with revenues exceeding 1 billion RMB ($120 million) and more than 100 "famous software brands." (SIIA-USITA, 2002) The government has allocated a total of 4 billion RMB ($480 million) to achieving these tasks.

The most important central government policy for the software industry is the June 2000 announcement of State Council Document 18, formally known as "Notice of Certain Policies to Promote the Software and Integrated Circuit Industry Development."[8] The documents policies for software companies include most notably:

- Value-added tax (VAT) refund for R&D and expansions of production, reducing the effective VAT for software firms from 17% to 3%
- No enterprise income tax (EIT) for two years for new enterprises, once approved, and 50% EIT for the next three years, beginning with the first year of profitability
- Tax rate of 10% EIT for companies designated as "key software enterprises" in the plan that do not qualify for the 0% EIT
- Fast-track approval of software companies seeking to raise capital on overseas stock markets
- Exemption from tariffs and VAT for all imports of technology and equipment
- Direct export rights for all software firms with over $1 million in revenues
- The right to set salary levels and to grant bonuses to inventors

[8] Municipalities like Beijing and Shanghai typically add their own incentives to the national policy for the sector. Beijing, for example, offers financial assistance, preferential land prices, and assistance to foreign managerial and technical personnel starting new companies.

These policies assume an internationally open and competitive market, in contrast with more protectionist industrial promotion efforts of the early 1990s (Lardy, 2002.) However Document 18 also requires that preferential policies be accorded only to companies that are certified as software enterprises with software products, based on standards set by the Ministry of Information Industry (MII) and the local audits by the Chinese Software Industry Association. The Authentication Standards measure an enterprise's scale (value of registered capital, annual income, and exports) and evaluate its products.

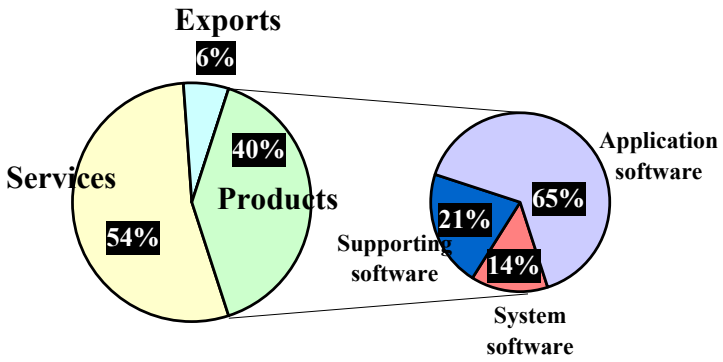
Chinese policymakers and businesses have also been energetic about learning from the international experience, and there is a proliferation of partnerships and joint ventures with foreign companies. This means that the software industry is developing in a far more global environment than earlier industries. Agencies at all levels target software through policies ranging from research funding and procurement to expansion of education and the creation of state-level software parks. One of the biggest unknowns in the development of the software industry remains the extent to which China's entry into the WTO will increase the transparency and predictability of the business environment and the legal system, particularly with regard to the protection of intellectual property rights.

THE CHINESE SOFTWARE MARKET

1. Domestic Market

China exports little software but is advantaged by a growing domestic market. Software services dominate with 54% output in 2000 ($3.9 b), followed by software products with 40% ($2.9 b) and exports with only 6% ($0.4 billion.) Application software such as pre-packaged financial services, security systems, electronic publishing or education products (65% of sales) dominate the product market, with smaller shares of supporting software such as application development tools (21%) and system software (14%). Figure 4.

Figure 4. Chinese Software Output, 2000



2. Market Players

International Data Corporation (IDC) estimates that by the end of 2000 there were more than 2,000 registered software companies in China and another 3,000 IT companies involved in the software business. The latter include computer, consumer electronics, and telecommunications companies that develop their own software systems internally. (The China Software Industry Association, an industry lobby, has estimated that there are 10,000 software companies in China. This may result from a broader definition of the industry. However the IDC numbers are consistent with the results of a 2001 survey of the industry conducted by the Chinese Ministry of Information Industries, MII, and the State Statistical Bureau.)

The domestic industry is extremely fragmented, with thousands of very small enterprises with fewer than 50 employees that lack economies of scale or distinctive competencies. These firms typically focus on developing niche applications tailored to unique needs of the domestic market (e.g. systems integration or specialized financial software developed for China's unique accounting practices) and adopting products to Chinese language platforms (e.g. education software.) Only a handful of domestic companies that have gained control of particular product niches have more than 1,000 employees or sales revenues over $50 million, including Founder (electronic publishing software), Kingdee (enterprise resource management software), and UFSoft (financial software.) In general these products are substantially less expensive and offer more limited functionality than their foreign

counterparts. (Table 7 shows, for example, that the Kingsoft WPS Office 2000 Office Suite is priced just over one-third of the Microsoft's Office XP that it competes with.)

Foreign corporations, including Microsoft, IBM and Oracle, dominate the software product market in China--accounting for over 65% of packaged software sales--because of their established brands and products. However this market has become increasingly competitive in recent years with new entrants as well as the emergence of new niches. Table 3 indicates that in 2000 the top ten firms in the Chinese packaged software market accounted for 28% of total revenues, compared to 1999 when the top ten firms accounted for 35% of the market.

Table 3. Top Ten Packaged Software Vendors: China, 2000

Vendor	Revenue, $M	Share, %
IBM	77.99	6.08
Microsoft	65.07	5.07
Oracle	58.28	4.55
Sybase	30.93	2.41
Informix	26.33	2.05
Computer Assoc.	25.74	2.01
UFSoft	23.30	1.82
Novell	21.49	1.68
Lotus	17.53	1.37
Kingdee	16.25	1.27
Others	919.37	71.69
Total	1,282.28	100.00

Source: IDC, 2001.

UFSoft and Kingdee are the only domestic software companies ranked in the top ten. This reflects their dominance of the financial software market--the two firms account for about 60% of China's accounting software market--and increasingly the market for enterprise resource management software (See Table 4.) This is due primarily to their privileged knowledge of Chinese financial and managerial practices. They have also benefited from the preferential purchasing practices of Chinese government agencies By 2002 UF Soft had moved from 7th to 4th ranked in total packaged software sales, following only IBM, Microsoft, and Oracle.

Table 4. Top Ten Enterprise Resource Management Vendors: China, 2000

Vendor	Revenue, $M	Share, %
UFSoft	23.3	12.9
Kingdee	16.3	9.0
SAP	14.5	8.1
Genersoft	11.2	6.2
New & Grand	5.7	3.2
Anyi	5.6	3.1
Oracle	5.3	2.9
QAD	4.4	2.4
Fourth Shift	3.3	1.8
Symix	2.6	1.4
Others	87.9	48.8
Total	180.0	100.0

Source: IDC, 2001

Software services, primarily of systems integration, account for more than half of China's total software output. This is at least in part due to the extremely high rates of piracy in the industry (over 90%) that provide a strong disincentive to develop new products; services do not face piracy risk. Table 5 lists some of the major players in the software services market. China's leading computer hardware manufacturers such as Legend and Great Wall are active the IT services market because they see it as a way of expanding beyond their original business. In fact there are very few specialized and dedicated Chinese software providers. US-based software specialist Jessica Ma reports:

> It is very difficult to be a specialized software producer in China: there is great pressure to become not just a producer of software technology, such as an office automation product, but also to become service provider and also a systems integrator for the same customer. The customers want software integrated with their product. This makes it very hard to sell stand-alone software. The large companies in China prefer to develop their own software.

As a result many of the largest software developers in China are diversified IT firms, such as Founder and Legend. Telecommunications equipment manufacturers, Huawei and Zhongxing, for example, are among the largest software producers in China because they develop most of their own software internally.

Table 5. Major Chinese software firms by year founded and ownership

Name of Firm	Year founded	State-Owned Enterprise	University Spin-off	Private Firm	Diversified IT Firm	Public Listing
Beijing Legend Software Co., Ltd.	1984		×		×	×
Peking University Founder Group Co.	1986		×		×	×
Beijing UFSoft Group Corporation Ltd	1988			×		×
Kingsoft Company Ltd	1988			×		×
Shenzhen Huawei Technologies Corp	1988			x	x	
China National Computer Software & Technology Service Corporation	1990	X				x
Sichuan TOP Group Science & Technology Development Co., Ltd	1992		x		×	×
NEUSOFT Group. Ltd.	1993		×		×	×
Kingdee International Software Group	1993			×		×
Shanghai Huateng Software Systems Co.*	1993	JV				
Beijing Beida Jadebird Company Ltd	1994		×			×
Shenzhen Zhongxing Telecom Co., Ltd	1997				×	×

* Shanghai Huateng is a joint venture between Warburg Pincus and Shanghai Information Investment Inc (a subsidiary of Shanghai Industrial Investment Holdings Co, which is owned by the Shanghai government.)

Chinese entrepreneurs remain pessimistic about the industry's future because of the limited success of domestic firms in the software product market. Lai Zhibin, the vice president of Beida Qianfang, a software company that spun out of Peking University, is blunt about this: "I don't think China has its own software industry. My understanding of the definition of a software firm is that: first, the firm has its own software product; second, it has a certain market share. However, most, almost all, of the so-called software firms in China now don't have their own brands. They are just doing low end programming jobs . . . One example of a real software firm is UFSoft. It really has its own brand. However, its success to a large degree is because it is doing accounting software. You know, the accounting system is unique in China, and that's why it's hard for foreign companies to compete with local companies in this field."

3. Immaturity of the Chinese Market

The Chinese software market, although potentially large, remains immature. Most industry participants agree that few domestic users--government, businesses, or individuals--fully appreciate the value of investing in and/or paying for software. This is related as much to organizational immaturity as to resource constraints: In the words of a Vice President of Beijing-based software firm Digital Wangfujing:

> The biggest problem for the software industry in China today is that the users have not matured enough to use or to understand software. The government and firms still don't have a well-defined governance structure which can tell them when and how to hire or fire employees. How can we expect them to know when they need software?

Most business or government customers--only recently weaned from the protection of the planned economy--are not sophisticated enough to make balanced independent purchase decisions. In addition, many Chinese enterprises and even local government agencies are still primarily paper-based or hand-labour based, so it makes little sense to talk about higher levels of automation or integration. Even managers who recognize the need to invest in software have great difficulty evaluating investments and the potential returns from investments because Chinese enterprises frequently do not know their actual costs.

In contrast with the Indian software industry, which has grown up serving extremely sophisticated foreign corporations (such as Fortune 100 companies from the US), the immaturity of the business market makes it difficult for Chinese software firms to develop new products or achieving scale economies. After the government, the largest domestic customers for software in China are the state-owned enterprises. These SOEs, while subject to aggressive restructuring over the past decade, still account for the majority of the software market outside of technology sectors. Yet it is rare for a Chinese SOE to depend on software-derived or -supported functionality for their competitive advantage. For most competition is based on price, distribution, and relationships. There are, of course, exceptions. There are sophisticated small and medium-sized Chinese companies with fully integrated ERP programs. However most systems in China still do not require highly advanced skill levels. Others fail to see the value of software to their operations. One software consultant reports "in today's China you can find $30 billion multinationals with virtually no IT functionality besides email and a marketing website."

