

# China's Industrial Policy in Relation to Electronics Manufacturing

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## Abstract

*China has become the biggest exporter of electronic products in the world. Government policy intervention has contributed significantly to the rapid expansion of the electronics industry. The present paper examines the evolutionary development of industrial policies related to the electronics industry in China and the impacts of such policies on the shaping of the industry. In particular, the relationship between foreign funded enterprises and domestic firms are examined in detail. The future trend of the industry is also discussed in the paper, and the policy focus of the Chinese Government is predicted.*

**Keywords:** China, electronics industry, industrial policy  
**JEL codes:** F14, L52, L63

## I. Introduction

China's electronics industry has been growing explosively since the 1990s and has gained increasing significance in world trade. In 2004, China surpassed the USA to become the biggest exporter of electronic products. In 2005, China became the second largest producer of electronic products in the world. There are many factors leading to the dynamics of the

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industry. Growing consumer demand and continued growth in the export-led sector have provided favorable market conditions to fuel the growth in electronics manufacturing in China. Government policy intervention has contributed significantly to the rapid expansion of the electronics industry. In the present paper, the development of the electronics manufacturing industry in China is reviewed, industrial policies and trade and investment policies related to the sector are examined, and policy implications in regards to technological progress, competitiveness of national firms and market penetration by foreign firms are analyzed. Section II includes a brief review of the development of electronics manufacturing in recent 10 years. In Section III, the evolutionary policy environment of the electronics sector in general and of sub-sectors in particular are analyzed, and policy effects on the sector's development are estimated. A summary and conclusion are presented in Section V, and some recommendations for China's electronics industry are provided.

## **II. Overview of the Development of Electronics Manufacturing in China**

The electronics sector discussed in this paper is electronics manufacturing, excluding software. There are four sub-sectors of electronics manufacturing: telecommunication equipment, computer and peripheral equipment, consumer electronics (audiovisual equipment) and electronic components.

### **1. Growth of China's Electronics Industry**

China's electronics industry has been experiencing explosive growth since the mid-1990s. The total output of the electronics industry expanded from RMB253.6bn in 1995 to RMB2723.64bn in 2005, a more than tenfold increase in a decade. Added value of the electronics industry increased from RMB63.5bn in 1995 to RMB583.9bn in 2005.

The significant contribution of the electronics industry to China's overall economic development is reflected by the much higher growth of the electronic sector compared with the national GDP and the manufacturing sector. In 1995, added value of the electronics industry accounted for only 1 percent of GDP and 5 percent of manufacturing added value, respectively. By 2005, the figures had increased to 3.2 percent and 10.2 percent, respectively.

The rapid development of the electronics industry has been firmly supported by expansionary capacity of supply and strong market demand. The investment flows into the electronics industry at an increasing rate. In 1997, the fixed assets of the industry had risen by 8.66 percent from 1996. In 2000, the figure climbed to 26.26 percent, and further increased to 89.16 percent in 2005. As a result of the accelerated rate of new investment, the total fixed

assets of the electronics industry rose from RMB110bn in 1997 to RMB622.9bn in 2005.

Market demand for electronic products has remained very strong in the past 10 years. The sales value of the electronics industry increased from RMB243bn in 1995 to RMB2698bn in 2005, a more than tenfold growth in a decade.

## 2. Structural Changes in China's Electronics Industry

The output structure of the electronics industry has gone through remarkable changes since the mid-1990s. The share of consumer electronics has declined, whereas the share of computers and related equipment has increased (Table 1). Although the shares of telecommunication equipment, electronic apparatus and components have changed slightly, some products within these sub-sectors have recorded rapid increases in output. For instance, mobile telecommunication and terminal units have rapidly increased in number, and integrated circuits have also experienced faster growth than the industry's overall growth rate. As a result, their shares in total output have both improved.

## 3. Regional Distribution of China's Electronics Industry

Regional distribution of China's electronics industry has become increasingly concentrated in the eastern coastal area, whereas the share has been continuously shrinking in the central and west of China. In 1995, central and western China accounted for 18 percent of the added value of the electronics industry, and the east accounted for 82 percent. By 2004, the figures have changed to 6 percent and 94 percent, respectively. The changing regional distribution pattern reveals a strengthening trend of clustering of the industry, with cooperators and competitors locating densely in an area to take advantage of linkage and spillover effects. The Yangzi River Delta, Pearl River Delta and Bohai Ring area are the three areas where the electronics industry is most densely located. In 2005, these three areas

**Table 1. Structural Changes in China's Electronics Industry (1995–2005)**

Year	1995		2000		2005	
	Output RMB (bn)	(%)	Output RMB (bn)	(%)	Output RMB (bn)	(%)
Electronics industry	253.61	100.0	765.83	100.0	2723.64	100.0
Telecommunication equipment	60.56	23.9	217.87	28.4	578.55	21.2
Electronic apparatus and components	70.76	27.9	200.09	26.1	719.77	26.4
Household audiovisual equipment	61.60	24.3	145.88	19.0	301.43	11.1
Computers and related equipment	35.45	14.0	167.70	21.9	1057.59	38.8

**Source:** National Bureau of Statistics of China (2006).

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accounted for over 80 percent of the electronics industry in terms of employment, sales value, added-value and profit.

