Globalization and the Firm in Developing Countries:

An Analysis of China's Electrical and Electronics Industry

（グローバル化と発展途上国の企業： 中国電機・電子産業の分析）

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Introduction

1 Background

Does globalization have positive or negative effects on economic growth of developing countries? Developing countries seek to accumulate technologies for industrialization; on the other hand, developed ones already have technologies as they began industrialization earlier. Technologies are sets of knowledge for production and make it possible to use new production methods and produce new products (Mansfield 1968). If countries were isolated from the world, development problems of developing countries would boil down to domestic problems of themselves. Since every country, however, influences others through international economic activities, such as international trade and foreign direct investment (FDI), under globalization, therefore developing countries cannot be unrelated to the existence of developed countries. Developed countries might become technologies givers or tough competitors for firms in developing countries, therefore the problem whether developed countries have positive or negative effects has attracted much attention.

Numerous studies have been conducted to evaluate the effects of globalization on developing countries and their local firms. In related field, technology diffusion has been focused on as a determining factor of the positive and negative effects of globalization.[1, 2] Specifically, if technologies diffuse from developed countries to developing ones through international economic activities, then developed countries promote the growth of developing countries and their local firms through a positive effect

[1] In this study, technology diffusion means that technologies developed in developed countries become used in developing countries. This is used for the same meaning as technology transfer.

[2] In addition to technology diffusion, the influences of globalization on growth in developing countries depends on terms of trade, mobility of capital, etc. (Bardhan and Udry 1999; Acemoglu 2009).

(technology spillover effect).[3] On the other hand, if technologies do not diffuse, then developed countries impede the growth of developing countries and their local firms, and firms in developed countries dominate markets in developing countries, causing a negative effect (market-stealing effect). In this way, the growth of developing countries and their firms depends on whether or not the technology level of developing countries can be homogenized with that of developed ones.

However, in reality, although firms in developing countries have not been homogenized technologically, however they have been growing under globalization. To show it, this study analyzes a growth mechanism of Chinese firms in the electrical and electronics industry as a case study on firms in developing countries. Since China's economic liberalization in 1978, the economy has gradually started transition from a planned economy to a market economy and opened up to the world. Under liberalization, the electrical and electronics industry has become a leading industry in China and a number of local Chinese firms have grown. Also in Southeast Asian countries, they have opened up and accepted large volume of FDI, realizing rapid economic growth. However, foreign firms from developed countries have a strong presence in some countries, such as Malaysia. As a result, unlike in China, their local electrical and electronics industries have developed at a sluggish pace. According to these circumstantial evidences, we might recognize that globalization has promoted the local industrial development through technology diffusion in China.

This is, however, not the case. FDI has not necessarily contributed to the growth of local Chinese firms, because FDI has not completely filled up technological gaps. However, local Chinese firms offset technology deficits by differentiating boundaries of the firm, in comparison with those of foreign firms in developed countries, and built a unique competitiveness through fierce competition among other local firms and foreign firms. Boundaries of the firm indicate make-or-buy choices for intermediate goods and services on the value chains of final goods (Besanko et al. 2009). In general, make-or-buy choices relate with manufacturing of components within a final product, however an interesting point in boundaries of local Chinese firms relate with not only manufacturing of products, but also development and sales of them. Therefore, we divide value chains into three stages: development, manufacturing, and sales. In China's electrical and electronics industry, foreign firms tend to develop new products by themselves; on the

[3] Technology spillover means that technologies of developed countries and their firms spread to developing countries and their firms through foreign firms. This is a form of technology diffusion.

other hand, local firms tend to outsource the development stage to outside firms, due to a technological disadvantage, and integrate their sales network, exploiting a home advantage. In this way, there is an alternative growth pattern of heterogenization or diversification in terms of boundaries of the firm.

The heterogenization relates to the following two factors: the technological change and the diversity of the Chinese market. Production systems of various manufacturing industries have been specialized vertically and structures of various products have been modularized since the 1990s. As a result, the changes have made entry and growth easier for firms in developing countries which do not have enough technologies. In addition, the demand side also has helped enter and grow for local firms. As the most populous country, the Chinese market is huge and fairly different from place to place, from urban to rural markets, and from high- to low-end markets. As a result, local firms have an advantage to develop such diversified markets in comparison with foreign firms which are not familiar with situations of the Chinese markets and tastes of Chinese consumers. The factors have influenced the decision making of boundary choice of local Chinese firms.

However, a relation between the boundaries of foreign and local firms has not been discussed explicitly in the past. Since strategies of competitors influence each other in markets, therefore, to evaluate grounds of rationalities of the heterogeneity of local Chinese firms, it is necessary to clarify the influence of foreign firms on local firms. In this study, we systematically analyze boundaries of local firms and related topics under the influence of foreign firms.

The rest of the introduction is organized as follows: Section 2 reviews previous studies in relation to globalization and developing countries, and clarifies our issue. Section 3 shows our analytical framework and overviews of each chapter in this study.

2 Survey and Issue

This section reviews relevant studies on the framework described above and raise a problem to be discussed in this study.

2.1 Relations between Developed and Developing Countries[4]

2.1.1 Globalization and Growth: Model Analysis

As mentioned above, it has been recognized that the relationship between openness and growth in developing countries depends on technology diffusion. The relationship has been studied dynamically since the development of the endogenous growth theory (Bardhan and Udry 1999; Long and Wong 1997; Todo 2008), though it had been previously analyzed using comparative statics (Meier 1963). In the endogenous growth theory, technology changes as a factor of long-run growth, which is explained in the models (Grossman and Helpman 1991; Barro and Sala-i-Martin 2004; Aghion and Howitt 2009; Acemogle 2009); however, technology changes are not explained explicitly through the neo-classical growth theory (Solow 1956). To do this, the endogenous growth theory incorporates mechanisms of technological improvement. The factors include learning-by-doing (LBD) increasing research and development's (R&D) productivity (Romer 1986), human capital investment through education (Lucas 1988), increasing variety of new goods (Romer 1990), etc.

Extending the endogenous theory in an open economy has advanced studies on the relationship. Grossman and Helpman (1991) showed that trade between developed and developing countries results in a positive effect on the growth of developing countries through absorbing technologies of products made by developed countries. This result implies that openness does not necessarily result in a positive result when technologies do not diffuse. Young (1991) analyzed the negative effects of openness explicitly. In his model, there were technological gaps, that is, productivity gaps, between developed and developing countries due to LBD. Consequently, developed countries concentrate on producing high-tech products, which have room for productivity improvement. On the other hand, developing countries produce low-tech products that do not have room for improvements in productivity. Therefore, globalization prevents the development of high-tech industries in developing countries.

In this way, the influences of globalization on industrialization depend on technology diffusion. The case of trade between developed and developing countries is in

[4] In addition to the influences of the former on the latter, the relationship between globalization and growth also includes influences of the latter on the former (Feenstra 2004). Furthermore, studies on the influences of openness include various viewpoints, such as the relationship between openness and growth not only in developing countries but in developed countries; the relationship between large and small countries, etc.

contrast to the case of trade between developed countries.[5] Rivera-Batiz and Romer (1991) showed that trade between developed countries in technology levels increases the knowledge available for R&D and enhances the growth of every country under globalization. On the other hand, their model suggests that, if countries which have technologies and do not have technologies open their economies each other and technologies do not diffuse, then the existence of countries with technologies impede the growth of countries without technologies.

2.1.2 Technology Diffusion

Technology diffusion is an essential factor of growth; therefore, it has always been studied. For example, Mansfield et al. (1982) discussed technology diffusion and its positive effects. According to the authors, 26 items of technologies developed in the United States (U.S.) were diffused to local firms abroad through the U.S.'s overseas subsidiaries in an average of four years during 1960 to 1978. The diffusion contributed to the decreased production costs of the local firms.

Such an effect, which decreases technology gaps, is known as an advantage of backwardness. Based on the experiences of European countries in the 19th century, Gerschenkron (1962) showed that when developing countries introduced technologies from developed countries industrialization occurs rapidly if developing countries can establish the appropriate foundations necessary to progress. The foundations include various measures, such as intensified investment using banking systems, aggressive interventions by governments, etc.

Reviewing the experiences of East Asian countries, we find many cases of the advantage of backwardness. In a study on Asian Newly Industrializing Economies (NIEs), Watanabe (1979) found that countries with social abilities, such as skilled labor, entrepreneurial abilities, and governmental administrative abilities, grew steadily. Amsden (1989) clarified that South Korea used aggressive government protection policies for home industries, industrial development centering on large-sized conglomerates (*chaebol*), and exerted opportunities to learn from developed countries. In addition to the roles of the government and *chaebol*, Fukagawa (1997) included emerging

[5] Even if countries can access the technology stocks of trade partners through openness, there is a possible disadvantage that competition in technology development will heat up among them (Eaton and Kortum 2001). As a result, there is a possibility that the positive effect of openness is mitigated by this disadvantage.

economic agents of labor (labor unions) and financial institutions (especially banks), and showed Korea's development through absorbing experiences from the U.S. and Japan and their problems.[6] Suehiro (2000) analyzed the social ability to realize advancement in industrialization at each level in the government, firms, and workplace, based on experiences in Thailand. In this way, emerging countries in East Asia have established foundations and seized the advantage of backwardness.

Specifically, technologies are diffused through importing, exporting, and FDI (Keller 2004).[7] Importing provides the opportunity for developing countries to come into contact with new products produced by developed countries; therefore, developing countries can expect to gain new knowledge through imports. Exporting provides opportunities for competing with competitive firms in international markets; therefore, firms in developing countries can expect to increase their productivities through exports (learning-by-exporting). Inward FDI has the opportunity to diffuse technologies through the business activities of multinational enterprises (MNEs) in host countries. For example, employee job changes from MNEs to local firms can spread knowledge.

Furthermore, transactions and affiliations with firms in developed countries becomes a channel of technology diffusion. Hobday (1995) revealed that firms in Asian NIEs, Korea, Taiwan, Hong Kong, Singapore, acquired technologies through transactions and affiliations with foreign firms. In addition, Kawakami and Sturgeon (2011) found that East Asian firms in various industries joined global value chains (GVC) and received opportunities to learn technologies.

In addition, technology obsolescence leads to technology diffusion. Based on the product lifecycle (introduction, growth, maturity, and decline), Vernon (1966) showed a product lifecycle (PLC) hypothesis that stated that as products produced in developed countries become obsolete, their production bases move to developing countries. Krugman (1979) formulated a model of the hypothesis. New products produced in developed countries are imitated by developing countries, therefore it showed that trade patterns of new and existing products between developed countries and developing ones depends on the speed of new product development by developed countries and imitation of new products by developing countries. The PLC hypothesis was employed to analyze developing countries under globalization. For example, suppose a cat-and-mouse game

[6] See Fukagawa (1989) for the development process of each industry and technology transfer from developed countries to S. Korea.
[7] In addition, Keller notes geographical proximity, etc., as factors of technology diffusion.

between technology progress in developed countries and imitation in developing countries, Grossman and Helpman (1991) developed an endogenous growth model about the growth of developing countries. Antràs (2005) incorporated the PLC hypothesis into the boundaries of the firm. He showed that sourcing to developing countries by firms in developed countries depended on the extent of technology obsolescence.

However, there are reasons why technologies do not diffuse. The first reason is the characteristics of technology. If technologies are implicit knowledge and know-how, then it is difficult to access technologies, by definition. LBD also contains this characteristic. Technologies in the form of LBD are acquired through production; therefore, they are restricted to the learners themselves. Also, if technologies are protected by patents, they are possibly restricted from diffusion virtually. Accessing technologies is easy due to the disclosure of technologies; however the usage of technologies is regulated and entails high costs in some cases. The second reason for a lack of diffusion relates to technology absorption capabilities. Abilities on the side of developing countries are required to take advantage of technology diffusion. For example, Keller (1996) indicated that some extent of R&D investment by firms in developing countries is required. The third reason relates to technology gaps. Technology gaps are an advantage of backwardness for developing countries; however, they can be a disadvantage of backwardness if gaps are too large to close. Aghion and Griffith (2005) found that firms facing significant gaps may not be able to absorb technologies because technologies of firms in developed countries are too difficult for firms in developing countries to master. The final reason for a lack of diffusion relates to historical backgrounds. For example, Parente and Prescot (2000) stated that a labor rebellion against the introduction of new technologies blocks technology progress and decreases income levels, based on the experiences in India's textile industry before World War II.

2.1.3 Globalization and Growth: Empirical Analysis

The question of whether globalization brings positive or negative effects actually has been verified using empirical analysis. However, it is difficult to reach a settlement due to methodological limitations.

Many studies have reported positive effects of trade on growth in developing countries; however, methodological problems have also been identified (Harrison and Revenga 1995; Harrison and Rodríguez-Clare 2010; Rivera-Batiz and Oliva 2003). Economic growth rates are generally regressed on a variable of openness, and researchers

face the challenge of determining what indicators to use to indicate openness. Some studies used differences between domestic and international prices; however, the proxies may reflect macroeconomic situations, such as foreign exchange rates, over trade policies. To deal with trade policies explicitly, tariffs were often used; however, there remains a question of whether tariff revenues or tariff rates should be used. In addition to the indicators relating to trade policies, ratios of trade values to GDP have also been used, but these may create an endogeneity problem between income as a dependent variable and trade values as an independent variable, unless the problem is dealt with appropriately.

In addition to the relationship between trade and growth, the relationship between FDI and growth has been studied empirically. Results are more ambiguous than those between trade and growth. For example, Kokko (1994) shown that FDI can have a positive effect of technology diffusion, using data in Mexico. By contrast, Aitken and Harrison (1999) shown that foreign firms entering the market through FDI have eaten away at the market and thus had a negative spillover effect on the productivity of local firms in Venezuela. Also in the Czech Republic, Djankov and Hoekman (2001) shown that FDI has had a negative impact on the sales growth of local firms.

Microeconometric studies of the relationship have increased since the 1990s because much of the micro data at the firm- and establishment-levels has become more readily available. As a result, differences in growth among firms and establishments have been widely studied. For example, Kinoshita (2001), Girma (2005), Todo (2008), etc., stated that the influences of FDI on the growth of firms in developing countries depend on whether or not firms have technology absorption abilities. Thus, it is known that the positive effect of FDI comes under the condition that local firms have technology absorption abilities.[8]

2.1.4 Infant Industry Argument

Negative influences of globalization have been discussed in the infant industry argument for a long time. An infant industry is generally a nascent industry in a developing country. Such an industry might get a comparative advantage in the future; however, the industry must be protected temporarily due to its low productivity in comparison with the mature

[8] Related to the abilities, Borensztein et al. (1998) shows that FDI has a positive effect when human capital is accumulated enough through education (secondary school attainment), although their study is based on country-level data.

relevant industry in developed countries (Krugman et al. 2012).[9]

We can track the concept of the infant industry argument back to mercantilism in the 17th century (Irwin 1996). Mercantilism, including protective trade, was criticized by Adam Smith, but the idea of protection has been maintained. When the United Kingdom (U.K.) experienced the industrial revolution in the late 18th century, the necessity of protective trade was realized for latecomers, such as the U.S. and Germany. At first, Hamilton (1791) appealed to the need for customs duties to develop the U.S. manufacturing industry.[10] This is because the U.K.'s mature firms had significant advantages in both quality and price compared to the U.S. Also, List (1870) explored the need for protective institutions that were necessary to develop the German manufacturing industry.

The infant industry argument has been sophisticated in terms of its justification and criteria for protection. Justification has been underpinned by a shortage of dynamic economies of scale and its spill-over externalities (Corden 1997). The former indicates a shortage of an effect which decreases the average cost along with an increase in accumulated production volumes, i.e., experience effect or learning effect. The latter indicates that private incentive probably does not create optimal social production if one's experiences also increase competitors' productivity. Only in cases in which market failures of externalities exist is government intervention justified. This means that every nascent industry should not be protected.

In addition, criteria of protection also have been tightened (Baldwin 1969). The following criteria have to be satisfied. Mill's criterion states that the average cost of firms in developing countries should decrease compared to that in developed countries. Bastable's criterion states that an increase in social benefit from protection in the end should exceed the decrease of the benefit at the beginning. The previously mentioned criteria are just comparisons between the costs and benefits of protection; therefore, they do not concern the necessity of government intervention (Ito et al. 1988). Kemp's criterion relates to government intervention. Kemp (1960, 1964) criticized the widely-used Mill-Bastable criteria and argued that intervention should be limited to cases

[9] There are the other policies to mitigate the negative effect. For example, even Bhagwati (2004), who has a viewpoint that globalization promotes the growth in developing countries, emphasizes the necessity of a policy for the class suffering losses by openness.

[10] However, it should be noted that the report was not only written to promote trade protection. It was reported to initiate the importance of manufacturing in comparison to agriculture.

of market failure, specifically the existence of externalities in infant industries.[11]

There are other aspects to be considered. For example, Sauré (2007) argued that protection does not necessarily promote the accumulation of new technologies in developing countries. That is because firms in developing countries are likely to prefer the technologies used in the past, even if there are new technologies that enable productivity increases.

Furthermore, protection policies themselves have been argued. Baldwin (1969) and Corden (1997) showed that domestic policies, such as subsidies, are better in terms of welfare distortions than trade policies, such as tariffs. According to Melitz (2005), however, subsidies are not realistic due to the burdens of expenditures on developing countries. He argues that quota systems are better in terms of social welfare than tariffs, because the former makes domestic prices close to international prices and increases LBD, whereas the latter does not.

2.1.5 Issue

The discussion about the relationship between openness and developing countries has not been settled. Influences in each case where technologies diffuse and do not diffuse were studied in model studies. Specifically, technology diffusion and its conditions have been investigated, primarily through East Asian experiences. In addition, the effects of globalization have been tested empirically. Furthermore, protection has also been studied from the viewpoint of the negative effect of globalization. In this way, the previous studies assumed that growth depends on technology diffusion from developed countries to developing ones or technological catch-up. In terms of a comparison in technology between developed and developing countries, we can say that growth depends on technological homogenization between them.

However, looking at actual growth in developing countries, we find that firms have been growing though technology gaps. Local firms in China's electrical and electronics industry faced a technology deficit; however, the institutions realized growth by offsetting the deficit. To do this, the firm had to differentiate its boundaries. Local Chinese firms have outsourced business activities with disadvantages and focused on activities with advantages.

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[11] To focus on a comparison between the cost and benefit of industrial development, the Mill-Bastable has been used as the criteria of protection, even after Kemp's studies. For example, Melitz (2005) uses the Mill-Bastable criteria to analyze optimal trade policies.

Therefore, there is a need to study a phenomenon that firms can grow by heterogenizing the boundaries of the firm even though technologies do not diffuse completely. Boundaries of firms in developed countries under globalization were studied by Antràs and Helpman (2004) and Antràs (2005). They analyzed whether firms in developed countries make products in-house or outsource, showing a mechanism of multi-nationalization of firms. In this study, we analyze boundaries of firms in developing countries under globalization. In the next section, reviewing the relationship between openness and growth in China, we will show that openness brings technology diffusion and growth, and makes the boundaries of the firm heterogenize.

