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September, 2004

In September of 2004, we visited Shanghai, Suzhou and Beijing, China to continue our ongoing research on the IT industry and IT policy in China.¹ Our focus was on notebook computer manufacturing shifting to China, and more broadly on trends in the IT sector. We met with industry managers, government officials, academics and industry analysts. The picture that emerged is large, complex and changing rapidly, and is of course only a part of the much broader transformation of China's economy. We found a continuing economic boom, evident in the soaring skyline of Shanghai, the massive industrial parks of Suzhou, and the thickening traffic of Beijing. In an experience more reminiscent of California, at least two people mentioned that the homes they had recently purchased were already worth twice what they paid for them—perhaps of sign of prosperity or maybe a warning of a real estate bubble.

Computer production

China's production of computers has grown at an extraordinary pace for the past decade. In 1995, China produced just \$5.6 billion worth of computer hardware. By 2003, China produced \$59 billion, passing Japan as the number two computer manufacturer (Table 2). China is forecast to replace the U.S. at the top of the list in 2004.

Table 2. Worldwide computer hardware production by location

Country	1995	2000	2001	2002	2003
United States	76,284	90,430	73,865	65,0010	66,301
China	5,600	27,500	34,900	45,400	59,023
Japan	72,678	65,129	49,086	41,232	41,644
Taiwan	16,007	27,211	22,063	24,269	26,211

Source: Reed Electronics, 2004.

However, this does not mean that Chinese companies are becoming major computer manufacturers. Instead, most of this output is the product of multinational computer makers

¹Acknowledgements: We are grateful to the companies and individuals who gave their time and provided insights to us during the two weeks of interviews in China. We do not name them as we promised confidentiality to individual respondents. We are also grateful to the Sloan Foundation for support of the Center. For our previous research on China, see:

- Jason Dedrick and Kenneth L. Kraemer (1998), *Asia's Computer Challenge: Threat or Opportunity for the U.S. and the World?* (New York: Oxford).

- Kenneth L. Kraemer and Jason Dedrick (1995) "From Nationalism to Pragmatism: IT Policy in China," *IEEE Computer*. 28(8) August.

- Kenneth L. Kraemer and Jason Dedrick (2002), "Enter the Dragon: China's Computer Industry," *IEEE Computer*. 35(2) February.

and especially Taiwanese companies, which are using China as a low cost manufacturing platform for global markets. On this trip, we investigated one large segment of the industry that has recently shifted much of its production to China: the notebook PC industry. We visited five major Taiwanese notebook manufacturers in the Yangtze River delta of eastern China, which includes the Shanghai and Suzhou metropolitan areas.²

Notebook PC industry

The global PC industry has long relied on Taiwanese original design manufacturers (ODMs) to manufacture, and increasingly to design and develop, notebook PCs. As early as 1995, Taiwanese companies accounted for 27% of world notebook production. By 2003 this figure topped 60%, when the top ten Taiwanese manufacturers produced over 23 million of the 39 million notebooks sold worldwide (Table 1).

The ODMs have continued to upgrade their production capabilities, and now many offer build-to-order production for worldwide markets. Some also offer warranty repair and other customer services as well as product design and development. It is possible for a PC vendor to outsource the entire process of developing, manufacturing, delivering and servicing notebook PCs to an ODM, although the larger vendors remain closely engaged in design and development, and closely monitor quality control and customer service. The only capabilities the ODMs do not have are in the areas of sales, marketing and distribution. This provides a clear division of labor, and ensures that ODMs are not seen as potential competitors by their brand name customers.

Leading customers of the Taiwanese ODMs include all the major OEM notebook vendors. The largest ODMs have 5-8 of the top ten notebook vendors as customers, while the larger vendors spread production among two or more ODMs. Some vendors, such as IBM and most Japanese companies, only outsource certain product lines, while others outsource all of their production.