#### **4. Ownership Distribution of China's Electronics Industry**

The electronics industry receives a great deal of foreign capital investment. Although domestic firms are rapidly catching up, foreign funded enterprises (FFE) are the major players of the industry. In terms of output, sales value, fixed assets, added value and exports, FFE have the edge over the state-owned enterprises (SOE).<sup>1</sup> In 2005, FFE share in total fixed assets was as high as 81.3 percent. FFE output and sales value was 6.49 and 6.4 times that of the SOE, respectively. FFE as a whole have a higher export ratio than domestic firms. FFE exports were 11.35 times that of the SOEs in 2005.

#### **5. Exports and Imports of China's Electronic Products**

China's electronic exports have expanded vigorously and its share in the world trade of electronic goods has grown rapidly through its "Strategy of Promoting Trade by Relying on High-tech" launched in 1999. In 1998, exports amounted to RMB176.9bn; by 2005, total exports increased to RMB1750.9bn, a near tenfold growth in just 7 years. In 2004, China surpassed the USA and the EU and became the leading exporter of electronic products in the world market.

China is also a large importer of electronic goods. Chinese imports are largely electronic components, especially integrated circuits and semiconductors, needed for China's export of computer and related equipment. Items for which China has the largest trade surplus are computers and related equipment, particularly in data processing machines, and in video cameras and recorders, TV receivers and telephones.

### **III. Evolutional Development of Policies Related to China's Electronics Manufacturing**

Since the 1980s, the electronics industry has been one of the priorities in the Chinese Government's industrial policy framework, as the industry's great economic potential was anticipated. Strong supervision was provided in 1982, with the establishment of the Ministry of Electronics Industry. The fast pace of technology led to a series of institutional restructuring. Finally, in 1998, the Ministry of Information Industry (MII) was established,

<sup>1</sup>According to the statistical rules, joint ventures whose Chinese partners are state-owned (even in the occasion that the state-owned enterprise holds the majority of the share) are not counted as SOE but rather FFE, such that the strength of FFE might be overestimated.

which administrates much broader industrial coverage and is able to make more integrated decisions for the most dynamic sector in China.

The electronics industry in China has been defined and selected as a key industry for: (i) the National Program of Key Science and Technology Development, the first comprehensive national science and technology program; (ii) the National Advanced Research Program (863 Program),<sup>2</sup> which focuses on technological progress in high-tech fields; and (iii) the National Basic Research Development Program (973 program), which targets original innovation in selected fields. These are some of the many programs that the Chinese electronics industry participates in.

The electronics industry was declared to be one of China's "pillar" industries in the "National Industrial Policy Outline for the 1990s" in 1994. The Chinese Government committed to providing various kinds of financial support to the pillar industries, to protect domestic products against foreign competition and to allow limited market access for foreign investment in exchange for advanced technology transfer. In addition, the government has been continuously updating the development goals for the electronics sector and its sub-sectors, and has been adjusting policy instruments as needed. Strategic arrangements are in place to enable a favorable macro-environment, and numerous regulations and policy instruments have been implemented specifically to support and to stimulate sub-sectors, including telecommunication equipment, computer and related equipment, audio and video equipment, and electronic components. Some of these measures have proven to be effective in shaping the fast growing and increasingly competitive industry.

### **1. Strategy of Technology Transfer in Exchange for Domestic Market Access**

In adopting the strategy of Technology Transfer in Exchange for Domestic Market (TTEDM) access in the late 1980s, the Chinese Government encouraged advanced technology transfers from transnational corporations (TNC) by offering access to the Chinese domestic market in exchange. The strategy was designed with the strong intention of attracting technologically advanced foreign direct investment, and to exploit the spillover effects of foreign direct investment (FDI). Given the fact that the electronics industry in China was severely lacking in infrastructure, and the prospect of taking "late-comer" advantages, the electronics industry was selected as a key industry with which to exercise the TTEDM

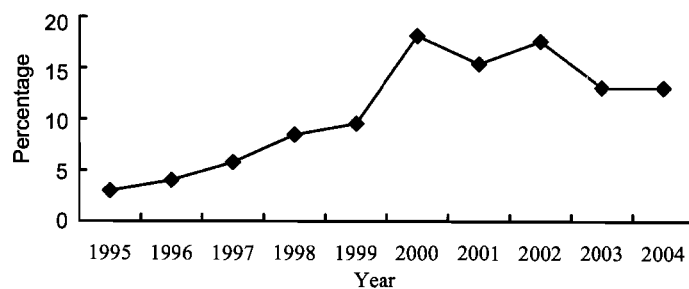
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<sup>2</sup> The program was enacted to benchmark world technological developments and to identify and pursue indigenous innovation capabilities in the seven priority development areas to serve the country's economic development goals. A detailed development program was outlined for each national economy and social development in the five year plan.

strategy. Measures include: (i) provisions of advanced and continuous technology transfers as part of future joint venture agreements; (ii) requirement of central government review and approval of certain electronics joint ventures to ensure the conformation to the state's industrial policies; (iii) restriction of wholly foreign-owned enterprises and requirement of no less than 50 percent of local equity in joint ventures; (iv) restriction of labor-intensive joint ventures unless export of 100 percent of the products is guaranteed; and (v) requirement of 70 percent export of joint venture-manufactured products in order to enjoy preferential treatment.

