The Chinese Telecommunications Manufacturing Industry: An Economic Analysis

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THE CHINESE TELECOMMUNICATIONS MANUFACTURING INDUSTRY

AN ECONOMIC ANALYSIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Social and Applied Economics

By

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The Chinese telecommunications manufacturing industry is one of the fastest growing industries in China. This paper addresses the question of how China can develop this industry and penetrate the U.S. market. To this end, I study the U.S. telecommunications manufacturing market to find market opportunities. Subsequently, I examine the Chinese telecommunications manufacturing industry, mainly focusing on the industry’s structures, and the vendors’ conduct and performance. Several government policies are discussed which will foster the development of this Chinese industry in the U.S. market. Moreover, I assess several strategies for overseas expansion by the Chinese telecommunications equipment vendors.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Chapter 1 Literature Review</td>
<td>3</td>
</tr>
<tr>
<td>1.1 Industry Analysis</td>
<td>3</td>
</tr>
<tr>
<td>1.2 International Economics Analysis</td>
<td>6</td>
</tr>
<tr>
<td>Chapter 2 Telecommunications Manufacturing Industry Analysis</td>
<td>10</td>
</tr>
<tr>
<td>2.1 Overview of the Telecommunications Manufacturing Industry</td>
<td>10</td>
</tr>
<tr>
<td>2.2 The U.S. Telecommunications Manufacturing Market</td>
<td>14</td>
</tr>
<tr>
<td>2.3 The Chinese Telecommunications Manufacturing Industry</td>
<td>22</td>
</tr>
<tr>
<td>2.4 Chinese Vendors' Efforts to Export</td>
<td>29</td>
</tr>
<tr>
<td>Chapter 3 International Economic Analysis</td>
<td>37</td>
</tr>
<tr>
<td>3.1 China and the WTO</td>
<td>37</td>
</tr>
<tr>
<td>3.2 Trade between the United States and China</td>
<td>41</td>
</tr>
<tr>
<td>3.3 Role of the Government</td>
<td>43</td>
</tr>
<tr>
<td>3.4 Analysis of Tariff</td>
<td>48</td>
</tr>
<tr>
<td>3.5 Analysis of Subsidies</td>
<td>52</td>
</tr>
<tr>
<td>3.6 Analysis of Other Trade Policies</td>
<td>55</td>
</tr>
<tr>
<td>Chapter 4 Conclusion</td>
<td>58</td>
</tr>
<tr>
<td>Bibliography</td>
<td>59</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Value Chain of Telecommunications Industry</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>U.S. Communication Equipment Market Outlook</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>U.S. Communication Equipment Market Share in 2002</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Leading Vendors Operating Revenues in U.S.</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>The Development of Telecom Services in China</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>China Telecom Equipment Market Share in 2002</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>ZTE’s Product Portfolio</td>
<td>34</td>
</tr>
<tr>
<td>8</td>
<td>History of China Foreign Trade</td>
<td>38</td>
</tr>
<tr>
<td>9</td>
<td>Product Life Cycle</td>
<td>46</td>
</tr>
<tr>
<td>10</td>
<td>Cost and Benefits of a Tariff in a Large Country</td>
<td>48</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1: Sizes of the Giant Vendors .................................................................................... 17

Table 2: Telecommunication Indicators: China vs. Selected Countries in 2002 .......... 24

Table 3: Summary of Vendors’ Profiles ................................................................................. 28

Table 4: Exhibitions List of ZTE .......................................................................................... 35

Table 5: U.S. and China WTO Agreement ........................................................................... 51

Table 6: Behaviors Possibilities I ......................................................................................... 52

Table 7: Behaviors Possibilities II ......................................................................................... 53
Introduction

China has increased dramatically its share of world trade since the end of the 1970s due to its market opening reforms. Chinese customs’ statistics show that the amount of foreign trade (including import and export) has risen from US$ 44 billion in 1981 to US$ 851 billion in 2003.\(^1\) Due to comparative advantages generated by lower labor costs, Chinese firms are growing rapidly and participating actively in international trade. Commodities marked “Made in China” are found in every corner of the earth, and most of them are primarily labor-intensive goods with an increasing number of high-technology exports.

The Chinese government does not view labor-intensive industries as strategic growth engines for the national economy. Instead of pursuing growth for growth’s sake, the new Chinese government, led by President Hu Jintao and Premier Wen Jiabao, is devoted to improving working conditions and wages for peasant workers, “the major force of the Chinese working class”.\(^2\) In the meantime, Premier Wen Jiabao has announced that agricultural taxes would be phased out in the next five years.\(^3\) As peasant workers return to the country-side, a labor shortage has developed in China.\(^4\) Therefore, China may be losing to other developing countries its low cost advantage in labor-intensive commodities.

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In the long term, the future of high-technology industries backed by skilled engineers is more promising. China is changing its export inventory from labor-intensive exports to technology-intensive exports. The telecommunication manufacturing industry is a driving force for the giant Chinese economy and is becoming a pillar for its national economy according to the Chinese government “863” high-technology research and development plan. Chinese telecommunications equipment vendors have joined the international telecommunications equipment market, especially the U.S. market. Huawei, the flagship of the Chinese telecommunications manufacturing industry, has set up 32 branches worldwide to support its global operations, and its contracted sales reached US$3.83 billion in 2003. Currently, the Chinese vendors have their eyes on the U.S. telecommunications equipment market which is one of the most advanced markets in the world.

First, what role can the telecommunications manufacturing industry play in the Chinese economy? Second, what strategies can China pursue to develop its telecommunications manufacturing industry and penetrate the U.S. market? Third, how can the Chinese vendors gain access to the U.S. market? Fourth, what policies shall the Chinese government make to advance the industry’s international participation? In seeking answers to these questions, chapter one reviews previous telecommunications industry studies and international trade theories. Chapter 2 examines the U.S. telecommunications manufacturing market and the Chinese telecommunications manufacturing industry. Chapter 3 traces the impact of Chinese government regulations on this industry. The conclusions are made in the last chapter.

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5 863 high technology research and development plan is launched to develop the Chinese economy through high technology. (http://www.chinatech.com.cn/techachieve/intro/plan863.htm#aaa)

6 Company Profile. (http://www.huawei.com)
Chapter 1 Literature Review

This chapter reviews previous industry studies and international trade theories, and establishes the groundwork for my economic examination of the industry. The first section focuses on several industry analyses from the industry's and the firm's perspectives. The second section introduces a policy evaluation criterion and explains two international economic trade models: the product life cycle model and the international Cournot duopoly model.

1.1 Industry Analysis

The two primary industry studies which suggest ways to analyze the U.S. and Chinese telecommunications manufacturing industry, are Susan McMaster's "Telecommunications: competition and network access" 7 and Qingxuan Meng and Mingzhi Li's "New economy and ICT development in China" 8. McMaster analyzes competition in the U.S. telecommunications industry and finds that the industry structure has changed dramatically since 1984. The U.S. telecommunications industry, which includes both service and manufacturing, has become more competitive than before. McMaster notes the role that federal regulations and state regulations, principally the Telecommunications Act of 1996, have played in fostering increased competition in the

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U.S. telecommunications industry. Further, she examines the industry changes provided by new technology and by mergers which have altered the U.S. telecommunications industry. McMaster states: “The changes seen throughout the industry since 1984 have been rapid and dramatic, with a multitude of new services and technologies being used to provide telecommunications to consumers… and competition is now a reality.”

McMaster concludes that the transition from a monopoly to multiple competitors was due to new regulations, judicial oversight, and technological innovation.

Qingxuan Meng and Mingzhi Li analyze the link between the new economy and the information and communication technology industry (ICT) development in China. By collecting data on China’s ICT industry development and diffusion, Meng and Li explore the status of the ICT industry in the Chinese economy. They also examine the impact of the ICT industry on the economic inequalities among three different regions of China: the eastern, the central and the western zones. The more ICT investment in a region, the higher the GDP per capita in that region. Meng and Li conclude that: “Developing countries can use the information and communication technology to their advantage to restructure their industry structures.”

High-technology industry can provide a “unique shortcut for the developing countries to learn from the industrialized world and to build a completely new market mechanism.” This is a cornerstone of the Chinese government “863” high-technology research and development plan.

From the firms’ perspective, Industry Surveys details methods of analyzing internal firm and external market factors of the telecommunications manufacturing

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10 Ibid, p294.
11 Ibid, p294.
industry. It emphasizes that both the financial and non-financial factors of firms must be considered in today’s competitive environment. According to Industry Surveys, the firm’s financial factors analysis can be divided into income statement analysis and balance sheet analysis. The firm’s non-financial factors analysis includes government regulations, the rapid development of technology, and management factors. I adopt this non-financial factors method to analyze the Chinese vendors. By examining the internal factors of the vendors, I identify their core competencies and weaknesses. Meanwhile, the analysis of external market factors helps to find market opportunities and threats for vendors. By examining external market factors, I make an assessment of the Chinese vendors’ international expansion and the development of the telecommunications manufacturing industry.