The business market in China remains limited as well by the general unwillingness of most enterprises to pay for externally developed software. Many large firms prefer to develop software internally because there is little tradition of outsourcing in China. In the 1990s, for example, many Chinese enterprises believed it was better to develop database capabilities

internally than to buy a database product. Even those enterprises that do purchase software products or services remain unsophisticated as customers, unsure of what they want and thus unable to provide the feedback that might help domestic producers develop innovative products.

The individual (household) market remains small because Chinese either cannot pay for software at all, or are willing to buy pirated versions. The household market is dominated by pirated or copycat versions of foreign application software products. Desktop software like Microsoft Office is almost entirely pirated. A domestic firm, Kingsoft, has succeeded by developing a local clone of Microsoft Word because its products are supported by government agencies. And Microsoft sells its operating system and application software to computer makers like Legend and Dell at a discount to install in PCs for sale in China.

4. Software Piracy

Extremely high rates of piracy reflect, and reinforce, the immaturity of the Chinese software market. China is ranked second internationally, behind only Vietnam, with a 92% business software piracy rate (Table 6.) This means that a Chinese company with a new product idea is more likely to have the idea stolen than become a market leader. A recent survey of Chinese software enterprises reports that more than one-quarter of respondents consider unauthorized copying, sharing and installation of software to be the most significant barrier to the industry's growth.

Software piracy is especially destructive in the consumer market. Enterprise applications that require large-scale implementation and training are less affected because they are more customized. This helps explain why software services currently occupy a greater share of the market than software products. Pirated software sales in China were estimated at $2.5-5.0 billion in 1999, compared to only $2.1 billion for legal software. In other words, a majority of the installed software base in the country is pirated software.

Table 6. Business Software Piracy Rates by Country, 2000

COUNTRY	*%*	**COUNTRY**	*%*
Vietnam	97	South Korea	57
China	***92***	Poland	54
Indonesia	88	Taiwan	52
Russia	87	Italy	46
Bolivia	81	South Africa	45
Thailand	79	France	40
Greece	64	Japan	38
India	62	Germany	23
Brazil	59	UK	22
Hong Kong	58	USA	21

Source: Access Asia, p56.

Piracy results, in large part, from the huge discrepancy between software retail prices and low household incomes. In Beijing, one of China's wealthiest urban areas, average per capita income is 19,500 RMB per year. The price of a desktop computer equipped with a Pentium III processor is 4,000-6,000RMB, and a desktop computer with a Pentium IV is 6,000-8,000RMB or more. Purchasing software packages at the official price soon makes these prohibitively expensive. The widespread availability of pirated versions of the leading software products means that virtually no individual consumers buy software at the official price. The limited sales revenues of companies like Microsoft suggest that many businesses select pirated alternatives as well. (See Table 7.)

Table 7. Software Prices in China

	MICROSOFT OFFICIAL PRICE	CHINESE COMPETITOR'S OFFICIAL PRICE	STREET PRICE FOR PIRATED VERSION
Operating System	Windows XP 1,498 RMB	Red Hat Linux OS 40-50 RMB	20 RMB
Office Suite	Office XP 3,930 RMB	Kingsoft WPS Office 2000 1,400 RMB	10 RMB

Source: Centre for the Future of China

Piracy forces domestic firms to compete by cutting price rather than by improving quality or features. A senior executive from Kingsoft reports that: "Each time we sell an authorized WPS copy, there will be 10 pirated copies. If there were only 9 pirated ones, our income would be doubled." In late 1999 the firm launched an “Authentic Software Storm” promotion in an effort to reduce piracy: the price of the Kingsoft bilingual and voice-enhanced translation-aid software package was cut 80% from RMB 168 (US$ 20) to RMB 28 (US$ 3.33.) Of course this type of price-cutting leaves minimal margins and undermines the ability of firms to invest in research or product development.

The Chinese government has repeatedly announced plans to crack down on software piracy. Most recently in 2000, State Council Document 18 outlined harsh penalties for piracy, including fines of 5-10 times the value of the pirated software and jail time and equipment confiscation for manufacturers. In some cases the penalty has included execution. Government official appear to understand the importance of intellectual property protection, particularly because they want to continue attracting foreign business. However it remains to be seen if these regulations will be adequately enforced. China's membership in the WTO should accelerate progress on formulation and implementation of intellectual property rights protection, but the backwardness of the legal system in China will continue to limit recourse.

5. Government as a Market

The government is one of the dominant paying customers of the Chinese software industry. Government ministries, agencies, and institutes at all levels procure software to support the goals of national industrial development as well as to improve their own productivity--and they are frequently urged to procure local rather than foreign-made software. Moreover resources remain heavily concentrated in the state sector. One Silicon Valley returnee who started an enterprise software company in Beijing puts it bluntly: "If you want to make big sales in China you have to be political. The telecommunications and finance (banking) sectors make up 50% of the IT budget in China and their structures still reflect the bureaucratic hierarchies of the planned economy. This means you are always dealing with the government."

Firms with good relations with the government are well positioned to get contracts. Government purchasing often takes the form of large-scale projects such as the central government's Golden Projects for Informatisation: Golden Card, Golden Bridge, Golden Custom, etc. and its more recently instituted E-Government programs. There are also a variety of city-sponsored "Digital City" or Information Port Programs that, in the large urban areas, provide huge software development contracts. And new generation of central government projects is also being developed as China prepares for the 2008 Olympics

games in Beijing: the "Digital Olympics" project, for example, should provide extensive funding for software as well as other IT firms.

While the government is generally seen as a good client in terms of technical competence, ability to communicate, cooperativeness, and ability to pay, most Chinese government agencies (like Chinese businesses) are technically unsophisticated and unable to articulate their requirements or specifications clearly. Government procurement can benefit an emerging industry under certain circumstances, but this role is regularly compromised in China by its other, often conflicting, roles. The strong desire among government officials, for either economic or security reasons, to create "national champions" leads them to invest heavily in domestic software companies, or to rigidly enforce purchasing fiats demanding that all departments and state-owned enterprises purchase Chinese-made components and/ or services.

In 2001, for example, the Beijing municipal government required that all its departments purchase WPS2000, a Chinese language office software package developed by a domestic firm KingSoft Co., rather than Microsoft Office2000--in spite of widespread agreement on the technical inferiority of the product. (WPS2000 is far less stable than Office and Kingsoft provides virtually no after service or customer support.) In 2002, following the lead of the Beijing, the Guangdong provincial government purchased over 4,000 packages of WPS2002 software for use in more than 40 departments and bureaus. In some cases, the government attempts to grow domestic competitors by subsidizing firms like Beijing-university spin-off Jade Bird continues to develop an indigenous database product to compete with Oracle and Sybase, or providing contracts to start-ups developing Linux software products.

Taking a still more aggressive stance, in early 2003 the State Informatisation Leading Group, an interagency group responsible for IT planning for China's central government, proposed procurement guidelines requiring all central and local governments to buy software from domestic vendors.[9]The guidelines require that all government purchases of foreign-made software gain approval from the Ministry of Finance on a case-by-case basis. These guidelines, would severely limit foreign software makers' access to the largest customer in China.[10] The proposal may not be enacted, and even if it is, it may not be well

[9] The proposal applies to all contracts from central and local budgets for E-Government, a multi-billion dollar initiative developed to upgrade the computer and communication networks of several key departments including the tax bureau and customs authority. At least 70% of the initiative's software budget would be earmarked for domestic products. In addition, 50% of most other kinds of government software would have to be purchased from Chinese companies. Matt Pottinger "Software Firms Face Setback in China" *The Wall Street Journal*, 3/7/03.

[10] The proposal apparently exploits a gray area in the WTO restrictions on laws giving domestic companies artificial advantage over foreign competitors (since government procurement contracts are not clearly covered under the WTO.)

enforced because of the inability of domestic software firms to meet government needs, however it exemplifies the capriciousness of the regulatory environment.

The administrative guidelines set by the Ministry of Information Industry (MII), purportedly to insure standardization and market regulation, also privilege state-owned enterprises and university-spin offs over their private competitors. All applicants for government and major SOE work are required to obtain a Certification of Capability and Quality. This Certification also establishes a firms' eligibility for the tax incentives and other promotional measures established for the industry. The standards for this certificate are based on traditional measures of scale such as number of engineers, total net assets, registered capital, and annual revenues, but have little to do with past projects executed or work process or quality. This makes if very difficult for private companies to actually (and honestly) meet the standards.

The few private software firms that have succeeded in China have exploited the government's preference for domestic products, whether for security or nationalistic reasons. UFSoft, Kingsoft, and Kingdee all developed an initial advantage by developing low-end copies, or Chinese variants, of Western software (so-called C2C or "Copy to China"), rather than on the basis of quality, technology, or service. Early access to the large and lucrative government market has positioned them well to tap other government and SOE clients, and the government in turn has a growing interest in their survival.

The "non-governmental" high tech spin-offs from government research institutes and university computer science departments (such as Founder, TOP, and Neusoft) have been heavily favoured in this environment. The founding university or institute, itself government-owned, already has well-established relations with the local governments and state-owned enterprises that helps them "compete for" government contracts. Most universities also own large businesses that require software, from publishing companies to restaurants. And most university spin-offs have little difficulty gaining access to bank financing, something that is not available to private firms. So at the same time that the government is radically restructuring the state-owned companies in traditional industries, it appears to be creating a new generation for the technology sector. See box on CS&S.

Building on government connections: Beijing UFSoft Group

China's leading producer of accounting and ERP software, UFSoft, was started by Wenjing Wang and Qiqian Su, both formerly employees of the Finance Department of the Government Office of Administration. It is the only private software company listed on the Chinese stock exchange. During the 1980s Wang oversaw development of the governmental accounting system and finance-related computer applications for all State Council affiliated institutions. Su was in charge of developing the standardized accounting forms that later provided the template for UFSoft accounting software products Wang's intimate knowledge of the market for financial software in China combined with Su's technical and product support capabilities enabled them to start UFSoft in Beijing in 1988.

The firm's first CEO, Xinping Guo, also had a government background. He reports that at his job at the Ministry of Finance gave him both deep knowledge of the status of computer applications in Chinese companies at the time and also invaluable government connections: "I was in charge of enterprise accounting information, which involved statistical analysis of data from 38,000 state-owned enterprises and 20,000 collectively-owned firms . . . Our government experience helped gaining users' trust quickly. We already had relationships with many potentially large customers [e.g. governments and state-owned enterprises] and this made it much easier for us to market our products, especially in the early stages."