The huge potential of the Chinese market and the TTEDM strategy attracted a large amount of foreign capital investment in China in the 1990s. An increasing proportion of this

**Figure 1. Proportion of Foreign Direct Investment in the Electronics Industry to National Total**



Source: ETIRI (1996-2005).

**Table 2. Technology Imported by Foreign Funded Enterprises (2000–2005)**

Year	Technology import (number of contracts)			Technology import amount (US\$ bn)		
	National	FFE	FFE/National (%)	National	FFE	FFE/National (%)
2005	9902	5992	60.5	19.05	0.83	43.4
2004	8605	5057	58.9	13.855	6.692	48.3
2003	7130	4313	60.6	13.51	7.607	56.5
2002	6072	3471	57	17.389	13.103	75
2001	3900	1170	30	9.091	NA	NA
2000	NA	NA	NA	18.76	7.27	40

Source: Division of Science and Technology, Ministry of Commerce (2006).

Notes: NA, not available; FFE, foreign funded enterprises.

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FDI flew into the electronics industry, reaching 18 percent in 2000; the ratio has remained above 13 percent since 2000 (Figure 1). Although data on the proportion of technology imported by FFE in the electronics industry is not available, based on the fact that the electronics industry has always been one of the five top industry destinations for imported technology, and that FFE are major importers of technology from abroad (Table 2), it could be surmised that the electronics industry is one of the sectors that has been most influenced by foreign technology obtained from the TNC.

The evolution of Chinese telecommunication equipment manufacturing is a typical case that reflects the positive and negative effects of the TTEDM strategy.

When China was opened up in the late 1970s, it was severely lacking in telecommunication facilities. Large-scale importation of program-controlled switching devices was chosen to relieve the bottleneck. Since the late 1970s, major telecommunication equipment producers from developed countries have occupied all of the program-controlled switching devices market in China. Some developed country governments even provided government loans to China to finance purchases of switching devices. The Chinese program-controlled switching devices market was described as "seven countries with eight systems", meaning all the devices were from eight companies in seven countries.<sup>3</sup> This round of large-scale importation greatly increased the supply of telecommunication facilities. However, China paid very high prices for the imported devices, and continued importation did not help domestic producers to catch up. They were still far behind the technology forefront. The Chinese Government started to negotiate with TNC on the terms of setting up joint ventures, intending to establish China's own production capabilities with the help of technology transferred from TNC. Shanghai Bell became the first joint venture to produce program-controlled switching devices in China in 1984. The Chinese Government held a policy of "few firms, large scale" in key industries, reducing TNC in each industry to a limited few, such that ample market share was left for domestic firms once they caught up. Just like Shanghai Volkswagen, which had once dominated the Chinese passenger car market for over 15 years, Shanghai Bell enjoyed a monopoly position in China until the early 1990s, when more rival joint ventures were set up and Chinese domestic firms started to catch up. While Shanghai Bell enjoyed the rapidly expanding Chinese market, the Chinese Government was highly concerned about Shanghai Bell's technology transfer and localization process. With support and collaboration from local and central governments, technology diffusion of program-controlled switching devices and localization of component production were progressing smoothly. The spillover effects from Shanghai Bell were believed to have

<sup>3</sup> "Eight systems from seven countries" refers to NEC, FUJITSU, AT&T, Nortel, Ericsson, Siemens, BTM and Alcatel from Japan, USA, Canada, Sweden, Germany, Belgium and France.

played positive roles in Chinese domestic firms' rise in the mid-1990s.

The negative effect of the "few firms, large scale" policy of permitting few large FFE in each strategic industry was evidenced by the mid-1990s. Although the initial motivation of the policy was to protect the domestic market of such industries from being dominated by foreign TNC, the consequences have been quite the opposite. Only a few foreign invested projects were approved in each industry, while domestic firms were neither competent to compete nor sufficient in number to capture adequate market share. Therefore, the early TNC entrants obtained dominant market positions, if not monopoly positions, which reduced the urgency of them transferring advanced technology to China.

Shanghai Bell was the only joint venture in the industry in China until 1990, when Siemens was approved to set up a joint venture in Beijing. However, Siemens' production capacity was negligible in the early 1990s. None of the domestic firms were capable of producing large capacity devices. Demand for Shanghai Bell's products was much greater than its supply capacity. When demand exceeded supply by a big margin, there was no pressure at all for Shanghai Bell to upgrade its technology. Competition had to be enhanced. The Chinese Government changed its policy of "few firms, large scale" and invited more TNC to access the Chinese market, which resulted in increased competition among TNC. During 1992–1995, Bell's major competitors, NEC, AT&T and Nortel, all set up joint ventures in China. Domestic firms also started to penetrate the large capacity program-controlled switching device market in 1995. Technology upgrading in the sector began to accelerate. Foreign companies were forced to bring into China state-of-the-art technology, and domestic firms were obliged to make continuous technology innovations. Now, TNC are locating more and more R&D activities of strategic importance in China. For instance, the R&D center of Alcatel Shanghai Bell has become one of the three pillars of Alcatel's global R&D networks.