2.2 A Case of China

2.2.1 Openness and Growth

To verify the heterogeneity of local firms in developing countries, we study growth of local Chinese firms under globalization. The Chinese economy has begun to grow rapidly since the economic transformation, that is, the economic reform and open-door policy (*gaige kaifang*), launched in 1978 (Hoken and Kimura 2004; Nakagane 2002; Naughton 2007; Wu 2010). The Chinese government had closed the economy due to worsening ties with the superpowers, the U.S. and former Soviet Union, in the Cold War era, so the open-door policy has had a significant influence on the almost closed economy when China has oped up to the world (Kojima 1997). The open-door policy is another of the two wheels of the economic transformation. The open-door policy has stimulated trade and inward FDI. China finally became a member of the World Trade Organization (WTO) in 2001. Outward FDI from China has also been increasing since the late 1990s; therefore, China has become a major investor. Openness has had a significant influence on growth in China, so its relationship has been studied intensively (Ohashi 2003; Kojima and Horii 2007; Branstetter et al. 2008; Pei et al. 2008).[12]

It has been recognized that the open-door policy has had a positive effect on economic growth in China, and technologies have been diffused by the reform (Fan 1992; Jiang 1993; Li 2009).[13] Technologies were introduced intensively through importing

[12] On the other hand, Huang (2003) indicates that the huge inflow of FDI shows the weakness of the Chinese economy. According to him, FDI has been inflowing to fill weakness in the private economy and fragmented markets in China.

[13] However, influences of FDI on industrial development depend on local governments. Thun (2006) compared automotive industries in Shanghai, where the local government exercises strong leadership;

plants and equipment associated with factory construction until the mid-1990s (Kimura 2012a). Technological introduction through patents and designs is not adequate for developing countries that have poor technology absorption ability and face significant technology gaps (Yin 2003). However, it becomes difficult to make high-quality products with only hardware, such as plants and equipments. The knowledge necessary for manufacturing management had also been introduced (Hao 1999; Yuan 2009). As a result, technology introduction has been expanded since the mid-1990s (Marukawa 1990; Maruyama 1988; Ohashi 2003). In addition to plants and equipments, technology transfer and consulting have also become major introductions. The content of technology introduction has upgraded along with the growth of Chinese firms and the increase in R&D investment. Openness has contributed to growth through technology diffusion.[14]

In addition, FDI from developed countries has diffused many technologies. Subsidiaries of MNEs in China have introduced technologies from their home countries, so technologies, which were not in China initially, have been accumulated. Also, FDI has brought knowledge spillover to Chinese firms indirectly. The Chinese government has tried to open the economy and receive FDI actively; therefore FDI has had significant influences on economic growth and industrial development. For example, Qiu (2009) analyzed a relationship between FDI and total factor productivity (TFP) at the industry-level and showed that there is a spillover effect through FDI. Jiang and Zhang (2006) also showed that, the higher the technology absorptive ability is, the bigger the spillover effect is.

Through economic growth, various industries have been developing in China. In particular, due to its abundant labor force, labor-intensive industries have developed significantly. During the planned economy, the Chinese government had ignored China's comparative advantage and placed emphasis on capital-intensive or heavy and chemical industry, such as steel, chemical, machinery industries, etc. (Lin et al. 1994). The resource allocation has been changed in line with the comparative advantage in China. In addition, the vertical specialization and the modularization of product structures have supported the

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in Beijing and Guangzhou, where the local governments takes a relative laissez-faire approach; and in Changchun and Wuhan; where local firms exerts strong leadership.

[14] At the same time, protection policies also contributed to domestic industrial development under gradual liberalization. For example, even though foreign firms entered the Chinese market, they faced some restrictions to selling there because rights for foreign trade and domestic sales were limited. Also, in production, they were limited to investment in some industries and areas and they were required to affiliate with local firms (especially, SOEs). In this way, there were some restrictions on foreign firms. In addition to technology diffusion, room for growth was restricted to Chinese local firms.

rapid industrial development. As it has been developing, some Chinese firms became subcontractors on value chains led by firms in developed countries, but local firms have other characteristics. Chinese firms also produce final goods with their own brand and compete with firms in developed countries. Therefore, we will study differences in boundaries between foreign and local firms with their own brand.

China's electrical and electronics industry has been developing and includes local firms with their own brands.[15] The defense industry, including the production of radar, specialized telecommunication equipments, aviation navigation equipments, etc., was initially promoted and the production of civilian goods was not (Dong and Wu 2004). However, state-owned enterprises (SOEs) in the defense industry started to produce consumer products in the late 1970s. Furthermore, a lot of SOEs run by local governments and Township and Village Enterprises (TVEs) entered the industry in the 1980s. Then, many private and foreign firms also entered the market, especially in the 1990s. As a result, China's electrical and electronics industry has continuously developed. When local firms entered the market, they introduced a lot of production lines and related technologies from developed countries like Japan (Amano 2005; Hao 1999). As a result, local firms became competitive with foreign firms. This fierce competition contributed to reduce product prices and local firm competitiveness in product quality, the establishment of sales, and the after-purchase servicing networks. As a result, local firms expanded market share in various markets under the processes of the diffusion of home appliances in urban areas from the late 1980s to the 1990s and in rural area from the late 1990s to the 2000s (Watanabe and Kimura 2012). Then, exports and outward FDI by local firms increased in the late 1990s (Kimura 2012b). At present, local firms continue to grow, though they have been challenged to increase R&D, to obey environmental regulations, etc. (Kimura 2008, 2010a).

2.2.2 Diversification of Firm Organizations

Although Chinese firms in the electrical and electronics industry have grown steadily under globalization, however they have not been completely homogenized with foreign

[15] In standard textbooks on the modern Chinese economy, descriptions of industrialization and industrial development in China is not much more than institutional reform, such as system transformation, SOE reform, etc. (Naughton 2007; Wu 2010; Kato and Uehara 2011). However, there are a lot of studies on industrial development. On the electrical and electronics industry, see *Dangdai Zhongguo* Congshu Bianji Bu (1987), *Zhongguo Dianzi Gongye 50 nian* Bianweihui (1999), Pecht et al. (1999), Fan (2004), Amano (2005), Kimura (2007a), Kong (2006), Ning (2009), Tang (2009), etc.

firms in developed countries through technology diffusion. They have gone through a distinctive pattern of growth, because technological gaps between foreign and local firms have not been filled up completely. Local Chinese firms do not have the technology to make the core components of products; however they compete with other local firms and foreign firms by outsourcing the production to outside firms while they focus on expanding markets to local and rural areas and developing products that are in tune with Chinese consumers' preference.[16] This growth pattern, with its market-oriented strategy, has been emphasized as a growth strategy for local Chinese firms (Ling 2005).[17]

Consequently, many related facts have been reported in the field of area studies on China. For example, according to Marukawa (1996, 2007), local firms that develop TV sets try to have an understanding of the cathode-ray tubes (CRTs) made by various manufacturers, instead of making CRTs themselves. Few TV manufacturers make CRTs themselves; most buy them from domestic specialized manufacturers (Shanghai Caijing Daxue Ketizu 2006). In addition, Ohara (1998, 2000) showed that local air conditioner firms do not make the core components, such as compressors, but focus on establishing sales and after-sales service networks. Kimura (2006a, 2010b) showed that local mobile-phone firms do not develop printed circuit boards (PCBs) with chips; they adopt a market-oriented strategy and focus on appearance design and the establishment of sales networks. Consequently, local Chinese firms have sought ways to grow by shifting the focus to the firm to sales and marketing, though they have faced technology deficits.

This characteristic of outsourcing is associated with a time background in technology and a property in the Chinese market. First, a decreasing necessity of making core components that require vast technological knowledge is an aspect of a recent technology change. Structures of some products have been modularized, and firms of final goods do not develop and make core components by themselves (Baldwin and Clark 2000; Breznitz and Murphree 2011).[18] Firms had been likely to make core components to differentiate products and increase values of products. However, the development of vertical specialization in industrial structures brought by the digitalization of products and the development of information and communication technologies (ICT) have provided

[16] This characteristic is shared with other manufacturing industries, such as the automotive industry (Marukawa 2007; Watanabe 2011).

[17] The growth strategy of Chuangzhi Liu, the founder of Lenovo, is the most famous one. According to Ling (2005), managers should run businesses in the order of "*mao*, *gong*, and *ji*" (sales, manufacturing, and technology development).

[18] It should be noted that modulization possibly weakens the incentive to innovate, though it has contributed to the expansion of developing countries (Nakagawa 2007).

specialized, outside firms to manufacture and develop core components since the 1990s (Fujimoto and Shintaku 2005; Yasumoto 2010).[19] For example, the modularization of core components has changed the industrial structure and firms in the mobile-phone industry (Imai and Shiu 2008, 2011; Li 2010; Shiu et al. 2008).

Second, diversification is an aspect of the Chinese market. In addition to the large size of the Chinese market, there is geographical diversity from urban to local and rural markets, and price diversity from high-end to middle- and low-end markets (Kimura 2006). Consequently, there is a market for high-quality and multi-function products supplied by foreign firms as well as a market for price-competitive products with only basic functions. Even if the urban market reaches points of saturation, there is still a vast rural market. Products for low-end markets can continue to be demanded. Therefore, local firms have a rationality to not accumulate technological abilities as core competencies.

The previous studies show that local Chinese firms in the electrical and electronics industry have aggressively used both the demand and supply factors and have gone through a distinct growth pattern. However, since the previous studies have not explicitly compared heterogenized boundaries of local firms with boundaries of foreign firms as competitors, therefore the rationality of the heterogeneity has not been clarified thus far. As shown in the previous section, the existence of foreign firms, whether positive or negative, can influence to local firms without technologies under the international economic structure. If we do not incorporate the existence of foreign firms in boundary choice of local firms, we cannot evaluate the extent to which local firms homogenize and heterogenize their boundaries. Surely, it must be irrational to heterogenize without end. Therefore, we analyze decision makings of local firms in the context of competition with foreign firms. To do this, we use an analytical framework as shown in the next section.

3 Analytical Framework and Outline

This section introduces our analytical framework and outline for the whole study.

[19] Because industrial agglomerations have been developed, especially in China, it has become easier to purchase intermediate goods (Kimura 2007b).

3.1 Analytical Framework

This study analyzes a growth mechanism of firms in developing countries, based on a case of China's electrical and electronics industry. China has succeeded in industrialization as a latecomer, depending on outside firms which provide development activities and core components under globalization of production and modularization of product structures. Local Chinese firms have particularly played a significant part in the industrial development. They have set the peculiar boundaries and realized the growth.

To analyze the heterogenization mechanism of firms in developing countries facing technology gaps, we must show: (1) technology does not necessarily diffuse. When we look at a relationship between FDI and the productivity of firms in developing countries, if FDI increases productivity, then there is a possibility that FDI will bring technology diffusion. But, if FDI does not increase productivity, then there is a possibility that FDI does not bring technology diffusion.

The relationship between FDI and productivity is analyzed using a method from previous studies. In them, it was common that the levels or growth rates of production or the productivity of firms were regressed on variables that show the presence of foreign firms (specifically, a ratio of capital of foreign firms on total capital in an industry). If a parameter of this variable is positive (negative), then the spill-over effect (market-stealing effect) can be found.

Based on the assumption, we verify that: (2) local firms offset technology gaps by differentiating their boundaries. If there are technology gaps, there is a possibility that it is not rational for local firms to integrate business areas that require significant technological abilities. Therefore, local firms tend to utilize a home advantage by focusing on sales to offset technology gaps. In this way, the boundaries of local firms can be heterogenized, leaving areas with disadvantages up to outside firms and integrating areas with an internal advantage. To be precise, local firms are likely to depend on Korean and Taiwanese firms and local firms specializing in product development. The existence of firms with technological abilities becomes an important condition for the growth of local firms. Consequently, there is a possibility that heterogenization is not a rational choice for the increase in product values.

To inquire about the link between technology gaps and the boundaries of local Chinese firms, this study analyzes an influence of LBD on boundary selection. A model of boundary selection was developed by Grossman and Hart (1986) and Hart and Moore

(1990). However, their model does not deal with the technological levels of firms facing boundary selection. Therefore, we incorporate the existence of technology gaps and the shortage of LBD into boundary selection, analyzing the boundary selection of firms in developing countries explicitly.

Finally, to show a condition to cultivate the home advantage for local Chinese firms, we clarify that: (3) there is fierce competition in the Chinese market. Competition among local firms has pressed them to build more effective sales networks than other local competitors which have the common advantage.[20] As a result, competition among local firms has contributed to improve their common competitiveness in sales and marketing for the whole local firms. Therefore, competition has an important role for heterogenization which is seen as a similarity in local firms.

To verify whether the market is competitive or not, a market structure and its change are analyzed. A market structure includes the number of entry firms and their market share. Reviewing these factors will verify whether a market is competitive or oligopolistic (Tirol 1988). In addition through determinants of a market structure, market growth is also analyzed. In growing markets, market structure tends to be dispersed by increasing new entrants (Siegfried and Evans 1994).

3.2 Outline

Chapter 1 analyzes the first issue.[21] Under the assumption of heterogenization mechanisms, the chapter shows that FDI does not necessarily diffuse technologies and has a possible negative influence on local firms. To conduct the analysis, we econometrically analyze the relationship between investment and growth. Specifically, we verify whether FDI has positive or negative influences on the added value and TFP of local firms in 38 sectors of China's electrical and electronics industry. As a variable of FDI, a ratio of fixed assets of foreign firms to total fixed assets in each sector is used. The results show that sectors with less experience and lower technology levels, in comparison with those in developed countries, are likely to experience negative effects of globalization. Consequently, although local firms in these sectors have greater potential

[20] Consequently, structures of sales networks vary from local firm to local firm. See Zheng (2012) for similarities and differences in their sales activities.
[21] Chapter 1 was published as Kimura (2012c).

for growth, they cannot absorb enough of the technologies from foreign firms due to the significant gaps and the shortage of experiences. Therefore, even though the industry has been developing as a whole, the effects of FDI depend on the characteristics of the sectors.

Chapters 2 and 3 analyze the second issue.[22] The chapters analyze the boundary selection of local firms facing technology gaps. At first, we conduct a case study of China's mobile industry to make selections of local Chinese firms. Chapter 3 also conducts a qualitative a case study and organizes complicated phenomenon in the industry.[23] We analyze the relationship between the technology levels of local firms and boundaries. Because the technological levels of local firms are lower in comparison with those of foreign firms, we show that local firms depend on external Chinese, Korean, and Taiwanese firms for product development and manufacturing, in some cases. On the other hand, local firms utilize their home advantage and tend to focus on the establishment of sales networks designed to match the preferences of Chinese consumers.

Next, Chapter 3 conducts a model analysis for the third issue. Because the boundary selection under technology gaps is the essence of this study, we generalize the case study in Chapter 3 as a model. Specifically, we incorporate the concept of technology gaps into a general boundary selection. Our results are as follows. Even though it is optimal to make core components, local firms may not be able to realize these goals if advanced technologies are required. As a result, local firms may choose to buy core components from suppliers. However, if there is a technological change in product structure, or if firms in developing countries exert the home advantage, they may increase their chances of market entry and growth.

Finally, Chapter 4 turns to analysis of the third issue.[24] Through an assumption of the heterogenization mechanism, the chapter shows that the Chinese market is competitive. To show this, the Chinese market is compared with the Indian market. Both

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[22] Chapters 3 and 4 were published as Kimura (2011b) and Kimura (2011c), respectively.

[23] In addition to literature surveys, the author and collaborators conducted the following eight field research trips on this topic in China: the first research in Beijing, Tianjin, Hangzhou, Suzhou, Ningbo, Shanghai, Nanjing, Huizhou, Guangzhou, and Shenzhen (August to September, 2004), the second one in Beijing and Shanghai (September, 2005), the third one in Guangzhou and Shenzhen (November, 2005), the forth one in Shenzhen, Xiamen, Shanghai, Guangzhou (July to August, 2007), the fifth one in Shanghai (January, 2007), the sixth one in Xiamen (April, 2007), the seventh one in Shanghai (June, 2007), and the eighth one in Beijing and Shanghai (August, 2007). We visited local and foreign electronics manufacturers, chip venders, software companies, design houses for mobile phones, distributors, retailers, marketing and consulting firms, telecom operators, etc. Moreover the author conducted frequent interviews at related firms and organizations in China.

[24] Chapter 2 was published as Kimura (2011a).

China and India's electrical and electronics industries have similar historic backgrounds, but the industrial development processes after the 1980s were really different. To compare differences in the details, we qualitatively analyzed the markets as a case study.[25] Specifically, we use a TV set market, which is a representative product in both China and India, to compare market structures and determinants. Because China and India's electrical and electronics industries were both a part of the defense industry until the partial liberalization around the early 1980s, the production of civil products, such as home appliances, was not emphasized by the government. Until the early 1990s, after the liberalization, China and India's industries grew rapidly, however China's industry has become a leading industry that influences the global market, but India's has not become so. A reason for this difference is in the characteristic differences between the markets. In China, homogeneous local firms competed with each other; therefore, the market was not dominated by a few champions. However, in India, an oligopolistic market with a few major firms occurred, so members of the top companies become to be fixed until the late 1990s. As a result, the competitiveness of local firms was established in China, but the market was eaten away by foreign firms (especially Korean firms) after the complete liberalization in India. The difference in market structures relates to entry barriers and market growth. A lot of firms were able to enter the TV market after the late 1980s in China, but licensing regulations applied until the late 1990s in India. In addition, the market continued growing in China, but the growth of the market slowed down in India. As a result, new entries continued in China, and the market structure became rigid in India.

[25] In addition to literature surveys, the author and collaborators conducted the following two field research trips on this topic: the first research in New Delhi, Mumbai, Bangalore, Kochi, Thiruvananthapuram, and Chennai, India (July to August, 2009), and the second research in Beijing and Qingdao, China (November, 2009). We visited local electronics manufacturers, industry organizations, secretariat offices of economic development zones, etc. In addition, the author and one of the collaborators visited Indian firms located in Tokyo and Kawasaki, Japan, to conduct interviews.

1

Does Foreign Direct Investment Affect the Growth of Local Firms? The Case of China's Electrical and Electronics Industry

1.1 Introduction

Whether foreign direct investment (FDI) into developing countries affects the growth of local firms in host countries is a critical question for countries seeking economic growth in the era of globalization. In published literature concerning FDI, two conflicting effects on host countries are recognized: the positive effect of technology spillover and the negative effect of market stealing (Todo 2008). Specifically, the technology spillover effect occurs when foreign firms of developed countries enter developing countries with new technologies, whereas the market stealing effect occurs when foreign firms interfere with the market entry and growth of local firms, which reduces the productivity, growth, and market share of local firms in host countries.

The results of empirical studies on this topic are ambiguous as shown at Introduction. For example, studies on the manufacturing industry in Mexico show that FDI results in technology spillover to local firms (e.g. Kokko, 1994). In contrast, FDI has a negative effect on the productivity of local firms in Venezuela (Aitken and Harrison, 1999). FDI into the Czech Republic has a negative impact on the sales growth of local firms (Djankov and Hoekman, 2000). In short, the effects of FDI vary by country.

To determine why these results are ambiguous, one must consider differences

among industries.[1] A national economy consists of various industries and each industry depends on different technologies and know-how. For example, although overall total factor productivity (TFP) in China has increased since the economic reform, there are vast differences among industries.

Ito et al. (2008) show that many industries in China, Japan and South Korea realized growth in TFP between 1999 and 2004, but some industries, such as construction, food processing and metal industries, had negative growth rates during this period. Moreover, although some industries in China, such as the motorcycle industry, recorded higher growth rates during this period than the corresponding industries in Japan and Korea, this was not always the case. For the electrical and electronics industry, the TFP growth rate was 5.2% in Japan, 11.1% in Korea, but just 2.8% in China during the period between 1999 and 2004 (Ito et al. 2008). Therefore, we investigate why the TFP growth is relatively low in this industry in China.