My research is carried out by implementing selected methods of the above three authors. Similar to McMaster, I examine the competition in the U.S. telecommunications manufacturing market and the Chinese telecommunications manufacturing industry. The industry’s structures, the U.S. and Chinese telecommunications equipment vendors’ strategies, and their respective performance are studied. The role of the Chinese telecommunications manufacturing industry in the national economy is consistent with Meng and Li’s high-technology argument. By analyzing the economic and market factors facing Chinese companies, I present the opportunities available in the U.S. market, which provides policy implications for the Chinese government in developing its telecommunications manufacturing industry.
1.2 International Economics Analysis

The proper form of government intervention remains very much an open question. Today, most people believe that free trade can improve the general welfare of all societies. Adam Smith, the founding father of economics, advocated free trade and presents the principle of absolute advantage. According to Smith, a country shall export goods with absolute advantage and import goods with absolute disadvantage. Absolute disadvantage means a country can produce a product with less input than other countries. Robert Carbaugh interprets absolute advantage as follows:

“In a two nation, two product world, international trade and specialization will be beneficial when one nation has an absolute cost advantage (that is, less labor to produce a unit of output) in one good and the other nation has an absolute cost advantage in the other good.”13

On the basis of absolute advantage theory, David Ricardo further developed a more important international trade theory—comparative advantage theory. Ricardo refined the absolute advantage theory, and he stated that both nations can achieve mutual benefits from free trade even when a nation is more efficient in production of all commodities than its trading partner. Through free trade, countries can arrange their resources more efficiently and improve their productivity.

Nevertheless, free trade is not realistic in the world despite the strong theoretical arguments mentioned above. Instead, almost every country has some protective regulations on international trade. The common regulations include tariffs, subsidies, quotas, and other non-tariff trade barriers. A tariff is levied on imported commodities to protect domestic manufacturing industries, especially infant industries. Subsidies are granted by the government to domestic producers so that they can compete with foreign

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rivals. Other non-tariff trade barriers include countervailing duties, antidumping regulations, local content requirements, government procurement policies, bilaterally negotiated restraints, administrative policies and voluntary export restraints. Under perfect competition, policies which cut tariffs and subsidies can improve general welfare. However, a government designs tariffs, subsidies and the other trade barriers to protect the domestic firms under imperfect competition. For an important industry such as the telecommunications manufacturing industry, the Chinese government is prudent to nurture its international expansion. The Chinese government has implemented numerous tariffs, subsidies, local content requirements and government procurement policies in the telecommunications manufacturing industry. A primary question for the government and economists is how to assess the efficiency of these protective government interventions and perhaps find more appropriate intervening policies. One key criterion in answering this question is to evaluate whether the policy is the most effective and justified way to achieve the national objectives. Chapter three applies this criterion to discuss policies of the Chinese government.

Furthermore, there are two models applied to analyze government regulations in chapter three, Vernon’s product life cycle model and Brander and Spencer’s international Cournot duopoly model. In his famous paper “International Investment and International Trade in the Product Cycle”, Raymond Vernon14 develops a dynamic product life cycle model which explores the innovation timing for industrial manufacturing goods. Vernon assumes that manufacturers in developed countries are similar to each other in terms of scientific knowledge, and he hypothesizes that a U.S. manufacturer is the innovator of a

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high-income or labor-saving product in his model. The U.S. producer dominates the
domestic and export markets as the innovator in the early stage. In the next stage, since
less developed countries are more attractive as production locations of standardized
products, then the production location shifts from the U.S. to a developing country due to
its lower labor costs. The producer in a developing country begins to imitate the U.S.
producer. Finally, the U.S. producer loses its market share and becomes an importer of
this product: “[T]he local markets henceforth will be filled from local production units set
up abroad… the obvious production-cost differences between the rival producing areas
are usually differences due to scale and differences due to labor costs.”

Vernon’s product life cycle model can be summarized with four stages. Stage 1 is
an introductory stage when a home country has an export monopoly to a foreign country
in terms of a new product. Stage 2 is an imitation stage where the foreign country begins
to produce the product. In Stage 3, the foreign country increases its production and
becomes competitive in the export market. In Stage 4, the home country production
declines, and the foreign country exports to the home country. This dynamic product life
cycle model is applied to analyze the trend of future development of the Chinese
telecommunications manufacturing industry in chapter three. In this model, the U.S.
vendors are supposed to be the innovators, and the Chinese vendors are supposed to be
the imitators.

Brander and Spencer, in their revolutionary paper, “International R&D Rivalry
and Industrial Strategy”, examine the government’s role in vital industries and present
their international Cournot duopoly model of approaching strategic policies. Brander and

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15 Raymond Vernon, International investment and international trade in the product cycle, Quarterly Journal
of Economics; May 1966, Vol. 80, p198.
Spencer build this model to examine behaviors of two competing firms: “In the first stage firms choose R&D levels, and in the second stage, output levels.”\textsuperscript{16} Their approach assumes that the government can commit itself to strategic policies and influence the set of credible actions of players. Brander and Spencer say that:

“If the government can use both export subsidies and R & D subsidies (or taxes), a fairly striking result is obtained: ... to use an export subsidy to enable the domestic firm to capture a larger share of the industry than it would unaided.”\textsuperscript{17}

Brander and Spencer’s international Cournot duopoly model is practical to develop strategic policies and to analyze the impact that the Chinese government has on the development of the telecommunications manufacturing industry. In this model, the U.S. vendors and the Chinese vendors are classified as two competing groups. The behaviors of these two groups are examined in two stages of R&D levels and output levels, and relative conclusions are made in chapter three.

\textsuperscript{17} Ibid, p717.
Chapter 2 Telecommunications Manufacturing Industry Analysis

The first section of this chapter is an overview of the telecommunications manufacturing industry. The second section examines the U.S. telecommunications manufacturing market and the Chinese telecommunications manufacturing industry respectively. Finally, the last section discusses strengths, weaknesses, and opportunities of the Chinese vendors in the international marketplace.

2.1 Overview of the Telecommunications Manufacturing Industry

Our planet has an electronic network linked by a telecommunications infrastructure. Individuals can use their home phones or cell phones to call friends around the world. The telecommunications equipment vendors sell wired and wireless networks to telecommunications carriers and enterprises. By offering diversified equipment, the telecommunications equipment vendors play an important role in connecting the world. The position of the telecommunications equipment vendors in the value chain is illustrated in figure 1.
The telecommunications equipment vendors are located in the downstream portion of the industry. They purchase original equipment and components from the upstream manufacturers in the industry, and supply synthesized telecommunications networks to telecommunications service providers. By delivering more sophisticated solutions and services to customers instead of supplying merely manufacturing equipment, telecommunications equipment vendors maximize their profits in this value chain.

Telecommunications equipment consists of telecom equipment and networking equipment. According to Industry Surveys, telecommunications products are classified as telecom equipment, which is sold to telecommunications carriers, and networking equipment, which is sold to enterprises. Networking equipment is comprised of

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switch/servers, routers, network interface cards and hubs, which provides enterprise a range of connectivity solutions. Telecom equipment has two segments: wired equipment and wireless equipment. Wired equipment includes switch/access networks, broadband, data communication and optical transmission. Wireless telecommunications equipment includes two types of networks, based on either GSM (Global System for Mobile Communications, the most popular wireless technology standard in the world) or CDMA (Code Division Multiple Access) technologies. Qualcomm, a U.S. company, invented the core CDMA standard, and collects license fees from carriers and vendors in the world.

The 3G (third generation) network, which provides voice and data transmissions with larger capacities and higher speeds than the current GSM and CDMA network, is expected to generate great profit in the market. There are two widely used 3G standards: WCDMA (wideband code division multiple access) and CDMA 2000. In addition, there is a TD-SCDMA standard which “has become one of the three dominant standards of third generation mobile (3G) telecommunications systems, along with WCDMA (wideband CDMA) in Europe and Japan and CDMA in the United States.”

The telecommunications products and technologies mentioned above provide business opportunities for the telecommunications equipment vendors. These diversified telecommunications products and technologies are evolving very quickly, and the life cycle of telecommunications equipment is becoming shorter and shorter. The vendors sell telecommunications equipment to public services carriers and big enterprises such as IBM. The number of such customers is limited because not every company needs to buy telecommunications equipment, and these giant customers usually make big purchases of

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telecommunications equipment. Sometimes it takes years for a telecommunications equipment vendor to make a deal with a telecommunications carrier due to the complexity of telecommunications equipment. By the time a vendor produces and launches a new telecommunications product after years of research, the market for this product might have already waned.

In view of this challenge, every competitor in the telecommunications equipment market has to race to stay abreast of the newest technologies. They differentiate their products by enhancing product features, and claim that they can provide the best network solutions to satisfy customers’ requirements. In the meantime, a precise estimation of technology development trends has great impact on the performance of the vendors. A telecommunications equipment vendor can strike it rich if the vendor invests in the practicable technology. Otherwise, the vendor may suffer financial losses if it bets wrong, as with the Motorola’s iridium satellite constellation plan. Motorola failed to meet its profit expectation as it bet heavily on this 77 satellite communication system. The system deployed the most advanced technology contemporarily, but it was not suitable for commercial uses.\(^{21}\)

The telecommunications manufacturing industry, being a capital-intensive and technology-intensive industry, faces high entry barriers. The minimum economy of scale (MES) for this industry is larger than many industries, which suggests higher opportunity costs for potential new entrants. Small companies are incapable of gaining MES. Consequently, the telecommunications manufacturing industry is an oligopolistic industry. R&D ability is essential in helping the telecommunication equipment vendors to be competitive in the market by providing total solutions and services. This

\(^{21}\) Iridium, Wikipedia, (http://en.wikipedia.org/wiki/Iridium_(satellite)).
technological-oriented industry provides opportunities for the high-technology firms in less developed countries to participate in the telecommunications equipment market.