## **2. Encourage Technology Innovation through Government Funding**

Technology importation is a major objective in the opening-up process. Technology imports from foreign sources have been steadily increasing with the rapidly expanding demand in China for advanced technologies. However, as a developing country that has a strong tradition of self-reliance, the Chinese Government has always put great emphasis on stimulating national technology innovation activities. The development of the Chinese electronics industry has provided sound evidence that importing equipment and technology can help to expand industry rapidly, whereas self-reliant technology innovation is the means to build up competitiveness.

Besides the national science and technology programs, a government financed



Electronics Industry Development Fund (EIDF) was set up in 1986. It was first set up to support R&D and production of four key electronic products: integrated circuits, computers, software and program-controlled switching devices. Producers who were eligible to apply for support from the fund have to meet the criteria of state-owned status and high local content of their products. The fund later enlarged its support to include all major electronic products, components, and to include non-state owned firms. According to Wang Xudong, Minister of MII, from 1986 to 2004, the central government directly provided RMB3.9bn (US\$4.87bn) through EIDF, supported 1859 projects, and channeled off much more investment from local governments, financial institutions and firms. More than 70 of the current top 100 firms in the electronics industry were once supported by the EIDF (Wang, 2006).

Many critical technological breakthroughs in the electronics industry have been generated from national science and technology programs or supported by the EIDF. For example, the HJD04 program-controlled switching device was the first large capacity switching device designed and produced by China (produced in 1991); its R&D was funded by the national 863 Program.

Integrated circuit (IC) design breakthrough is another example. Vimicro Corporation's "Starlight chips" were generated from independent innovation projects sponsored by EIDF. "Starlight chips" are embedded multimedia signal processing chips and solutions, which are recognized as one of the most advanced level compared with similar products. "Starlight chips" accounted for 60 percent of the PC video chips market by 2003.

Establishment and international recognition of industrial standards are two of the focuses in international competition in the electronic sector. Supported by EIDF, Datang Microelectronic Technology Corporation submitted their TD-SCDMA technology solution to the International Telecommunication Union, and was recognized as one of the three 3G international standards together with WCDMA and CDMA2000. This is of great significance to the restructuring and competition pattern of the telecommunications market. TD-SCDMA gives China a chance to be a standard technology leader rather than a follower, and provides huge market opportunities for Chinese telecommunication equipment producers. In 2004, TD-SCDMA was selected for a project to be jointly funded by various national R&D programs. To support follow-up R&D, the central government injected RMB700m (US\$87.5m) into the project, which is among one of the largest industrial projects the government has supported.

The EIDF will continue to serve as a major channel for allocating government resources to support the electronics industry in a manner compatible with WTO rules. During the 11th Five Year Plan, EIDF will prioritize the innovation of core technologies, including IC, core components and software (Wang, 2006).

### **3. Provide Favorable Environment for Domestic Firms through Regulatory Direction**

The government's intervention at certain stages of the electronics industry's development has proved to be essential for the expansion of domestic firms.

#### *(1) Establishing Technical Standards*

In the 1980s, the market for large capacity program-controlled switching systems was dominated by foreign brands. These large capacity devices were applied in large and densely populated cities. Although domestic producers were not able to compete with foreign brands in large capacity product markets, they chose to start in rural markets where smaller capacity devices were needed and foreign brands had not penetrated. By the mid-1990s, major domestic producers had, as a group, accumulated adequate capital and technology, and had innovated systems of their own,<sup>4</sup> to enter the large capacity systems market. At this critical stage, the Chinese Government enacted a series of regulations to stipulate that new program-controlled switching systems sold in the market had to be compatible with the V5.1 access network. Foreign brand systems generally do not support V5. Therefore, domestic firms took full advantage of the opportunity and entered the market by providing equipment that was compatible with V5.

In addition to technical regulations, in 1995, the government banned the import of large capacity program-controlled switching systems that were financed by loans from foreign governments. Foreign governments' loans had been very helpful in supporting overseas firms to occupy the Chinese market in the 1980s and early 1990s. By the end of the 1990s, the domestic brand program-controlled switching system had captured 80 percent of the Chinese market. Foreign brands were forced to withdraw from the Chinese market where they once dominated and enjoyed substantial profits. The price had dropped from US\$300–500 per line in the early 1990s to US\$30 per line. Currently, the only non-domestic brand with a slice of the Chinese market is Shanghai Bell Alcatel.

#### *(2) Market Access Regulations*

The Chinese Government's market access regulation has been very effective in supporting domestic mobile telecommunication equipment producers. China's severe lack of information and telecommunication infrastructure is, in fact, advantageous in allowing China to "leapfrog" from old technologies. In the late 1990s, China started to build an advanced SDH telecommunications network, for which Chinese firms were only slightly lagging behind

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<sup>4</sup> Julong with HJD04, Datang with SP30, ZTE with ZXJ10, Huawei with C&C08C and JinPeng with ETM-601.

in technology compared to foreign firms. To protect and support domestic firms, the Chinese Government enacted a regulation in 1998 that contains the essential industrial policy to build up the domestic mobile telecommunication equipment industry. Its provisions include: (i) Strict control of new mobile telecommunication equipment production projects. Sino-foreign joint ventures are subject to restrictive administration. (ii) Strict supervision of mobile telecommunication equipment production, particularly the production of mobile handsets, which are included in the government's guidance plan. Import quotas for components are decided in accordance with the production plan. (iii) To sell mobile handsets, producers have to apply for and be granted a production license and a network access license. (iv) No less than 60 percent of mobile telecommunication products produced by FFE should be exported; this is a prerequisite for FFE to obtain the import quota for components. (v) Stricter restrictions are applied in the import of mobile telecommunication equipment production lines.