Table 1. Top 10 Taiwanese notebook manufacturers

Name	2003 volume (thousands)	Major OEM partners
1. Quanta	8,500	Gateway, Dell, HP, IBM, Apple, Sharp, Sony, Fujitsu-Siemens (F/S)
2. Compal	6,000	Dell, HP, F/S Toshiba, Acer
3. Wistron	2,500	IBM, Dell, Acer, Hitachi, F/S
4. Inventa	1,800	HP, Toshiba
5. Arima	1,500	NEC, Gateway
6. FIC	1,500	NEC, Legend
7. Asus	1,500	Epson, Canon, Sony, Apple, Trigem
8. Mitac	1,100	Sharp, F/S, NEC, JVC
9. Uniwill	1,000	Clone, F/S, Actebis, Samsung
10. ECS	1,000	Apple
Total	23,900	

Source: Taiwan Ministry of Economic Affairs, 2003

² In the future, we will prepare a report on what we learned from these companies in more detail and share it with them for comment before making it public.

Taiwan's computer makers and other electronic companies began moving production offshore in the early 1990s in response to rising land and labor costs in Taiwan. While some production went to southeast Asia, Europe and elsewhere, most went to mainland China, including desktop PCs, monitors, motherboards, keyboards, cables and connectors, and passive components. However, Taiwanese firms were forbidden by the Taiwan government from doing final assembly of notebooks in China. A few ODMs skirted these regulations by manufacturing subassemblies in China and shipping them to Taiwan or elsewhere for final assembly. When the government restrictions were finally lifted in 2001, the ODMs moved en masse to the mainland.

Interestingly, all of the major notebook ODMs bypassed the established electronics industry cluster in Guangdong province and located in the Yangtze River delta, specifically the Shanghai and Suzhou areas.³ There they found an amenable location for Taiwanese managers to live, good schools and universities, an educated work force, export processing zones, industrial parks with good physical infrastructure, and access to international air and sea cargo via Shanghai. Local governments also provided various incentives and have worked with firms to solve problems such as speeding up customs processing and training workers with needed skills. The area also had a good supply chain, as many suppliers had already moved there, and others were quick to follow their ODM customers. One government official claimed that 88% of the parts needed for a notebook PC are now manufactured in the Suzhou region.

We visited several major ODMs in the area, and got a first-hand view of their operations. They are all located in large industrial parks, complete with worker housing and other living facilities created by either the company or local government. Companies we interviewed said they hired operations workers as well as engineers from all over China. There is a good supply of most skill levels needed, but turnover rates are high, as firms try to hire experienced workers from each other. In particular, it was said that large multinational firms come in to China and try to ramp up quickly by hiring experienced workers, and are able to offer higher pay than Taiwanese firms can afford. At the operator level, most of the workers are young women who generally stay only a few years before returning to their home towns to marry.

One company commented that the working style in China is totally different from Taiwan. In Taiwan, they feel they can trust people to follow the processes they have set up so the company doesn't need to do routine checks on them. In China people are less conscientious, so they have to be monitored more closely. In Taiwan they have a shop floor system that gives a lot of flexibility to managers to make decisions. In China they've had to modify the shop floor system so there is little or no flexibility, and usually only Taiwanese managers have authority to make significant decisions.

Partly as a result of this perception, most of the key positions in these facilities are held by Taiwanese managers. A single company may have hundreds of Taiwanese living and working on site. These may initially be one or two year placements, but many Taiwanese have moved their families to Suzhou or Shanghai, which suggests a longer term relocation.

³ The Suzhou metro region includes Suzhou city, Kunshan and Wujiang, all of which are home to major ODMs.

The ODMs are being squeezed hard by PC vendors to lower costs as notebook prices fall rapidly. There also has been overcapacity for notebook production as investment ran ahead of demand. Survival depends on winning contracts, but pricing too low has resulted in disastrous losses for some ODMs. One top manager asked us directly, "Can you tell us how we can survive in this environment?" Yet this is not so different from ten years ago when more than one Taiwanese firm told us "We're all killing ourselves to make money for Microsoft and Intel." Somehow, they have survived, and *Business Week* this year included two Taiwanese companies (Quanta and Hon Hai) in the top 5 spots of its IT-100 list. It appears that the larger ODMs, Quanta and Compal are increasingly dominating and gaining economies of scale. For the smaller players, consolidation would appear to make sense, but Taiwanese companies historically have rarely engaged in merger and acquisition activities, so an alternative route for smaller competitors might be a shift of focus to other products and technologies.