To discuss whether or not the technology spillover from FDI occurs to increase productivity, we verify the effects of FDI on growth of local firms in China's electrical and electronics industry. To study the influence of foreign firms, we estimate the relationship between the growth of local firms and the amount of FDI in each sector in this industry. Added value and TFP at the firm level are used as proxies for the growth of the firm. To discuss TFP of local Chinese firms, we have to remind the following two things. Firstly, factors of TFP of firms in developing countries have strong relations with not only technology diffusion from developed countries but also learning-by-doing (LBD) by local firms themselves. Secondly, since local firms might not choose to accumulate technologies purposely and depend them instead on outside firms as shown in Introduction, therefore there is a possibility that their TFP become low. However, to find an effect of globalization on local firms, we focus on the relation between TFP and FDI. The ratio of fixed assets owned by foreign firms to the total fixed assets in China is used as a proxy for FDI. In the present chapter, we examine the relationship between the positive and negative effects of FDI and technology disparities between foreign and local firms, and the relationship between the positive and negative effects of FDI and business

[1] Girma (2005) and Todo (2008) also indicate that technology absorptive capacity affects the impact of FDI on firms. If local firms have capacity, they can acquire technology. If not, they can suffer negative effects from FDI due to significant disparities in technology. Moreover, other factors also relate to technology diffusion. For example, there are possibilities that foreign firms keep technology secrets to protect competitiveness, governments ban the transfer of technologies due to diplomatic reasons,.

experiences of local firms. On the basis of this examination, we find that sectors with large technology disparities resulting from lack of business experience in local firms tend to experience negative effects from FDI. Comparing every sector in an industry applying similar technologies in electrical and electronics products, this study clearly shows the potential negative effects of FDI in each sector.

The present chapter is organized as follows. In Section 1.2, we overview China's electrical and electronics industry, introduce our dataset and estimate productivity using firm-level production functions. In Section 1.3, we estimate the effects of FDI on the growth of local firms and discuss the results related to the findings in Section 1.2. Section 1.4 concludes the chapter.

1.2 Overview of China's Electrical and Electronics Industry, Dataset and Estimation of Productivity

In this section, we outline the development process of China's electrical and electronics industry, we introduce the dataset and variables used for our analysis and, finally, using the dataset, we estimate the productivity of local and foreign firms.

1.2.1 Overview of China's Electrical and Electronics Industry

Since economic reforms started in 1978, the Chinese economy has been growing rapidly and its industries have witnessed significant transformation. The electrical and electronics industry, as one of the country's key emerging industries, has been leading the economic growth in China.[2] As shown in Table 1.1, the ratio of added value in the electrical and electronics industry compared to overall industrial production was only 6.9% in 1985, but rose to 12.9% by 2005 after a period of rapid development in the 1990s. This shows that this industry has grown at a faster rate than the Chinese economy as a whole. Although its ratio fell somewhat in 2010, the electrical and electronics industry still maintained over 10% of annual added value in national total industry in 2010.

[2] The electrical and electronics industry includes electrical machinery and equipment manufacture and communication equipment, computers and other electronic equipment manufacturer.

Table 1.1 Added Value of Electrical and Electronics Industry, 1985–2010

Item	1985	1990	1995	2000	2005	2010
Added value						
National total in industry (RMBbn)	276.7	509.3	1544.6	2539.5	7218.7	11248.7
Electrical and electronics industry (RMBbn)	19.0	35.6	123.9	305.6	929.6	1289.8
Ratio (%)	6.9	7.0	8.0	12.0	12.9	11.5

Source: National Bureau of Statistics of China (various years).

Note: Added value for 2010 is not published by the NBS; therefore, it is calculated by subtracting cost of pricipal business from revenue from principal business.

Many national champions in the industry, including Haier, TCL, Changhong, Konka and Hisense, have not only grown rapidly, but have also gained large market shares in China by pushing out foreign firms. According to statistics collected by a leading marketing company, GfK Group, almost half of the air conditioner market in 2007 was dominated by Gree, Midea and Haier, and approximately 40% of the television market in the same year was controlled by Konka, Changhong and Skyworth. There are many emerging countries in which their home appliance markets have been dominated by Korean and Japanese manufactures, such as India and South Africa; however, Chinese markets have mainly been serviced by local firms (Kimura 2011a, 2012b).

In addition, the electrical and electronics industry was the largest exporter during the remarkable period of development in the 1990s. As shown in Table 1.2, the export value of electrical and electronics products accounted for 44.2% of total exports in 2010, increasing from 18.6% in 1995.[3] Moreover, this industry has become a net exporter and has contributed to the increase in China's trade surplus.

[3] The electrical and electronics industry belongs to Chapters 84 and 85 of the Harmonized Commodity Description and Coding Systems for international trade.

Table 1.2 Imports and Exports of Electrical and Electronics Industry, 1995–2010

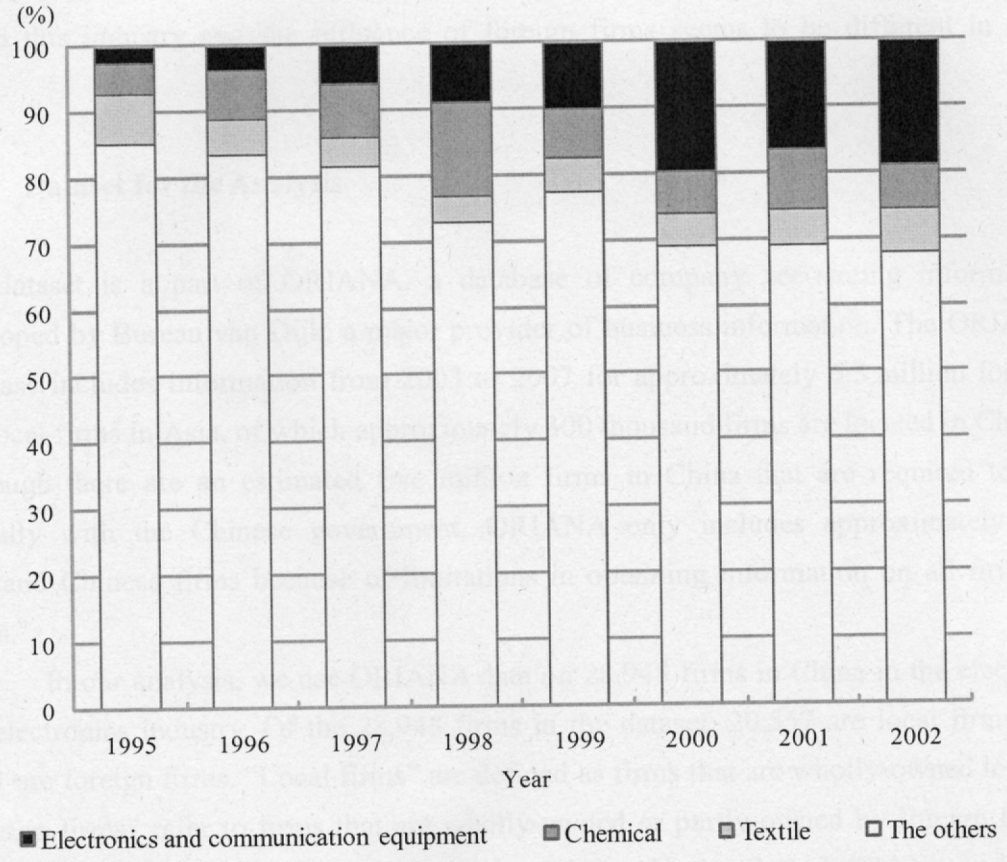
Item	1995	2000	2005	2010
Electrical industry				
Export value (US$bn)	867.1	2681.6	14983.5	30995.8
Ratio in total (%)	5.8	10.8	19.7	19.6
Import value (US$bn)	2758.1	3444.0	9641.8	17240.3
Ratio in total (%)	20.9	15.3	14.6	12.4
Electronics industry				
Export value (US$bn)	1899.7	4606.6	17240.6	38891.6
Ratio in total (%)	12.8	18.5	22.6	24.6
Import value (US$bn)	1941.6	5074.9	17491.3	31440.5
Ratio in total (%)	14.7	22.5	26.5	22.6

Source: World Trade Atras provided by Global Trade Information Services.

Moreover, inward FDI in the electrical and electronics industry also increased when this industry experienced remarkable growth in the 1990s. As shown in Figure 1.1, the FDI ratio of the electronics and communication equipment industry accounted for approximately 10% of total FDI in 1999. Although the dot-com bubble burst in 2001, the FDI ratio of the electronics and communication equipment was maintained at approximately 20% in 2002. Here, we take FDI in the electronics and communication equipment industry as a proxy for that in the electrical and electronics industry, because the industry classification of FDI statistics is different for production and trade statistics. The ratio of added value in the electrical and electronics industry compared to overall industrial production in China between 2001 and 2002 continued to increase, from 12.1 to 12.4%, despite the bursting of the economic bubble.[4] This shows that investment opportunities in the electrical and electronics industry did not decline in China. Therefore, inward FDI in the electrical and electronics industry remained vibrant. At present, almost all the major global players in the industry, including Intel, Sony, Panasonic, Samsung and LG, have established factories and R&D branches in China.

[4] The author calculated this using the source in Table 1.1.

Figure 1.1 Ratio of FDI by Industry (Amount of Contract), 1995–2002



Source: Department of Trade and External Economic Relations Statistics, National Bureau of Statistics of China (various years).

As a result of industrial development and the increase in FDI in the electrical and electronics industry, FDI might be expected to have a positive effect on the development of this industry. However, we find that productivity of local Chinese firms in the electrical and electronics industry is relatively lower than that in the other leading manufacturing industries, as stated by Ito et al. (2008). Moreover, local Chinese firms lack core technologies to design and develop new products (Kimura 2011b). To produce more final consumption goods, local manufacturers in the electrical and electronics industry have to import more core components. In addition, exports of the electrical and electronics industry are reliant on foreign firms. For example, foreign firms accounted for approximately 80% of export value in the Chinese information industry in 2009 (*Zhongguo Xinxi Chanye Nianjian* Bianweihui 2010). Therefore, it is difficult to evaluate

the actual competitiveness of local firms in China and the effect of FDI on industrial development. Next, we investigate whether or not FDI has a positive effect on local firms' development in the electrical and electronics industry, because various sectors exist within this industry and the influence of foreign firms seems to be different in each sector.

1.2.2 Dataset for the Analysis

Our dataset is a part of ORIANA, a database of company accounting information developed by Bureau van Dijk, a major provider of business information. The ORIANA database includes information from 2003 to 2007 for approximately 6.3 million foreign and local firms in Asia, of which approximately 300 thousand firms are located in China.[5] Although there are an estimated five million firms in China that are required to file annually with the Chinese government, ORIANA only includes approximately 300 thousand Chinese firms because of limitations in obtaining information on all firms in China.[6]

In our analysis, we use ORIANA data on 28,948 firms in China in the electrical and electronics industry. Of the 28,948 firms in the dataset, 20,557 are local firms and 8,391 are foreign firms. "Local firms" are defined as firms that are wholly-owned locally. "Foreign firms" refer to firms that are wholly-owned or partly-owned by foreign firms. Therefore, joint venture companies are also regarded as foreign firms in China.[7]

We classify the electrical and electronics industry into 38 sectors using the six-digit North America Industrial Classification System (NAICS) classification code (Table 1.3). Consequently, technologies for the industry are grouped at the product level. In general, the electrical and electronics industry includes codes beginning with 334 (computer and electronic product manufacturing) and 335 (electrical equipment, appliance and component manufacturing). However, these codes do not cover air conditioners, which are classified under code 333 (machinery manufacturing). Therefore, our dataset includes the classification codes beginning with 334, 335 and 33341. The five-digit classification codes and descriptions are listed in Table 1.3 to show all the

[5] Because missing data are frequent for small and medium-sized enterprises in the dataset for 1999 to 2002 and for 2008, we exclude these years.
[6] The ability to gather information on firms depends on Bureau van Dijk's partner in China: for example, SinoRating and Chinese Export & Credit Insurance Corporation.
[7] Among 8,391 firms, 3,287 manufactures are joint ventures.

product types included with the six-digit classification codes.

Table 1.3 List of the 38 Sectors in the Electrical and Electronics Industry

Five-digit	Six-digit	Definition
33341		**Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing**
	333412	Industrial and Commercial Fan and Blower Manufacturing
	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing
33411		**Computer and Peripheral Equipment Manufacturing**
	334111	Electronic Computer Manufacturing
	334112	Computer Storage Device Manufacturing
33421		**Telephone Apparatus Manufacturing**
	334210	Telephone Apparatus Manufacturing
33422		**Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing**
	334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
33429		**Other Communications Equipment Manufacturing**
	334290	Other Communications Equipment Manufacturing
33431		**Audio and Video Equipment Manufacturing**
	334310	Audio and Video Equipment Manufacturing
33441		**Semiconductor and Other Electronic Component Manufacturing**
	334411	Electron Tube Manufacturing
	334412	Bare Printed Circuit Board Manufacturing
	334413	Semiconductor and Related Device Manufacturing
	334414	Electronic Capacitor Manufacturing
	334416	Electronic Coil, Transformer, and Other Inductor Manufacturing
	334419	Other Electronic Component Manufacturing
33451		**Navigational, Measuring, Electromedical, and Control Instruments Manufacturing**
	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
	334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
	334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables
	334514	Totalizing Fluid Meter and Counting Device Manufacturing
	334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
	334516	Analytical Laboratory Instrument Manufacturing
	334518	Watch, Clock, and Part Manufacturing
	334519	Other Measuring and Controlling Device Manufacturing
33461		**Manufacturing and Reproducing Magnetic and Optical Media**
	334612	Prerecorded Compact Disc (except Software), Tape, and Record Reproducing
33511		**Electric Lamp Bulb and Part Manufacturing**
	335110	Electric Lamp Bulb and Part Manufacturing
	335129	Other Lighting Equipment Manufacturing
33521		**Small Electrical Appliance Manufacturing**
	335211	Electric Housewares and Household Fan Manufacturing
33522		**Major Appliance Manufacturing**
	335221	Household Cooking Appliance Manufacturing
	335222	Household Refrigerator and Home Freezer Manufacturing
	335224	Household Laundry Equipment Manufacturing
	335228	Other Major Household Appliance Manufacturing
33531		**Electrical Equipment Manufacturing**
	335311	Power, Distribution, and Specialty Transformer Manufacturing
	335312	Motor and Generator Manufacturing
	335313	Switchgear and Switchboard Apparatus Manufacturing
33591		**Battery Manufacturing**
	335911	Storage Battery Manufacturing
33592		**Communication and Energy Wire and Cable Manufacturing**
	335921	Fiber Optic Cable Manufacturing
	335929	Other Communication and Energy Wire Manufacturing
33599		**All Other Electrical Equipment and Component Manufacturing**
	335991	Carbon and Graphite Product Manufacturing
	335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing

Source: US Census Bureau (http://www.census.gov/eos/www/naics/).

Descriptive statistics for our dataset are provided in Table 1.4. The average amount of sales of foreign firms is approximately 2.7 times larger than that of local firms. In addition, the average number of firms in each sector is 762 firms, including both local and foreign firms. There is a large difference between the number of firms in the smallest and the largest sectors.

Table 1.4 Descriptive Statistics for the Dataset in 2007

	Number of firms	Sales (US$)			
		Mean	Minimum	Maximum	SD
All firms	28,948	33,905	0	25,597,879	310,936
Local firms	20,557	21,835	0	12,425,221	201,860
Foreign firms	8,391	59,315	0	25,597,879	462,071
	Number of firms	Number of firms by sector			
		Mean	Minimum	Maximum	SD
Sector size	28,948	762	96	3,255	704

Source: The author's calculations.

Table 1.5 provides variables used in our study. TFP (*tfp*) and added value (*av*) are used as dependent variables for the growth of the firm. TFP is calculated through estimation of a firm-level production function with added value as output, and fixed assets (*k*), number of employees (*l*) and costs of goods sold (*c*) as inputs. Added value is calculated by subtracting the costs of goods sold (*c*) from sales (*s*); that is, $av = s - c$.

Table 1.5 List of Variables

Variables	Denotation
Total factor productivity	*tfp*
Added value	*av*
Fixed assets	*k*
Number of employees	*l*
Costs of goods sold	*c*
Sales	*s*
Ratio of foreign firms in fixed assets	*rk*
Age	*age*
Dummy of the Central	*cent*
Dummy of the West	*west*

Source: The author's compilation.

The ratio of foreign firm fixed assets to total fixed assets (*rk*) is the independent variable, the coefficient of which we examine in the present study.[8] The ratio used for this variable is calculated by dividing the fixed assets of foreign firms by those of local firms. This ratio (*rk*) indicates the impact of FDI on the accumulation of fixed assets by both local and foreign firms. We expect the effects of FDI to be laged, so we use the ratio of foreign firm fixed assets to total fixed assets (*rk*) for the previous year. In addition, we use sales (*s*) and age of firm (*age*) as control variables. We also add regional dummy variables for the central region (*cent*) and the western region (*west*), and the eastern region is treated as the baseline.[9]

1.2.3 Estimation of Productivity

In this subsection, the technology disparities between local and foreign firms and the relationship between these disparities and the business experience of local firms are examined. We use the TFP as a proxy of technological levels of local and foreign firms, and the Cobb-Douglas production function to estimate TFP as follows:

$$Y_{it} = A_{it} K_{it}^{\beta} L_{it}^{\gamma}, \tag{1.1}$$

where the output, Y, is the amount of production, the input, K, is the capital stock, L is labor, and A represents the state of technology and TFP. β and γ stand for the input shares of K and L, respectively, and i and t stand for sector and time, respectively. Making Equation (1.1) a log-linear model, we obtain the following equation:

$$\ln Y_{it} = \ln A_{it} + \beta \ln K_{it} + \gamma L_{it}. \tag{1.2}$$

Therefore, according to Equation (1.2), the TFP of sector i at time t can have the

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[8] It might seem more adequate to use a ratio of sales as a variable of market share for capturing the market stealing effect. However, our purpose is to verify the relation between growth of local firms and investment by foreign firms; therefore, we use the ratio of fixed assets.

[9] According to the traditional regional classification after the Seventh Five-Year-Plan (1986–1990) and level of development, a classification is set as follows in this study. The eastern region comprises: Beijing, Tianjin, Hebei, Liaoning, Shandong, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong and Hainan. The central region comprises: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Inner Mongolia and Guangxi. The western region comprises: Sichuan, Chongqing, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

residual form:

$$\ln A_{it} = \ln Y_{it} - \beta \ln K_{it} - \gamma L_{it}. \tag{1.3}$$

We use the following equation based on Equation (1.3) to derive TFP:

$$\ln Y_{it} = \alpha + \ln A_{it} + \beta \ln K_{it} + \gamma L_{it} + \varepsilon_{it}, \tag{1.4}$$

where α is the constant term and ε is the error term. In our firm-level production function of Equation (1.4), we use the variables of added value (av), fixed assets (k) and number of employees (l) as the output and inputs of Y, K and L, respectively.

However, an endogeneity problem is likely to occur from interdependent relationships between inputs and outputs in production functions. Therefore, we use the method of Olley and Pakes (1996) to avoid this problem and estimate the production function non-parametrically. Using their method, we can filter out influences of productivity of each firm on level of inputs and calculate each firm's TFP. However, the method developed by Olley and Pakes requires information on investment to estimate production functions, though small and medium-sized firm do not necessarily invest every year. To solve this problem, Levinsohn and Petrin (2003) develop a method using information of intermediate inputs instead of investment. Therefore, we apply the Levinsohn and Petrin method to use the variable for costs of goods sold, c, instead of a variable for investment.