UFSoft's marketing strategy reflects knowledge of the government market. According to Linjie Yang, a former UFSoft Marketing manager, the company has adopted the "top to-bottom" strategy: it starts marketing a new product by establishing a close relationship with the central government. Adoption by the central government in turn makes it easier to sell to local governments. Yang reports that: "About 95% of the central government departments in Beijing now use UFSoft products." The company has also established about 500-600 agents and 50-60 subsidiary companies throughout China, most of which have focused on building good relationships with the local government. According to Yang: "it is much easier to market software to local governments than the central government because usually only one person is in charge. In the central government you have to convince many different people."

The government still controls the market in several ways. Xinping Guo elaborates: "First, a software product must receive evaluation and approval from the Ministry of Finance before it can be marketed in the country. Second, 'market entering permission' is required before a product can be sold in local markets. So, for example, only three types of accounting software might be permitted in the Beijing market, even though some fifty financial software products are available in China.) A strong relationship with the government helps a lot for entering markets in other provinces and cities." Not surprisingly, UFSoft has developed China's most extensive and larges software distribution and sales network, with 60 subsidiaries, 60 customer service centres, 500 distributors, and 100 authorized training centres throughout China.

There are many domestic critics of government purchasing as a strategy to develop the domestic industry, both inside and outside of the Chinese bureaucracy. Zhibin Lai, Vice President of Beida Qiangfang, argues that substantial government investments in development of operating system and database software have had no public return: "In the process of investing, a lot of state assets have been visibly or invisibly transferred to these companies, which may produce no return at all." The central government has invested considerably into the development of Linux operating system, for example, yet after the market share remained 4.1% in 2002. Shaowen Su, general manager for a venture capital company in Hong Kong concurs: " China has no comparative advantage in developing Linux. How can Chinese companies compete with Microsoft Windows?"

The decentralization of economic policy in China could also undermine the impact of preferential procurement strategies. The growing autonomy of provincial governments to pursue independent development strategies has produced an intense process of inter-regional competition, particularly for technology development. The powerful Shanghai government, for example, continues to use Microsoft products. This does not mean, however, that they oppose preferential purchasing. The success of financial services firm Shanghai Huateng Software Systems Co appears to be the result of more than a decade of large-scale contracts from China Post and other government agencies.[11]

Government as both producer and customer:
China National Computer Software & Technology Service Corporation

China National Computer Software & Technology Service Corporation (CS&S) is a state-owned enterprise that was established in 1990 as a subsidiary of the China Electronics Corporation (CEC.) The company is based in the Zhongguancun Science Park in Beijing and it has more than 30 holding and share-holding companies that specialize in software and information product development, system integration, information service and software development outsourcing. The company's turnover in 2001 was 1.33 billion RMB and it had 2020 employees (80% with university degrees), making it one of the largest software enterprises in China.

CS&S has apparently achieved the status of a "national champion" that fulfils the administrative guidelines established by the government to qualify for the major government software projects. According to the company website: "CS&S was appointed by China's State Planning and Development Commission as China's North Region Software Base. CS&S is the only software company listed as one of the 520 National Key Enterprises since 1999 and it was the first software company to be classified as a Software Enterprise. CS&S obtained ISO9001 Certification in software development, systems integration, computer training, and software export. CS&S has been ranked as among the nation's Top 100 Electronic Information Enterprises for eleven consecutive years and was ranked 62nd in 2002. CS&S was the only systems integrator in China that obtained the National Systems Integration First-Level Qualification in 2000 and passed the national security-related Systems Integration Qualification for systems integration in 2002." www.css.com.cn/en/index.html

The company website lists 25 major customers; virtually all are large state-owned enterprises, including the State Taxation Bureau, Ministry of Finance, the People's Bank of China, Industrial and Commercial Bank of China, Huaxia Bank, People's Construction Bank of China, Huaxia Bank, Bank of China, Ministry of Railways, Civil Aviation Administration of China, State Education Commission, China Telecom, China Unicom, and China Offshore Petroleum Co.

[11] Huateng built the government's first Golden Card center (for IT banking), the Golden Card National Center in Beijing, and is the market leader in all Golden Card projects. It is also the market leader in the Postal Savings Banks' Green Card National Network, built the first bankcard Internet payment gateway in China, installed 16 bankcard Internet payment gateways for China Post's "E-Post" project, and provided the solution for China Post's E-Remittance system.

6. Relationship Marketing

The dominance of the government market, as well as the absence of the rule of law, is reflected in the pervasiveness of "relationship marketing" in China. The importance of connections in obtaining contracts from Chinese enterprises and government institutions is widely recognized. While policymakers are attempting to change this, especially in the newer technology sectors, software producers still spend far more time and energy building reputations and relationships than in the West. A Silicon Valley-based entrepreneur whose company provides content for the mobile Internet in China refers to this as the problem of "high transaction costs." He reports:

> For most of us doing business in China today, the biggest challenge is the time that we have to spend going to dinners and banquets, drinking, making friends, and building trust. The hard infrastructure here (like telecommunications and airports) works very well, but the soft infrastructure is still barely developed. If you can't depend on the legal system for remedies, you have to make sure that you trust your business partners, that you speak the same language and know one another well. And since there are no rules, we have to do business on a case-by-case basis, which means building trust on case by case.

The Chinese government's inner networks are maze-like in their complexity and there are issues that must be negotiated at municipal and provincial as well as central levels. Establishing and maintaining good government relationships is thus essential to getting anything done in the economy. As Yifei Chen, a Senior Researcher at the Beijing IT Industry Promotion Centre, puts it: "The so-called Chinese *guanxi* leads to unfair market competition. No matter what you want to do, there are always lots of realistic (sic) problems facing you, most of which require time-consuming coordination." (Chen, like many Chinese, uses the word 'coordination' to refer to the continuous wining, dining and relationship building that is required to solve the many problems that arise in the closed Chinese environment.) In the absence of transparency, stable regulations and the rule of law, there is no alternative.

Foreign and small firms face particular challenges in this environment. A senior manager from Oracle argues that it is critical for a foreign company trying to compete in China to recruit sales people with great care. The two criteria that Oracle uses in hiring for its sales and marketing team: (1.) the individual's capability, and (2.) the quality of his/her network of relationships. A strong relationship network, in his view, depends upon working experience either in related government sectors or for major customers in the target market (which themselves are likely to have strong government ties.) Another Overseas Chinese manager suggests that: “the main task for a marketing vice president in China is to deal with relationships. Marketing depends on *guanxi*.” Virtually every individual we interviewed in the software industry confirmed that sales in China depend on the

intensive-intensive process of building and maintaining relationships. Jian Zhang, a department manager of the CASS Information Systems Inc., a small firm from the Chinese Academy of Sciences, notes that small firms like his that have limited personnel and resources are greatly disadvantaged in this environment.

One indicator of the importance of personal connections in post-reform China is the experience of returnees from the US. Many of these entrepreneurs, coming from an environment where the quality of the technology and service are key to competition in the software industry, overlook this factor. Having spent more than a decade in the US most lack the personal connections needed to succeed in the Chinese business environment. In fact it does not seem accidental that the only clear successes among start-ups run by Silicon Valley returnees, UTStarcom and AsiaInfo, are those in which the founders have been able to build on pre-existing personal or family ties in top Chinese business and government circles. For a majority of returnees, however, breaking into the closed relationships of Chinese business remains a major challenge that demands both time and resources.

7. Government as Gatekeeper: Microsoft in China

The experience of Microsoft illustrates how the government continues to shape the Chinese software market without directly regulating it. Approximately sixty percent of computers in China run on Microsoft Windows, but piracy means that the firm's China revenues are less than 5% of what they would be if customers had paid for the software in newly sold computers (IDC). As a result Microsoft has not yet made money in China after more than a decade in the market. The firm's lawyers responded to this situation initially by suing Chinese computer makers as well as corporate users for piracy of its operating systems. However the immaturity of China's legal system meant that they had only limited success in the courts. Instead, Microsoft developed the reputation as a bully, a reputation that was reinforced by the US government's antitrust actions against the firm.

China's state-run newspapers reported in 1999 that several government departments had blacklisted Microsoft and that government officials preferred the Linux operating system to Windows. In 2000 the Ministry of Information Industry subsidized the Chinese Academy of Sciences to commercialise an operating system developed by Red Flag Linux, a Chinese Linux firm. A year later Microsoft lost out to a handful of Chinese Linux firms in bidding for a contract to supply software for the Beijing government. Soon many agencies, from the Chinese Post Office and National Statistics Bureau to the Ministry of Education, had adopted Linux-based systems. Linux controlled only 1.6% of the operating system market in 2001 but its share is expected to double by 2006.

In June 2002 Microsoft abandoned its legal strategy and began instead to invest in building good will with the Chinese government. This underscores the firm's determination to remain a player in China, even at the cost of continuing losses in the short to medium term. In an attempt to relieve concerns that the Windows operating system is not sufficiently secure for government use, Microsoft founder and CEO Bill Gates signed an agreement that gives the Chinese government restricted access to the source code of its operating system. This represents a rare concession from a firm that protects its intellectual property aggressively.

Microsoft also committed $750 million over three years to the development of the Chinese software industry in what amounts to a massive technology transfer scheme.[12] A Memorandum of Understanding (MOU) between Microsoft and China's State Development and Planning Commission (SDPC) states that this investment will be managed by a joint SDPC-Microsoft Cooperation Committee that is chaired by SDPC Minister Zeng Peiyan and Microsoft's Chairman Bill Gates. The MOU involves education and training, research cooperation, strategic investments, and joint ventures with local software companies. As part of this program, experienced Microsoft employees are now providing software engineering training, promoting basic research in computer science at universities, and establishing joint research labs at Chinese universities. The funds are also underwriting salaries for university faculty and fellowships for dozens of PhD computer science students annually. At the same time, in a high profile announcement, Microsoft became the first foreign corporation admitted as a formal member into the China Software Industry Association, itself a quasi-government organization.

Microsoft has already established two joint ventures with small local software firms. One is a 50% share of a software services company called Wicresoft--in partnership with Shanghai Allliance Investment--that will develop proprietary software applications for Chinese and foreign customers. Microsoft has already awarded a global outsourcing contract to Wicresoft to provide technical support for Microsoft Windows and Office. The firm hopes to serve other multinationals in China that want to outsource software development. The other joint venture, Censoft, with two publicly listed Chinese IT companies, will develop enterprise and government application software, provide system integration services for government departments and enterprises, and offer software outsourcing, training and consulting services. CENTEK, which holds 51% of the new venture, publicizes its "strong governmental background." In addition, Microsoft has agreed to open up seven more offices in China by 2005. The payoff for these investments appears to be a growing share of government contracts with agencies like China Telecom, the Public Security Bureau, the Ministry of Inspection, and the Port of Ningbo. However the real results may not appear for years. (Legard, 2002; Meredith, 2003)

[12] In addition to the $1 billion the company already spends on business and research in the country.