Industrial parks and regional economic development

Developing industrial parks and attracting foreign investment to fill them is a key economic development strategy for many regions of China. There are four national and 11 local parks in the Suzhou area alone.⁴ In Suzhou city we visited two huge industrial parks, Suzhou New High-Tech Park (SND), which is run by the local government and Suzhou Industrial Park (SIP), a joint venture of the Chinese and Singaporean governments. In addition, we visited Kunshan's industrial park.

SIP was originally 65% owned by the Singapore government and 35% by the Chinese government, and for a long time the Singaporeans complained about competition from SND, which attracted more investment throughout the 1990s. However, in 2000, the ownership ratio was reversed, and since China has been the majority owner, SIP has grown rapidly. SIP is being developed as a complete city which could reach 600,000 in population, situated alongside the existing city of Suzhou. It will be complete with industry, housing, commercial real estate, hotels, recreation, shopping, and a large lake. In this case, the industrial piece of the development seems to be dwarfed by the larger real estate project. However, without the industry, the rest is probably not economically viable, so the park continues to pursue manufacturing investment. Currently, there are about 400 Taiwanese companies in SIP, equal to the number in SND. Overall, there are 5500 Taiwanese companies in the Suzhou region, including 1500 electronics companies.

There is aggressive competition for foreign investment among the industrial parks of the Suzhou region, as well as with Shanghai, Guangdong and other parts of China. Various incentives are offered. The central government can offer a two year corporate tax holiday, followed by a 50% discount the next three years. Local governments offer land, housing, infrastructure, worker training and other benefits. While investment continues to flow in, it is possible that lower value manufacturing will begin to move elsewhere in China, to take advantage of cheaper land and incentives offered by the Chinese government to encourage development in western China. Perhaps anticipating this, Suzhou and Shanghai are shifting their focus towards attracting higher value semiconductor and LCD fabrication, and Shanghai is emphasizing software as well.

⁴ National industrial parks are larger and can offer a wider range of incentives to companies.

A different type of industrial park is the Zhongguancun technology park in Beijing, which we also visited. The focus here is more on attracting R&D centers and software companies. Many foreign companies are visible, but the largest tenant is local PC vendor Lenovo, whose name is prominent on numerous buildings in the park. A large software industry section is being built to attract more foreign firms and provide incubation for domestic software companies.

IT Policy

China's government has been promoting IT production and use since the mid-1980s, through support for domestic companies, infrastructure investment, incentives to attract foreign investment, and R&D efforts. Currently, policy seems to be focused on developing domestic technologies and standards, as well as continued promotion of domestic firms. At a strategic level, semiconductors and software are considered the two pillars of the IT industry.

Software

Both the central government, and local governments such as Beijing and Shanghai, are promoting the software industry through measures such as funding for software startups and software incubators. Both have attracted foreign software companies, but their activities are generally limited to product localization and customer services. One exception may be Microsoft, whose R&D center in Beijing is touted as doing more advanced work. Still, much of the foreign software activity is probably aimed at cultivating good relations with the government more than for economic reasons. Local software companies are mostly small and few have developed commercially successful packages.

One policy that has caused some concern is a requirement that Chinese government agencies purchase Chinese-made software. This is aimed at helping domestic software firms, but the problem is that there is no clear definition of "Chinese-made" software. Does it have to be owned by Chinese companies, or does it have to be developed in China, or simply localized by foreign firms in China? One interviewee suggested that the government leaves such ambiguity intentionally, and that the law will serve as a starting point for negotiation with foreign firms.

IT services

In addition to software, China also is hoping to develop an IT services industry, following in India's path to become an offshore outsourcing location. In fact it has even attracted a few Indian IT companies to test the market. However, China's lack of English language skills tends to negate the value of its large engineering work force. Also, Chinese firms have no experience in the U.S. or other foreign markets, and thus have not worked with clients on the front end of an IT services contract, i.e. business process requirements, system architecture and system design. For now, the hope is to become a low cost coding and maintenance location, but for this to happen, bridges will have to be built to foreign markets.

According to CCID Consulting, the domestic IT services market grew 26% in 2003, reaching nearly \$7 billion. The fastest growing area is in network services. Traditionally, Chinese firms

have been cautious about outsourcing IT services, but as firms become more focused on their own core business activities, they are more willing to purchase IT services.