First, TFP level and growth rate by ownership are shown in Table 1.6. The growth rate of TFP is derived as the log difference of TFP levels in two periods. It is evident that the average TFP level of local firms is lower than that of foreign firms in China.[10] Although the average TFP growth rate of local firms is a little bit higher than that of foreign firms, local firms do not appear to catch up to the TFP level of foreign firms rapidly (Table 1.6), despite the fact that the Chinese Government encouraged the adoption of new technologies during our observation period.

[10] Previous studies also indicate differences in productivity and its growth by ownership. Chen et al. (1988) and Jefferson et al. (1996) show that TFP growth rates vary by ownership. In addition, Brambilla (2006) shows that foreign firms located in China are more productive than local firms (by 18 percent), using data for 1500 firms from the *Investment Climate Survey* (the 2001 edition) published by the World Bank.

Table 1.6 TFP Level and Growth by Ownership

	Mean
TFP level	
Local	3.8245
Foreign	5.0991
TFP growth	
Local	0.1614
Foreign	0.1586

Source: The author's calculations.

As a second step, we calculate the TFP level of local firms for each sector (Table 1.7). The TFP levels of local firms are lower than those of foreign firms in every sector, indicating the technology disparities between local and foreign firms. The fourth column shows the technology disparities in terms of TFP differences, which is the ratio of the TFP level of foreign firms to that of local firms. The average disparity is 1.3333, indicating that the productivity of foreign firms is 1.3 times higher than that of local firms. Sector 335224 (household laundry equipment manufacturing) has the largest disparity, 1.4769, and sector 334220 (radio and television broadcasting and wireless communications equipment manufacturing) has the smallest disparity, 1.1642. This shows that there are technology disparities within the electrical and electronics industry.

Table 1.7 Productivity of Local and Foreign Firms by Sector

Sector	Local		Foreign		Technology disparity	Ratio of experience
	Mean	SD	Mean	SD		
333412	3.9086	1.3134	5.5828	1.3605	1.4283	15.6
333415	3.6577	1.1550	4.6652	0.9958	1.2755	33.4
334111	4.6140	1.5621	5.6071	1.8887	1.2152	82.2
334112	4.0534	1.2295	5.4516	1.4380	1.3450	95.8
334210	4.2556	1.3078	5.7852	1.7758	1.3594	80.2
334220	3.9699	1.3361	4.6217	1.2697	1.1642	14.0
334290	4.3043	1.3203	5.2872	1.4614	1.2284	26.8
334310	3.6944	1.2922	5.1178	1.4582	1.3853	71.9
334411	3.7197	1.4063	5.3850	1.6554	1.4477	58.6
334412	3.6910	1.1651	5.2961	1.3546	1.4348	91.5
334413	3.7935	1.2586	5.0394	1.4099	1.3284	76.4
334414	3.6761	1.1226	4.6613	1.0891	1.2680	51.3
334416	3.8832	1.2074	5.0570	1.3459	1.3023	46.6
334419	4.2855	1.3713	5.1533	1.4195	1.2025	52.5
334511	4.6944	1.0946	5.5671	1.0181	1.1859	4.4
334512	3.8883	1.1019	4.9567	1.1006	1.2748	17.5
334513	3.9684	1.1818	5.3393	1.2721	1.3455	37.3
334514	4.1630	1.0389	5.2321	1.3379	1.2568	45.6
334515	3.8247	1.2116	5.1254	1.1554	1.3401	42.9
334516	3.8719	0.9727	4.9724	1.2674	1.2842	41.5
334518	3.4955	1.1466	4.4250	1.2261	1.2659	64.6
334519	3.9929	1.3457	5.1508	1.0542	1.2900	19.6
334612	3.3228	1.2882	4.7021	1.6379	1.4151	49.4
335110	3.4319	1.0418	4.6455	1.0869	1.3536	46.7
335129	3.4494	0.9885	4.8391	1.1446	1.4029	54.3
335211	3.8459	1.1479	5.2373	1.2291	1.3618	40.1
335221	3.7985	1.0494	5.0999	1.4045	1.3426	70.0
335222	4.0618	1.5287	5.5063	1.7512	1.3556	26.9
335224	3.8820	1.2229	5.7335	1.6223	1.4769	72.2
335228	3.8416	1.2690	5.0304	1.3412	1.3094	29.4
335311	4.0249	1.2156	5.3531	1.4853	1.3300	27.6
335312	3.6590	1.2010	4.9854	1.3377	1.3625	26.4
335313	3.7967	1.1567	5.3003	1.4163	1.3960	24.0
335911	3.6203	1.2910	5.0350	1.4211	1.3908	53.5
335921	4.4427	1.2582	5.2848	1.2193	1.1895	39.6
335929	3.7262	1.2614	4.9509	1.2548	1.3287	27.6
335991	3.9055	1.2198	5.1068	1.2298	1.3076	12.4
335999	3.7349	1.1810	4.8981	1.2689	1.3114	32.6
Average	3.8245	1.2367	5.0991	1.3910	1.3333	44.8

Source: The author's calculations.

Note: Ratio of experience means sales of foreign firms to the total sales.

Finally, we examine the relationship between the technology disparities and the

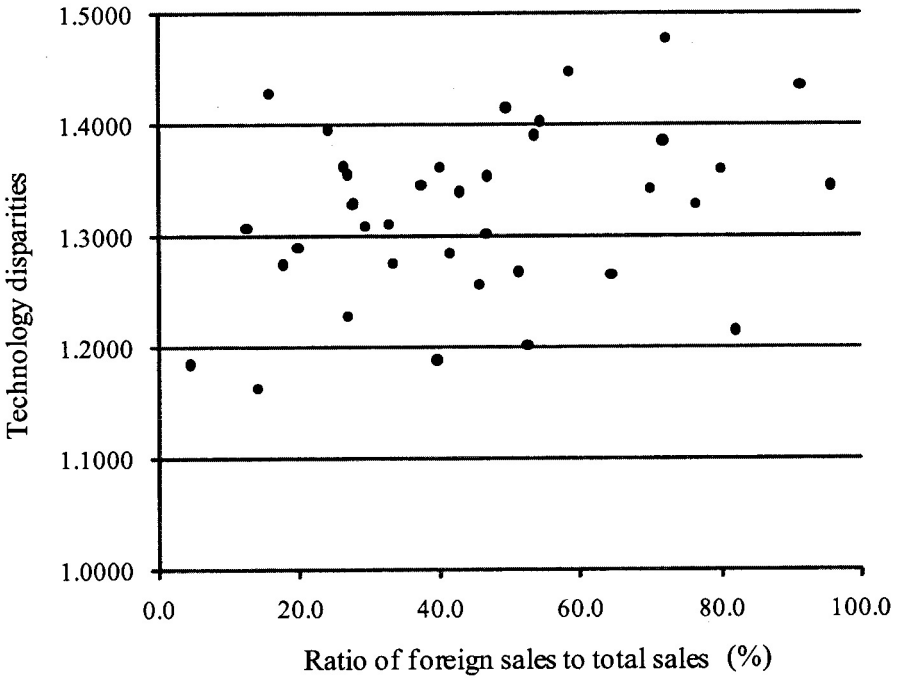
business experience of local firms and find a positive correlation. When we consider the disparities between first movers in developed countries and latecomers in developing economies, the concepts of the experience effect, the learning effect and LBD should be taken into account. The more a firm produces, the more it can decrease the average cost of production. However, we do not have sufficient long-term information on accumulated production volume in each sector for the early years in our dataset.[11] Therefore, we use a ratio of foreign firms in sales in each sector to show comparative experience of local firms. Viewing each sector as a product market, it is reasonable to expect that if local firms can produce and sell more than foreign firms, then this ratio of experiences would decrease. The ratio certainly does not indicate experience of local firms directly; however it shows comparative experience between foreign and local firms. Similarly, if the production of local firms relative to foreign firms increases, then the productivity disparity would decrease. Although the relationship does not identify a direction of causality, it is reasonable to suppose that there is a relationship between the two.

We use the five-year (2003–2007) average value of the ratio of experience to smooth fluctuation of the ratio of experience (see the last column of Table 1.7). The average ratio of foreign firm sales to total sales is 44.8%. Therefore, over half of total sales are made by local firms. Sector 334112 (computer storage device manufacturing) has the largest ratio, 95.8%, and the sector 334511 (search, detection, navigation, guidance, aeronautical, and nautical system and instrument manufacturing) has the smallest ratio, 4.4% (Table 1.7). This shows that there are significant differences in the experiences of foreign and local firms.

The relationship between the technology disparity and the foreign firm sales ratio by sector is shown in Figure 1.2. It is found that the larger the ratio of foreign firms' sales to total sales, the greater the technology disparities in a given sector. That is, the smaller the relative production of local firms, the greater the technology gaps. Based on these facts, in the next section, we will analyze the effects of FDI on the growth of local firms.

[11] In addition, we do not have information about ages of firms or dates of establishment for every firm.

Figure 1.2 Relationship between Technology Disparities and the Ratio of Foreign Firms Sales to Total Sales



Source: Drawn by the author.

1.3 Analysis of Effects of Foreign Direct Investment

1.3.1 Method

We estimate the correlations between the growth of local firms and the ratios of foreign firms' fixed assets to all fixed assets. Using a combination of dependent and independent variables, we estimate the relation between local firm's growth and FDI as follows:

$$\ln av_{it} = \alpha + \beta rk_{it-1} + x'_{it}\,\gamma + \varepsilon_{it}, \tag{1.5}$$

$$\ln av_{it} = \alpha + \beta rk_{it-1} \times industrialdummy + x'_{it}\,\gamma + \varepsilon_{it}, \tag{1.6}$$

$$\ln tfp_{it} = \alpha + \beta rk_{it-1} + x'_{it}\,\gamma + \varepsilon_{it}, \tag{1.7}$$

$$\ln tfp_{it} = \alpha + \beta rk_{it-1} \times industrialdummy + x'_{it}\,\gamma + \varepsilon_{it}, \tag{1.8}$$

where i indicates firm and t indicates year. The two dependent variables are added value (*av*) in Equations (1.5) and (1.6), and TFP (*tfp*) in Equations (1.7) and (1.8). The two independent variables are ratio of foreign firms' fixed assets to total assets (*rk*) in Equations (1.5) and (1.7), and a cross-term dummy variable (*industrialdummy*) for industry sector in Equations (1.6) and (1.8). In addition, we add control variables of sales (*s*) and age of firms (*age*), and regional dummy variables (*cent* and *west*), as *x*.

We use random-effects generalized least squares (GLS) regression for our estimation. Because the age and the regional dummy variables take constant values over time, we cannot use a method that assumes fixed effects. Moreover, we use GLS to avoid problems with heteroscedasticity in the error terms.

1.3.2 Results

Estimation results for Equations (1.5) to (1.8) are shown in Table 1.8. In Equation (1.5), we estimate a regression of ln*av* on *rk*, with a 1-year lag and control variables. The table shows that FDI has a negative effect on the electrical and electronics industry as a whole, at a significance level of 1% for the coefficient of added value (*av*). Consequently, the expansion of foreign firms, indicated by the fixed assets ratio, decreases added value level for the next year. Therefore, we detect a market-stealing effect. Coefficients of ln*s* and ln*age* are positive at significant levels, indicating that larger and older local firms tend to create more added value. The dummy variables are positive, indicating that local firms in the central and western regions tend to create more added value in comparison to firms in the eastern region. The eastern region is considered to have a much higher number of small and medium-sized firms than the other regions, because the business environment in the east is well developed. Equation (1.5) indicates a negative effect of FDI on industrial development. Therefore, we examine the positive and negative effects at sector level and investigate reasons for the different effects.

Table 1.8 Results of Estimation

	lnav		lntfp	
Equation	(1.5)	(1.6)	(1.7)	(1.8)
rk	-0.0047 (0.001) ***		-0.0045 (0.001) ***	
Cross term				
333412		-0.0084 (0.037)		-0.0099 (0.037)
333415		-0.0009 (0.007)		-0.0035 (0.007)
334111		-0.0007 (0.003)		-0.0031 (0.003)
334112		-0.0102 (0.002) ***		-0.0080 (0.002) ***
334210		-0.0077 (0.004) *		-0.0067 (0.004) *
334220		-0.0059 (0.022)		-0.0077 (0.021)
334290		-0.0067 (0.007)		-0.0066 (0.008)
334310		-0.0121 (0.004) ***		-0.0100 (0.004) ***
334411		-0.0024 (0.008)		-0.0075 (0.011)
334412		-0.0064 (0.002) ***		-0.0057 (0.002) ***
334413		0.0020 (0.002)		0.0008 (0.002)
334414		0.0102 (0.007)		0.0106 (0.007)
334416		-0.0026 (0.006)		-0.0014 (0.007)
334419		0.0012 (0.003)		-0.0026 (0.003)
334511		0.3496 (0.380)		0.4814 (0.376)
334512		0.0028 (0.020)		-0.0104 (0.024)
334513		-0.0076 (0.010)		0.0068 (0.010)
334514		0.0074 (0.016)		0.0008 (0.015)
334515		0.0244 (0.013) *		0.0083 (0.014)
334516		-0.0052 (0.019)		0.0261 (0.022)
334518		0.0126 (0.012)		0.0088 (0.012)
334519		0.0007 (0.022)		-0.0011 (0.021)
334612		-0.0175 (0.010) *		-0.0267 (0.010) **
335110		-0.0151 (0.006) **		-0.0104 (0.006)
335129		0.0091 (0.010)		0.0031 (0.010)
335211		-0.0109 (0.008)		-0.0223 (0.010) **
335221		-0.0094 (0.005) *		-0.0091 (0.005) *
335222		-0.0221 (0.017)		-0.0257 (0.017)
335224		-0.0075 (0.006)		-0.0033 (0.006)
335228		-0.0078 (0.006)		-0.0089 (0.006)
335311		0.0119 (0.015)		0.0086 (0.014)
335312		-0.0072 (0.013)		-0.0147 (0.013)
335313		0.0033 (0.012)		-0.0018 (0.013)
335911		-0.0148 (0.004) ***		-0.0131 (0.004) ***
335921		-0.0047 (0.007)		0.0016 (0.007)
335929		-0.0152 (0.007) **		-0.0076 (0.007)
335991		-0.0116 (0.028)		-0.0354 (0.027)
335999		-0.0045 (0.006)		-0.0065 (0.006)
lns	0.9228 (0.013) ***	0.9124 (0.014) ***	0.6556 (0.015) ***	0.6529 (0.015) ***
lnage	0.1731 (0.069) **	0.1414 (0.070) **	-0.0023 (0.068)	-0.0282 (0.071)
Dummy				
cent	0.2344 (0.103) **	0.2010 (0.107) *	0.1159 (0.101)	0.1315 (0.107)
west	0.2828 (0.110) ***	0.2642 (0.112) **	0.0934 (0.108)	0.1171 (0.113)
Constant	-1.1610 (0.214) ***	-0.9791 (0.225) ***	-1.1866 (0.224) ***	-1.0834 (0.245) ***
Sample size	20557	20557	20557	20557
R^2	0.8700	0.8862	0.7719	0.7928

Source: The author's calculations.

Notes: Standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10%, respectively.

We estimate the effects of FDI on added value in each sector in Equation (1.6) to determine the different effects in the electrical and electronics industry. Table 1.8 shows that FDI has significant effects in some sectors (e.g. 334112, 334210 and 334310). These effects are almost entirely negative, except for sector 334515 (instrument manufacturing for measuring and testing electricity and electrical signals). Some other sectors show positive effects, but not at a significant level. All the other independent variables reveal similar results in comparison with Equation (1.5). Consequently, in some sectors, FDI has negative effects on the added value of local firms.

We estimate the effects of FDI on the TFP level in Equations (1.7) and (1.8). As in Equation (1.5), the results of Equation (1.7) show that FDI has a negative effect on the TFP level of local firms. The control variables are not significant, except that sales, s, is significant. This shows that there is a negative effect of FDI on the TFP level of local firms in the electrical and electronics industry.

When we estimate the effects of FDI on TFP level in each sector level in Equation (1.8) we find that, in some sectors, FDI has significant effects. Moreover, all of the significant sector effects are negative. These facts also indicate that FDI has negative effects on the TFP levels of local firms in some sectors.

As the above results show, FDI has a negative effect on added value and TFP levels for the electrical and electronics industry as a whole. However, by breaking down the industry, we find that there are different effects, mostly negative or zero, for the 38 sectors. Therefore, we will investigate factors contributing to the difference in the next subsection. We could not find positive effects of FDI at significant levels in many sectors. However, this does not mean that there is no technology spillover effect occurring in the industry at all. A positive effect might be found when longer and different datasets are used.

1.3.3 Discussion

In this subsection, we will discuss the relationship between sectors' technology disparity and the ratio of experiences discussed in Section 2 and the results presented above. In Section 2, we show the technology disparities and the ratios of foreign firms' sales to the total sales for each sector. In this subsection, we will discuss relations between these characteristics and the positive and negative effects found through our regression models. Table 1.9 shows the relationships between these characteristics and the effect of FDI,

sorting by the size of the technology disparities in Table 1.9(a) and by ratios of foreign firms' sales to the total sales in Table 9(b), respectively.

Table 1.9 Relations between Sector Characteristics and FDI Effects

(a) Technology Disparity and FDI Effects

Sector	ln*av*	ln*tfp*	Technology disparity	Ratio of experiences
335224			1.4769	72.2
334411			1.4477	58.6
334412	---	---	1.4348	91.5
333412			1.4283	15.6
334612	-	--	1.4151	49.4
335129			1.4029	54.3
335313			1.3960	24.0
335911	---	---	1.3908	53.5
334310	---	---	1.3853	71.9
335312			1.3625	26.4
335211		--	1.3618	40.1
334210	-	-	1.3594	80.2
335222			1.3556	26.9
335110	--		1.3536	46.7
334513			1.3455	37.3
334112	---	---	1.3450	95.8
335221	-	-	1.3426	70.0
334515	+		1.3401	42.9
335311			1.3300	27.6
335929	--		1.3287	27.6
334413			1.3284	76.4
335999			1.3114	32.6
335228			1.3094	29.4
335991			1.3076	12.4
334416			1.3023	46.6
334519			1.2900	19.6
334516			1.2842	41.5
333415			1.2755	33.4
334512			1.2748	17.5
334414			1.2680	51.3
334518			1.2659	64.6
334514			1.2568	45.6
334290			1.2284	26.8
334111			1.2152	82.2
334419			1.2025	52.5
335921			1.1895	39.6
334511			1.1859	4.4
334220			1.1642	14.0

(b) Ratio of Experiences and FDI Effects

Sector	ln*av*	ln*tfp*	Technology disparity	Ratio of experience
334112	---	---	1.3450	95.8
334412	---	---	1.4348	91.5
334111			1.2152	82.2
334210	-	-	1.3594	80.2
334413			1.3284	76.4
335224			1.4769	72.2
334310	---	---	1.3853	71.9
335221	-	-	1.3426	70.0
334518			1.2659	64.6
334411			1.4477	58.6
335129			1.4029	54.3
335911	---	---	1.3908	53.5
334419			1.2025	52.5
334414			1.2680	51.3
334612	-	--	1.4151	49.4
335110	--		1.3536	46.7
334416			1.3023	46.6
334514			1.2568	45.6
334515	+		1.3401	42.9
334516			1.2842	41.5
335211		--	1.3618	40.1
335921			1.1895	39.6
334513			1.3455	37.3
333415			1.2755	33.4
335999			1.3114	32.6
335228			1.3094	29.4
335311			1.3300	27.6
335929	--		1.3287	27.6
335222			1.3556	26.9
334290			1.2284	26.8
335312			1.3625	26.4
335313			1.3960	24.0
334519			1.2900	19.6
334512			1.2748	17.5
333412			1.4283	15.6
334220			1.1642	14.0
335991			1.3076	12.4
334511			1.1859	4.4

Source: The author's own creation.