Technology-transfer: Microsoft's joint venture with Censoft Corp. Ltd

In 2002 Microsoft announced that it would pay $2.3 million for a 19% stake in the Censoft Corp Ltd., which has 150 employees in Beijing's Zhongguancun. Most of the companies top employees, including its CEO, have working experience at Microsoft- China and were recommended by the company; most, in fact, are returnees who were educated abroad and have only recently returned to China. These managers brought to Censoft the engineering techniques and the system for large-scale software development they learned at Microsoft--critical managerial know-how that was lacking in Chinese software industry. The Censoft CEO reports that they also learned a great deal from Microsoft about marketing, building sales in China, demonstrating a product to customers, and launching a product. The benefits for Censoft are clear: the company has won accounts for high-end enterprise applications software and consulting for major Chinese clients such as Huawei and the Bank of China. Their revenue of $20 million in 2003 makes Censoft the 31st ranked indigenous software provider in China; and the firm may well become profitable before Microsoft does in China.

This type of partnership is likely a far more effective mechanism for upgrading the Chinese software industry than most government research and procurement programs. In fact, Microsoft has already invested more than 1,200 hours in this intensive-intensive partnership. The gamble for Microsoft, that it will earn more business as a result of this project, appears to be paying off in contracts with government entities. Perhaps more important in the long run, Chinese software developers and customers will become hooked on Microsoft software and they will triumph as a defacto market standard.

SOFTWARE INDUSTRY LABOR MARKET

1. Labour Supply

The shortage of highly skilled software professionals is a concern for many software companies in China. The China Software Industry Association reports that there were approximately 330,000 professionally trained programmers employed in the industry in 2002, including 180,000 technicians. However the supply of university-trained computer and software graduates remains limited. Most Chinese universities do not have software programs or departments, so software engineers are recruited from Computer Science and Applied Mathematics departments. Approximately 37,000 students graduate annually from Chinese universities and colleges with Computer Science degrees; 50% have a software certificate and only about 5% have advanced (master's or doctoral) degrees (Ju, 2001.)

This compares poorly to the 60,000 graduates a year in India, a fact that contributes to the insecurity of Chinese policymakers at India's successful software outsourcing. Some scholars believe that China is short of “blue collar” programmers who could take on low-end programming jobs. Many industry representatives believe however that high-end talent is the most pressing need for the Chinese software industry. They claim that low-end workers can be recruited from universities and the real shortage is in high-level system architects and designers as well as project managers. University science and engineering programs in China continue to emphasize the traditional engineering fields rather than computer science. As a result Chinese software firms have even started to recruit workers

from India for these positions. If the lack of technical capabilities required for systematic analysis and design of software helps to explain the limited presence of Chinese firms in the international software outsourcing business, in spite of their relatively low wages, Chinese workers also typically lack the English language skills needed to communicate with customers and the connections to or knowledge of international software markets.

Wages for workers in the software industry are very low by international standards. The data suggest that Chinese software workers earn wages that are half of their Indian counterparts. There is also a fair amount of regional variation in China. In 2000, the yearly salary for a BA degree-holder in Computer Science was $7,300 in Beijing (North China), $6,000 in Shanghai (Southeast China), and $2,900 in Xi'an (Western China.)[13]

Table 8. Yearly salaries for Computer Science degree-holders, US dollars (2000)

	BA	MA	PhD
Beijing	$7,300	$14,500	$21,000
Shanghai	6,000	9,000	n.a
Xi'an	2,900	4,300	n.a.

There is intense competition for Chinese software developers, in spite of their relatively limited capabilities and work quality. This is reflected in very high turnover rates--as high as 20-30% annually, even in the leading firms. Some people in the industry deem high turnover as the biggest obstacle for further development, especially for small firms. This problem is magnified by the preference of Chinese workers for jobs in foreign companies or joint ventures, which pay higher salaries and offer the potential opportunity to go abroad. A study of employment flows in the software industry found that a majority of the employees of Chinese firms--whether state-owned, collectively-owned or private- moved to foreign firms or joint ventures or went overseas for additional training rather than moving to local firms, whether private or state owned (He, 1996). Finally, in spite of labour reforms in the mid-1980s that gave enterprises the right to lay off surplus workers, many Chinese software companies also have difficulty laying off employees because of the need to avoid causing the loss of “face” in relationships.

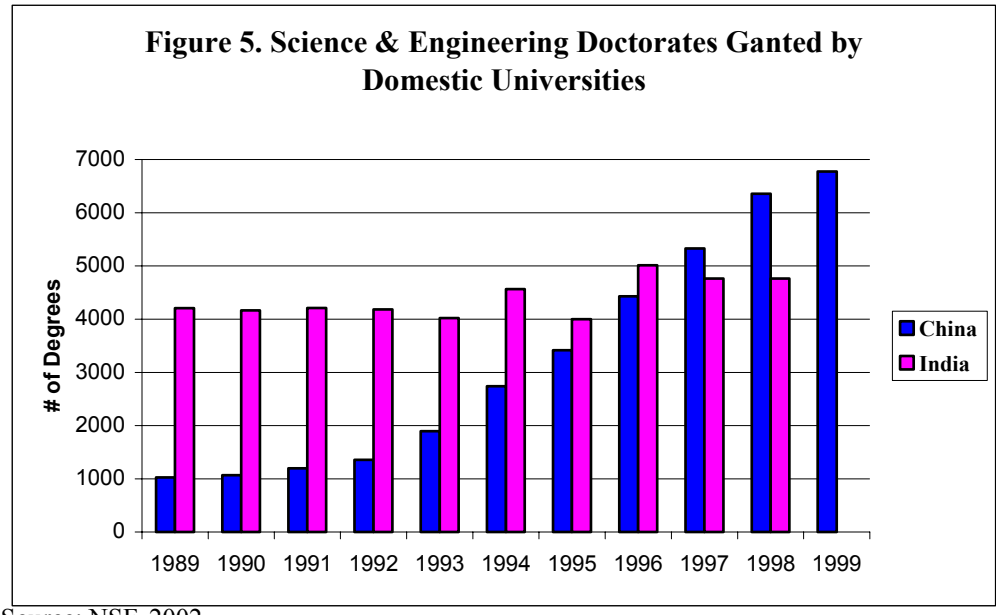
[13] This data is similar to that in a 2001 study by a US consulting firm, which reports wages in software industry in Shenzhen (Guangzhou province) as 3000 RMB/month for a junior engineer, 6000 RMB/month for a senior engineer, and 12,000 RMB/month for a department director. This amounts to average salaries of $4,400/year, $8,700/yr, and $17,500/yr respectively. The report estimates that Shenzhen wages are 70-80% of those in Beijing and Shanghai.

2. Education and Training

The Chinese government began to focus attention on software education with the industry's designation as strategic by the 10th Five-year Plan. The State Department of Education in 2001 authorized the launch of 35 model university-based Software Institutes, with financing from China's banks and domestic as well as foreign companies. The first six software institutes in Beijing are associated with the elite universities such as Peking University, Beijing University of Aeronautics and Astronautics, and Tsinghua University. They admitted approximately 5,000 students in 2002. In recognition of the limits of an educational system where memorization is the dominant method of learning, these institutes have developed are using international textbooks and a corporate management model. They are also free to offer courses and hire faculty based on market demand--unlike China's traditional, government controlled educational institutions.

This is an example of the ability of the Chinese government to redirect resources quickly and on a large scale. Another is the substantial increase during the 1990s in the number of post-graduate degrees granted in Science and Engineering fields (Figure 5.) Between 1995 and 2000 the number of S&E doctorates granted in China increased 240% from 518 to 1247. While these degrees were historically oriented toward traditional engineering fields, the field of Computer Science is gaining faculty and students fast. According to Professor Dehua Ju of East China University of Science and Technology, China has developed a "talent strategy" in which "software productivity and quality will be a national priority, with special stress put on such skill upgrading as process improvement, product management, quality assurance, and system analysis and design." (IEEE, 2001)

Figure 5. Science & Engineering Doctorates Ganted by Domestic Universities



Source: NSF, 2002

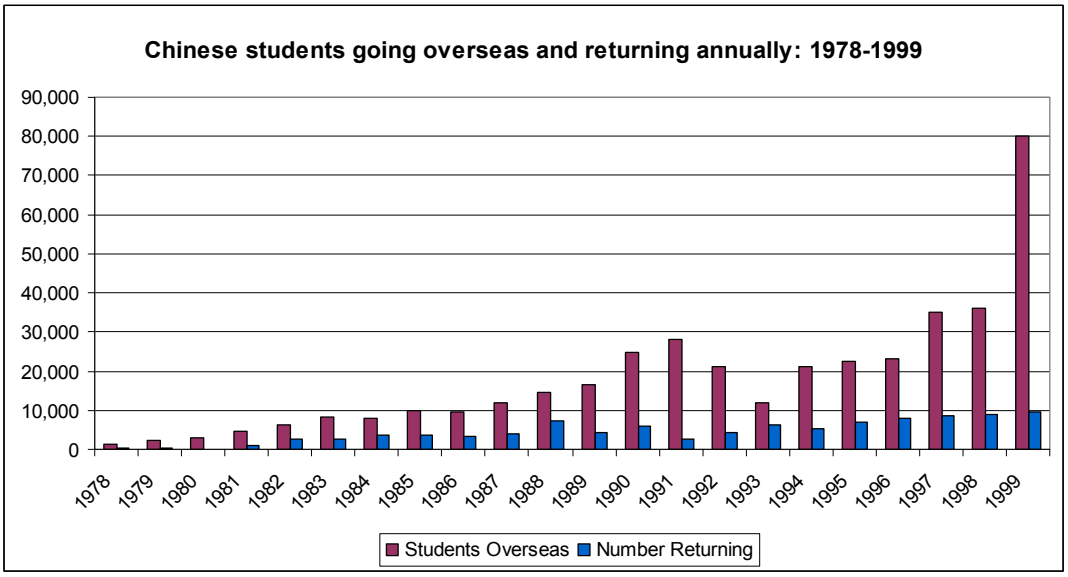
The market for IT training in China reached 560 million RMB (about US $68 million) in 2001, about one-quarter of which (US $16 million) is dedicated to software training. In an attempt to build domestic outsourcing capabilities, the government as well private firms are developing new software training and English language programs. Jade Bird, for example, established a software engineer-training program that attracted more than 12,000 trainees in 2001. Foreign corporations and educational institutions are also involved. Carnegie Mellon University has contracts with several large Chinese cities for training courses based on its Software System Development model. Indian IT training schools are also competing aggressively in the China market: NIIT has opened more than 100 branches in China; and Aptech has close to 90 along with a joint venture with the Chinese Ministry of Science and Technology.

3. Brain Drain and Brain Circulation

The brain drain is a serious problem for China's software and the IT industries. An estimated 30% of the computer science degree-earners from China's most elite universities such as Tsinghua and Peking University went abroad to pursue higher degrees in the 1990s. This represented a substantial increase over the prior decade. Figure 6 shows that in the 1980s only 3-5% of China's total postgraduate enrolment left annually to study overseas, but the proportion increased to 10-15% per year in the following decade. This amounted to an estimated total of 80,000 Chinese students studying abroad in 1999 (Guochu and Wenjun, 2001.)[14]

While accurate data on the number of Chinese students returning after graduation is difficult to find, most sources estimate very limited rates of return, particularly among those studying the United States (the dominant destination for Chinese postgraduate students.) Between 1978-1999, for example, one scholar calculates a 14.1% return rate from the US. Similarly an NSF study in the late 1990s found that 88% of Chinese S&T doctorates in the US reported that they planned to stay abroad (NSF, 1999.) The data in the table below, calculated for the OECD, provides the most reliable available estimate.