2.2 The U.S. Telecommunications Manufacturing Market

The U.S. telecommunications manufacturing market enjoyed positive growth until 2001. The Encyclopedia of American Industries states that "the telecommunications equipment manufacturing industry at the end of the 1990s was very strong...The Telecommunication Industry Association reported that U.S. spending in 1998 totaled $121 billion."\(^{22}\) In 2001, the spending declined significantly, and the demand for telecommunications equipment from enterprises dropped 28%.\(^{23}\) The aggregate losses continued because the U.S. telecommunications manufacturing market suffered from poor economic conditions in 2002 and from telecommunications infrastructure overinvestment in the late 1990s. This telecommunications infrastructure overinvestment created an excess capacity in telecommunications and led to the decreased spending in 2001 and 2002.

According to DATAMONITOR: "Many American businesses chose to step back from the cutting edge of communication equipment, no longer concentrating upon having the latest equipment, instead preferring to continue using their current equipment and reduce overheads."\(^{24}\) Since 2001, the giant telecommunications equipment vendors, particularly Lucent, had financial trouble. From 2001 to 2003, Lucent announced multiple layoffs to cut costs for surviving in the harsh economic environment.

Despite the decline of the U.S. telecommunication manufacturing market in 2001 and 2002, the U.S. telecommunications manufacturing market is expected to recover in the next few years because of new demand for network equipment. Technology development and the government’s efforts are the most important driving forces for the U.S. telecommunications manufacturing market. According to Icon Group,\textsuperscript{25} the potential world telecommunications equipment market is expected to expand to US$574,044 million by 2005, and the U.S. telecommunications equipment market potential shall reach US$162,330 million by 2005, which accounts for 28\% of the global market. Figure 2 demonstrates the growth of the U.S. telecommunications equipment market as a percentage of global markets from 1995 to 2005.

The U.S. telecommunications equipment market is dominated by several giant telecommunications equipment vendors. The four major companies, Motorola, who has the largest share in the U.S. telecommunications equipment market, Cisco, Lucent and Nokia, account for 45.9% of the 2002 U.S. market. The other big competitors in this market include Alcatel, Nortel, and Ericsson.

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All the current telecommunications equipment vendors have close relationships with the major carriers, and they are expanding in the industry and gaining revenues. Table 1 lists the sizes (in employment) and revenues for the current main vendors in the U.S. market. These seven transnational telecommunications equipment vendors currently dominate the U.S. market.

Table 1: Sizes of the Giant Vendors (source: company profiles)

<table>
<thead>
<tr>
<th>Firms</th>
<th>Employees in 2003 (world)</th>
<th>Revenues in 2003 $billion (world)</th>
</tr>
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<tbody>
<tr>
<td>Lucent</td>
<td>32000</td>
<td>8.5</td>
</tr>
<tr>
<td>Cisco</td>
<td>34000</td>
<td>18.9</td>
</tr>
<tr>
<td>Alcatel</td>
<td>60486</td>
<td>15.7</td>
</tr>
<tr>
<td>Ericsson</td>
<td>52000</td>
<td>16.3</td>
</tr>
<tr>
<td>Motorola</td>
<td>88000</td>
<td>27</td>
</tr>
<tr>
<td>Nokia</td>
<td>51000</td>
<td>35.2</td>
</tr>
<tr>
<td>Nortel</td>
<td>37000</td>
<td>9.8</td>
</tr>
</tbody>
</table>

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Lucent has a proud and long R&D history from its Bell laboratories parentage though it is a new independent company.\textsuperscript{28} Compared to the long R&D history of Lucent, Cisco is much younger. It has grown very fast and has become one of the largest networking equipment providers in the world.\textsuperscript{29} In terms of networking equipment, Cisco accounts for almost 40\% of the 2002 U.S. market share.\textsuperscript{30} Nortel Networks, headquartered in Ontario, Canada, is another famous vendor in the North American telecommunications manufacturing industry. Alcatel, established in 1898, is the largest telecommunications equipment vendor in France.\textsuperscript{31} Motorola, originally founded in 1928, is the leader of wireless and broadband telecommunications worldwide.\textsuperscript{32} Nokia is a Finnish mobile telecommunications company which primarily provides GSM and CDMA standard voice-centric wireless phones and mobile networks to operators and businesses. In 2003, Nokia’s pro forma operating profit achieved EUR 5.1 billion.\textsuperscript{33} Ericsson, a Norwegian company, claims itself as the largest total solution supplier of mobile 3G terminals, networks and services in the world because 40\% of mobile calls in this planet were made through Ericsson’s wireless systems in 2003.\textsuperscript{34}

The telecommunications equipment of these companies is homogenous functionally. The costs to develop and manufacture telecommunications products create high entry barriers and a small number of large firms. Vendors try their best to capture more market share so that they can increase profit. Normally, vendors gain market shares by pursuing the economies of scale, economies of scope, good relationships with

\textsuperscript{28} Company profile (http://www.lucent.com/corpinfo/history.html).
\textsuperscript{29} Corporation overview (http://newsroom.cisco.com/dlls/corpfact.html).
\textsuperscript{31} Company profile (http://www.alcatel.com/apropos/history/index.htm).
\textsuperscript{32} Company profile (http://www.motorola.com/content/O,,l,00.html)
\textsuperscript{33} Company profile (http://www.nokia.com/nokia/0,8764,624,00.html)
\textsuperscript{34} Company profile (http://www.ericsson.com/about/)
customers, and updated technologies. Another reason why the current dominant vendors have large market shares is because of switching costs for carriers. In order to obtain consistency and stability of the network, usually the carrier chooses the equipment from the same vendor, who had provided the equipment for the existing network, to upgrade and expand its network. Otherwise, the carrier has to bear the extra costs for new vendor evaluation, equipment testing, and maintenance training. The incumbents made great profits from their large market shares in the market, and they have high revenues every year. For example, Cisco’s revenue in fiscal year 2003 was US$18.9 billion, and its profit was US$3.6 billion. Although these telecommunications equipment vendors are competing against each other, this industry is less competitive than a perfect competitive industry. What makes this industry an oligopoly is the fact that the firm’s decisions are interdependent, impacting one another.

In 2002, the U.S. telecommunications equipment market was comprised of two parts: telecom equipment (54%) and networking equipment (46%). Industry Surveys notes that the U.S. telecommunications infrastructure is “evolving into a series of linked electronic networks capable of performing a variety of functions...As wireless and wired networking standards evolve, consumers and businesses will be able to connect every electronic application in their homes or workplace.” This trend offers market opportunities to the telecommunications equipment vendors. Industry Surveys points out that:

“data from the US Department of commerce for October 2003 (latest available)

show strong momentum in new orders for communications equipment, a leading indicator of equipment demand... For 2004, Standard & Poor’s sees a mid-to upper single digit recovery in enterprise networking gear sales.”

Sharon Grace estimates that enterprises’ spending on networking equipment including voice and data communication equipment will increase to US$122 billion in 2007. She comments that: “The small to medium-sized business market, for example, will become a more important source of spending as companies upgrade their technological infrastructure to be competitive.” As a comparison with networking equipment, Grace estimates that carriers’ spending on telecom equipment will decline to US$19 billion in 2007. Note that customers of networking equipment differ from customers of telecom equipment. The number of enterprise customers is more than the number of carriers, and the enterprises market is more competitive than the telecommunications carriers market. The enterprises’ demands are more elastic than the telecommunications carriers’ demands and the escalating demand for network equipment impacts on the vendors greatly. Figure 4 lists the operating revenues of the telecommunications equipment vendors in the U.S. market.

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The above figure illustrates that the revenues of the telecom equipment vendors, such as Alcatel, Nortel, and Lucent, are declining substantially, while the revenues of the networking equipment vendor Cisco is increasing. Paul Travis reports that: “Wall Street expects the world's largest maker of networking equipment [Cisco] to report profit gains based on sales of home networking products and phones for sending calls over IP networks.”41 Therefore, new entrants who manufacture the cost-effective networking equipment, have an opportunity to enter the U.S. market by focusing on enterprise customers.

Another U.S. market opportunity for a foreign vendor is optical switches, a rapidly expanding market. Industry Surveys estimates that this optical switches “market

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will expand 13% in 2004 to $286 million.\textsuperscript{42} The third U.S. market opportunity lies in the wireless market. In the U.S. market, analysts expect the 3G wireless networks, which provide fast data transmission speeds, to create huge market potential for both wireless networks vendors and terminal (handsets) vendors.

Parts of the U.S. market with strong demand growth are where entry opportunities exist. The growing demands for networking equipment, optical switches, and 3G wireless networks supply enter opportunities to potential entrants who have cost-effective products and strong R&D capabilities. The U.S. telecommunications manufacturing market is a potential gold mine for international telecommunications equipment vendors.