Notes: The second and third columns in Tables 1.9(a) and (b) show the positive and negative effects and the significantt levels from Table 1.8. – – – (+++), – – (++) and – (+) show negative (positive) effects of FDI at significant levels of 1, 5 and 10%, respectively. Empty spaces mean that there is no significance, whether effects are positive or negative.

As shown in Table 1.9(a), FDI tends to have negative effects on sectors with larger technology disparities. Local firms that lag technologically cannot absorb technology effectively because the technology brought by foreign firms is too advanced.

However, at the same time, technological lag provides more room for technology progress for local firms.

This same trend also holds in Table 1.9(b), which is sorted by foreign firms' sales ratio. The results show that local firms lacking in business experience tend to experience negative effects from the expansion of FDI. In other words, too large a difference in business experience results in inhibition of growth for local firms.

In fact, when foreign firms have higher shares in sales in comparison with local firms, local firms are likely to suffer negative effects of FDI. Table 1.10 shows the relationship between sales share in the top 10 firms in each sector and FDI effects. The first to fifth columns are the same as those in Table 1.9(a). The sixth column is the concentration ratio of the top 10 firms in sales (CR10) for each sector and the last column is share of foreign firms in the CR10. The concentration ratio is the ratio of total sales of the top 10 firms in all of sales in a sector. As shown in Table 1.10, we do not find an obvious relationship between CR10 and FDI effects; however, sectors with higher shares of foreign firms in the top 10 tend to experience negative effects. Consequently, large technology disparity between foreign and local firms and the existence of foreign firms provide a possibility of negative effects. Therefore, when local firms cannot accumulate experience in production, they cannot improve technological levels and technology disparities between foreign and local firms do not decrease.

Table 1.10 Sales Share in the Top 10 Firms and FDI Effects

Sector	ln*av*	ln*tfp*	Technology disparity	Ratio of experiences	CR10	Share of foreign firms in the top 10
335224			1.4769	72.2	48.3	100.0
334112	---	---	1.3450	95.8	45.7	100.0
334111			1.2152	82.2	74.9	95.4
334412	---	---	1.4348	91.5	40.8	91.7
334413			1.3284	76.4	32.0	90.2
335221	-	-	1.3426	70.0	46.8	86.5
334612	-	--	1.4151	49.4	51.4	74.0
334518			1.2659	64.6	31.2	73.6
334210	-	-	1.3594	80.2	73.6	72.3
334515	+		1.3401	42.9	31.3	71.4
335911	---	---	1.3908	53.5	31.7	65.2
334310	---	---	1.3853	71.9	47.1	62.2
335129			1.4029	54.3	41.8	59.2
334414			1.2680	51.3	55.6	58.8
334516			1.2842	41.5	41.8	57.2
334514			1.2568	45.6	62.9	55.3
335110	--		1.3536	46.7	19.2	53.2
335929	--		1.3287	27.6	12.6	50.9
334411			1.4477	58.6	83.4	44.5
334416			1.3023	46.6	25.0	38.7
334513			1.3455	37.3	28.6	38.6
334419			1.2025	52.5	34.8	37.6
335311			1.3300	27.6	46.7	34.6
335211		--	1.3618	40.1	51.9	30.7
335921			1.1895	39.6	59.1	29.4
334290			1.2284	26.8	74.3	25.9
335222			1.3556	26.9	83.1	24.1
335999			1.3114	32.6	41.7	22.0
335312			1.3625	26.4	32.7	18.2
334519			1.2900	19.6	69.9	15.9
333415			1.2755	33.4	55.5	15.6
335228			1.3094	29.4	56.5	15.3
333412			1.4283	15.6	50.3	15.3
334512			1.2748	17.5	26.7	13.1
335313			1.3960	24.0	36.7	9.3
334220			1.1642	14.0	76.8	3.1
335991			1.3076	12.4	37.3	0.0
334511			1.1859	4.4	55.6	0.0

Source: The author's own creation.

Notes: CR10 means the top 10 firms in sales. – – – (+++), – – (++) and – (+) show negative (positive) effects of FDI at significant levels of 1, 5 and 10%, respectively. Empty spaces mean that there is no significance, whether effects are positive or negative.

1.4 Conclusions

In this chapter, we investigated the effects of FDI on the growth of local firms. Our results show that FDI is likely to have a negative effect on growth for firms in sectors with large disparities in technology and less experience in business. The main points of our study are summarized below.

First, in Section 2, we discussed how characteristics of different sectors affect productivity. We found that every sector in the electrical and electronic industry faces technology disparities, which vary in size. Therefore, we compare the technology disparities with the ratio of experiences by sector. Although this relationship requires more rigorous analysis, it seems reasonable to say that the business experience of local firms correlates to technology disparities in the sector as a whole.

Next, we conducted a regression analysis to determine the effects of FDI on the growth of local firms. This analysis shows that FDI has different effects on the growth of local firms in terms of added value and TFP; however, we find negative effects of FDI in some sectors.

Finally, we compared our findings on technology disparities and foreign firms' sales with the findings from the regression model. We find that there is a relationship between the negative effects of FDI and technology disparities. Sectors with large technology disparities tend to suffer greater negative effects. Moreover, based on the relationship between technology disparities and business experience, it is possible to say that sectors with lower levels of experience tend be negatively impacted by FDI.

Our results show that China's electrical and electronics industry has been developing remarkably, but young local firms might suffer negative effects from the expansion of FDI. At the same time, the local firms have plenty of capacity for future growth. Therefore, if local firms are not able to find markets with no competition from foreign firms or to determine strategies to compensate technology disparities, young local firms will not be likely able to successfully enter markets and achieve growth. To support them, governments in developing countries should implement policies to improve their technology level. Although these conclusions are not meant to encourage protectionist policies to block any international economic activity, they do call for further investigation into the conditions necessary for market entry and growth for local firms in developing countries.

2

Is There Hope for Firms Facing Technology Gaps? A Case of China's Mobile Industry

2.1 Introduction

How do local firms in developing countries achieve growth when confronted by technology gaps between themselves and foreign firms from developed countries? We answer the question by examining the behavior of China's mobile-phone handset manufacturers, who have managed to compensate for their technology deficit by differentiating the organization of the firm. To do this, we explore the concept of boundaries of the firm, which relates to decisions to produce or purchase components. Furthermore, this chapter will analyze decision-making behavior of local firms under competition with foreign firms.

The question of whether international trade and foreign direct investment (FDI) have a positive or negative effect on the growth of developing countries facing technology gaps has been debated for a long time. It has been recognized that technology diffusion is a growth condition for developing countries. However, the results have been ambiguous both in theoretical and empirical analysis as shown in Introduction. Recently, it also has become evident that local firms need to be equipped with the absorptive capacity to make the technology transfer possible (Girma 2005).

By examining the way in which local Chinese firms compete with foreign firms, we can confirm a growth pattern relating to the organization of the firm. From investigating this pattern, another growth condition can be extracted. Investigation of local firms in the electrical and electronics industry have shown that, though such firms have been confronted by a technology deficit, they have compensated for it through the

purchase of key production components from outside firms and by focusing their business strategies on sales and marketing (Kimura 2006; Marukawa 2007; Ohara 1998).

Therefore, we can find a growth pattern of local Chinese firms in the industry under insufficient transfer of technology conditions. Though the pattern has been studied, however, the general decision-making process and mechanism as exemplified by the make-or-buy policy has not been analyzed explicitly. In this chapter, we investigate the decision-making characteristics of Chinese firms within a framework incorporating technology gaps, to identify a growth condition.

To do this, we take China's handset industry in the period between the 1990s up to 2008 as our case study.[1] Although the production of mobile-phone handsets requires advanced technological capability, local firms have grown successfully, especially since the late 1990s. We hope that the case study will illustrate and clarify the behavior of local firms that are confronted by the technology deficit.

To analyze this, we apply the theory of boundaries selection and incorporate an influence of technology gaps in the theory. In this chapter, we will first examine the nature of technology gaps. In existing literature on technology diffusion, it has generally been assumed that manufacturing a product embodies a single technology, whereas in reality, several technologies are typically required as part of a whole hierarchical system of technologies. Firms in pursuit of product differentiation need to employ higher-level technology. However, to master such technology and to come up with ideas that are critical for product differentiation associated with higher-level technology, firms often need to sufficient experience and know-how in the use of lower-level technology. This means that it is difficult for latecomers, such as local firms who have little experience of development, to absorb all the available technologies in a short period of time. This is far less of a problem for foreign firms which have already accumulated sufficient experience.

We next go on to introduce the theory of boundaries selection. Boundaries of the firm are decided to solve the "hold-up" problems incurred by incomplete contracts (Grossman and Hart 1986; Hart and Moore 1990).[2] To understand the problems, suppose

[1] Therefore, we do not include changes after the introduction of 3G and the smart-phone boom in this study.

[2] The theory of boundaries is originated from studies on the existential reason of the firm. The reason was verified by Coase (1937) based on the concept of transaction cost. Transaction cost is caused by transaction, such as search of information, bargaining between buyers and sellers, and enforcement of contracts. Williamson (1985) developed the idea of the cost further and contributed to establish transaction cost economics (TCE). Although TCE clarifies transaction cost in markets, however, it does not reveal why internal transaction within the firm can avoid transaction cost. Therefore,

that there is a manufacturer and a supplier, and the value of the buyer's products can be increased by investing in human capital of the seller only for the buyer's products. Human capital includes factors such as technology skills, knowledge, and accumulated experience, all of which increase the value of products and enhance the firms' profits. The seller makes intermediate goods or service to increase the value of the buyer's products, investing in human capital. The contract however, is incomplete, because the parties cannot draw up all unforeseen contingencies in advance. Therefore, incomplete contracts cannot secure that the buyer inevitably buy intermediate goods or service made by the seller. As a result, the seller would hesitate to agree to such a relation-specific investment, concerned that the investment may be sunk through contractual default. The risks associated with the agreement result in underinvestment in human capital from both parties. This inefficiency in investment for mutual benefits is called the hold-up problem. To solve this predicament, the buyer may decide to produce the components themselves to maximize the value in products through investment in human capital. Consequently, the hold-up problem brought by incomplete contracts serves as the basis for internalized boundaries.

However, the theory of boundaries selection does not assume that the buyer faces technology gaps in comparison with rival buyers. Therefore, we incorporate the existence of technology gaps into the theory of boundaries. Then, decision-making among local firms can be generalized as follows for the analytical framework in this study. When local firms face significant technology gaps, they do not integrate the production process related with the technology. But instead of integration, they buy goods and services from external firms. This is because, even if they intended to invest human capital to achieve a level of technology as high as that employed by foreign firms, their investment would not increase the value of the products because of their lack of experience in the use of the technology. On the other hand, if there are production processes in which the investment in human capital by local firms is substantially more effective than that by foreign firms, the local firms tend to internalize the processes and make goods and services by themselves. Therefore, the behavior of local firms maximizes the effects of human capital investment so as to compensate for the technology deficit and results in heterogenized boundaries in comparison with boundaries

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Grossman, Hart, and Moore assume that owners of the property right of the firm can control everything which is not able to be drawn unforeseen contingencies, solving the transaction cost problem. This is, therefore, called property rights approach (PRA).

of foreign firms.

Thus, the growth of local firms facing technology gaps depends on whether or not local firms can compensate for the technology deficit by differentiating the boundaries of the firm. That is, it is important for local firms that they can outsource production processes in which they have no advantage and internalize production processes in which they have an advantage. As of this moment, it is difficult to predict their further growth and its patterns, however, local firms have adapted successfully to business environmental changes in the global production network and modularization, and realized entry and growth in the high technology industry.

The remainder of the chapter is organized as follows. In the next section, we review the growth pattern of local firms by providing an introduction to development of the Chinese handset industry. In sections 2.3 and 2.4, we investigate the relationship between technology gaps and boundaries in two industrial development phases. The final section draws together our findings into a conclusion.

2.2 Growth and Boundaries of Local Firms

In this section we review the relationship between growth and boundaries of local firms. This analysis enables us to verify that growth corresponds to a specific selection of boundaries along with each industrial development phase. Although output, added value, and profits can be used as measures of expansion, in this chapter we will use market share as the indicator of growth. We have chosen this indicator as we are interested primarily in the growth of local firms in competition with foreign firms. Changes in market share suggest that the growth of local firms can be divided into three phases.

2.2.1 The First Phase

Although market share of local Chinese handset manufacturers has increased since 1999, during the first phase which lasted until 1998, the market was almost entirely dominated by foreign firms.[3] About 80% of the market was held by three companies: Motorola (the United States [U.S.]), Nokia (Finland), and Ericsson (Sweden, at present Britain in the

[3] The mobile-phone service was started in Guangdong in 1987.

form of Sony Ericsson). The remaining market share was accounted for by foreign firms such as Siemens (Germany), Philips (the Netherlands), NEC (Japan) and Matsushita (Japan, at present in the form of Panasonic).

Though the Chinese government and some local firms intended to manufacture handsets domestically, but domestic production was not a commercial success. Some Chinese firms processed handsets through contract manufacturing with foreign firms. In addition, the Chinese government facilitated a nationalization project that involved local firms. However, between foreign and local firms, there were significant gaps in technology and amount of capital. In particular, there was an absence of core component technology, which resulted in increases in production costs (Xinxi Chanye Bu Jingji Tizhi Gaige yu Jingji Yunxing Si 2003). In short, local firms were prevented from expanding their market share by persistent technology gaps.

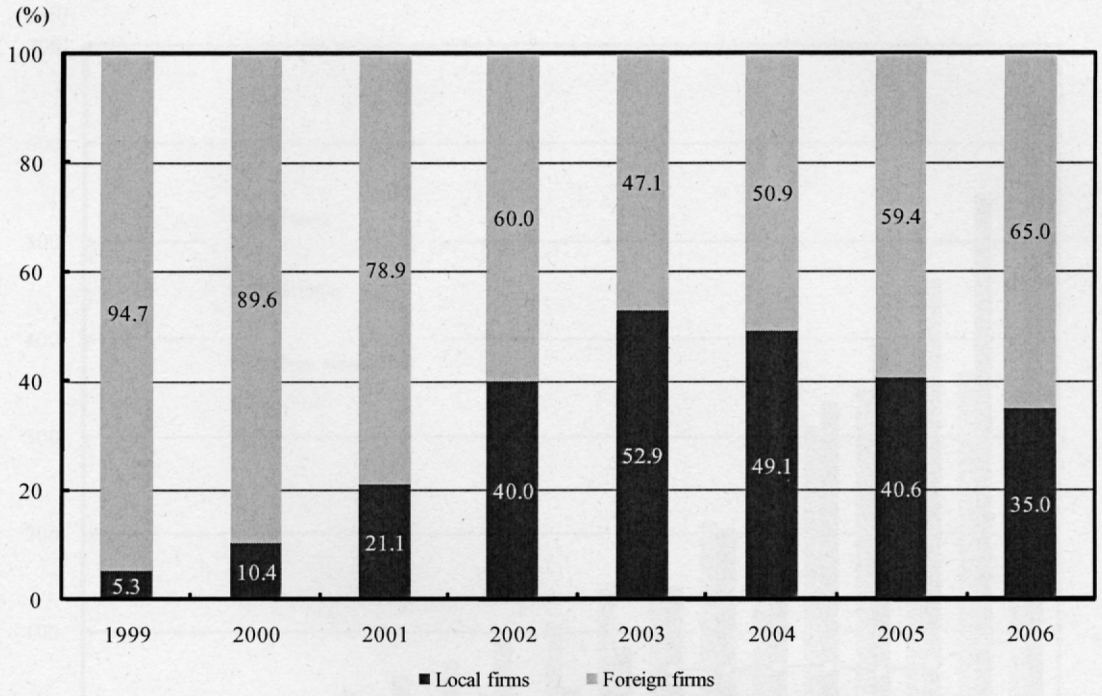
2.2.2 The Second Phase

In the second phase of growth, from 1999 to 2003, local firms continued to expand their market share in the number of handsets, from 5.3% in 1999 to 52.9% in 2003 (Figure 2.1).[4] This expansion went hand-in-hand with a rapid increase in the number of subscribers.[5] There has been a sustained increase in the number of subscribers ever since the start of the mobile-phone service in China, and numbers have grown swiftly, especially since the late 1990s (Figure 2.2). About 60 million people have subscribed since 2001, the total national number of subscribers amounted to more than 800 million people in 2008.

[4] However, the data does not necessarily present real pictures of the market. Firstly, the data indicates shipping volume from manufacturers, not market share at retail level. Therefore, the data can include channel inventories at distribution level. Table 2.1 also faces this problem. Secondly, since the data are "official" ones, therefore they do not include shipping volumes of illegal handsets. See footnote number 7 of this chapter for the definition of illegality.

[5] In China, the GSM, CDMA as 2G and TD-SCDMA as 3G channel access methods are in operation as of 2008. We have chosen GSM because it has the most subscribers, and unless otherwise stated, our remarks throughout the paper apply to GSM. CDMA is used by only 10% of Chinese subscribers, and use of TD-SCDMA has just begun, a test installation having gone into operation in April 2008. In addition to the carriers mentioned in the paper, there are two others, namely China Mobile and China Unicom. China Mobile operates the GSM and TD-SCDMA systems, while China Unicom uses GSM and CDMA.

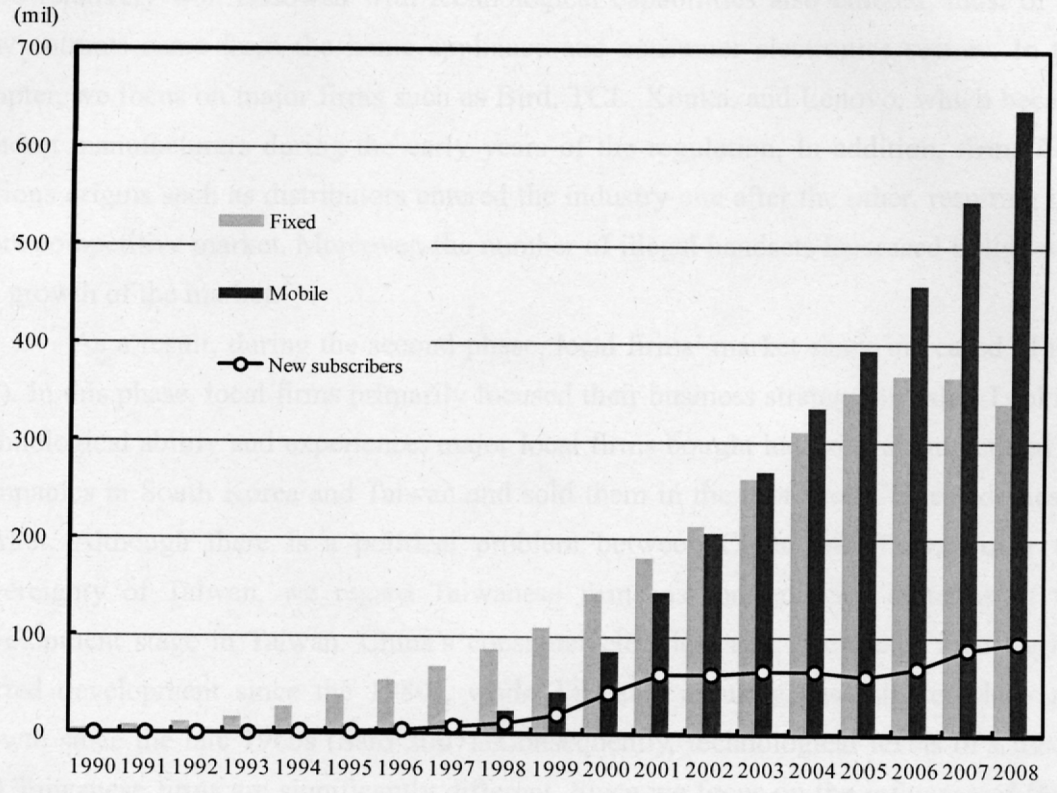
Figure 2.1 Share of Local Firms, 1999–2006



Sources: Data for 1999 to 2002 are from Ministry of Information Industry of China (2003). Data for 2003 to 2004 are from CCID (China Center for Information Industry Development). Data for 2005 are from Ministry of Information Industry. 2006. "2005 nian Woguo Shouji Chanye Fazhan Pingshu [Commentary on Development of Our Country's Mobile-Phone Handsets Industry in 2005]." accessed at http://www.mii.gov.cn/ on April 5, 2006 (Chinese). Data for 2006 are from Ministry of Information Industry of China (2007).