[14] Guochu and Wenju (2001) estimate that China has permanently lost 200,000 science and technology workers, which is equivalent to a loss of over RMB 40 billion in human capital investment. He calculates the investment by imputing a total investment of RMB 200,000 per student.



Source: China Statistics Yearbook, as reported by Guochu and Wenjun, 2001

Chinese provincial and central governments, recognizing the severity of the loss of human capital have meanwhile developed a range of programs that aggressively court talented returnees. The Chinese Academy of Sciences developed the "Hundred Talent Program," which offers scholars higher salaries than they might earn in the US as well as generous housing packages, extensive research funding, and research teams. (Anecdotal evidence suggests, however, that if these scholars return, they accept positions in multinationals or in local start-ups rather than in university or government research programs.)

Chinese policymakers have devoted substantial resources to promoting technical and business exchanges that involve overseas Chinese students. This typically involves events such as conferences, investigation tours, joint research projects, and exhibits. Such activities are designed to involve scientists and researchers, business people, and policy makers in cross-regional exchanges of know-how and information. They also provide opportunities for overseas mainland professionals to build relationships with their domestic counterparts. In some cases a local and central government agency will develop a program that directly funds such events, in others it will subsidizes non-government agencies and the private sector to sponsor such activities. In the late 1990s, Chinese policymakers, academic institutions and technology companies increased their commitment to improving external communications with the Overseas Chinese. They sponsored an increasing number of events and programs in the US, while also inviting Overseas Chinese academics and industry representatives to China to attend conferences and other events. In addition, the Ministry of Education established the ‘‘Chunhui Program’’ to finance short-term trips to China by Overseas Chinese who were trained abroad to participate in

technology-associated activities such as conferences, research projects or other authorized programs.

Government agencies in China also compete to recruit students to return home to start technology enterprises. Representatives of cabinet-level ministries as well as municipal governments from large cities such as Shanghai and Beijing as well as more remote Western provinces pay regular visits to Silicon Valley to encourage Chinese technology professionals to return home. The visiting Chinese officials usually hold dinners or meetings with Chinese community and use the occasion to publicize the favourable policy and business environment in China. Many municipal governments have established "Returning Students Venture Parks" within the Development Zones of High & New Technology Enterprise. These parks are exclusively for enterprises run by returnees, and in addition to the infrastructure and financial benefits available in all science parks, they seek to address special needs of returnees such as accelerating bureaucratic processes involved with establishing residency or insuring access to prestigious primary and secondary schools for their children (See recruitment email from Suzhou as an example.)

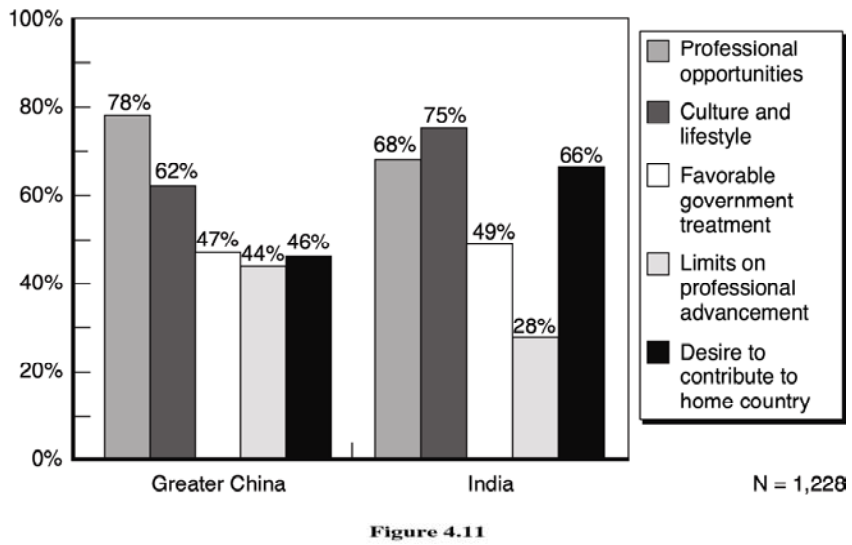
Distributed electronically to Bay Area China Network (8/11/98) with subject heading:
A Great Business Opportunity for You
Sponsors:
Chinese Scholarly Exchange Service Centre, Ministry of Education
Torch Program Office, Ministry of Science and Technology
Jiangsu Service Centre for the Shift of Qualified Personnel
Jiangsu Science and Technology Commission
The Administrative Committee of the Suzhou New Technology District
Suzhou Science and Technology Commission
Location:
The Park is located in the Suzhou New District (Suzhou National New & High Technology Industrial Development Zone) to the west of the old city proper of Suzhou. The district is only 80km away from Shanghai and 1.5 hour drive from Shanghai Hongqiao Airport.
Mission:
To create a favourable environment for exploitation of research results and development of small and medium-sized technology based enterprises by providing all around service and quality facilities
Target clients:
Technology-based companies and research institutes run by students and scholars studying or working or returned from abroad
Incentives for tenants:
-Three year refund of business tax starting the first day of operation
-Three year-refund of the local part of VAT
-Exemption from income tax in the first two profit-making years, six-year reduction of the rate by 50% that and then levied at a special rate of 15% for the next three years
-Minimum registered capital of US$10,000 provided for technology consultancy or service provider, US$60,000 for manufacturing enterprises
-Application priority for different-level grants and funds
-Application priority for certificate of new & high technology product/enterprise
-Building management and business services
-Free provision of registration formalities
-Provision of advice on policy and technical issues
-Business promotion
-Assistance in obtaining financing and refunds of duties
-Provision of training programs

Progress to date:
A news conference was held in Beijing this February to declare the establishment of the Park. The six sponsors have jointly set up the Torch New & High Technology Investment and Guarantee Company and registration is now underway. The company is not-for-profit and will specialize in venture capital and credit guarantees for tenants of the park.
Building:
The park owns one four-story building with floor space of 10,000 square meters. It hosts 88 units ranging from 20 to 100 sq meters. Services and facilities include the following:
-Conference room with conferencing facilities
-Seminar room
-Product display chamber
-Internet access, central air conditioning
-Reception
-Fax, typing, word-processing, and photocopying services
-Air ticket booking, hotel room reservations
-24-hour security services
Applicants and companies:
Til now, the Park has received more than 50 applications and 30 of them are in operation. Business of theses companies mainly covers electronics, biotech, mechanics (sic), computer software, and environmental protection. Presidents or managing directors of these companies have studied in U.S.A., Japan, France, and U.K.
China Suzhou Pioneering Park for Overseas Chinese Scholars invites you to apply today.

It is difficult to determine whether such policies contribute to individual decisions to return. Anecdotal evidence suggests, however, that a growing number of Overseas Chinese have returned in recent years--lured by the promise of lucrative market opportunities and pushed by the economic downturn in the US. Many are accepting jobs at multinationals with China operations; others are returning to start businesses or to work for businesses started by other returnees. It is likely that these returnees will become an important source of technical and managerial skill for the Chinese software industry in the coming decade.

In a survey conducted from May to July 2001 in Silicon Valley, 43 percent of the highly skilled respondents from Mainland China reported that they would consider returning to live in China in the future. When asked to identify the factors that would influence their decision to return, the great majority (78%) ranked “professional opportunities” as "very important" (these factors were ranked between 8-10 on a ten point scale with 10 as most important.) followed by considerations of “culture and lifestyle.” They ranked other factors such as favourable government treatment or the experience of barriers to professional advancement in the US significantly less important (Figure 6.)

Figure 7. Factors ranked "very important" in decision to return to live in country of birth



Source: Saxenian, 2002

There is ample evidence of "brain circulation" as well. A small but significant proportion of Chinese technical professionals in Silicon Valley report that they regularly exchange information about jobs and technology with friends and colleagues in China, travel to China for business purposes, advise and help establish business contracts with firms in China, and invest in start-ups based in China. A majority of those who have been involved in starting new companies also report establishing business operations in China, particularly marketing and sales as well as hardware design and manufacturing, R&D, and software development and services. These operations are concentrated in the main East coast cities, especially Shanghai, Beijing and Shenzhen/Guangzhou.

The survey sought to determine the likelihood of return entrepreneurship to China. When asked what factors would figure most importantly in their decision to start a business at home over 50 percent of Mainland Chinese respondents listed access to the market, the availability of skilled workers, and access to capital as the key factors. Conversely, when asked about problem areas that would deter them from starting a business in China, the factors most frequently mentioned were: (1.) government bureaucracy and regulation, (2.) an inadequate legal system, and (3.) political or economic uncertainty. In short, while the domestic market and skill base will continue to attract entrepreneurs in software and other IT-related fields, the institutional and political environment will likely remain a significant barrier for decades.

OWNERSHIP AND MANAGEMENT

1. Ownership in Transition

Transformations in enterprise ownership in China have outpaced those in other elements of the economic infrastructure. The introduction of non-governmental, or collective-ownership (university spin-offs) alongside state-ownership in the 1980s was followed in the 1990s by the sanctioning of private ownership of enterprises. However the institutions necessary for a system in which private enterprises compete on equal terms with other enterprises remain underdeveloped. China's financial markets and regulatory system, in particular, still favour firms that are either government-owned or that are strongly connected to the government through personal and business relationships. The absence of the rule of law leaves little recourse for those who lack such connections.

Currently 30% of the software companies in China are state-owned, 27% are Sino-foreign joint ventures, 20% are collectively owned (university spin-offs), 17% are private, and 6% are foreign-owned. These distinctions are often blurred. State-owned and collectively owned enterprises both involve substantial government involvement in management as well as finances. Foreign companies often prefer joint ventures with these enterprises precisely because they provide access to the government relationships that are essential to doing businesses in China. And the private software companies that are most successful in China have succeeded on the basis of strong government relationships.

In 2000 Tsinghua Tongfang Software Co., a spin-off of Tsinghua University, became the first Chinese enterprise to allow employees to buy shares in the company. The company's research employees now own 8% of the RMB 50 million (US $6.02 million) software company's capital. According to the company's Chairman, Sun Jianguan: "We want to make it easier to translate research results into products and profits." This recognition of the importance of researchers' knowledge as intangible assets and the role of incentives in motivating the workforce represents an important development in China. There are few models in China for creating an environment that provides incentives to attract and retain skilled employees--something that is critical in the software industry.

The increasingly flexible forms of enterprise ownership in China appear to have provided sufficient incentives for managers and employees to invest their time and resources to grow viable software businesses. It is worth underscoring, however, that ownership patterns do not appear to be a significant constraint on growth because domestic firms are primarily developing low cost local variants of foreign products or providing customized services uncompetitive state markets. However the lack of a reliable legal system, and in particular the failure to protect intellectual property rights, will increasingly undermine efforts by

Chinese firms to become technologically innovative because it limits firms' investments in research and new product development.