2.3 The Chinese Telecommunications Manufacturing Industry

As a developing country, China, which wants to advance its economic progress and build a domestic telecommunications defense system, has been fostering the development of its telecommunications manufacturing industry. The Chinese telecommunications industry is experiencing significant development because of economic opening and reform. Previously, a monopoly existed in the Chinese telecommunications industry. Liang Xiongjian and Zhang Jing write:

"From 1949 to 1977 telecommunications developed very slowly in China because its role in the national economy was not recognized correctly. By the end of 1977, the telephone density was only 0.36 percent [of total population], having increased less than 0.02 percent per year."\textsuperscript{43}

Before the economic reforms, the Chinese telecommunications industry lagged behind many comparable developing countries, let alone developed countries. The


\textsuperscript{43}Liang Xiongjian and Zhang Jing, Development and Regulatory System Reform of the Telecommunications Industry in China, Global Communications Newsletter. (http://www.comsoc.org/pubs/gcn/gcn1103.html).
Chinese government then made policies to stimulate the telecommunications manufacturing industry growth. Due to these preferential policies, the telecommunications manufacturing industry became a strategic supportive industry for the Chinese economy. Icon Group estimates that this industry's expected sales will reach US$23,056 million in 2005.\(^4\)

Since the Chinese telecommunications manufacturing industry is connected closely to the Chinese telecommunications services industry, the telecommunications services industry is examined firstly. Figure 5 illustrates the substantial growth of the main telecommunications services subscribers, which include fixed line subscribers, mobile subscribers and internet subscribers.

Although the mobile subscribers and the fixed line subscribers are increasing rapidly, the wired and wireless Chinese subscriber densities (the number of telephone subscribers per 100 persons in a country) are still very low compared to developed countries. Table 2 lists the differences of telecommunications indicators between China and several other countries.46

Table 2: Telecommunication Indicators: China vs. Selected Countries in 2002

<table>
<thead>
<tr>
<th>Nation</th>
<th>Population</th>
<th>Tele-density</th>
<th>Cellular density</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1.3 billion</td>
<td>17%</td>
<td>16%</td>
</tr>
<tr>
<td>India</td>
<td>1.0 billion</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Japan</td>
<td>127 million</td>
<td>56%</td>
<td>64%</td>
</tr>
<tr>
<td>United States</td>
<td>280 million</td>
<td>65%</td>
<td>48%</td>
</tr>
</tbody>
</table>

In 2002, China’s telephone density was about one fourth of the United States and only 17 of 100 people in China had a telephone line. Fortunately, the booming Chinese economy is fueling the rapid growth of the domestic Chinese telecommunications industry: both the fixed line subscriber density and the wireless subscriber density are now approximately 24%.

The Chinese government always retains part ownership of the carriers, and is prudent in issuing new telecommunications licenses. The government believes that the information technology and the telecommunications industries propel both the national modernization and the Chinese economy. Therefore, the government assigns high priority to and creates favorable policies for this industry. Currently, the Chinese Ministry of Information Industry licenses six state-owned carriers that are engaged in the wired and wireless telecommunications services. These giant carriers are growing rapidly and constructing their own infrastructure networks. As the telecommunications industry expands, so does its thirst for telecommunications equipment. The telecommunications manufacturing industry is fueled by the strong demand of the telecommunications services industry. Compared to the telecommunications services industry, the domestic telecommunications manufacturing industry is more open and competitive.

At the beginning of the economic reform, the Chinese telecommunications manufacturing industry lagged behind the world because China had only one skeleton telecommunications network at that time. Until the late 1990s, the Chinese telecommunications equipment markets were dominated by transnational companies: Motorola, Alcatel, Ericsson, Nokia and Siemens, who established joint ventures or subsidiaries in China. The domestic telecommunications equipment manufacturers are

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growing very fast and achieving remarkable accomplishments. Several prominent vendors took the market back from foreign giant vendors using government legislated priority status and low interest loans. Also, these Chinese manufacturers improved product quality and reduced costs. Figure 6 displays the main competitors’ shares in the China telecommunications equipment market in 2002.

**Figure 6: China Telecom Equipment Market Share in 2002**

![China Telecom Equipment Market Share in 2002](source: datamonitor)

Established in 1988 as a small company with only RMB20,000 (US$2400) registered capital, Huawei is the flagship Chinese telecommunications equipment vendor with 12.3% market share. Forty-six percent of Huawei’s 22,000 employees are engaged in R&D. Its products and services range from traditional switching equipment to state-of-the-art networks (e.g. 3G and DWDM). In 2003, Huawei ramped up overseas sales to RMB31.7 billion (US$3.83 billion) and grasped increased market shares throughout the world. For example, the sales of Huawei’s U-SYS NGN (next generation network) ranked second in the world NGN market according to Dittberner (a renowned

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telecommunication consultant), and Huawei won over 40% of China's high-end market share according to the CCIID (China Center of Information Industry Development). Huawei is a privately-owned company at present, and it has the ambition to be listed on either the Hong Kong or the U.S. stock market soon.

ZTE, established in 1985, is the largest telecommunications equipment provider listed in Shenzhen stock market. As Huawei’s main competitor in China, ZTE is expanding rapidly and annually has 17,000 employees and RMB16.03 billion (US$ 1.9 billion) revenue. ZTE pursues growth strategies which emphasize stability. It obtains its core competitiveness by CDMA technology investment, and currently is the largest CDMA equipment supplier in China. In June 2004, the ITU (International Telecommunication Union, a specialized agency of the United Nations) chose ZTE to draft two important international standards which will shape the future of the world’s next generation networks.

The other major vendors in the Chinese telecommunications manufacturing industry include less-famous domestic companies and joint ventures. Datang Telecom Technology, established in 1998, is famous for inventing the TD-SCDMA technology which is an alternative core 3G technology of WCDMA and CDMA2000. Datang’s 2003 revenue is RMB1.8 billion (US$212 million). Expecting Datang to be another Qualcomm, the Chinese government strongly supports Datang’s cooperation with Siemens on the TD-SCDMA R&D. The China Putian Institute of Technology, established in 1980, has a close relationship with the Ministry of Information Industry. In 2001 and

50 Company profile: (http://www.zte.com.cn/English/01about/index.jsp).
52 Company profile: (http://www.chinanex.com/company/datang.htm).
2002, Putian was the largest company listed in the government publication entitled “Top 100 Chinese Electronic & Information Enterprises”. Its revenue in 2003 was RMB36 billion (US$4.3 billion). Though it has a wide range of products and core networks, Putian’s revenue mainly derives from wireless terminal sales.\(^5\) Table 3 briefly summarizes the profiles of the major Chinese vendors.

**Table 3: Summary of Vendors’ Profiles**

<table>
<thead>
<tr>
<th>Company</th>
<th>2003 annual sales</th>
<th>Owned</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huawei</td>
<td>US$3.83 billion</td>
<td>Privately owned</td>
<td>Shenzhen</td>
</tr>
<tr>
<td>ZTE</td>
<td>US$1.9 billion</td>
<td>State-owned</td>
<td>Shenzhen</td>
</tr>
<tr>
<td>Datang</td>
<td>US$212 million</td>
<td>State-owned</td>
<td>Xian</td>
</tr>
<tr>
<td>Putian</td>
<td>US$4.3 billion</td>
<td>State-owned</td>
<td>Beijing</td>
</tr>
</tbody>
</table>

By examining the histories of these Chinese vendors, I can identify several strategies which they are using to compete against foreign companies. The first one is to focus on R&D. For example, ZTE spent a large amount of money on R&D and diversified its products ranging from wired and wireless telecommunication to data and optical networks. The second method is the two-part tariff technique which helped vendors to increase their market shares. A two-part tariff is “a pricing technique in which the price of a product or service is composed of two parts.”\(^5\) The Chinese vendors entered the market by first selling the basic equipment or network at a rock-bottom price, and then they charged the customer a profitable price for every additional piece of equipment or network. Meanwhile, they created high entry barriers by offering such low price networks to the carriers. The third method is rent-seeking. The Chinese vendors

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\(^5\) Corporate summary, (http://www.chinanex.com/company/ptic.htm).

persuaded related government departments to make favorable policies for them. On the one hand, rent-seeking created entry barriers for potential new entrants. On the other hand, new entrants can use rent-seeking strategy to ease entry barriers as well. With these methods, the major Chinese vendors perform well in earning profit. For example, Huawei’s 2003 net profit of US$460 million ranks number one in the Chinese electronic and information industry, and ZTE’s 2003 profit, US$147 million, ranks sixth.\(^5\)

Having dramatically increased their R&D capabilities and competitiveness in the past decade, the Chinese companies are competing with foreign giant companies (e.g. Nortel, Cisco, and Lucent) in the Chinese market. The foreign vendors are attracted to China partly because of the lower engineering costs. The competition triggers a cutthroat price war, and the average price of telecommunications equipment is much lower than that of twenty years ago. Moreover, the successful R&D (product development), production, domestic sales and the protective government policies have positioned Chinese vendors financially to be ready to expand into the U.S. market.