In 1999, MII granted the first 10 mobile handset production licenses, with all of them going to domestic firms. In 2000, MII declared the discontinuation of the issue of new licenses; by then 37 firms had obtained 29 GSM handset licenses and 20 CDMA handset licenses (14 firms obtained both GSM and CDMA licenses). Among 29 GSM licenses, 12 went to joint ventures and 17 went to domestic firms. For CDMA, 11 went to domestic firms and 1 for Motorola. In 2005, another 20 mobile handset producers were granted production licenses. From 2005, new production projects of mobile communication system equipment and handsets are no longer subject to government approval, but are subject to a registration process.

Market access regulations have played a crucial role in supporting the Chinese telecommunication equipment industry. In 1998, the domestic brands' market shares for mobile communication switching systems, stations and handsets were zero. Since 1999, domestic brand market share has been increasing rapidly. Mobile handsets can be taken as an example. In 1999, domestic products accounted for only 5.3 percent of the Chinese market. The ratio almost doubled every year till 2003, when it reached a peak of 52.9 percent. In 2004 and 2005, the domestic brands' market share went down slightly, reflecting the fact that Sino-foreign joint ventures that produce foreign brands have adjusted their strategies to penetrate into low-end product markets and have successfully gained a larger slice of the market.

The vast domestic market has helped domestic mobile handset producers to cumulate capital, and the technological progress has enabled them to compete in the international market. In 2005, export of domestic brand mobile handsets reached 13 million units, an increase of 106 percent compared with 2004, although its share in China's total mobile handset exports was only 5.8 percent, with FFE taking the lion's share of 94.2 percent.

### *(3) Comprehensive Support for Targeted Fields*

China's integrated circuit industry is among those industries that benefited most from comprehensive support from central and local governments since 2000. As stated, the Chinese electronics industry has been growing explosively as a whole since the 1990s. However, IC constituted the weakest link in the industry, despite heavy governmental direct investment to set up IC foundries through 908 and 909 projects in the 1990s<sup>5</sup>. IC demand grows much faster than IC domestic supply, leading to higher rates of imports. Imports meet 90 percent of domestic demand (International Finance Corporation, 2005).

The gap between the Chinese IC industry and that of the more advanced countries has widened from two generations in the 1970s to three in the 1990s. The Chinese Government has been aware of the strategic stature of the semiconductor sector and the weak position of China. In 2000, "Policies for Encouraging the Development of Software and Integrated Circuit Industry" was enacted, identifying several measures to support IC manufacturing and IC design, including subsidized bank loans, government direct investments, tax reductions and development funds. IC products have enjoyed low value-added tax of 6 percent (further reduced to 3 percent in 2002), whereas the standard VAT rate is 17 percent. The reduced tax is to be used for IC R&D and manufacturing expansion. For new IC projects approved by the government, the government provides follow-up investment of 15 percent. The government also provides 1.5–2 percent interest subsidies for bank loans for up to 3 years. The IC products designed by domestic firms but processed abroad enjoy a reduced special import tariff rate. The central government's policies are complemented by additional incentives provided by local governments, who often compete with each other to offer better incentives in an attempt to attract IC investment. Beijing, Yangtze River Delta (including Shanghai, Zhejiang and Jiangsu) and Pearl River Delta are three locations that offer the most favorable incentives, and are locations of emerging IC industry clusters.

These preferential policies for the IC industry were viewed as critical government intervention that provided great impetus for the IC industry. Between 2000 and 2003, China's IC industry received approximately RMB60bn (US\$7.5bn) in investment, nearly twice as much as all previous investment in the sector. From 2000 to 2005, the annual increasing rate of output and sales of the IC industry remained at a high rate (Table 3). In 2004, a 12-inch fab capable of manufacturing 0.13–0.18  $\mu\text{m}$  process technologies was built in Beijing, indicating a step up in the technology ladder. The IC design sector has developed much faster than those of manufacturing and testing. In 2000, there were less than 100 IC design houses in

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<sup>5</sup> The Chinese Central Government invested in the 908 and 909 projects in the 1990s, which generated the Huajing Electronic Group based in Wuxi and the Huahong Electronic Group based in Shanghai. These two companies are among the top IC manufacturers in China.

**Table 3. China's Integrated Circuit Industry Development  
(2000–2005)**

	2000	2001	2002	2003	2004	2005
Output (100 million pieces)	33.92	33.23	96.31	124.1	211.47	265.78
Growth rate (%)	37.95	-2.03	189.83	28.85	70.4	25.68
Sales (100 million pieces)	42.16	32.58	88.8	124	207.28	265.77
Growth rate (%)	70.55	-22.72	172.56	39.64	67.16	28.22

Source: MII (2006)

China. Most of them were state-owned or device makers with some design capabilities, but not truly independent design firms. By 2004, there were over 400 design houses in China. Their products account for 14.8 percent of the world market, taking third place after USA and Japan.

With the rapid growth of its design and manufacturing sectors, IC industrial structure has seen improvements. The share of testing in the industry has reduced gradually, whereas design and manufacturing has increased steadily. The shares distribution of the three segments is approaching the international average of 40 percent manufacturing, 30 percent design and 30 percent testing.