Note: The share in 2005 is for January to September.

Figure 2.2 The Number of Users, 1990–2008



Sources: Data for 1995 to 2007 are from National Bureau of Statistics of China (various years). Data for 2008 are from Ministry of Industry and Information Techonology of China, accessed at http://www.miit.gov.cn/ on June 24, 2009 (Chinese).

Note: Fixed telephone includes the Chinese PHS system.

What triggered the expansion of their market share was the adoption in 1999 of a new industrial policy that favored local firms.[6] Concerned that local firms might fail to seize the opportunity in the growing market, the Chinese government instituted a license system as an entry barrier, provided subsidies to local firms for research and development (R&D) expenditure, and enacted local manufacturing content requirements to foreign firms. The license system had a particularly important effect for it helped local firms to enter into the market in the early development phase by blocking the new entry of foreign firms. Later, licensing was eased in 2005 and finally abandoned in 2007.

This protective policy led to an upsurge in the number of entries of local firms into the industry. The great majority of the new entrants, however, did not have the technological capabilities or the experience necessary for success in the handset business.

[6] At that time, since China did not join the World Trade Organization (WTO) yet, therefore to adopt such a favorable policy was not so restricted than at present.

Although telecommunication equipment manufacturers, such as ZTE and Huawei, which were relatively well endowed with technological capabilities also entered, most of the new entrants came from the home appliance and consumer electronics sectors. In this chapter, we focus on major firms such as Bird, TCL, Konka, and Lenovo, which became handset manufacturers during the early years of the regulation. In addition, firms from various origins such as distributors entered the industry one after the other, resulting in a more competitive market. Moreover, the number of illegal handsets increased in line with the growth of the market.[7]

As a result, during the second phase, local firms' market share increased (Table 2.1). In this phase, local firms primarily focused their business strategy on sales. Lacking technological ability and experience, major local firms bought handsets manufactured by companies in South Korea and Taiwan and sold them in the protected Chinese domestic market. Although there is a political problem between China and Taiwan over the sovereignty of Taiwan, we regard Taiwanese firms as foreign ones in terms of the development stage in Taiwan. China's consumer electrical and electronics industry has started development since the 1980s, while Taiwan's industry has initiated the rapid growth since the late 1960s (Sato 2007). Consequently, technological levels of Chinese and Taiwanese firms are significantly different. Since we focus on the influence of firms with technologies on the growth of firms without technologies, therefore we do not treat Taiwanese firms as local ones.

[7] "Illegal handsets" means nonregistered handsets for gaining access to mobile networks, imitation products, and contraband sets. Before deregulation, handsets produced by manufacturers without the necessary license were also deemed to be illegal handsets.

Table 2.1 Market Share by Major Firms, 1999–2008 (%)

	1999	2000	2001	2002	2003	2004	2005	2006	2007*	2008**
Foreign firms										
Nokia	32.3	25.1	22.3	18.2	11.1	15.0	23.8	33.6	28.9	37.2
Samsung	n.a.	n.a.	n.a.	n.a.	n.a.	8.3	9.6	9.0	11.1	14.3
Motorola	39.4	35.4	29.3	28.5	9.3	8.9	13.3	24.1	18.8	8.6
Sony Ericsson***	6.4	9.2	6.5	2.1	1.1	2.9	4.1	7.4	5.5	3.1
Philips	n.a.	n.a.	n.a.	n.a.	n.a.	2.8	n.a.	n.a.	n.a.	n.a.
Siemens	6.0	8.1	9.7	4.7	2.5	1.4	n.a.	n.a.	n.a.	n.a.
Local firms										
Tianyu	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.3	4.9
Lenovo	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4.7	6.5	4.0
Amoi	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4.1	3.2	2.7
Bird	n.a.	3.2	6.4	9.9	14.2	10.2	6.1	4.1	4.3	2.5
Gionee	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.1	2.0
Konka	n.a.	n.a.	n.a.	n.a.	6.2	5.8	2.8	2.5	1.8	1.4
TCL	n.a.	1.0	3.0	8.7	11.2	6.5	3.7	1.9	n.a.	n.a.

Sources: Data for 1999 to 2004 are from Ministry of Information Industry of China (various years). Data for 2005 are from Norson Telecom Consulting, accessed at http://www.norson.com.cn/ on April 5, 2006. Data for 2006 are from Analysys International, accessed at http://comm.ccidnet.com/ on June 5, 2007 (Chinese). Data for 2007 are from Imai and Shiu (2009). Data for 2008 are from Analysys International, accessed at http://www.analysys.com.cn on July 28, 2008 (Chinese).

Notes: * Data for 2007 are as of April, 2007. ** Data for 2008 are for the first quarter of 2008. *** The share given for Sony Ericsson before October, 2001, is for Ericsson.

2.2.3 The Third Phase

The latest stage of growth began after 2004. With increased competition, which included the availability of illegal handsets in the market (which were not included in the official figures), local firms' market share dropped to about 40%. In this stage, although local firms continued to depend on foreign firms for developing and designing new models, they expanded their production processes to include partial design and development of models.

Although Lenovo was also unable to keep expanding market share indefinitely, as Table 2.1 shows, they increased their market share contrary to the contraction in market share experienced by local firms. The technology deficit made it difficult for Lenovo to stay at the forefront of expansion; however the firm achieved growth by incorporating a marketing ability based on Chinese consumer preferences.

In the following chapters, we analyze the decision making of boundaries under the technology deficit in the second and third phases.

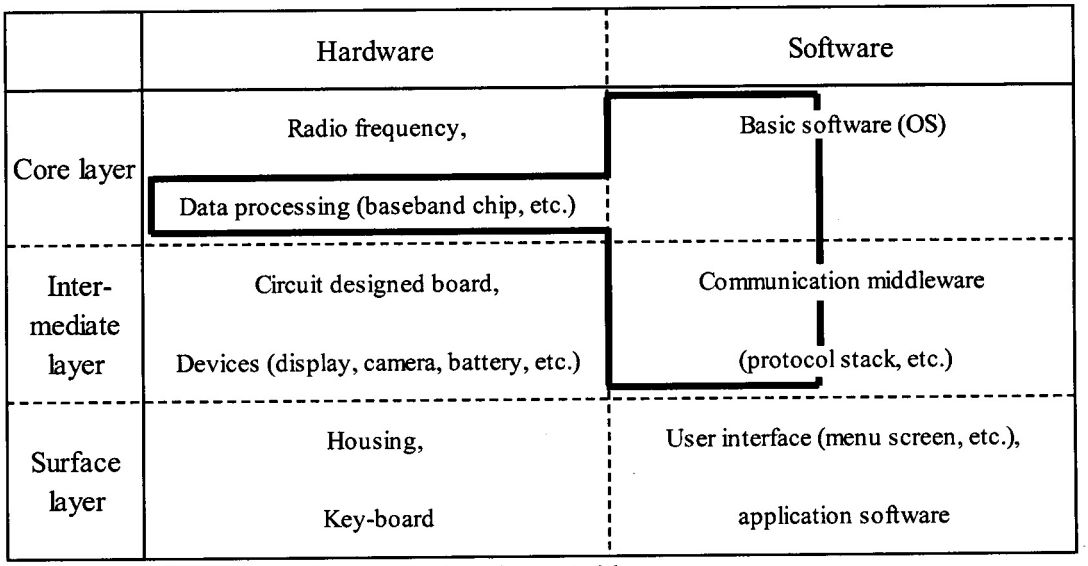
2.3 Analysis of the Second Phase

2.3.1 Product Structure and Technology Deficit

In China's handset industry, there is the technology deficit between local firms and foreign ones, though the situation is complicated by the fact that technology can reach maturity and the simplification of product structures. The Global System for Mobile Communications (GSM), a second-generation mobile communications system (2G) that is prevalent in China, was taken up mainly by European countries in the mid-1990s and has reached maturity to the extent that some key components can be modularized. However the product structure is still complicated in comparison with other consumer electronics such as desktop personal computers and consequently the technology deficit is closely related with complexity of the composition of the product.

In terms of their structure, handsets are composed of hardware and software, each of which can be divided into three layers (Figure 2.3). Hardware is comprised of the following layers: (1) the core layer, which contains mainly a radio frequency (RF) device for communication functions and information processing for processing signals; (2) the middle layer, which consists of a printed-circuit board (PCB) on which is mounted various devices; and (3) the surface layer, which comprises the outer case of the handset and the keypad, both of which have to withstand frequent handling by users. Meanwhile the software is comprised of the following: (1) the core layer, which contains mainly the operating system (OS) for the basic software; (2) the middle layer, consisting of middleware for communication functions; and (3) the surface layer, which carries the user interface and various types of application software.

Figure 2.3 Product Structure



Source: The author's own creation according to various materials.

Note: The elements contained within the bold line are modularized as platforms.

As we can see from Figure 2.3, the structure is a complicated one, but its intricacy has been simplified to some extent by partial modularization. The information processing element and the basic components of the OS and the middleware, all of which are contained within the bold line in the figure, have been modularized as platforms developed by major chip vendors in the US and EU, such as Texas Instruments (U.S.).[8] Major foreign firms also use platforms to develop and design new products. The handset manufacturers, therefore, do not need to independently develop key components for new-product development.

Thanks to the platforms, new entrants did not need to independently develop and design the more advanced technological content of the handsets. However, to differentiate in an increasing range of handset functions, they still needed sufficient development and design experience to have a good command of platform structure. Moreover, the platforms developed by Texas Instruments demanded an advanced technological competence and were not friendly to inexperienced newcomers. In addition, the available technical support was not always sufficient to their needs (Interview at Konka, July 26,

[8] It is not that whole elements of the OS and the middleware are modularized, so the bold line contains a part of the elements. Although platforms are provided by chip vendors, parts of software included in platforms, such as the OS and middleware, are developed by other specialized firms, not by chip venders.

2006). In short, although ready-made platforms were available, they were not compatible for the limited technological capabilities of the local firms.

The situation of China's handset industry in the 1990s was very much one that was dominated by lack of technological capabilities. As mentioned above, the Chinese government launched a nationalization project for the handset industry, but the initiative was not a commercial success. Moreover, some major local electronics firms tried to enter the industry and expand their market share, but gained only a foothold, and were unable to achieve large-scale production.

2.3.2 Outsourcing

Lacking as they were in technological capability, local firms turned to external firms for design and manufacturing, and bought handsets mainly from original equipment manufacturing (OEM), original design manufacturing (ODM) firms, and design houses in Korea and Taiwan. Design houses are firms that provide services of product design and development. For example, Bird bought from Pantech (Korea), Sewon Telecom (Korea), BenQ (Taiwan) and Quanta Computer (Taiwan), while TCL purchased from Pantech (Korea), LG (Korea) and Hon Hai Precision Industry (Taiwan). It is said that in 2003, two-thirds of the handsets marketed by local Chinese firms originated in Taiwan. Korean and Taiwanese firms provided almost all of the finished products and the Chinese firms, protected by the government licensing system, sold them under their own-brand logos.

While the Chinese firms depended heavily on outside suppliers, their decision-making was shaped by two economic rationales. First, Korean and Taiwanese firms had already accumulated technology and know-how through orders from foreign firms and as a result of the stimulus provided by domestic competition. For example, Hon Hai and Quanta established in 1974 and 1988, respectively, have accepted orders from the US's Dell and Hewlett-Packard, Japan's Sony, etc., and built capabilities for production and development of electronics products. Transactions with firms in developed countries have given Taiwanese firms opportunities for learning and the capability building (Kawakami 2012; Kawakami and Sturgeon 2011). As a result, they have increased their abilities for OEM/ODM businesses. In addition to Taiwanese firms, Korean firms also have built capabilities through transactions with firms in developed countries. For example, Pantech established in 1991 accepted orders from Motorola and learned about handset manufacturing business (Abe 2006). Consequently, local Chinese firms depended

on Korean and Taiwanese firms and could keep up their handset business, because local firms did not have enough capabilities to develop and manufacture products. As a result, Korean and Taiwanese firms could expanded their business through transactions with local Chinese firms, while foreign firms intending to enter the Chinese handset market were blocked by China's protective industrial policy.

Second, during this period, simple and low-cost handsets were in demand in the Chinese market, and Chinese firms had no need to offer a differentiated range of sophisticated handsets, as simple basic specifications were enough to meet market demand from new subscribers. The basic specifications comprised telephone call and short message service (SMS) functions. Simple and inexpensive handsets incorporating these two functions were important for new subscribers.

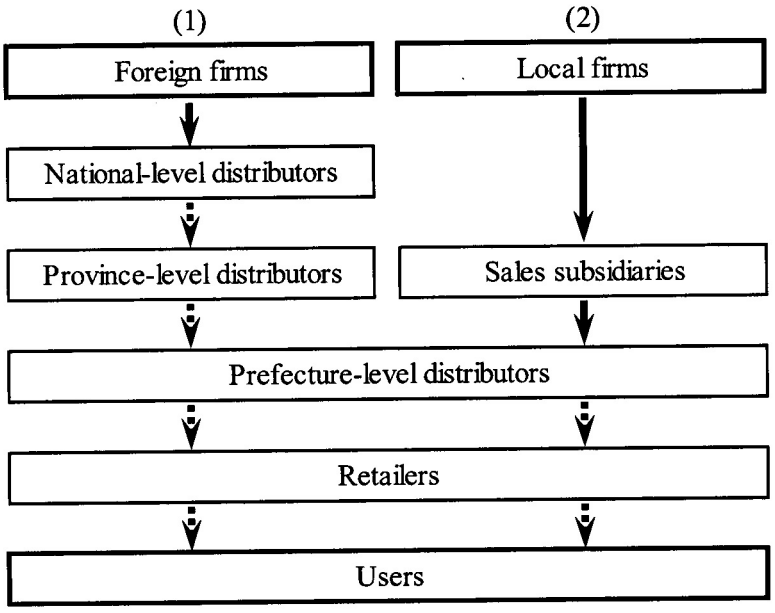
2.3.3 Internalization

Although local Chinese firms depended on Korean and Taiwanese suppliers, at the same time, they pursued a sales-and-marketing oriented strategy. They faced the technology disadvantage, but had a home advantage as local firms in the home market. Foreign firms do not have enough knowledge for foreign markets and strong positions in foreign business networks (Johanson and Vahlne 1977, 2009). They need to adapt their businesses for local market environment, business customs, tastes of local consumers, etc. Therefore, competitiveness and higher productivity are required for multinational enterprises to enter foreign markets (Helpman et al. 2004). Like two sides of a coin, the away disadvantage for foreign firms becomes the home advantage for foreign firms at the same time. Local firms have the inherent competitiveness to the extent that they play in the home market. Consequently, local Chinese firms focused on the sales-and-marketing business. For example, they focused on developing surface layers appropriate to the preferences of Chinese consumers. In addition, they launched major advertising campaigns, in particular via television, to promote recognition of their new brands. Moreover, a distinguishing strategic feature of local firms was that they independently constructed their own sales networks. Given the vast national landscape of China, and the great distances involved in the transport of products, creative distribution policies were needed to expand sales.

Figure 2.4 shows in diagrammatic form the general distribution channels for GSM handsets in China, and columns (1) and (2) shows the distribution channels

followed by foreign and local firms, respectively.[9] A significant difference can be seen between the distribution strategies of domestic and foreign firms. After shipping the products to a small number of national-level distributors, foreign firms were not involved with distribution, and handsets produced by them flowed through national-level distributors to province-level and prefecture-level distributors and retailers. The advantage of this distribution policy was that the foreign firms were relieved of having to follow cost controls over the distribution channels; the disadvantage was that the firms were unable to control the distribution margins, which tended to increase along with each of the distribution stages.

Figure 2.4 Distribution Channel



Source: The author's own creation.

Note: The dashed arrows indicate transactions outside firms' boundaries; the solid arrows indicate transactions firms' boundaries. However, in the case of local firms, they engage in every distribution stage.

By contrast, major Chinese firms were closely involved with the distribution channels. They established sales subsidiaries at the provincial level, and these

[9] Obviously, the actual distribution stages are more complicated and longer. The more products go down the distribution stream, the more there are a lot of distributors and retailers. Therefore, the problem that trade areas of same brands are overlapped occurs. In addition, the distribution stages must be longer in local and rural markets.

subsidiaries carried out various sales policies, the details differing from one firm to another. Generally, subsidiaries selected prefecture-level distributors and monitored the behavior of these distributors, especially in matters such as pricing and the choice of sales destinations. Moreover, subsidiaries sent sales promoters to retail shops to expand the sales of their own brand handsets. Bird in particular was strongly committed to this sales-and-marketing oriented strategy and substantially expanded its market share during this phase (Interview at Bird, August 31, 2004). For example in 2000, they set up 28 subsidiaries in provincial capitals and 300 offices in local major cities.

Constructing own sales networks is based on rationality. To increase their sales-and-marketing capabilities, firms needed to collect and analyze market information on each distribution stage, and to train salespersons and promoters. Foreign firms had already established close relationships with major national-level distributors during a long period of transactions with them that began in the mid-1990s, and this made it difficult for local firms to sell their products by way of the existing major distributors (Huang 2003). Meanwhile for their part, the distributors were wary of devoting their human resources to transactions with specific local firms because of the uncertainty of sales of local brand product. Consequently, local firms tended to be trapped inside a vicious circle in which their products were not taken up because of the expectation of poor sales, and it was to avoid this problem that major firms such as Bird and TCL constructed their own sales networks to mobilize human resources for the expansion of sales.

This strategy enabled local firms to expand their market share, especially in small and medium local cities and in rural areas. Although during the 1990s handsets in China were expensive and mainly for business use, local firms sold simple functional ones through their own distribution channels and expanded their sales all over the country. The outcome was that the handset markets of the major cities were still largely dominated by foreign firms, whereas elsewhere in China, new subscribers welcomed the simple and low-cost handsets that were offered by the Chinese firms. In other words, local firms established their own presence by creating local and rural low-end markets.

2.4 Analysis of the Third Phase

2.4.1 Change in Competition Environment and Technology Deficit

Changes in the competitive environment increasingly required local firms to differentiate their products, and this requirement again confronted them with the realities of the technology deficit.

The changes were caused by the following four trends, two of which were related to an increase in competitive pressures. First, foreign firms changed their strategies by developing new product lines that included low-end handsets, while altering their distribution channels so as to gain access to local markets. Second, a succession of new local firms entered the handset business following the easing and eventual cancellation of the industrial policy. In addition, illegal handsets began to be sold in high volumes in response to rapid market growth.[10] The problem was known as "*hei shouji*" (black handsets) at first, and then, "*Shanzhai ji*" (mountain stronghold handsets) in China. These handsets began to be easily made and sold under the changes of business environment, such as vertical specialization and modularization of products. Consequently, the favorable environment for local "legal" firms also became the nest of local illegal firms. The latter two trends were related to a weakening in the advantages hitherto enjoyed by local firms. First, as replacement demand began to increase, consumers' tastes began to change and users started to demand more complicated and multi-functional models. In addition, chain retail stores (Gome, Suning, etc.) and new carriers entered the distribution business, and as a result, distribution channels diversified. The outcome was that local firms lost their advantages in business capability and were saddled with an excess of sales networks.