### 2.4 Chinese Vendors’ Efforts to Export

The Chinese vendors are making a big push to expand their businesses outside the country. Initially, the Chinese vendors focus on easy-to-enter markets in developing countries, and then they focus on entering the U.S. market. In 2001, Huawei established its subsidiary Futurewei in the United States to respond to the customers’ requirements more quickly. Futurewei provides a wide range of advanced telecommunications products (including CDMA2000 1X & 1xEV-DO Total Solutions, Metro Optical Networking, [www.nanfangdaily.com.cn/southnews/tszk/nfdsb/smzk/200406020473.asp](http://www.nanfangdaily.com.cn/southnews/tszk/nfdsb/smzk/200406020473.asp)).

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\(^5\) Net profit of the telecommunications manufacturing industry ranks first in the electronic and information industry.

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Broadband Access, LAN Switches and Access Servers/VOIP Gateways) to serve carrier and enterprise customers. In 2003, Huawei doubled its overseas sales to US$1.05 billion. The commitment to overseas expansion can also be observed by Huawei's cooperation with 3Com. Huawei established a joint venture with 3Com to build a reputable brand name in the United States and, most importantly, to obtain 3Com's sales channels in the U.S. ZTE also has the ambition to be a global player. It set up 13 wholly owned R&D centers worldwide and achieved high overseas sales. For example, it was chosen by the Greek Telecommunications Organization to supply the ADSL network covering sixteen points for the Athens 2004 Olympic Games.

These Chinese vendors have great competitive advantages compared to their American and European competitors due to lower engineering costs and manufacturing material costs. Engineers working for the Chinese vendors earn only one fifth to one tenth of the salaries of their counterparts in Silicon Valley. ZTE has 17,000 employees of whom 42% are in R&D, and 32% have Master’s degrees. Huawei has 22,000 employees of whom 46% are in R&D, and 85% have university degrees or higher degrees.

Christopher Rhoads and Charles Hutzler point out that Chinese equipment makers are expanding with their new weapon of competitive technology, in addition to their well-known low prices: “The Chinese incursion comes at a time when the incumbents are still smarting from the recent, three-year bust that has claimed hundreds of thousands of jobs in the West.” They use Nortel as an example, who has trimmed its work force down to 35,000 from 95,000 since 2001 and plans to reduce a further 10% of its employees mostly because of its new Chinese competitors. With more manufacturing and R&D

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56 Christopher Rhoads and Charles Hutzler, China’s Telecom Forays Squeeze Struggling Rivals, The wall street journal, September 8, 2004.
outsourcings, Nortel commits to “become a more marketing-led company.”57 The Chinese high quality and relative low cost telecommunications products attract customers and threaten the giant incumbents in the global market.

The technology revolution also provides opportunities for the Chinese vendors. Thanks to the biggest wireless domestic market in the world, the Chinese vendors are developing state-of-the-art technologies under every standard. Huawei’s WCDMA end-to-end solution is one of the most matured wireless technologies in the world, and is currently deployed in many countries for mobile telecommunications. The Huawei and ZTE WCDMA solutions performed excellent in the individual system test of the MTNet organized by the Chinese Ministry of Information Industry.58 The Chinese vendors hope to achieve success with their mobile products in the U.S. wireless market.

Also, the elastic demand for networking equipment in the U.S. market provides an opportunity for the Chinese vendors. This price-oriented networking equipment market benefits the Chinese vendors because the prices of their networking equipment are much cheaper than the prices of comparable U.S vendors’ equipment. Pete Engardio discusses “the China price” in Business Week:

“On Nov. 15, struggling 3Com Corp. (COMS ) in Marlborough, Mass., launched a data-communications switching system for corporate networks of 10,000 users or more. It claims twice the performance of Cisco Systems Inc.’s (CSCO ) comparable switch. At $183,000, 3Com’s list price is 25% less. Its secret? 3Com is settling for lower margins and taking advantage of a 1,200-engineer joint venture with China telecom giant Huawei Technologies Co. This is the first high-end piece of networking gear sold by a U.S. company that is designed and manufactured in China.”59

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The Chinese vendors also have opportunities in the U.S. optical equipment market, since the U.S. optical networking market is growing rapidly. Meghan Fuller states: “Huawei has grown from a 1% global optical-networking market share in 1999 and 2000 to an 8% share by mid-2003, when it was ranked fifth worldwide.”\(^{60}\) If the Chinese vendors take advantage of this business opportunity, then they can gain a foothold in the U.S. market and become co-players with the global networking giants.

However, Chinese telecommunications equipment vendors also have many problems in contrast with other giant transnational companies. The first problem is that the Chinese vendors are mainly good at low-end telecommunications equipment, though they claim that they can offer total solutions. Second, Chinese telecommunications equipment vendors are inexperienced in operation and management. After all, the Chinese economic environment is different from that of mainstream economic institutions. Cisco’s patent and copyright lawsuit with Huawei last year taught Chinese telecommunications equipment vendors a lesson about international competition rules. Cisco claimed that Huawei “violated at least five of the company’s patents and copied Cisco’s Internetwork Operating System source code”.\(^{61}\) Although Cisco later dropped the lawsuit, the infringement accusation damaged Huawei’s reputation and made the U.S. customers hesitant to choose the Chinese vendors as suppliers. The success of the Chinese vendors in the domestic market can by no means be copied in overseas markets.

The third problem is U.S. telecommunications technology standards, which are dominated by Cisco, Lucent and other big companies. The Chinese telecommunications

\(^{60}\) Meghan Fuller, Market Watch, Huawei emerges as a credible optical player, Lightwave Magazine, July 2004.
equipment vendors complain that it is difficult to break into the U.S. market because of different standards. At present, there are two interfaces to develop telecommunications technologies in the world: E1, which is deployed in Europe, and T1, which is used mainly in the United States and Japan. The Chinese telecommunications industry follows the E1 standard to develop equipment and products, and it takes time and money for them to develop double-standard products that satisfy the requirements of the U.S. industry.

Besides the standards, foreign industry regulations also block the Chinese telecommunications equipment vendors' expansion. They need approval from the relative countries' telecommunications authorities to export the telecommunications equipment. For example, if they want to sell the equipment in the United States, they have to deal with the FCC regulations; if the Chinese vendors try to export to the United Kingdom, they have to be approved by the BABT (British Approvals Board for Telecommunications).

The above analysis indicates the demands of the U.S. telecommunications manufacturing market. With the knowledge of the market, the Chinese vendors should make detailed strategies which include establishing joint ventures, R&D centers and sales channels, choosing product portfolio, setting low prices and building brands to enter the U.S. market. Paul Ross describes the Chinese telecommunications equipment vendors' globalization in his article:

"Huawei's product portfolio is largely oriented toward GSM/W-CDMA and the company pursues a decidedly aggressive style in moving quickly to set up local offices and establish relationships with local vendors in target markets. ZTE, in contrast, has put its efforts into developing CDMA 2000 products and takes a more conservative approach to new markets, often watching and evaluating Huawei's experience before moving forward."62

Indeed, Chinese telecommunications equipment vendors should develop state-of-the-art technologies and set appropriate product portfolios in terms of their core competences to suffice the demands of the U.S. market. For example, ZTE makes the following product portfolio for the U.S. telecommunications manufacturing market.

**Figure 7: ZTE’s Product Portfolio**

![ZTE's Product Portfolio](image)

In this portfolio, ZTE eliminates the old-model analog phones, and focuses on the Switch and access products, which are regarded as cash cows to generate revenues. Also, ZTE produces mobile telecommunications products, data communication products, optical switch and terminal products.

The distribution channels through which to enter the U.S. market consist of establishing subsidiary or sales offices, and cooperating with other U.S. telecommunications equipment companies. To attract customers in the United States, the

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63 Company internal profile.
Chinese telecommunications equipment vendors need to build a strong brand reputation, and to respond quickly to customers, and to provide complete after-sale maintenance services. Another effective method for Chinese telecommunications equipment vendors to gain access to the U.S. market is to attend telecommunications fairs and exhibitions. Chinese telecommunications equipment vendors are very active in promoting and participating in exhibitions. In 2001, Huawei designed a new Silk Road Plan (Shenzhen—Shanghai—Beijing). The important international exhibitions, which Huawei attended recently, included ITU Telecom World 2003, SVIAZ/EXPO COMM MOSCOW and Expocomm Mexico. Similarly, ZTE attended nine major overseas exhibitions in 2004.