Neusoft Group: Growth by Building Reputation and Alliances

Shenyang Neu-Alpine Software Co. Ltd. was established in 1993 as a joint venture between China's Neusoft Co. and Japan's Alpine Electronics to develop car navigation and audio systems. In 1996 it became the first specialized software developer in China to be listed on the Shanghai Stock Exchange. Neusoft Co., a spin-off from the Software Development Centre of China's North East University developed the software solutions for the business and is the largest shareholder (35%) along with Japan's Alpine Electronics (China), Co. Ltd., which manufactures and distributes automobile navigation and audio systems (25%). Neusoft Group Ltd. is now the largest publicly listed software company in China with sales of $134 million and more than 4000 employees in 2000.

As with most large Chinese IT companies, there is a complex set of relationships between the university, the provincial government, state-owned enterprises and the central government. Professor Jiren Liu from the Computer Science Department at North East University (NEU) in Shenyang, Liaoning Province was the founder of the NEU Software Centre in 1990. He is now the CEO and Chairman of the Board of Neusoft Group. He is also the Vice President of Northeast University. His biography notes that he has engaged in 46 national projects and has been awarded more than 30 other government projects and that he is a Member of the National People's Party Consultative Committee.

Professor Liu founded the NEU Software Centre in 1990 and the State Planning Commission named it as the first National Engineering Research Centre for Computer Software in 1993. In the decade following its founding Neusoft was selected to participate in all of the major national research programs in China including the National Torch Project, the National 863 Program, the National Ninth Five-Year Plan projects, the National High-tech Industrialization projects, and so forth. The firm also received honours including being named the Software Industry Base for State Torch Program, an "Elite Enterprise" for the national software industry base, an Achievement Industrialization bases for State 863 Program, a National Trial Enterprise for Technology Innovation, etc.

Neusoft's national reputation improved after China's leading steel maker and one of its largest SOEs, Shanghai BaoSteel Group Corp., made a large investment making it a 50% owner in Neusoft Group in 1998. A year later, Jiang Zemin, General Secretary of the Communist Party of China and President and Chairman of the Central Military Commission of the CPC made a high profile visit to Neusoft Park and praised its achievements. China's Premier Zhu Rongji in turn visited in 2000 and Hu Jintao, then Vice President and Vice Chairman of the Central Military Commission of the CPC, visited in 2002. According to the company's website, Neusoft's 10th Anniversary celebration in Shenyang was attended by "more than 1600 people, including officials from state, province and city government, as well as representatives of 400 key enterprises in China, representatives of global renown (sic) enterprises as well as Neusoft employees."

Neusoft has built important local alliances: it joined with the Liaoning Science & Technology Venture Capital Co, Ltd. to establish the Liaoning Oriental Information Industry Venture Capital Co. in 2000; and it invested in the Neusoft Institute of Information Technology as well as a series of Institutes of Information Technology in other locations including Dalian, Nanhei, and Chendu. Neusoft's most significant domestic partnership, however, may be the cooperation agreement announced in late 2002 with Legend Group, to jointly address the fields of social insurance and medical insurance by combining Legend's line of computer storage products with Neusoft's system integration capabilities in order to provide high quality customized solutions at low cost.
Neusoft continues to grow its international alliances as well but its exports remain low ($14 million in 2000.) In 2001 the US software company, Computer Associates (CA) invested $65 million to establish a strategic partnership with the Neusoft Group, and took a seat on the Board of Directors. Neusoft also established Neusoft Japan and Neusoft USA in the same year. Neusoft's website also reports strategic partnerships with companies such as Sun, Cisco, Nokia, and IBM. The 2002 announcement that Neusoft had formally achieved SEI-CMM (Capability Maturity Model) Level 5, becoming the first Chinese company to be certified CMM5, suggests that it has been using its international connections to improve its software development process and capabilities.

continues…

One of Neusoft's most distinctive achievements is the development of a line of innovative digital medical imaging devices, including CT scanners, X-Ray, ultrasound, and MRI products. The firm developed capabilities in embedded software during the 1990s and saw an opportunity to link its own imaging software and Intel microprocessors to digital sensors. Neusoft went on to develop and manufacture multipurpose scanners. The firm has had great success selling its products to Chinese hospitals because they are substantially less expensive and also more flexible than the specialized X-Ray, MRI, ultrasound and CT scanners made by leading medical electronics companies in the West. Having developed a large-scale market in China, the company is now well positioned to expand to the global market.

Source: www.ufsoft.com

2. Management Models and Experience

The lack of managerial experience and models for software development is one of the most significant weaknesses of China's software industry. Very few managers have experience in a market economy and most of the software developers in China are young and inexperienced. There are few role models for either group. As a result, there is a proliferation of small software enterprises in China that have had no exposure to process management models or systems integration. Zhibin Lai of Beida Qianfang claims that most things are done haphazardly in Chinese software firms: “Strictly speaking, there is no real management at all for most firms, especially the small ones.”

It is thus perhaps no surprise that Chinese firms have failed so far to achieve the level of quality and reputation associated with successful outsourcing in India. There is little evidence of the ability to organize large scale, complex software projects involving the development of separate but linked modules by multiple development teams A 2001 article in *IEEE Software* reported that the average yield of a software developer in China was about $25,000/year, or roughly 1/7 to 1/8 of that of their Western counterparts. This may be partly related to low labour costs, however it is likely due as well to inadequate management skill and organization.

The continuing quality gap between Western and Chinese software is one indicator of the immaturity of the industry. Specialists agree that most Chinese software is of poor quality and does not function well: the original source code is rarely maintained, upgrades (when the exist) often do not work as promised, and patches are not available. Chinese firms have also paid very little attention to marketing and customer service. Documentation is recognized in the West, for example, as an essential tool in software development. By recording and explain their work in detail, software developers can identify and correct problems in a timely way. The documentation process also provides a way to minimize the costs of employee turnover because the documentation belongs to the employer not the programmer. According to Shelby Chen, a venture capitalist who splits his time between Beijing and Silicon Valley, software engineers in the United States typically spend 70% of

their working time on documentation, while engineers in Chinese firms devote virtually no attention to the documentation process.

Chinese software firms typically lack the knowledge or resources needed for managing human resources as well. The President of KingSoft Co, Bojun Qiu, believes that the greatest challenge in running a software company in China is learning how to motivate and retain talented software developers. He says that programmers, unlike sales employees who respond bonuses or higher salaries, require more than financial incentives and deadlines: "You cannot be too strict because programming is an innovative job. You cannot force them to finish programming in a certain number of days . . . We are still in the stage of experimentation . . . It is easy for a big international company who adopts some software engineering process to invest a few hundred people to develop one product. We cannot afford that. We often have to ask one person to do what really requires a whole team."

Faced with competition from the Indian software industry, Chinese software companies have started to apply for the Carnegie-Mellon capability maturity model (CMM) certification. Government agencies are also beginning to provide financial incentives for software companies to engage in these CMM-based evaluations. The Shanghai Software Quality Consortium was established in 2000, for example, to promote software process improvement. In December 2002, Neusoft Co. became the first Chinese enterprise certified CMM Level 5. However most Chinese firms dramatically underestimate the extensive resources and commitment required to achieve these quality management standard--and the industry as a whole is likely to remain behind India and the West in the short run. The limited capabilities of Chinese software developers suggest that most firms will have difficulty competing with foreign companies in global software markets, and that the main market opportunity for these enterprises, at least in the near-term, will remain systems integration for domestic customers.

SOURCES OF CAPITAL

The immaturity of the Chinese financial system reinforces the advantages of state and collectively owned companies in the software industry--and limits the growth of their non-state counterparts. A 1999 survey conducted by the World Bank's International Finance Corporation reports that 80% of Chinese private sector companies believe the lack of access to financing has constrained their growth (IFC, 2000.) The great majority of software enterprises, like all other private enterprises in China, are self-financed because they lack access to bank loans or capital markets. There is a strong bias among bankers in China against lending to private enterprises largely because it is far more risky than investing in state-owned enterprises. According to Central Bank data, in 1999 less than 1% of all working capital loans went to private companies, and these were likely not to local private firms but rather to joint ventures with foreign private companies (Studwell, 2002.)

This problem is particularly acute in software because the banks have virtually no credit analysis capabilities, and in any case prefer to invest in businesses with physical (as opposed to intangible, intellectual) assets.

Software enterprises with close government ties, by contrast, have little trouble gaining access to funding from the state-owned banks that control 65% of the banking sector assets in China. This includes both state-owned enterprises and collectively owned, university spin-offs like Neusoft, Founder, and Legend. It also appears to include the few firms, such as UFSoft and Shanghai Huateng, that have gained the status of "national champion." Ironically, this means that in spite of their lack of technical capabilities or commercial track record, state-owned or collectively owned enterprises have become one of the most important sources of funding for software start-ups in China because of their privileged access to capital either through venture capital arms (e.g. Legend Capital and Neusoft Venture Capital) or through the financing of subsidiaries or spin-offs.

The Chinese stock market in turn is organized to provide capital for the continued expansion of state-controlled companies. The government approves the list of companies that can raise equity on the public markets, and in 2002 only a handful of over one thousand companies listed on the Shanghai and Shenzhen exchanges were private companies. It took four years of intense lobbying for UFSoft, China's market leader in accounting software, to be publicly listed on Shanghai's main board because of Chinese regulators' reluctance to approve a privately owned firm. UFSoft remains the only private enterprise among the 13 software firms listed on the Shanghai and Shenzhen exchanges.

Venture capital (VC) has been an important mechanism for financing new technology ventures in the West, but it is rarely an option for software companies in China. The Chinese central government has aggressively promoted the development of the industry for over a decade, but local and provincial governments have become the key players in the business. The first VC firm in China "China New Technology Venture Investment Corp." was established as a limited corporation in 1985 by the State Science and Technology Council and the Ministry of Finance. The fund was declared bankrupt and closed by the People's Bank of China in 1997. This did not stop local Science & Technology Commissions and Finance Departments from setting up their own VC firms during the 1990s. There has been ongoing study and analysis of the Western experience, and growing sophistication at all levels. The challenge is that the government needs to lead in the creation of VC in order to induce private investors (who in China remain extremely risk averse); however the very involvement of the government has undermined the incentives needed for true VC.

By 2000 there were 160 domestic VC firms in operation in China with a total of over 43 billion RMB under management, along with 50 foreign firms. While domestic VC firms are organized differently (by local governments, universities, and enterprises) virtually all of the capital in their funds comes from the public sector. However government financing systematically undermines the financial incentives required to encourage fund managers to make truly high-risk investments, particularly in private enterprises. Nobody loses their job by investing in an SOE--even if it is a bad loan; however a bad investment in a private firm could be very costly. As one Silicon Valley-based entrepreneur who has advised the Chinese government on developing the VC industry notes: "Venture capital fund managers in China have nothing at stake in the success of their ventures. If they are honest they will take no risk at all; if not, they take advantage of the opportunity to make under-the-table deals with entrepreneurs." Another claims that most VC in China is simply a new form of job creation for local governments.