As a result of US government claims that tax reductions implemented as part of the encouragement package to the IC industry were against WTO rules, tax reductions were withdrawn in April 2005. However, this has not deterred the Chinese Government from continuously and resolutely providing incentives for the development of the IC industry, by adopting measures compatible with WTO rules. As announced by China's National Development and Reform Commission, incentives other than tax reduction stipulated in "Policies for Encouraging the Development of Software and Integrated Circuit Industry" are still effective, and stronger government R&D funding is replacing tax reduction. In the national 11th Five Year Plan, the IC industry is identified as one of the core sectors that will receive priority. The specific goals of the government include the establishment of national IC R&D centers and commercialization of 0.09  $\mu\text{m}$  process technologies.

#### 4. Foreign Direct Investment Policy and Trade Barriers

FDI inflow to China can be classified into two categories: export-oriented and import-substitutive. In the 1980s and early 1990s, export-oriented FDI ventures consisted of numerous small firms from the newly industrializing economies of East Asia, from Hong Kong in particular. They usually focused on labor-intensive industries. Because parent companies of this kind are usually not at the forefront of technology innovation, and the export-oriented production is, to a great extent, isolated from domestic production networks, the export-oriented FDI is believed to have a limited contribution to advanced technology

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transfer and to China's economic structural upgrading. However, this type of FDI has a huge job-creating and trade effect.

The import-substitutive FDI mainly consists of subsidiaries set up by large TNC based in developed countries. The attractiveness of China as an investment destination for this kind of FDI mostly lies in China's huge potential market. This group of investment tends to be distributed to technology and capital-intensive manufacturing sectors, including electronics.

For the electronics industry, both import substitutive and export-oriented FDI were encouraged by the Chinese Government. Import-substitutive FDI was targeted as a source of advanced technology, while export-oriented FDI was also encouraged to reap export expansion and employment effects (regulations such as export ratios were set for this kind of FDI, to prevent the FFE from breaking into the domestic market). As a result, FDI has been seen playing an increasing role in China's electronics industry. Since 1999, on average, approximately 15 percent of total FDI has been invested in electronics, making the electronics industry the top recipient of foreign capital.

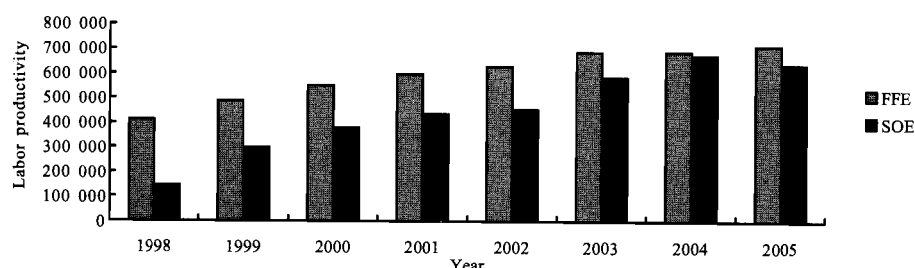
Foreign funded enterprises account for the lion's share of both domestic and export markets. FFE sales revenue in the domestic market increased from 64.5 percent in 1998 to 83.7 percent in 2005. In the export sector, the FFE share increased from 89 percent in 1998 to 93.8 percent in 2005. For high-tech products exports (electronics accounted for 92.3 percent of high-tech exports in 2005), almost all the export expansion since mid 1990s is attributed to FFE, whereas SOE export experienced only a slight increase. Although private firms' exports increased rather rapidly, their contribution was negligible because of their minimum initial share.

The higher market shares of FFE reflect their stronger competitiveness, which can attributed to their obvious edge over SOE in many aspects, including more efficient management systems, and better knowledge of the international market. The productivity of FFE is much higher than SOE (Figure 2), which partially explains the higher market share of FFE.

The increasingly dominant position of FFE in the explosively expanding domestic and export markets also indicates that the Chinese Government has provided wider access for foreign capital, reflected by the increasing number of encouraged items and the shrinking number of restricted items in various versions of *Industrial Guidance for Foreign Investment*. In the 1997 version, there are 20 electronic items that are under encouraged category and 9 items in the restricted list. From the 2002 version, the restricted item is limited to satellite TV receivers and related key components, with 29 encouraged items. In the 2005 version, the encouraged item increases to 45 (Table 4).

As a result, both import-substitutive and export-oriented FDI have successfully assisted the Chinese electronics industry to integrate into the global production network. As China increasingly becomes a production base for the global market, its domestic market also

**Figure 2. Labor Productivity of State-owned Enterprises and Foreign Funded Enterprises in China's Electronics Industry (yuan/per worker)**



**Source:** National Bureau of Statistics of China (2006).

**Notes:** FFE, foreign funded enterprises; SOE, state-owned enterprises.

**Table 4. Encouraged and Restricted Electronic Projects in Various Versions of Industrial Guidance for Foreign Investment**

Category/version	1997	2002	2004	2005
Encouraged	20	29	30	45
Restricted	9	1	1	1

**Source:** China National Development and Reform Commission (1997, 2002, 2004, 2005).

delivers a high return rate for foreign capital.