### Table 4: Exhibitions List of ZTE

<table>
<thead>
<tr>
<th>Number</th>
<th>Time</th>
<th>Exhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2004-08-09-08-11</td>
<td>ITCN ASIA 2004 (Karachi, PAKISTAN)</td>
</tr>
<tr>
<td>2</td>
<td>2004-08-04-08-08</td>
<td>ICT EXPO 2004 (Bangkok, Thailand)</td>
</tr>
<tr>
<td>3</td>
<td>2004-05-11-05-15</td>
<td>SVIAZ/EXPO COMM Moscow 2004</td>
</tr>
<tr>
<td>4</td>
<td>2004-05-04-05-08</td>
<td>ITU TELECOM Africa 2004 (Cairo, Egypt)</td>
</tr>
<tr>
<td>5</td>
<td>2004-03-18-03-20</td>
<td>Convergence INDIA 2004 (New Deli, India)</td>
</tr>
<tr>
<td>6</td>
<td>2004-03-02-03-05</td>
<td>Telexpo 2004 (Sao Paulo, Brazil)</td>
</tr>
<tr>
<td>7</td>
<td>2004-02-29-03-04</td>
<td>SAUDI COMMUNICATION 2004</td>
</tr>
<tr>
<td>8</td>
<td>2004-02-23-02-26</td>
<td>3GSM World Congress (Cannes, France)</td>
</tr>
<tr>
<td>9</td>
<td>2004-02-10-02-13</td>
<td>EXPO COMM MEXICO 2004</td>
</tr>
</tbody>
</table>

In short, the Chinese telecommunications equipment vendors have great advantages and opportunities in exploring overseas markets if they overcome their weaknesses. Meanwhile, parts of the U.S. telecommunications equipment market offer many opportunities for the Chinese vendors. I have several suggested strategies for the Chinese vendors to develop the U.S. market: (1) investing more in R&D and marketing, taking advantage of the low engineering costs and setting low prices; (2) establishing

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joint ventures, R&D centers, and sales channels in the United States; (3) building more reliable brands to assure customers that they can offer complete-solution services; (4) learning more about the U.S. regulations and standards. Only with these strategies can Chinese telecommunications equipment vendors get a foot hold in the U.S. market. Further, the Chinese government needs to aid the Chinese vendors’ exploration in the U.S. market, which is discussed in the next chapter.
Chapter 3 International Economic Analysis

This chapter discusses government regulations which can help the international development of the Chinese telecommunications manufacturing industry. The first section examines the impact of China’s accession to the WTO on the international expansion of the telecommunications manufacturing industry, and the second section overviews the trade relationship between China and the United States. The third section reveals the role that the government can play in this industry’s development path. The following sections present analyses of tariffs, subsidies and other international trade policies.

3.1 China and the WTO

The world is increasingly interdependent through economic globalization. Economic globalization influences China greatly. In 1978, the Chinese government, led by President Deng Xiaoping, vowed to transform the centrally planned economy into a socialist market economy. During the last thirty years, the Chinese economy achieved impressive accomplishments by reforming and opening its economy. The average annual GDP growth rate during 1978 to 2002 was 9.3%.65 According to 2003 Chinese customs statistics,66 Chinese exports ranked fourth in the world at US$ 438 billion, and Chinese imports ranked third in the world at US$ 413 billion, which accounted for 5.3% of the

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65 Chinese Economy Overview: (http://www.in.ah.cn/analyses/zw2004/zw0402.HTM).
world imports. Figure 8 outlines the Chinese foreign trade growth.

Figure 8: History of China Foreign Trade

Also, China’s growing domestic market attracts investments around the world, and the foreign investment has been playing a key role in driving the Chinese economy. In a news release on worldwide foreign direct investment, the Organization for Economic Cooperation and Development (OECD) indicates: “China attracted $53 billion in 2003 compared to $40 billion for the U.S. economy… and became the largest recipient of foreign direct investment (FDI) in 2003.” The BBC News also stated that a giant flow of FDI poured into China during 2004: “for the first half of 2004 as a whole, China’s foreign direct investment was up 11.99% on last year to $33.9bn.” Despite the rampant SARS threat, the Chinese economy growth rate in 2003 achieved 9.1%. The secret of Chinese rising economy is simple: a stable society with a fairly complete infrastructure, cheap workers, and talented engineers.

Given the size and robust growth of its economy, China attracts more and more attention of the world. According to the IMF: “The expansion of China’s role in the world trading system has been no less remarkable, with its overall share in world trade rising from less than 1 percent in 1979 to about 6 percent in 2003.” China’s enthusiastic involvement in the world economic arena is convincing the world that China is an integrated part of the world economy, and many people acknowledge that the Chinese economy is a market economy.

Meanwhile, there are complaints that China is lagging behind in following WTO regulations, especially in protecting intellectual property rights. China promises to deepen its economic and political reform and eliminate trade barriers. Economic globalization also will promote Chinese democracy. Only with the compliance to its WTO pledges can the world's most populous nation provide immense opportunities for the domestic telecommunications manufacturing industry.

The WTO’s impacts on Chinese telecommunications equipment vendors have two aspects. On the one hand, these vendors can enjoy the tariff eliminations from many countries, a benefit of WTO membership. According to the ITA (Information Technology Agreement) tariff cutting mechanism of WTO:

"ITA provided for participants to completely eliminate duties on IT products covered by the Agreement by 1 January 2000. Developing country participants have been granted extended periods for some products…. While the Declaration provides for the review of non-tariff barriers (NTBs), there are no binding commitments concerning NTBs. There are three basic principles that one must abide by to become an ITA participant: 1) all products listed in the Declaration must be covered, 2) all must be reduced to a zero tariff level, and 3) all other duties and charges (ODCs) must be bound at zero. There are no exceptions to product coverage, however for sensitive items, it is possible to have an extended implementation period. The commitments undertaken under the ITA in the WTO

are on an MFN basis, and therefore benefits accrue to all other WTO Members.\textsuperscript{71} Under such ITA regulations, Chinese telecommunications equipment vendors gain access to many countries in the world, and the Chinese vendors’ international expansions are geared towards further Chinese economic development. On the other hand, joining in the WTO means more market openness. More foreign companies are allowed to enter the Chinese market gradually. Joining in the WTO benefits the most those Chinese labor-intensive industries such as the textile industry. The developed countries have cultivated their capital-intensive and technology-intensive industries for many years, and today their firms have broader marketing networks and more renowned brands than those of developing countries. When foreign firms enter the Chinese telecommunications equipment market, they bring investment, technology transfers, and, most importantly, competition. If the foreign vendors flood into the Chinese market without any regulations, the Chinese telecommunications industry may be damaged. Song Hong says:

\textit{“WTO accession does not mean the weakening of the role of government in supporting enterprises and industries. What should however be changed is the ways and means; for example, studying protection measures which do not violate WTO regulations, the strategy of anti-dumping, the qualitative standard and system for every industry, and so on.”\textsuperscript{72}}

To be a WTO member is a major challenge for the Chinese government to spur the development of the telecommunications manufacturing industry. Obviously, the government must study the influences of WTO’s regulations on the telecommunications manufacturing industry carefully, and make unbiased policies to foster the development of the telecommunications manufacturing industry.

\textsuperscript{71} Information Technology Agreement: (http://www.wto.org/english/tratop_e/inftec_e/inftec_e.htm).
\textsuperscript{72} Song Hong, The Impact of China’s WTO Accession on Industrial Development, Institute of World Economics and Politics, 2000, p7.
3.2 Trade between the United States and China

The United States and China have witnessed the rapid growth of economic cooperation since 1979 when the two countries established diplomatic relations. Today the United States is one of China's most important trade partners. People's Daily Online shows that the United States is the second largest trade partner of China and "[t]he trade volume between China and the US hit a historic high of 126 billion US dollars in 2003."\footnote{Sino-US trade volume tops US$100 billion in 2003, People's Dairy Online, February 09, 2004.}

Meanwhile, the huge U.S. trade deficit with China generates many debates, and skeptics doubt the value of the close trade relationship between the United States and China. They claim that mass imports from China damages the U.S. labor market and causes a race to the bottom—a decline in real wages for the U.S. domestic laborers. Economists hold different opinions. For example, Paul Krugman and Maurice Obstfeld find these adverse concerns unjustified. They argue that "[t]he effect of one country's growth on another country's real income depends on the bias of that growth; only if it biased toward the other country's exports will it reduce its real income via worsened terms of trade."\footnote{Paul Krugman and Maurice Obstfeld, International economics, sixth edition, 2002, p103.} By comparing the average annual trade percentage changes between advanced countries and developing countries, they find that the negative influence of the cheaper labor costs of developing countries is too small to affect the developed countries' economies.

In reality, China has a comparative advantage with the United States mainly in low-end markets. Close Sino-U.S. economic cooperation is mutually beneficial to both countries, and the trade between these two countries is complementary to each country's
economy. Economists claim that the economic rise of China helps the U.S. economy. U.S. consumers save billions of dollars by importing cheaper manufactured goods from China. Clay, Joan and Zhang agree with “the more of a boon than a bane” point of view and state that:

“[imports from China] has helped Alan Greenspan keep interest rates lower for longer, making it easier for America's consumers to buy houses and for its companies to invest. And the charge that China is mercantilistic, focused solely on exports, just doesn't wash. Yes, China ran a $59 billion trade surplus with the U.S. last year. But for the most part, its U.S. trade gains came at the expense of rival exporters.”

The Chinese government continues to express its intent to cooperate with the United States. The People's Daily Online lists Chinese Premier Wen Jiabao's five principles of economic partnership between China and the United States which were proposed at a meeting with American scholars in New York on December 8, 2003:

“First, mutual benefit and win-win result. Thinking broadly, one should take account of the other's interests while pursuing its own. Second, development first. Existing differences should be resolved through expanded trade and economic cooperation. Third, greater scope to coordinating mechanisms in bilateral trade and economic relations. Disputes should be addressed in a timely manner through communication and consultation to avoid possible escalation. Fourth, equal consultation. The two sides should seek consensus while reserving differences on major issues, instead of imposing restrictions or sanctions at every turn. Fifth, do not politicize economic and trade issues.”