Most of the fund managers in China have no technical or business understanding of the software industry, they lack procedures for objectively evaluating potential projects and ideas, and they have no ability to raise funds outside of the government sector. Moreover, there is little understanding in China of corporate governance. As a result, while the Chinese venture capital industry has funded many domestic software firms, the funds have typically generated no return at all. And as in most of the rest of the world, the dot-com crash has slowed investments considerably and there have been no new VC firms created since 2000.

Growing interest in China from foreign investors has created pressure for reform to improve the environment for equity investments. In 2001 the government issued a notice announcing that foreign companies would be allowed to set of wholly-owned or Sino-foreign cooperative ventures capital firms in China.[15] There were also regulatory changes targeted at the VC investments in technology firms including: reduction of minimum levels of capital invested, establishment of a preferential tax regime (10%) for venture capital investors, and recognition of the limited liability partnership structure that is common to many venture capital funds in the West.[16] However the failure to specify

[15] Foreign VC firms are not, however, allowed to invest in securities, futures or other financial markets as well as real estate and other industries that are not open to foreign investment. They are also not allowed to make loans or underwrite or invest with borrowed money (CIEC, 2001.)

[16] Chinese Company Law limits the amount of an enterprise's registered capital that could be granted for the contribution of intangible technology to a maximum of 20%. This limit has been abandoned in practice but not yet in regulations.

The Chinese government in the late 1990s planned a second board in Shenzhen, modeled after NASDAQ, for high risk, high return companies. However the anticipated opening in 2000 was delayed following the US stock market crash and remains delayed indefinitely.

restrictions on the qualifications for the general partners in a limited liability partnership, it is likely that many more venture capital firms in China will fail to earn returns.

International investors remain reluctant to finance start-ups in the Chinese software industry, however, for two reasons: (1.) the scarcity of local ventures with viable business plans and technical and managerial talent, and (2.) the absence of viable exit strategies, since access to the Chinese stock market is impossible for these firms. Equally important, the RMB is not convertible, so there is no (legal) way to get earnings out of the country. Foreign investments in joint ventures with Chinese enterprises have, since 1980s, grown as an alternative source of finance for a small number of Chinese software companies. One popular strategy for foreign investors today is to finance IT start-ups that are incorporated abroad, e.g. in Silicon Valley, and leverage the technical skill in China for research and product development. This minimizes their exposure to the arbitrariness of China's legal and financial institutions, while allowing them to take advantage of its large, very low cost supply of technical talent. In the process they are developing more sophisticated software engineering and development capabilities in China that should contribute to the long-term development of the software industry.

The underlying problem of the Chinese financial system, which affects the entire economy, including software, is the overwhelming burden of the non-performing loans (NPL) that in 2002 accounted for 50% of total banking sector assets.[17] This problem, combined with the lack of sophisticated financial management skills, suggests that it will take at least a decade to reform China's financial system. The development of a healthy financial system will, of course, also require a reliable and well-functioning legal system.

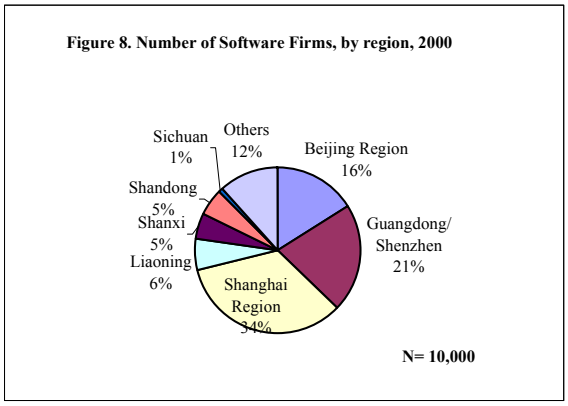
REGIONAL DIFFERENTIATION AND THE SOFTWARE INDUSTRY

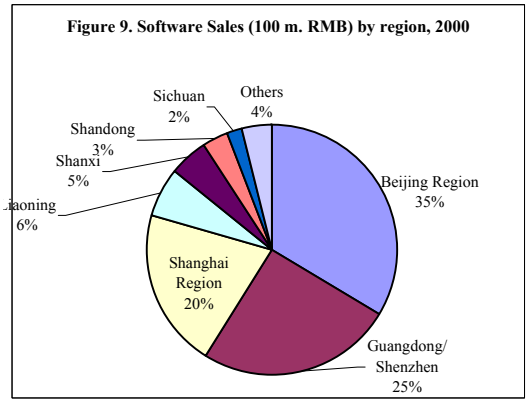
The growing disparity in the business environments in different regions of China is a striking aspect of the economic transition. While the country has always been diverse, the decentralization of government authority and increased administrative autonomy of city and provincial governments has resulted in substantial differences in resources, regulations, and performance across China. The uneven geographic distribution of the software industry reflects these differences.

Software firms and employment in China are heavily clustered in Beijing, Shanghai and Guangdong regions along the eastern coast of China. These three urban areas alone account for 80% of total software sales. It is worth noting, however, that only 16% of the firms are located in Beijing, but they account for 35% of software sales; conversely 34% of the firms are located in Shanghai but they account for only 20% of sales. The dominance of Beijing

[17] The total cost of cleaning-up the NPL problem, according to Standard & Poors, amounts to $700 billion, or about 50% of China's current GDP.

in software likely reflects the concentration of human capital as well as the presence of both city and central governments--and their heavy investments in the development of the IT infrastructure.





The leading research institutes and elite universities in China are located in urban areas on the Eastern coast. This contributes to the disproportionate concentration of technical skill and research. Beijing, for example, is the home of 68 universities, 260 research institutes, and one-third of the employees of the Chinese Academy of Science. State funding for R&D goes overwhelmingly to five coastal provinces: Beijing, Shanghai, Jiangsu, Guangdong and Shandong provinces. Even then, it is highly focused. For example, Peking University and Tsinghua University in Beijing alone received about 3.6 billion RMB in government research funding, or more than half of the total of 6 billion RMB allocated for the promotion of excellence in elite institutions in 2000. Jiaotong University, the top university in Shanghai, doubled the number of graduates between 1995 and 2000 and tripled its total research funding to 300 million RMB. Other provinces such as Shanxi, Shandong and Liaoning (home of Neusoft) have successful software firms that are closely linked to local universities and/or research institutes. The concentration of technical skill, research, and university connections in these coastal cities contributes to external economies and a self-reinforcing process of increasing returns, as software firms benefit from the pooling of managerial and technical skill and know-how as well as the benefits of connections to universities or research labs.

In recent years these agglomerations have been strengthened by the growing concentration of the market, including high tech businesses and the urban middle class, along the coast. These regions have become wealthiest urban centres in China. If they were separate nations they would each have GDPs ranking among the top ten in Asia, and ahead of Singapore, Malaysia, and the Philippines. See Table 9.

Table 9. GDP ($ Billion) in South and East Asia 2001

South Korea	457
Taiwan	310
Yangtze Delta (Shanghai)	**234**
Hong Kong	163
Northeast Tristates	**119**
Pearl River Delta (Guangzhou)	**116**
Beijing Area	**112**
Shandong	**104**
Singapore	97

Source: Ohmae, 2002

Chinese policy-makers have designation of development bases, parks, incubators, and zones in their efforts to promote new technology industries is the. Appendix A provides a map of the 53 National High Tech Industry Development Zones in China. The total R&D investment in these 53 high-tech parks grew dramatically in the 1990s, from RMB 15.2 million in 1992 to RMB 230.8 million in 1999 (Ministry of Science and Technology, 2001.) These parks, however, include all businesses that qualify as high technology. The Torch High-Tech Industry Development Plan also developed 14 state-level Software Parks during the 1990s. By 2002, however, China had a total of 48 software development parks dispersed widely around the country.

In 2001 the Ministry of Information Industry announced a plan to re-centralize resources in the software industry in hopes of enhancing competitiveness. They have identified 10 National Software Industrial Bases located in Beijing, Shanghai, Dalian, Chengdu, Xi'an, Jinan, Hangzhou, Guangzhou, Changsha, and Nanjing. These 10 areas will receive preferential policies including venture capital funding, support-services, and assistance being listed on the stock exchanges. This represents part of an effort to reinforce the existing concentration of IT-related industries in the urban centres in the Eastern and Middle regions of China, and should reinforce the already existing agglomeration of the software industry along the coast.

THE FUTURE OF THE CHINESE SOFTWARE INDUSTRY

China’s software industry is still in its infancy. It lacks technical skills, experience, management know-how, and the capital market, legal protections and transparency that will allow software enterprises to take risks, invest, innovate, and become global actors. The goals of the post-1978 reforms--to shift from a planned to a market economy--remain only partially accomplished. Two non-market factors, government and *guanxi*, will continue to

affect most aspect of the software business until policymakers address the real challenges facing the software industry, including the need for greater transparency and regulatory consistency, effective financial market regulation, the rule of law and protection of intellectual property rights.

There is also no doubt that China's software industry will continue to grow rapidly. The government's large-scale investments in R&D, education and training, and improvements in the physical infrastructure have already contributed greatly to economy and will increasingly benefit the software industry, as will its huge supply of low cost skill. The state has also been very effective in channelling multinational investments into beneficial relationships with local companies by taking advantage of their desire to gain access to the China market. The level of technology and know-how transfer occurring through joint ventures as well as in the research labs and training programs set up by foreign firms is already quite high. The Intel China Software Lab, for example, has over 90 engineers engaging in state-of-the-art software for applications ranging from DSP/Multimedia products, device drivers, signal integrity technology, etc. There are unique opportunities in developing application software and embedded software for the sophisticated IT hardware manufacturing capabilities that have developed in China over the past decade, including the recent expansion of IC and high end laptop manufacturing.

Chinese companies are rapidly expanding their foreign connections in part to enhance their management and process capabilities. The telecommunications equipment company, Huawei, has invested over $60 million in a 3-year old software development centre in Bangalore India. The company plans to increase local employment from 600 to 900; with the overwhelming majority being Indian engineers who receive training in China. While Neusoft was the first Chinese company to achieve CMM Level 5, it is likely that many more will follow in the near future. Chinese bookstores in major urban areas are filled with management books, and there is a level of focus and motivation among workers that is easily visible to outsiders. The recession in the US combined with a high degree of nationalism appears to be triggering a accelerating reverse brain drain of highly educated Chinese engineers from the US and elsewhere. The success of Legend Computer in dominating the Chinese PC market suggests that domestic firms will be advantaged as well by their local market knowledge and connections.