Intellectual property rights

Piracy remains a serious concern of software vendors, and is a major barrier to the development of a packaged software industry. While the government has tough anti-piracy laws and has conducted publicized crack-downs over the years, the Business Software Alliance still reports a piracy rate of over 90% in China. This discourages local firms from developing new software, and also creates a dilemma for foreign vendors who want to establish themselves in the fast-growing Chinese market, yet may find that their biggest competition is illegal copies of their own software. One solution that some interactive game companies have tried is to sell a low-priced version of their game without the software key that allows users to play online. The hope is that some will pay extra for the key, while others will be restricted to playing only with others on a local area network.

One surprising finding was that some PC vendors may be encouraging piracy while technically offering legal software bundled on their machines. Some vendors sell PCs pre-loaded with DOS, which is a cheap legal operating system, but which cannot run modern PC applications. This lowers the selling price of the PC, but would seem to invite customers to replace the operating system with a (probably pirated) copy of Windows.

Open-source software

The Chinese government has established a policy of promoting open source software as an alternative to proprietary, and usually foreign software. In fact, China's latest five-year plan is said to mention Linux specifically. It is believed that open source offers China an opening into the software industry that is currently dominated by Western firms. The government promotes open source through its own procurement rules, which require open source in some purchases. It also has backed a local company, Red Flag Linux, which was spun out of the Chinese Academy of Sciences, and is now the top Linux distribution in China. Red Flag has worked with partners in Japan and Korea on Asianux, a common Asian language platform for Linux, and has based the latest version of Red Flag Linux on Asianux.

Actual use of open source is growing on the server side, especially in government, although it was suggested that some agencies may purchase hardware with Linux, but then remove it in favor of Windows. As for Linux on the desktop, there have been few Chinese applications that run on Linux, so penetration is very low. However, there are now various office, e-mail, multimedia and browser applications available, which may encourage use. The local open source community is said to be very small and isolated from the international community. In spite of the nascent nature of the open source market in China, it may be providing leverage for the government, which has negotiated with Microsoft for that company to turn over some of its source code to the government.

Standards

In recent years, China has begun to experiment with creating national standards for several IT and electronic products. Some of these have attracted international attention, as they have been opposed by foreign firms and governments. One example is in DVDs, where Chinese manufacturers created the Enhanced Versatile Disc (EVD) standard in response to a royalty dispute with Western companies that nearly destroyed China's DVD industry. However, in spite of the government's seal of approval, EVD has been slow to catch on in China, and is unlikely to be adopted as a global standard.

Another standards battle that grew into a serious international dispute involved wireless networking standards. The Chinese government said that the international wireless 802.11 standard had security holes and announced it would establish its own incompatible security standard called WAPI. To sell in China, foreign companies would have to comply with the standard, and also would have to work with licensed Chinese partners, requiring them to give those partners access to detailed product blueprints. Intel balked, and announced it would not make its wireless Centrino chips for notebook PCs available under those conditions. The U.S. government became involved, and after eight months, the Chinese government "indefinitely postponed" (but did not revoke) the WAPI regulations.

A third standards issue involves third generation (3G) mobile phone standards. There is a worldwide standards competition between WCDMA (favored by major European manufacturers) and CDMA-2000 (favored by CDMA inventor, Qualcomm). China has now added a third standard to the mix—TD-SCDMA, a standard supported by Siemens and by local Chinese companies. The government has not licensed any 3G networks yet, and may license carriers to develop mobile networks on any or all of these standards. Again, there is little apparent interest in TD-SCDMA outside of China.

So far, efforts to develop domestic standards have had limited impact, but if the government begins to move more aggressively in this direction, it could be a major concern for foreign companies in the Chinese market. The need to develop separate product lines based on incompatible standards would put outsiders at a competitive disadvantage in the local market. However, the impacts for China could be even more serious. Chinese firms would be able to compete in the domestic market behind the invisible barriers of incompatible standards. But they would be unlikely to succeed outside their home market if they have to develop separate products for export based on global standards.

A better standards strategy for China might be to use the weight of its large and growing market to influence global standards decisions in ways that are favorable to it. For instance, it can encourage adoption of open standards over proprietary standards to reduce the royalty burden on its domestic companies and allow them to develop their own technological competences within open technology platforms. It also can promote use of innovative IT applications that fit domestic needs, as a way to encourage technology vendors to use China as a test-bed for new standards. In general, strategic engagement is more likely to succeed than isolationism in the standards world.