Correspondingly, the U.S. government shows confidence in the economic collaboration with China. For example, the U.S. Department of Commerce secretary, Donald Evans expressed the U.S. government’s optimistic attitude toward the economic cooperation with China in the third China-U.S. Telecommunications Summit which was held on June 17, 2004. Donald Evans stated:

“We look forward to building on the success of these previous Summits and

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76 Wen proposes principles on Sino-US trade economic ties, People’s Dairy Online, December 2003
Donald Evans's speech encouraged communication and international trade between these two countries. He argued that both the United States and China can win if they avoid unnecessary conflicts and promote fair trade.

### 3.3 Role of the Government

The current global trade environment and the progressively closer trade relationship between the United States and China provide opportunities for the Chinese vendors to further expand into U.S. markets. In turn, the Chinese economy can develop further if the Chinese vendors succeed in their international expansion. The international growth of the Chinese telecommunications manufacturing industry is a major objective of the Chinese government. Statistic of the Ministry of Information Industry, which is the regulatory agency of the Chinese telecommunications manufacturing industry, shows that the 2003 taxes collected from the telecommunications industry are RMB 17.72 billion (more than US$2 billion), dwarfing other products. The 2003 taxes collected from Huawei is RMB 2.8 billion (US$338 million), and the 2003 taxes collected from ZTE is RMB 2.2 billion (US$266 million). 78 The importance of the telecommunications manufacturing industry to government revenue implies that the government must play an active role and make strategic policies to support the development of the industry.

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Observations of strongly performing Asian economies show the payoffs of government interventionism. Far from free trade, some successful eastern Asian countries, such as Singapore, South Korea, and Taiwan (region), followed complex policies including tariff, quotas, export subsidies, national bank loans, import restrictions, and most importantly, R&D subsidies in their high-technology information industries. The Singapore government has directed the economy in all sectors. South Korea has sponsored telecommunication equipment vendors to grow as giant transnational companies. For example, Samsung, a Korean company, becomes a famous telecommunication equipment vendor in the U.S. market with the Korean government support.

Many developed countries have a range of favorable policies which support their high-technology telecommunications manufacturing industry. The Japanese government took a proactive role in developing high-technologies industries and embarked on many strategies of promoting digitization. In March 2001, the Japanese government launched an “E-Japan Priority Policy Program” to realize its goals of ensuring security of its telecommunications infrastructures, to develop its advanced information and telecommunications industries, and to become a leading IT nation. The U.S. government also provides R&D subsidies to its telecommunications industry. For example, Sumit Majumdar states: “Whether the criticism of cross-subsidization is fair or not, in an allocative efficiency sense, it remains a key institutional mechanism in the U.S. telecommunications industry.”

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expansion is strongly supported by their respective governments. U.S. companies dominate a number of areas in broadband telecommunications and multimedia technologies and are likely to win major export markets.”

In a less developed country, it is also necessary for the government to promote the development of its high-technology industries. Import-substituting industrialization encourages the development of these industries. By using tariffs, subsidies and other trade policies, a less developed country’s government can buttress its domestic industries and replace imported manufacturing commodities with domestic commodities, and become more industrialized. Krugman and Obstfeld state: “As a strategy for encouraging growth of manufacturing, import-substituting industrialization has clearly worked.” The Chinese government has applied this strategy in its telecommunications manufacturing industry and encouraged carriers to replace imported telecommunications equipment with domestic products.

This import-substituting policy is consistent with Vernon’s product life cycle theory. Applying Vernon’s dynamic product life cycle model to the Chinese telecommunications manufacturing industry, four stages are shown in figure 9.

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3, pp. 445-70.
81 John Langdale, International Competitiveness in East Asia, Telecommunications Policy, April 1997, p239.
There is a product life cycle after an innovative telecommunication product X is invented. The U.S. vendors’ production and Chinese vendors’ production of X are shown in this figure. In stage one, the U.S. vendors begin mass production of X and export to China. In Stage two, the Chinese vendors start producing imitations of X, and the output of the U.S. vendors begins to decline. In Stage three, imported X diminishes from the Chinese market. In stage four, the Chinese vendors begin to export X to the U.S. market.

The Chinese vendors have passed the imitation stage, and now are competitive in both the domestic and overseas markets. They are increasing Chinese domestic market shares, especially in the low-end equipment markets. Finally, as the chart shows, the Chinese producers may enter the U.S. market. The indigenous Chinese telecommunications equipment vendors have an important competitive edge with their

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83 Dr. Tran Dung, Product Life Cycle, (http://www.wright.edu/~tdung/product_cycle.htm).
great comparative advantages, and can provide customers with more cost-effective solutions in the low end telecommunications market. The 2002 total local production of Chinese telecommunications equipment industry was US$19 billion.\textsuperscript{84} The above product life cycle analysis depicts the development trend of the Chinese telecommunications manufacturing industry, and hints at policies implications for the Chinese government, such as subsidies and local content requirements.

Nevertheless, there are some problems in the Chinese government’s current policies for the telecommunications manufacturing industry. As the Chinese economy relies heavily on foreign investment, the government encourages foreign investment in China by promising an open market and favorable policies. Sometimes the Chinese government makes the competition unfair to the domestic firms. For example, the \textit{Telecommunications Reports} states that Chinese carriers signed contracts worth US$2.3 billion with U.S. telecommunication equipment vendors in order to balance the trade surplus in January 2004.\textsuperscript{85} The director of the China Academy of Telecommunications Research under the Ministry of Information Industry, Chen Jinqiao, cautioned the above US$2.3 billion purchasing: “The large amount of purchases may also have some negative impact on the research and development of domestic enterprises.”\textsuperscript{86}

In all, the Chinese government must pay more attention to the strategic policies so that it can facilitate the development of domestic telecommunications equipment vendors in international trade. The possible policies include tariffs, quotas, export subsidies, import restrictions and low-interest loans. I assess the strategic policies and regulations


47
one by one in the following sections.

3.4 Analysis of Tariff

China enjoyed a rapid economic growth rate and a relatively stable government for the last three decades. Economists study the impact of government regulations, principally tariffs, on the overseas development of the telecommunications manufacturing industry. A specific tariff imposed by a large country can raise the price at home and lower the price in a foreign country. To assess the tariff policy, the point is to evaluate the benefit and cost of a tariff. Krugman and Obstfeld state the cost and benefit of a tariff in a large country:

"A tariff raises the price of a good in the importing country and lowers it in the exporting country. As a result of these price changes, consumers lose in the importing country and gain in the exporting country. Producers gain in the importing country and lose in the exporting country... To compare these costs and benefits, it's necessary to quantify them."87

According to the above industry analysis, I assume that both the United States and China are relatively large countries, and China is considering the tariff policy for a telecommunications product. Figure 10 sketches the cost and benefit effects of a tariff in China.

Figure 10: Cost and Benefits of a Tariff in a Large Country

Before the tariff, the world price of this telecommunications product is $P_w$, and China’s import of this product is the difference of the world supply and domestic supply: $S^1 D^1$. The world supply curve changes to $S_{w+\text{tariff}}$ if the country imposes a tariff on a telecommunications product. After the tariff, the import of this product is reduced to $S^2 D^2$. The Chinese government receives the tariff revenue of $BCFG$ which is comprised of two parts: the revenue from the domestic consumers: $BCEH$, and the revenue from foreign producers: $HEFG$. The domestic producer’s surplus changes from $IDP_w$ to $JCP_w+\tau$. The consumer surplus is decreased, and the net consumer welfare is negative $CDP_w+\tau P_w$, which is the consumer’s efficiency loss. In this case, the country’s net welfare depends on the difference of the government revenue, producer’s surplus change, and the consumer’s efficiency loss (also called deadweight loss). If the result of the
government revenue, producer’s surplus change, and the consumer’s efficiency loss is positive, then the country has a net gain, otherwise, the country has a net loss.