These changes in the competitive environment meant that the focus of competition shifted to product differentiation. Because each firm extended its product range in an attempt to improve its brand appeal, about 600 models were launched every year. Consequently, the product life cycle became shorter, and the average volume of shipments also contracted. Then, the price range have expanded from low-end products

[10] There are mainly four reasons of illegal handsets: (1) handsets made by firms without the license, (2) handsets without the certification to connect to the mobile networks, (3) smuggled handsets, and (4) handsets violating intellectual property rights. However, the industrial policy was cancelled as mentioned above, therefore the illegal case of (1) does not exist at present.

retailing at 1,500 RMB and below (100 RMB = 14.5 US$); to middle-end products selling at 1,500–2,500 RMB; to high-end handsets that commanded a price of 2,500 RMB and above. Models produced by the local firms were concentrated in the 1,000–1,500 RMB price range. In this latter category, fierce competition pressured firms to develop differentiated models. As new concepts of handsets were developed and introduced by foreign firms, local firms competed by focusing on price-reduction of foreign cutting edge models.

The differentiation requirement, however, brought local firms face-to-face with the technology deficit. Following their entry, most local firms had concentrated their energy on the development of the sales-and-marketing oriented strategy, therefore they accumulated little experience in technological development. Consequently, the significant gaps in experience between foreign and local firms resulted in stagnation among the Chinese firms post-2003, with some local firms leaving the industry.

2.4.2 Outsourcing

Many local firms decided to rely on outside firms for development (and manufacturing for some firms), because they did not have enough technological expertise to embark on production on their own account. Although dependence on external firms remained in place, the partners changed. The increase in demand for handsets led to the emergence of local Chinese design houses, devoted to the development of handsets, and many local firms began to abandon transactions with the OEM/ODM firms and started to buy handsets from these design houses instead (Marukawa et al. 2006). The local houses provided design services and offered handsets at lower prices than those charged by the Korean and Taiwanese OEM/ODM firms.

Although the local handset firms continued to depend on outsourcing, two new concepts emerged. First, because design houses accepted orders from many local firms at the same time, there was a decrease in the average cost per model and they began to accumulate experience for further technological development. Second, because local firms were required to equal new functions and design achieved by their rivals, design houses helped widen their product ranges with customers' needs. In this way, outsourcing was an efficient way in which to develop and widen product ranges.

2.4.3 Internalization

While small and medium-sized local firms depended wholly on outsourcing, major local firms began to develop some new models by themselves. Although some firms did not succeed in developing new models, Lenovo expanded its market share by integrating a certain level of independent development capability with marketing ability. To accumulate such development capability, they leveraged off from the easy-to-use platforms developed by a major Taiwanese chip vendor for consumer electronics, MediaTek (MTK).[11]

On the other hand, many major firms suffered setbacks in their attempts to accumulate development capability. For example, although Bird agreed on the establishment of a 50-50 joint development venture with Sagem (France), and TCL merged with the handset division of Alcatel (France) to enhance its development capability, management of joint ventures and M&A initiatives were never easy for inexperienced local firms. As a result, many local firms were unable to improve their economic performance.

In response to this situation, the easy-to-use MTK platforms began to be accepted by local Chinese firms and design houses. At first, MTK and a local design house, Longcheer, cooperated and refined the MTK platforms for the Chinese handset market (Shiu and Imai 2010). As a result, in addition to design houses, even local Chinese firms began to use the platforms and develop products. Their platforms include a core hardware layer and almost all the software as circled with a bold line in Figure 2.5, and it very much eased the difficulties of design and development. Although this simplification of product structure came at the expense of product differentiation, the acceptance rate of MTK platforms among local firms jumped from 13% in 2004 to 71% in 2005, an increase that reflects the advantage offered by the platform in the development process. In addition to the simplification, MTK provides reference designs for newcomers of handset manufacturing. Reference designs provided by chip venders are design drawings of products using relevant venders' platforms. The US and EU's chip venders also provide reference designs, but experiences and capabilities are required to develop products with their reference designs for handset manufacturers. On the other hand, the MTK's reference designs show complete component lists to develop products with the MTK

[11] On the role of chip vendors to local industrial development, see Shiu and Imai (2007; 2010).

platforms. Consequently, Many major local firms, such as Bird, TCL, and Lenovo, have accepted MTK platforms to develop new models.

Figure 2.5 Product Structure (In the Case of Using the MTK Platforms)

	Hardware	Software
Core layer	Radio frequency, Data processing (baseband chip, etc.)	Basic software (OS)
Inter-mediate layer	Circuit designed board, Devices (display, camera, battery, etc.)	Communication middleware (protocol stack, etc.)
Surface layer	Housing, Key-board	User interface (menu screen, etc.), application software

Source: The author's own creation.

Note: As noted in Figure 2.3, the elements contained within the bold line are modularized as platforms.

Lenovo, in particular, grew by integrating a certain level of development capability with its own product policy at a time when other local firms were stagnating. Lenovo was one of the pioneers in the use of the MTK platforms. While other major local firms remained completely dependent on outside firms, Lenovo accumulated its own development experience. Because use of the MTK platforms alone sacrificed differentiation, Lenovo adopted a mix of MTK and various other platforms to retain their competitiveness (Interview with Lenovo, August 27, 2007). Exploiting its development capability with the MTK platform, Lenovo seized the opportunity by launching a rapid succession of new products that suited the home market for middle-range products. In 2004, for example, Lenovo changed its monochrome displays to color ones across its entire product range, and in 2005 the company launched handsets with an MP3 function at a time when this was becoming a popular feature. In addition, they had capabilities to design and develop housings and circuit designed boards, allowing them to release sophisticated design models.

To differentiate models and diversify their own product portfolio, local firms

needed to develop new models in the middle of the range to satisfy the market. However, design houses had no intention of devoting their human resources entirely to the requirements of specific local firms. As a result, products developed by design houses have often been inferior in differentiation and quality. For this reason in particular, Lenovo decreased its dependency on outsourcing and began to develop its own models. In their range of product models, 90% have been designed by the company.

2.5 Concluding Remarks

In this chapter, we have examined the way in which local Chinese firms confronted with technology gaps have achieved growth, using the Chinese handset industry as a case study. With limited technology, local firms depended on outside firms for development and design. In particular, the MTK platforms helped local firms enter and grow in the market. At the same time, they themselves focused on sales and marketing, using their advantage of familiarity with the home market. Consequently, by establishing a growth condition in which their selection of boundaries offsets technology gaps they were able to expand their market share.

For the local firms, the existence of the large Chinese market has worked well. The market has been big enough to provide room for the growth of local firms as well as the playing field for entry of local design houses and the launch of the easy-to-use platforms. Local firms operating in situations where market size is not as favorable as it is in China may need to utilize other advantages and characteristics unique to their own countries.

The growth process of the Chinese handset firms shows that local firms can grow by a creative selection of boundaries under the constraint of the technology deficit. Globalization on its own does not guarantee the growth of local firms in developing countries nor does it necessarily impede such growth.

3

Technology Gaps and Boundaries of Firms

3.1 Introduction

How do firms in developing countries achieve entry and growth when they face technology gaps with firms in developed countries?[1] In the era of economic globalization, when firms in developed countries have been expanding their businesses to emerging markets through exports and foreign direct investment (FDI), it is important to consider the influence of developed countries on economies in developing countries. To do so, this chapter focuses on boundaries of business firms and analyzes boundary selection of firms in developing countries that face technology gaps. Firm boundaries are ranges of make-or-buy selection of intermediate goods and services for making final goods. Viewing value chains, products generally consist of various components and services. Products are thus related to various business areas such as development, manufacturing, and sales. Consequently, even though firms in the same industry or same market are viewed, there is a possibility that boundaries may be different in each firm.

Firms in developing countries may actually differentiate their boundaries in comparison with firms in developed countries in the same industry. China's electrical and electronics industry is a notable example. The Chinese economy has been growing in economic liberalization since 1978. In particular, it has developed significantly and become a leading industry (Kimura 2007a). In other significant development, local Chinese firms have not been likely to develop and manufacture high-technological key components or buy them from outside suppliers (Kimura 2006a, 2010b; Marukawa 1996,

[1] This study concerns competition between firms in developed and developing countries here, so the focus is on firms in emerging countries that have realized a certain level of industrialization among developing countries.

2007; Ohara 1998, 2000; Shanghai Caijing University Ketizu 2006). Behind significant industrial development has been a dependence on modularization of product structures and vertical specialization of industrial structures that have avoided the problem of technology gaps.[2] On the other hand, utilizing the advantage they have as local firms in their homeland, they have built nationwide sales networks and expanded their market share.[3] They have shared business customs in China with wholesalers and retailers. They have been able to cooperate with distributors that have better channels than foreign firms (Furuta 2007). In this way, Chinese firms have compensated for any technology gaps they may have.

Such heterogeneity in firm boundaries has been discussed in case studies on firms and industries in developing countries. It has, however, not been generalized as a model of boundary selection for firms in developing countries. Therefore boundary selection for firms in developing countries to avoid technology gaps and realize entry and growth is analyzed here. In addition, by clarifying entry conditions for firms in developing countries, possibilities of diversification in boundaries due to the extent of technology gaps and changes of business environment can be shown.

The remainder of the chapter is organized as follows: In the next section, an analytical framework is shown. In sections 3.3 and 3.4, the model is developed and entry conditions are analyzed. Findings are presented in the concluding section.

3.2 Framework

There are many studies regarding influences of globalization on developing countries. However, many take the viewpoint of developed countries. Hence, developing countries and their firms tend to be described as having passive existence, being given technology from developed countries and their firms. Consequently, previous studies have focused on

[2] Since the 1990s, product structures have become more simplified for modelers, so manufacturers for final goods have not needed to develop and manufacture core components (Baldwin and Clark 2000). Manufactures have tended to make core components "in-house" to differentiate products and improve product value. By incorporating progressive vertical disintegration of industrial structures due to digitalization of products and development of information and communication technology (ICT), specialized firms have tended to develop and make core components (Fujimoto and Shintaku 2005; Yasumoto 2010).

[3] Though not a primary concern of this research, this is also an important reason why local firms have grown so significantly that they have included functions suited to the lifestyle of Chinese consumers for products (Liu 2002).

the issue of whether or not technology leads to diffusion, or on the issue of how technology can be diffused. Therefore it is consistently assumed that firms in developing countries can enter and grow if technology is diffused. On the other hand, they cannot if it is not.

Looking at actual firms in developing countries, boundaries of Chinese growing manufacturers are differentiated under technology gaps. This fact is related to changes in modularization and digitalization of products as well as fragmentation of production systems. Consequently, an industrial structure in which firms can avoid making them and buy core components, even if they face significant technology gaps, has been established.

In this chapter, a model of boundary selection for firms facing the gaps is analyzed. Such a model of boundary decision-making was by Grossman and Hart (1986) and Hart and Moore (1990) (GHM model).[4] In the GHM model, boundaries are decided through selecting an ownership pattern of physical assets to mitigate a hold-up problem by an incomplete contract (Chapter 2).

Antràs and Helpman (2004) and Antràs (2005) (AH model) apply the GHM model to analyze multi-nationalization of firms through international trade and FDI. We use the AH model and analyze behavior of firms in developing countries under globalization. Antràs and Helpman (2004) show that firms in developed countries select integration of manufactures in developing countries (FDI), outsourcing to manufactures in developing countries (trade), integration of manufacturers in developed countries (domestic investment), or outsourcing to manufacturers in developed countries (domestic procurement) in descending order of productivity. On the other hand, Antràs (2005) shows that firms in developed countries select manufacturing in developing countries when the technology get obsolete and/or the wage in developing countries is low, even if firms in developed courtiers face the problem of incomplete contracts in developing countries. In this way, they have modeled boundaries selection; however, in the AH model, they have focused on behavior of firms in developed countries and the relation of division of labor between firms in developed and developing countries. Consequently, the AH model has been based on the viewpoint of firms in developed countries, not on that of

[4] In addition to the property rights approach (property rights theory or PRT) as in the GHM model, there is also the transaction cost approach (transaction cost economics or TCE). According to TCE, by comparing costs between transactions inside firms and through markets, boundaries are decided in order to minimize costs. A major difference between these approaches is that the PRT places weight on holding down opportunistic behavior at the stage of enforcement after contracting while TCE does this by holding down such before contracting (Furubotn and Richter 2005).

firms in developing countries which compete with firms in developed countries in a same market.

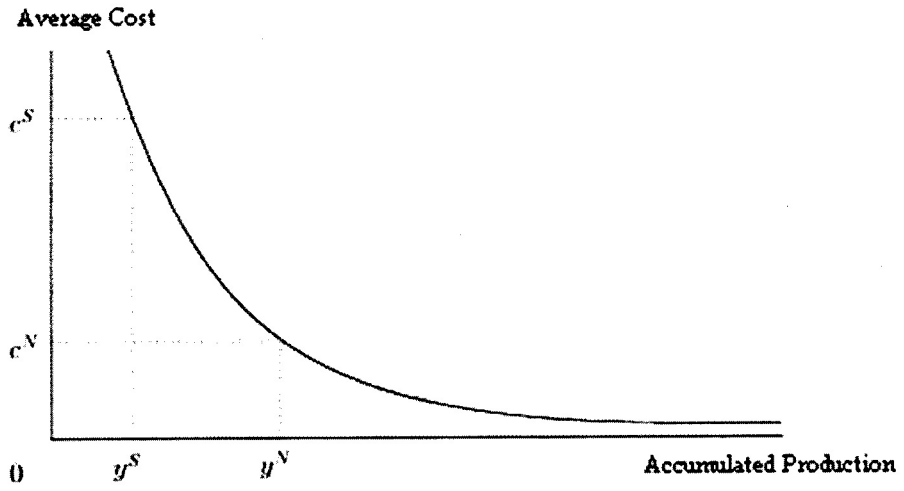
Therefore, we apply the AH model to analyze firms in developing countries under globalization. Although we directly use the AH model's basic idea and settings for the demand function and the revenue and profit functions of firms as shown in the next section (3.3), however, the relation between firms in developed and developing countries and the decision making of boundary choice faced by firms in developing countries are entirely different. Firms in developing countries are competitors of firms in developed countries, not subjects to be integrated or outsources by firms in developed countries. Moreover, we are focusing on boundary choice of firms in developing countries, not that of firms in developed ones as focused in the AH model. Moreover, to describe a difference between firms in developed and developing countries, the existence of technology gap is incorporated in this research.

Technology gap is considered to be the result of a lack of experiences. When a product structure is complicated, and development skills are not able to be manualized, then it becomes difficult to diffuse technology. Consequently, LBD is required to design and develop new products successfully.[5] Actually, there was a problem in the lack of experiences in the nationalization project of mobiles in the 1990s. According to a report by the Chinese government, the project was hopeless for commercialization because of significant gaps in technology compared with foreign firms and increased costs due to the lack of technology (Xinxi Chanye Bu Jingji Tizhi Gaige yu Jingji Yunxing Si, 2003).

Figure 3.1 shows a learning curve or an experience curve effect for decreasing unit cost with increasing cumulative production volume. As shown in the figure, cumulative volume of firms in developed countries, y^N, is already large. Therefore, their unit cost, c^N, is already low. On the other hand, the cumulative production volume of firms in developing countries, y^S, is still small. Therefore, their unit cost, c^S, is also not yet low.

[5] In this article, it is assumed that technology is not completely diffused from developed countries to developing ones. However, possibilities of technology diffusion cannot be denied. Such an assumption is for explicitly considering boundary selection in cases where a technology gap exists.

Figure 3.1 Learning Curve



Source: The author's creation.

Therefore, we can expect as follows. Even if it is requires investment in specific human capital in order to increase product value, it is rational for firms to refrain from integrating such intermediate input when this investment in human capital does not produce effects immediately. This is because firms without enough experiences face relatively high average costs. Boundary selection of firms in developing countries facing technology disparity is thus investigated here showing entry conditions.

3.3 Model

An economy in which there exists a developed country (North) and a developing one (South) is considered relative to the AH model. Suppose that there is a North firm N and a South one S in each country and that both firms are competing in a market in the South. The North firm exports or invests in the South and enters the South market.[6] In addition, suppose that both firms input only labor and produce goods for final consumption y.

Consumers have a simple demand function for the consumption goods as follows:

[6] It is assumed that there is no difference in entry between modes, export, or investment.

$$y = \lambda p^{-1/(1-\alpha)},\ 0 < \alpha < 1, \tag{3.1}$$

p is the price of the final goods, and $1/(1-\alpha)$ is price elasticity of demand. $\lambda > 0$ is a coefficient given exogenously.

Behaviors of firms are then set. Suppose that both firms run businesses by combining a headquarters service x_h and technology goods x_t. The headquarters service indicates various activities for producing and selling final goods. Technology goods indicate core components in all parts consisting of the final goods.[7] The headquarters service is provided only by assemblers of the final goods both in the North and South. Technology goods are provided by the North firm which produces the final goods in the North and by the South firm or a components supplier in the South. The North firm makes technology goods, and the South firm may make technology goods by integrating suppliers, or it buy them from outside independent suppliers rather than integrating them. Optimal selections of make-or-buy of technology goods for the South firm are analyzed under certain situations in the next section.

3.3.1 Behavior of the North Firm

The North firm produces technology goods by itself. Therefore, two inputs, x_h and x_t, are combined based on a Cobb-Douglas production function producing the final goods:

$$y = \sigma_z x_h^{1-z} x_t^z, 0 < z < 1, \tag{3.2}$$

z is elasticity of production of the technology goods. $\sigma_z = z^{-z} (1-z)^{-(1-z)}$. The final goods industry becomes a technology goods-intensive industry when $z > 1/2$. It becomes a headquarters service-intensive one when $z < 1/2$. The following revenue function of the North firm R^N may be derived from Equations (3.1) and (3.2):

$$R^N = \lambda^{1-\alpha} \sigma_z^{\alpha} x_h^{\alpha(1-z)} x_t^{\alpha z}.$$

When it bears a wage rate w^N in the North to produce every unit of production, the North firm chooses x_h and x_t to maximize a profit function as follows:

[7] Other components and materials that make up final goods are not of concern.

$$\pi^N = \lambda^{1-\alpha}\,\sigma_z^{\alpha}\,x_h^{\alpha(1-z)}\,x_t^{\alpha z} - w^N x_h - w^N x_t. \tag{3.3}$$

3.3.2 Behavior of the South Firm

Unlike in the North, the South firm does not make technology goods by itself from the first. Therefore the South firm makes a decision of boundary selection $k \in (M, B)$ as to whether the firm makes M or buys B. If the firm follows the GHM model, the South firm will integrate a supplier and make x_t by itself in order to avoid a hold-up problem when the firm needs to invest in human capital for x_t to increase the value of final goods.