In the last 20 years of rapid development of the electronics industry, the Chinese Government has closely monitoring the direction and pace of FDI inflow through FDI regulation and trade measures. Varying policy packages have targeted different sub-sectors.

#### *(1) Consumer Electronics*

In the mid-1980s, consumer electronics was identified by the Chinese Government as a sector of priority (Lu, 2003). Color TV was selected as a breakthrough product to facilitate the establishment of the electronics industry, because the technology involved in production was not sophisticated and market demand was very strong. By 1985, as many as 147 color TV production lines were imported, and most of the components were also imported. Color TV production was basically assembly processing. In 1985, the Ministry of the Electronics Industry launched a program of color TV localization, focusing on the localization of component production. In 1986, color TV localization was listed as a priority projects in the

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national 7th Five Year Plan. Thanks to the localization campaign, local content of color TVs grew steadily. In 1997, the government announced that China had established an integrated color TV industry. All components except high-end IC chips could be produced locally. Color TVs made in China have dominated the domestic market since then. The import substituting industry is becoming an export-gear industry. Color TV exports have expanded steadily since 1997.

Trade measures have also played a role in the process of TV localization. Although regulations were adopted to encourage various forms of Sino-foreign corporations to bring in technology to build the color TV industry in China, import restrictions were adopted to reinforce local production. Imports of color TVs were strictly restricted; the tariff rate for color TVs remained at the high level of 100 percent until 1994, when it was reduced to 50 percent.

## *(2) Computer and Related Equipment*

The computer industry was highly protected in the 1980s. Production licenses were granted to a few state-owned producers like Great Wall and Langchao. The import of computers was under the control of import licenses and high tariffs. There was an internal policy stipulating that computers procured by the government had to be Great Wall. High trade protection and high prices of computers resulted in a small computer market. By 1990, Great Wall, as the top computer producer in China, only produced around 10 000 units.

The year 1990 was viewed as a turning point in opening up for the computer industry. Import licenses for computers were removed and tariff rates were reduced. Production licenses were granted to more non-state owned enterprises. The computer sector has since become a relatively open market compared with other electronics sub-sectors. Measures that constitute major trade barriers and FDI restrictions are no longer implemented. Firms in the industry are basically subject to market forces.

The domestic computer industry experienced serious setbacks in the market opening of the early 1990s. Established in a highly protective environment, domestic firms lost large market shares to foreign brands with policy changes that permitted wider access by foreign competitors. Transnational PC producers from the USA and East Asia quickly established production bases in China. Higher quality foreign brand PCs, such as AST, IBM and Compaq gained increasing market shares.

The rise of Chinese domestic brands commenced in the early to mid-1990s, aided by rapidly expanding demand and scheduled enterprise reform. Factors affecting this expansion in the computer market included increasing income and, more importantly, the government's promotion of the national information system. In 1993, China's Golden Project for IT was launched, which is one of China's most far-reaching infrastructure development programs.



The aim is to build a state-of-the-art telecommunications and information system.<sup>6</sup> Included in the rapidly expanding market were some state-owned spin-offs and non-state owned enterprises, which had been taking advantage of less government control resulting from enterprises reform, and which had accumulated capital and experience through trade and assembling of computers. By then they were able to penetrate into the market with their own brand of computers, such as Legend, Stone and Founder. In 1996, Legend surpassed Compaq in PC sales and became the leading brand in the Chinese market, and later in the Asian market.

### *(3) Telecommunication Equipment*

As discussed in regards to the TTEDM strategy, the telecommunication equipment sector was subject to heavy intervention because of the government's FDI policy and domestic regulations, which helped domestic firms to fight against competition from foreign brands.

In relation to FDI and trade, the development of the electronics industry in China can be divided into three phases. Phase 1 is characterized by large-scale importation of products, including consumer goods, such as TVs and refrigerators, and capital goods, such as computer and program-controlled switching devices. In phase 2, tariff and non-tariff barriers restricted imports of final products, whereas imports in technology were encouraged together with the inflow of foreign capital, with the intention of establishing increased production capacity in China. At this stage, strict regulations on FDI were adopted to ensure the catching-up of domestic firms. In phase 3, regulations on FDI were loosened, trade barriers were removed, and more foreign competition was invited to create a more competitive market environment. Within the electronics industry, computer and electronic component sectors were more liberalized than consumer electronics and telecommunication equipment sectors.

## **5. High Technology Development Zone, and the National Electronic and Telecommunication Industry Base**

Like in many East Asian economies, a High Technology Development Zone (HTDZ) policy was adopted in China to deliver incentives for high technology industries. China's first HTDZ was developed in 1988, the year the Torch Program was instituted, to integrate research institutions with start-up incubator facilities for local and international firms that are committed to commercializing China's high technology R&D achievements. Preferential policies, including

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<sup>6</sup> China's Golden Projects for information technology consists of three core Golden Projects: the Golden Bridge, which will develop information and data communications network spanning 500 cities and 12 000 large enterprises; the Golden Customs project, which will track quota permits, foreign currency transactions, and import and export statistics; and the Golden Card project, which will replace cash transactions with an electronic service system for savings, withdrawals and payments through credit and debit cards.

tax breaks, are provided for tenant companies located in the zones. There are now 54 central-government-approved HTDZs. The information and telecommunication industry is the leading industry in HTDZ. For instance, ICT accounted for 29.15 percent of total output and 25.4 percent of industrial added-value of HTDZ in 2003.