Since bilateral trade between the United States and China is large, tariffs cause big consumer’s efficiency losses both to China and the United States. A tariff can benefit domestic manufacturers, however it may hurt the economy in the long run since international trade is not a zero sum game. Therefore, a tariff is not suggested as a good policy. The WTO requires its members to reduce tariffs, and the United States and China have reached an agreement on tariffs. Table 5 details the changes of Chinese tariffs on imported industrial products and electronics.
### Table 5: U.S. and China WTO Agreement

<table>
<thead>
<tr>
<th>Market Access Issue/Product</th>
<th>Current Conditions</th>
<th>Post-Accession Conditions</th>
<th>Impacts</th>
</tr>
</thead>
</table>
| **Industrial Products**     | Tariffs: 1997 average 24.6% | **•**Average tariff: 9.4% by 2005.  
**•**Average tariff for priority products: 7.1%, with majority of cuts by 2003.  
**•**Existing quotas will be eliminated upon accession for the top US priority goods (e.g. fiber-optic cable). Most remaining quotas will be phased out by 2003, but no later than 2005.  
**•**From current trade level, quotas will grow 15% annually, ensuring that market access increases progressively. | Elimination of broad systemic barriers to US exports, such as limits on import and distribution rights, and licenses, will open up trade opportunities across the board. |
| **Electronics**             | Average tariff: 13.3% | **•**Tariff: 0 by 2005.  
**•**China will participate in the Information Technology Agreement (ITA), and eliminate tariffs on semiconductors, computers, and all Internet-related equipment by 2005. | New opportunities for the rapidly growing US information technology sector.  
Elimination of cumbersome distribution and retailing regulations will provide new opportunities for US exporters and foreign manufacturers in China |
3.5 Analysis of Subsidies

Non-tariff protection policies include quotas, export subsidies, and the priority use of domestic products and standard. This sector discusses the policy of subsidies to the Chinese vendors. Game theory is introduced in this section to analyze the impact of subsidies on the firms’ rational behaviors. Specifically, I use the international Duopoly model to analyze the proposed subsidies. In this model, firms make strategies to compete, and finally achieve a Nash equilibrium: no player can benefit from changing their strategy while holding the other player’s strategy constant. Assume that the current giant U.S. vendors to be a group, and the Chinese vendors to be another group. Since the U.S. and Chinese telecommunications manufacturing industries consist of a small number of large competitors, international competition between the Chinese group and the U.S. group is imperfect. The possibilities of the two groups’ rational behaviors under the free competition are shown in the following Table 6:

Table 6: Behaviors Possibilities I

<table>
<thead>
<tr>
<th>COMPETITION</th>
<th>The U.S. Vendors</th>
<th>Don't Produce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produce</td>
<td>The U.S. Vendors: -$10</td>
<td>The U.S. Vendors: $0</td>
</tr>
<tr>
<td></td>
<td>Chinese Vendors: -$10</td>
<td>Chinese Vendors: $200</td>
</tr>
<tr>
<td>Don't Produce</td>
<td>The U.S. Vendors: $200</td>
<td>The U.S. Vendors: $0</td>
</tr>
<tr>
<td></td>
<td>Chinese Vendors: $0</td>
<td>Chinese Vendors: $0</td>
</tr>
</tbody>
</table>

In this situation, assume the U.S. vendors are first-movers (the U.S. vendors are usually first-movers in the telecommunications manufacturing industry historically), and
they plan to produce and make $200 profit. The Chinese vendors choose not to produce when they see that there is no margin profit left in the U.S. market.

However, if the Chinese vendors receive a $50 subsidy from the Chinese government to produce, they will produce and make profits, whether the U.S. vendors produce or not. This induces the U.S. vendors not to produce unless they get a subsidy too. If both the Chinese vendors and the U.S. vendors produce, supply will outstrip demand, then the price and profit will fall. The Chinese vendors still get $40 profits via government subsidy, whereas the U.S. vendors lose $10. Seeing this, the U.S. vendors choose not to produce. Refer to Table 7.

Table 7: Behaviors Possibilities II

<table>
<thead>
<tr>
<th>EFFECTS OF $50 SUBSIDY ON CHINESE VENDORS</th>
<th>The U.S. Vendors</th>
<th>Don't Produce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produce Chinese Vendors: $40</td>
<td>The U.S. Vendors: $-10</td>
<td>The U.S. Vendors: $0</td>
</tr>
<tr>
<td>Produce Chinese Vendors: $200</td>
<td>The U.S. Vendors: $200</td>
<td>The U.S. Vendors: $0</td>
</tr>
<tr>
<td>Don't Produce Chinese Vendors: $0</td>
<td>The U.S. Vendors: $0</td>
<td>The U.S. Vendors: $0</td>
</tr>
</tbody>
</table>

This result yielded by the model is consistent with the conclusion of Brander and Spencer. The Chinese vendors can succeed in international competition with government help. The Chinese government can choose export subsidies as a development strategy, and moreover, the government also can use R&D subsidies or other investment subsidies to accelerate the international development of the telecommunications manufacturing
industry even when the export subsidies are constricted by international rules.

The R&D subsidies are better than direct export subsidies because the R&D subsidies facilitate the development of innovative technologies instead of firms. The telecommunications manufacturing industry is different from other industries because it is a high-technology industry which deploys the most advanced technologies. Information technology is usually linked with economic growth, particularly in China, a less-developed country. Francisco Rodríguez and Ernest Wilson examine the information and communication technology (ICT) gap between rich and poor countries and find the relationship between ICT and the national economy: “these new innovations have the potential for transforming societies internally, and transforming their relationships to the global economy.”89 They suggest the expansion of ICT will bring positive possibilities for development in less developed countries. Since the telecommunications manufacturing industry is applying the advanced ICT and the telecommunications vendors are very important in developing the ICT further, R&D subsidies to the telecommunications vendors are necessary. Likewise, Krugman and Obstfeld suggest R&D subsidies instead of the general subsidy for the government to foster the high-technology industry: “A general subsidy for a set of industries in which this kind of knowledge generation is believed to go on is pretty blunt instrument for the purpose.”90

Therefore, R&D subsidies for the telecommunications manufacturing industry, which applies and develops information and communication technologies, are more helpful than direct export subsidies. The official research institutes, for example, Chinese
Telecommunications Science & Technology Research Institute, sponsor

telecommunications manufacturing firms by providing R&D resources. Many Chinese firms benefit from rapidly upgrading technology. With higher R&D capability, the Chinese vendors gain more competences in the U.S. market.

3.6 Analysis of Other Trade Policies

In addition to the subsidies policy, the Chinese government can make other policies to support the Chinese telecommunications manufacturing industry development. For example, the government can have local content requirements to limit the import of telecommunications equipment. This policy requires that at least a certain percentage of equipment be produced domestically, and stimulates international vendors to establish joint ventures or manufacturing plants in China to be localized.

The most famous joint venture in the Chinese telecommunications manufacturing industry is Alcatel Shanghai Bell, the first telecommunications joint venture with majority foreign ownership. Lucent has two labs in Beijing and Shanghai and three other joint Chinese ventures. It opened another R&D center in Nanjing in 2004. Motorola, one of the largest foreign investors in China, invests more than US$3.4 billion and has eight joint Chinese ventures.91 After dropping the lawsuit against Huawei, Cisco views China as a major technology center, and it plans to invest US$32 million in its new Shanghai research center in the next five years. Cisco’s CEO John Chambers say: “We believe in giving something back and truly becoming a Chinese company.”92 The Chinese government assists the Chinese telecommunications manufacturing industry by absorbing capital investments and by transferring technology from these joint ventures to domestic

91 Company profile, (http://www.motorola.com.cn/about/inchina/).
Alternatively, the Buy Chinese Acts requires the Chinese state-owned carriers to buy Chinese telecommunications equipment. Some local Chinese governments ask the carriers to purchase domestic telecommunications equipment unless comparable foreign equipment is much cheaper. There are U.S. firms claiming that the “buy local” policies increase costs for the Chinese telecommunications carriers. For example, the American Chamber of Commerce in the People's Republic of China (AmCham-China), which represents the U.S. companies and individuals doing business in China, says that:

“AmCham-China believes it would benefit Chinese industry to purchase telecommunications equipment on the basis of functionality and cost requirements for any given project, rather than favoring domestic enterprises. Buy local policies that treat joint ventures as completely foreign vendors serve only to discourage further foreign capital or technology investment in the country.”

The Chinese government has a different perspective on these policies. By fostering the growth of the Chinese vendors, the Chinese government has helped the Chinese telecommunications manufacturing industry to pass its infancy. Today, the Chinese vendors compete with the U.S. vendors and resulting in dramatic telecommunications equipment prices decreases for the Chinese carriers.

To support the future development of the telecommunications manufacturing industry, the Chinese government also sponsors new telecommunications technology R&D, such as the TD-SCDMA standard, which is a substitute for the 3G WCDMA and CDMA2000 standards. The Ministry of Information Industry (MII) is keen to issue 3G licenses “because the government wants to use its market clout to influence the development of 3G worldwide.”

of the TD-SCDMA standard is to achieve independent technology to negotiate with foreign vendors and facilitate the domestic telecommunications equipment vendors.
Chapter 4 Conclusion

Viewed as an economic engine, the telecommunications manufacturing industry is very important to China's national economy. By analyzing the U.S. telecommunications manufacturing market and the growing Chinese telecommunications manufacturing industry, I find that the Chinese telecommunications equipment vendors have comparative advantages from lower costs (mainly engineering costs) and some technologies in competing with the current U.S. incumbents. Chinese vendors have developed enough to enter the U.S. market. Possible strategies for the Chinese vendors to enter the U.S. market are suggested: investing more in R&D, setting low prices with appropriate portfolios, establishing joint ventures and R&D centers, building reliable brands, and learn more about the U.S. regulations.

In the meantime, this paper suggests that government should play an active role in the Chinese telecommunications manufacturing industry’s international development for the sake of China’s future prosperity. After analyzing different government protective regulations, tariffs are not recommended. Instead, I suggest the Chinese government use R&D subsidies, local contents requirements, and Buy Chinese Acts. Supported by the Chinese government, the telecommunications manufacturing industry promises to achieve its international development.
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