Visitors to China are regularly impressed by the sophistication of the government officials--many of whom speak fluent English, have travelled extensively abroad, are open to outside view, and are articulate about the challenges facing the corporate and financial sectors. The Chinese Software Industry Association, for example, a government-sponsored approved association of software companies, is engaged in a wide-ranging set of ambitious

activities and experiments aimed at accelerating the development of the industry[18] Visitors who return regularly are also amazed by the pace of change at every level in Chinese society and economy. This makes it very difficult to look into the future with any certainty: China is changing very fast, and also very unevenly, and there are too many political as well as economic factors at play to say much more than there will be continuing change.

1. The Impact of Entry into the WTO

Since entering the World Trade Organization China has taken steps to liberalize its information technology (IT) sector, including the software industry. This liberalization is a double-edged sword: on one hand has increased the presence of foreign competitors in the Chinese software market, but on the other it should help address some of the constraints on the growth of domestic producers as well. According to the US-China agreement there are now no restrictions on foreign commercial presence in providing consulting services related to hardware installation. Foreign services providers are also be allowed to provide software implementation and data processing services in the form of a joint venture. Starting in January 2001, foreign companies were also allowed to establish joint ventures with majority share to provide computer maintenance and repair services.

China's WTO commitments required that after January 2003 wholly foreign owned enterprises be allowed to enter the Chinese IT market. In addition, foreign personnel, certified engineers or bachelor degree holders with three years experience will be allowed to provide software services. And China will phase out all software tariffs by the end of 2003 according to the WTO Information Technology Agreement. Foreign suppliers will also be allowed to provide software support services and have more freedom in establishing service centres. This should increase the competitiveness of foreign software vendors in China. However software sold in China must also meet the standards set by the Chinese Platform Standard Committee, which also approves the sale of software in the domestic market. Foreign companies often need to modify their software products in order to meet these local requirements.

Piracy is a major concern of foreign investors in China's software industry. The protection of intellectual property rights has achieved several milestones since 1991, starting with the implementation of the Copyright Law, followed by China's joining the world community in upholding the Berne Convention and the World Copyright Convention. The opening of the

[18] These activities include sponsoring symposia that bring together government officials, experts, scholars, and representatives of firms and other institutions to discuss shared challenges, such as the availability of capital for startups. They also run international software exhibitions, help promote brands and brand names, survey the market, promote international exchanges and cooperation, conduct training, formulate industry standards as well as rules and regulations, and promote software exports. See www.csia.org.cn

Software Registration Centre under the administration of the National Copyright Administration has normalized copyright enforcement in China.

China has also agreed to abide by WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights to achieve better enforcement of IPR protection. In May 1999, the State Council issued a notice to all government organizations urging them to use only licensed software. Recent reports suggest that the central government plans to begin a nationwide inspection to enhance awareness of protecting copyrighted software in governments. "Those found using pirated copies will be severely punished," according to Xu Chao, Deputy Director-general of the Department of Intellectual Property Rights under the general Administration of Press and Publication (GAPP). The GAPP, the State Development Planning Commission, the Ministry of Finance and the Ministry of Information Industry have required all government departments to take the lead in using authorized software.

Some who do business in China also report that the true value of the WTO is that it provides an excuse among reformers in the government to undertake far-reaching changes. Others believe that its main value is to provide the perception of China's competitiveness even if there is a tendency among regulators to follow the letter rather than the spirit of their WTO commitments.

2. Trends in the Chinese Software Industry

This report suggests four distinct--and not necessarily incompatible--trends that are likely to shape the development of the Chinese software industry in coming decades. There is evidence of each of these trends and, while all coexist in China today, they each support different dynamics.

2.1 Government-led development

It seems clear that the government will continue to play a dominant role in the Chinese software industry, both as a customer and as a promoter, investor and regulator. The central government has made several major purchases in recent years in order to support the development of domestic software products. It will likely continue to make large investments in software research, concentrate these resources leading companies, and then enforce purchasing fiats demanding that government departments and state-owned enterprises buy Chinese-made components and/or services. The vision underlying in this behaviour is that Chinese software companies will be able to first replicate and then improve upon other people's ideas--much as Japan did with VCR technology in the 1960s and what Microsoft did in the '80s with the user friendly Macintosh Graphical User Interface and Operating System.

2.2 Software services outsourcing

Many government officials would like China to follow the model of Indian software outsourcing and leverage its abundant pool of cheap programming talent and growing English language capabilities to provide software services for global corporations. China has already attracted a handful of Indian software companies to locate in urban centres like Shanghai and Beijing. Over time they might induce these companies to make large investments and to outsource their cheaper work to China. This would support the development of management and technical capabilities in the Chinese software industry, while allowing India to focus on higher value-added activities. China's leading telecommunications equipment vendor, Huawei, already has a software centre in Bangalore that employs some 400 Indian programmers. However Indian companies possess what Chinese software firms will continue to lack for a long time to come: excellent English language skills; the ability to conduct business with Western clients in their cultural idiom; an established pipeline of clients; and an internationally acclaimed reputation for trustworthiness, reliability, and credibility as a provider of skilled services. Moreover, the existence of a big domestic market means that China will never simply follow India's software offshore development strategy; but this trend could help China adjust its current completely domestic concentration.

2.3. Foreign investors as partners and mentors

Foreign information technology companies, attracted by the large local market and the pool of low cost skilled researchers and programmers, are a fast growing presence in China. Multinationals like Microsoft, Oracle, Adobe, IBM, Lucent, and Intel all have software and computing related R&D centres in China. Many have entered into joint ventures with local Chinese companies as well. These firms work primarily on high-quality, large-scale software projects that are not appropriate for the domestic market. However as they continue to attract the top computer science and programming talent from domestic software firms, and as they accumulate first-hand knowledge of the local market, they could become formidable competitors in the low-end software market. These joint ventures and R&D centres could also serve as training grounds for a future generation of Chinese software entrepreneurs and managers.

2.4 Brain circulation and industrial upgrading

There are hundreds of thousands of foreign-educated Chinese technical professionals living and working abroad. The global recession in technology industry combined with China's continued robust growth has been responsible for a growing number of Overseas Chinese returning to China (or moving to China for the first time in the case of thousands of

Taiwanese.) These returnees bring with them the skills, knowledge and contacts they have developed in the West. They also often bring a much needed, first-hand understanding of Western business practices, as well as a more finely tuned, quality oriented mindset. That, coupled with their ability to speak both English and Chinese, along with their understanding of local Chinese business practices, should allow software firms to make themselves attractive candidates for Western outsourcing contracts. The growing brain circulation between Silicon Valley and major metropolitan areas such as Beijing and Shanghai in China suggests the increasing importance of this group of people, as does the growing number of returnees starting software and other technology businesses or setting up business operations in these urban areas.

APPENDICES

A1. National High-Tech Industry Development Zones in China

Zhongguancun Science Park	Weihai Hi-tech Industry Park
Shenzhen Hi--tech Industry Park	Qingdao Hi-tech Industry Park
Guilin Hi-tech Industry Park	Yangling Agriculture Hi-tech Park
Chengdu Hi-tech Industry Park	Xiangfan Hi-tech Industry Park
Kunming Hi-tech Industry Park	Suzhou Hi-tech Industry Park
Urumqi Hi-tech Industry Park	Hangzhou Hi-tech Industry Park
Jilin Hi-tech Industry Park	Foshan Hi-tech Industry Park
Anshan Hi-tech Industry Park	Guiyang Hi-tech Industry Park
Shijiazhuang Hi-tech Industry Park	Lanzhou Hi-tech Industry Park
Jinan Hi-tech Industry Park	Guangzhou Hi-tech Industry Park
Zibo Hi-tech Industry Park	Harbin Hi-tech Industry Park
Luoyang Hi-tech Industry Park	Xiamen Hi-tech Industry Park
Wuhan East Lake Hi-tech Industry Park	Mianyang Hi-tech Industry Park
Nanjing Hi-tech Industry Park	Changsha Hi-tech Industry Park
Changzhou Hi-tech Industry Park	Daqing Hi-tech Industry Park
Fuzhou Science Park	Shenyang Hi-tech Industry Park
Haikou Hi-tech Industry Park	Tianjin Hi-tech Industry Park
Huizhou Hi-tech Industry Park	Taiyuan Hi-tech Industry Park
Zhangjiang Hi-tech Industry Park	Weifang Hi-tech Industry Park
Xi'an Hi-tech Industry Park	Zhengzhou Hi-tech Industry Park
Zhuhai Hi-tech Industry Park	Baoji Hi-tech Industry Park
Chongqing Hi-tech Industry Park	Hefei Hi-tech Industry Park
Zhuzhou Hi-tech Industry Park	Wuxi Hi-tech Industry Park
Baotou Hi-tech Industry Park	Nanchang Hi-tech Industry Park
Changchun Hi-tech Industry Park	Zhongshan Hi-tech Industry Park
Dalian Hi-tech Industry Park	Nanning Hi-tech Industry Park
Baoding Hi-tech Industry Park	

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NAME	COMPANY	DATE
Kaimeng Huang	China Office, Adobe Systems Incorporated	Jan. 3, 2002
Hui Luo	Ministry of Science & Technology, China	Jan. 3, 2002
Zhibin Lai	Vice President, Beida Qianfang, Beijing	Jan. 4, 2002
Jianguo Yang	IT Director, Transportation Planning Institute,	Jan. 4, 2002
Jijun Shi	Vice President, Digital Wangfujing, Beijing	Jan. 7, 2002
Tiyan Shen	Assistant Professor, Peking University	Jan. 7, 2002
Shaowen Su	General manager in PRC, Asia Cyber Republic	Jan. 8, 2002
Shelby Chen	Founding partner, NorStar Ventures Beijing	Jan. 8, 2002;
Yun Cao	Group Project Manager, Datang Telecom, Beijing	Jan. 8, 2002
Min Luo	Software Engineer, Basic (GIS software firm),	Jan. 8, 2002
Yifei Chen	Senior researcher, Beijing IT Industry Promotion	Jan. 9, 2002
Jianmin Wu	Administrative officer, Beijing IT Industry	Jan. 9, 2002
Daliang Zhou	Marketing manager, EC-Founder, Beijing	Jan. 11, 2002
Wufeng Cao	Software engineer, EC-Founder, Beijing	Jan. 11, 2002
Brian Yu	New Alliance Consulting Intl., Beijing	Jan. 13, 2002
Ning Cao	Senior Business Development Manager, Asia	May 18, 2002
Frank He	SuperTechSystems, Inc. Chairman	May 28, 2002
Linjie Yang	Former UFSoft Marketing manager, still related	June 9, 2002
Cheng Gai	Zhongguancun Administration Commission,	June 10, 2002
Jian Zhang	Beijing Software Engineering Centre, CAS;	June 11, 2002
Mingming Xie	President, Soft Tech Development, Inc. USA	June 11, 2002
Min Wu	Project manager in a Singapore company	June 15, 2002
Xinping Guo	CEO of UFSoft (till 2002), Beijing	June 20, 2002
Ziqiang Cheng	CEO, UF Global Resources, Shanghai	June 25, 2002
Spencer Loh	President & CEO, Shanghai Huateng	June 27, 2002

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