In addition to the HTDZ, the National Electronic and Telecommunication Industry Base (NETIB) was instituted in 2004 to accommodate the trend of rapid clustering of the industry. NETIB aims at a better layout of development priorities of each site and at enhancing development of clusters to increase the competitiveness of the electronics industry. Beijing, Tianjin, Shanghai, Qingdao, Suzhou, Hangzhou, Shenzhen, Fujian coastal area and the Pearl River Delta are identified as the first nine cities or areas of NETIB. The output of these nine NETIBs accounted for three-quarters of the total output of the electronics industry in 2005.

The Chinese Government has exercised the "Large Firm Strategy" to foster Chinese multinational corporations. The strategy was initiated in 1987. In 2002, combining 46 state-owned research institutes and 26 SOE, China Electronic R&D Group (CER&DG), a giant R&D company, was set up. CER&DG is one of the 20 large institutions that the State Council has granted investment authority to. The establishment of CER&DG was intended to restructure state-owned R&D resources and to pursue higher levels of R&D activities to support the Chinese electronics industry to transform from "big" to "strong".

Leading firms are encouraged to "go out" and invest abroad: to transform into multinational corporations. Local governments are urged to set up matching funds, to provide additional support to firms that are granted support by the central government. Local governments where NETIBs are located are required to set up specific funds to support those large firms whose R&D expenditure accounts for more than 6 percent of their sales value.

#### **IV. Concluding Remarks**

China has emerged as a major producer and exporter of electronic products and has the fastest expanding market for electronic products. The electronics industry has been growing more rapidly than the general manufacturing sector, and faster than GDP. The electronics industry is gradually shifting from a consumer electronics oriented structure to a more balanced structure with capital electronics (telecommunication and computer related equipment) taking a greater share (although the electronic components sector is still rather weak). The industry has shown a strengthening trend of clustering. The Yangzi River Delta, the Pearl River Delta and Bohai Ring area are the three locations most densely clustered with the electronics firms. The majority of the firms are FFE. They possess dominant shares in terms of investment, sales value, added value and exports. China enjoys an overall trade surplus in electronic products. However, the trade deficit in components, particularly in integrated circuits, is huge.

The Chinese Government has been an active player in shaping the Chinese electronics industry. Multiple policy instruments have been adopted to support and monitor the industry, including the strategy of Technology Transfer in Exchange for Domestic Market access, R&D funding, market access regulation, FDI and trade policy, HTDZ, NETIB and large firm strategies. The government's industrial policy has been effective in attracting foreign investment and fostering domestic firms. With the accession to the WTO, China has been active in adapting policies to accommodate WTO rules.

Low labor cost and huge potential market will still play key roles in the future development of the electronics industry in China. However, the competitiveness of the industry in the world market and China's position in the global production network depend primarily on the building up of the innovation capability of the nation. The Chinese Government is well aware of the significance of the issue, and future policies will focus on the establishment of national IC R&D centers, on increasing funding for R&D and commercialization, on encouraging technology standard innovations and relevant commercialization, and on strengthening weak links in the industry, such as IC design.

## References

- China National Development and Reform Commission, *Industrial Guidance for Foreign Investment*, (*Waishang touzi chanye zhidao mulu*), various versions. Available from <http://www.foreigninvest.cn/index5.htm> [Cited on 2 March, 2006].
- Division of Science and Technology, China Ministry of Commerce, 2006, *Technology Importation Statistics Database*. Available from <http://kjs.mofcom.gov.cn/static/column/bn/bt.html/1>.
- ETIRI (Electronic Technology and Information Research Institute), 1996-2005, *Yearbook of China Electronics industry (Zhongguo dianzi chanye nianjian)*, Beijing: Publishing House of the Ministry of Information Industry.
- International Finance Corporation, 2005, *The ICT Landscape in the PRC: Market Trends and Investment Opportunities*. Available from: [http://iris37.worldbank.org/domdoc/PRD/Other/PRDDContainer.nsf/WB\\_ViewAttachments?ReadForm&ID=85256D2400766CC7852570AD006D68FB](http://iris37.worldbank.org/domdoc/PRD/Other/PRDDContainer.nsf/WB_ViewAttachments?ReadForm&ID=85256D2400766CC7852570AD006D68FB).
- Lu, Xinkui (vice minister of the MII), 2003, *20 Years Reform and Open-up of Chinese Electronics industry*. Available from: <http://www.cnii.com.cn/20030915/ca230405.htm>.
- MII (Ministry of Information), 2006, *Overview of China's Mobile Handset Sector 2005*. Available from: <http://www.cei.gov.cn/LoadPage.aspx?Page> [Cited on 17 March, 2006].
- National Bureau of Statistics of China, 2006, "*China Statistical Yearbook of High-tech Industries*," (*Zhongguo gaoxin jishu chanye nianjian*), Beijing: China Statistics Publishing House.
- Wang, Xudong (minister of MII), 2006, *Opening speech on the conference on EIDF*, Beijing, 11 January 2006. Available from: [http://www.mii.gov.cn/art/2006/01/11/art\\_64\\_4669.html](http://www.mii.gov.cn/art/2006/01/11/art_64_4669.html) [Cited on 15 March, 2006].

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