Next, the influence $\beta_k \in (0, 1)$ on gains between the South firm and a supplier is explained. On shares between these two entities, suppose that both sides can receive gains of each outside option and half of the rest, based on the Nash bargaining solution. The outside option is a gain which each side can receive when negotiations fail. When bargaining fails in cases where the South firm buys x_t (that is, does not integrate a supplier), the outside option of the south firm for technology goods is zero. On the other hand, even when bargaining fails in cases where the south firm makes technology goods, the firm can receive δ as an outside option. Suppose $0 < \delta < 1$, then the south firm which integrates technology goods can keep δ^{α} against sales. In the case that the south firm makes x_t, the share is R^S and is the total amount of sales in the South. This shows that the supplier has become a part of the South firm as a department of production of technology goods. Consequently, their shares decrease more than in existence as an independent firm.[8] When firms in the South buy x_t, the supplier can keep the outside opportunity of technology goods as an independent firm. In summary, the relation between both sides is as follows:

$$\beta_M = \delta^{\alpha} + \frac{1}{2}(1 - \delta^{\alpha}) > \frac{1}{2}(1 - \delta^{\alpha}) = \beta_B.$$

While the above is based on a general mechanism of boundary selection, the influence of technology gaps to the mechanism can be connected. It can be assumed that

[8] In this article, the relation between firms in the South and suppliers is based on the relation between firms manufacturing low-technology goods and firms manufacturing high-technology goods, as in Antràs (2005). He also supposes that low-tech and high-tech firms receive half after (excluding outside opportunity) respectively.

technology levels required to produce technology goods are high due to technological difficulties of production of core components for the final goods and transfer from North to South. Therefore the South firm needs to accumulate experiences to master the technology by itself. However, productivity of the South firm is initially lower than that of the North firm because of the lack of experiences. Hence, even if the South firm integrates the supplier to improve the quality of the core component, it cannot receive the effects of human capital investment in as much an amount as does the North firm. Consequently, it can be assumed that the average cost in the South becomes higher by $a_k > 1$ when the South firm makes a choice to produce technology goods by itself, even though $w^N > w^S$. Therefore, while the wage rate in the South is lower than that in the North (depending on the degree of technology gaps), the labor cost in the South possibly exceeds that of the North.

Hence, the South firm's and the supplier's revenues are, respectively, as follows:

$$\begin{aligned} R_f^S &= \beta_k \lambda^{1-\alpha} \sigma_z^{\alpha} x_h^{\alpha(1-z)} x_t^{\alpha z}, \\ R_s^S &= (1-\beta_k) \lambda^{1-\alpha} \sigma_z^{\alpha} x_h^{\alpha(1-z)} x_t^{\alpha z}. \end{aligned} \tag{3.4}$$

When the South firm makes technology goods, the supplier receives the above revenue as a department of the South firm. Moreover, the South firm's and the supplier's profits are, respectively, as follows:

$$\begin{aligned} \pi_f^S &= \beta_k \lambda^{1-\alpha} \sigma_z^{\alpha} x_h^{\alpha(1-z)} x_t^{\alpha z} - a_k w^S x_h, \\ \pi_s^S &= (1-\beta_k) \lambda^{1-\alpha} \sigma_z^{\alpha} x_h^{\alpha(1-z)} x_t^{\alpha z} - w^S x_t. \end{aligned} \tag{3.5}$$

It is also the same in profit. When the South firm makes technology goods, the supplier receives the above profit as a department of the South firm. In addition, it can be assumed that the supplier also employs workers at lower wage rates than those in the North firm because the South firm and the supplier locate in the South despite integration or disintegration by the South firm.

3.4 Equilibrium

In this section, optimal prices and marginal costs for the North and the South firms from

the profit functions in the previous section are developed, and boundary selection of the South firm is analyzed. Possibilities of mitigation of an entry condition are also considered.

From Equation (3.3), the optimal price for the North firm is as follows:

$$p^N = \frac{w^N}{\alpha}. \tag{3.6}$$

The price depends on the wage rate and price elasticity of demand in the North.

Next, from Equation (3.5), the optimal price for the South firm is as follows:[9]

$$p^S(\beta_k) = \frac{a_k^{1-z} w^S}{\alpha \beta_k^{1-z}(1-\beta_k)^z}. \tag{3.7}$$

The North firm does not need to make a decision regarding boundary selection. Hence the optimal price depends on the wage rate in the North. On the other hand, the South firm is required to choose boundaries minimizing the optimal price. The South firm then must choose β_k depending on z and consider an influence of $a_M > 1$ on the optimal price when it chooses integration.

We first consider influences of z on boundaries selection $k \in (M, B)$. The South firm chooses β_k to minimize the optimal price under a certain z. Looking at β_k in Equation (3.7), the South firm can minimize the optimal price when it chooses the smaller β_k if z is bigger, and conversely, the larger one if smaller. In cases where the industry is a technology goods-intensive one, the supplier's investment in human capital becomes bigger than the South firm's because significance of the core component to the value of the product is higher. On the other hand, in cases where the industry is a headquarters service-intensive one, the South firm's investment becomes bigger than the supplier's because the significance of the headquarters service to the value of the product is higher. Buying is the optimal boundary in cases of technology goods intensive-industries;

[9] Differentiating the profit function of the South firm with respect to headquarter service x_h, results in an optimal amount of that profit. Similarly, differentiating the profit function of the South firm with respect to technology goods x_t, results in an optimal amount of profit. Substitute these derivatives of the South firm and the supplier and solve for x_h and x_t. When these optimal amounts are substituted into the price function $p = \lambda^{1-\alpha}\sigma^{\alpha-1}x_h^{(\alpha-1)(1-z)}x_t^{(\alpha-1)z}$ derived from Equations (3.1) and (3.2), then Equation (3.7) results.

making is optimal in cases of headquarters service-intensive industries.

Next, entry conditions faced by the South firm may be set based on optimal prices. It is assumed here that North and South firms compete in the South market under a Bertrand competition.[10] Consequently, the South firm's optimal price should be lower than that of the North because rational consumers do not intend to buy homogenous goods at higher prices. It would not be realistic to expect that both North and South firms, that is, firms in developed and developing countries, make homogenous goods and compete in the same market together because the South firm tends to avert competition with the North firm directly in the same market. However, to consider influences of existences of the North firm on the South firm's boundary selection explicitly, competition between both the North and the South firms may be assumed. Then, under the Bertrand competition, the entry condition becomes $p^N / p^S > 1$.

However, it is not adequate to make a simple comparison between the optimal prices of the North and the South firms for the entry condition. Since the optimal prices are monopoly ones of the North and the South firms, therefore, there is room to bring the price down in response to another competitor for both parties. Consequently, there exists no equilibrium in our model. To avoid the influences of the monopoly prices and compare true competitiveness of the North and the South firms, we should compare the lowest prices, that is, marginal costs, of both as the actual entry condition. In our model, the marginal costs (MC) equal the product of the monopoly prices and α.[11] Therefore, the marginal costs of the North and the South firms are as follows, respectively:

$$MC^N = w^N \tag{3.8}$$

$$MC^S(\beta_k) = \frac{a_k^{1-z} w^S}{\beta_k^{1-z}(1-\beta_k)^z}. \tag{3.9}$$

To ensure to compare the marginal costs as the entry condition, we suppose that

[10] If a Cournot model of competition is assumed, then optimal boundary selection based on differences of optimal production volume depending on technology level of firms in the South can be considered. However, this article focuses on entry conditions and whether or not firms in the South can enter in comparison with the cost level of firms in the North and South. This is considered based on a Bertrand competition model considering comparison between prices of firms in the North and the South.

[11] As described above, $1/(1-\alpha)$ is the price elasticity of demand ($-\{dy/dp\}/\{y/p\}$) and constant in our model. In the case of monopoly, the marginal revenue (MR) is as follows: $MR = (dp/dy)y + p = p(\{dp\}/\{dy\}/\{p/y\} + 1) = p(1-1/\{-[dy/dp]/[y/p]\}) = \alpha p = MC$. Therefore, the monopoly price is MC/α.

there are two homogeneous North firms in the South market and one South firm seeking to enter the market. The reason why we suppose the two North firms is to equalize their prices at the marginal cost of the North firm under the Bertrand competition. Therefore, if the marginal cost of the South firm is higher than those of the North firms, then the South firm cannot enter and the marginal costs of the North firms becomes the equilibrium price in the market. On the other hand, if the marginal cost of the South firm is lower than those of the North firms, then the South firm, in turn, enters and a price that is slightly lower than the marginal costs of the North firms becomes the equilibrium one in the market.

Under the model setting and the assumptions, the following condition from Equations (3.8) and (3.9) arises:

$$\omega \geq A(\beta_k) \tag{3.10}$$

where ω and $A(\beta_k)$ are defined as follows,

$$\omega \equiv \frac{w^N}{w^S}$$

$$A(\beta_k) \equiv \frac{a_k^{1-z}}{\beta_k^{1-z}(1-\beta_k)^z}.$$

Thus, the South firm must choose boundaries in which $A(\beta_k)$ is equal to or smaller than ω. Depending on circumstances, the South firm may not be able to set boundaries or enter into markets.

3.4.1 Technology Goods-Intensive Industry

Based on the entry condition, the South firm's boundaries selection in a technology goods-intensive industry can be considered. Depending on the extent of the wage ratio ω, the firm may decide to run business by purchasing the core component or not to enter business at all. The condition is as follows:

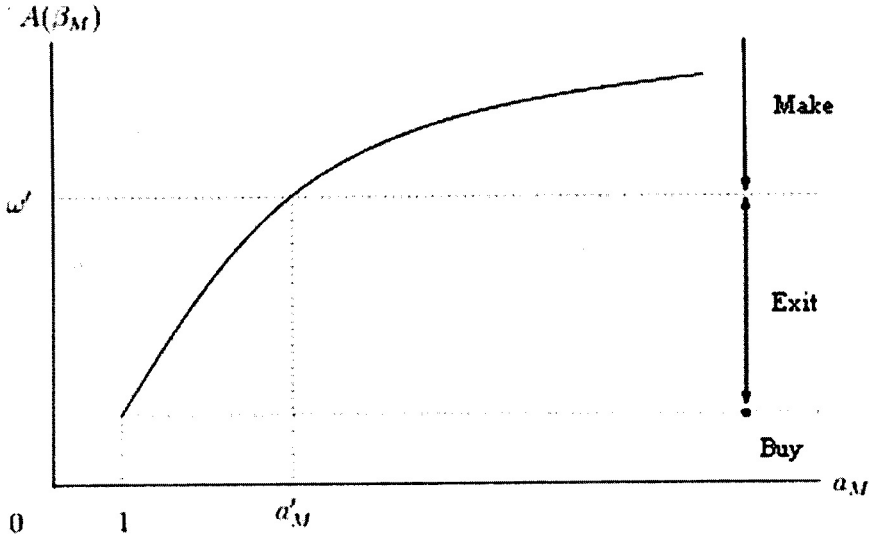
$$\omega = \frac{1}{\beta_B^{1-z}(1-\beta_B)^z}. \tag{3.11}$$

As shown in Equation (3.11), in the industry the South firm chooses to buy, $a_B = 1$. The South firm does not need to bear a cost increase of production brought by making. However, $\beta_B < 1/2$ and $1/2 < z < 1$, therefore the right side of Equation (3.11) is larger than 1. Depending on ω, the firm may decide to enter through purchasing or not to enter. Even if the right side of Equation (3.11) becomes larger than 1, the South firm can enter through buying if the wage ratio is large enough to compensate for it. On the other hand, if the ratio is not large enough, then the firm cannot enter at all.

3.4.2 Headquarters Service-Intensive Industry

The South firm's boundary selections in the headquarters service-intensive industry are considered next. The firm chooses among making, buying, and non-entry depending on the wage ratio ω and a_k. This condition is seen in Equation (3.10). Even if the industry is the headquarters service-intensive, the firm is required to choose boundaries in consideration of the burden of $a_M > 1$ to make by itself. This situation is described in Figure 3.2. The South firm cannot clear the entry condition if the wage ratio ω is getting bigger when the productivity disparity a_M is getting bigger. As shown in the figure, if a_M is at the same level of a'_M, then the wage ratio must be more than the level of ω'. This is the condition for the South firm to integrate the supplier.

Figure 3.2 Relation between $A(\beta_M)$ and a_M



Source: The author's creation.

When the South firm has to bear excessive costs, a_M, even if integration is optimal, then there is a possibility that the South firm can clear the entry condition by choosing to buy. Because the South firm has to bear $a_M > 1$, even if integration ($\beta_M > 1/2$) is optimal in the headquarters service-intensive industry ($z < 1/2$), the South firm can decrease a_M to $a_B = 1$ by choosing to buy ($\beta_B < 1/2$). Consequently, when $A(\beta_M) < \omega$, the South firm can clear the entry condition. The new entry condition is similar to that in Equation (3.11). However, $A(\beta_M)$ gets bigger in comparison with boundary selection which is optimal for choosing to buy because the South firm chooses $\beta_B < 1/2$ despite the fact that $z < 1/2$. When the South firm cannot clear the new "compromising" condition, then the firm chooses non-entry.

As seen above, the South firm chooses boundaries when the wage ratio is large or technology gaps are small, and this depends on characteristics of the industry. When the industry is a technology goods-intensive one, the firm may choose buying or non-entry. When the industry is a headquarters service-intensive one, the firm may choose making, buying despite the fact that making is an optimal selection, and non-entry.

3.4.3 Mitigation of Entry Condition

Finally, cases of softening the entry condition are considered. In the first case, when final goods are products of a technology goods-intensive industry as shown in Equation (3.9), then South firms do not need to bear the burden of $a_M > 1$ brought on by making technology goods. Therefore, if technology changes and z in Equation (3.2) becomes larger, then final goods are changed from products of a headquarters service-intensive industry to those of a technology goods-intensive one. Even if South firms cannot enter when the industry is service-intensive, the possibility for them to enter will increase.

The second case involves advantages for local firms. Being different from technology which is usable in various markets, there is a possibility that firms cannot exert effects of headquarters services such as sales activities without understanding consumers' preference and adapting business customs in each market. Therefore, as the North firm has the advantage in production costs of technology goods, there is a possibility that the South firm has a home advantage in production costs of the headquarters service to be used at the South market. The South firm can then increase revenue R^S_f by an increment of the advantage. Thus, the South firm can choose

boundaries to offset its technological disadvantage with a locality advantage. Suppose that the increment of the revenue is $\varphi > 1$, then Equation (3.4) is as follows:

$$R_f^S = \beta_k \varphi \lambda^{1-\alpha} \sigma_z^{\alpha} x_h^{\alpha(1-z)} x_t^{\alpha z},$$
$$R_s^S = (1-\beta_k) \lambda^{1-\alpha} \sigma_z^{\alpha} x_h^{\alpha(1-z)} x_t^{\alpha z}.$$

The optimal price of the South firm then becomes smaller than the previous one seen in Equation (3.7) by φ^{1-z}, and the entry condition is softened as below:

$$p^S(\beta_k) = \frac{a_k^{1-z} w^S}{\varphi^{1-z} \beta_k^{1-z} (1-\beta_k)^z}.$$

3.5 Conclusion

This chapter has shown that firm boundaries in developing countries are likely to be heterogenized. In first considering the case that final goods are from a technology goods-intensive industry, the optimal boundaries for the South firm are that it buys technology goods from the supplier. The South firm then does not need to bear the increase of average cost due to integration. If only the wage ratio offsets inefficiency, the South firm can clear the condition for entry.

Considering the case of a headquarters service-intensive industry, making of technology goods in-house is the optimal boundary selection for the South firm. They must take on the increase in cost burden due to technology gaps. If the increase becomes so large that it cannot be covered by the wage ratio, the South firm cannot clear the entry condition. However, there is a possibility that it can enter by switching from making to buying technology goods.

Finally, possibilities for mitigation of the condition were considered. In the first case where an industry becomes a technology goods-intensive one through technological change of product structures, when products become modularized, then roles of the supplier of core components to increase the product value are enhanced. Consequently, buying technology goods becomes a new optimal boundary selection for the South firm. In the second case of locality advantage in production of the headquarters service for the South firm, this firm can increase possibilities of entry by offsetting its technological

disadvantage with a home advantage.

Except for the case where the South firm is making technology goods in a headquarters service-intensive industry, the South firm's boundaries are diversified from those of the North firm. Specifically, a South firm can be seen to exert a home advantage in its South market. There is a possibility that firm boundaries in developing countries can become diversified in each developing country to exert the home advantage of each.

Finally, we recall the case of boundary-level homogenization of the North and South firms. Previous studies have assumed that boundaries become homogenized when technology diffuses, and this was confirmed by research in this chapter. If the cost increase due to technology gaps is small when the South firm makes technology goods (that is, if technology diffuses enough), then the South firm can choose similar boundaries to those of the North firm and can catch up throughly. If the North firm has already chosen optimal boundaries, and it is not difficult for the South firm to follow the precedent, it is a rational decision for the South to choose similar boundaries of the North firm because the South firm can avoid learning by mistake. Therefore, when integration of suppliers is not difficult, then boundaries of the South firm converge to those of the North firm.

However, when integration is difficult, then there is a possibility of heterogenization of boundaries of the South firm. Looking at growth of firms in developing countries from boundary levels, there is a possibility that boundaries are diversified depending on ways used to offset technology gaps.

4

China and India's Electrical and Electronics Industries: A Comparison between Market Structures

4.1 Introduction

Growing countries do not necessarily follow the same industrial development process, despite sharing similar starting points. China and India have both been growing remarkably under gradual economic liberalization since the 1980s; however, they show a significant contrast in industrial development processes. As we see later, the role of secondary industry in the Chinese economy is consistently larger than that in the Indian one.

In particular, a large difference could be found in the electrical and electronics industry. Although the industries in both China and India were regulated as a part of the defense industry before liberalization, they have started to develop with the production of civilian goods. Consequently, in China, the electrical and electronics industry has consistently developed since the 1980s and has become a leading industry, whereas in India, it stagnated in the 1990s after development in the 1980s. The results in both countries reveal another contrast between their information and communication technology (ICT) industries. Within the ICT industries, the hardware industry has developed remarkably in China; on the other hand, software and IT-enabled services have developed very well in India (Popkin and Iyengar 2007). China and India are on different paths of economic growth from the viewpoint of industrial development.[1]

[1] The Indian development process is interesting from the viewpoint of not only the Chinese pattern but also the East Asian pattern. Unlike India, the growth of East Asian industrializing countries and areas also tends to depend on hardware-centered industry. Therefore, a comparison between China and

According to previous studies, we know that the existence of competition among local firms is a key factor of the different results in the electrical and electronics industry. In China, the transition from a planned economy to a market economy has been gradual, and economic liberalization is therefore incomplete, with the entry of private firms being low at first (Naughton 1995; Wedeman 2003). Continuous entries led by local governments, however, have increased competition as a consequence—especially in the 1980s—and competition among local Chinese firms has promoted industrial development. Although local firms were technologically backward compared to foreign firms, they have shaped their competitiveness, for example, with quality improvement, product differentiation in tune with Chinese consumers' preferences, construction of nationwide sales channels and after-sales service networks, etc., through fierce competition (Kimura 2006; Marukawa 1996, 2007; Ohara 1998).

In India, too, partial liberalization in the 1980s increased competition in the electrical and electronics industry (Joseph 2004). According to Rodrik and Subramanian (2005), although the partial liberalization in the 1980s still favored incumbents, it has definitely contributed to Indian growth. [2] However, the license system remained—possibly discouraging the promotion of competition—and the relatively uncompetitive situation did not bring opportunities to build competitive advantage for local Indian firms.[3] Although entries into the electrical and electronics industry increased with the liberalization, the industry was still tied by the influence of the previous entry regulations, which favored small-scale firms and kept in a state of technological backwardness (Esho 1988). Small-scale firms tended to purchase various components rather than manufacture them by themselves. This consequently reduced opportunities to develop the industry including components (interview at the Electronics and Computer Software Export Promotion Council on July 30, 2009). Consequently, the industry has

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India would shed light on the differences between East Asia and India.

[2] Therefore, they describe the partial liberalization in the 1980s as "probusiness" and the full liberalization in the 1990s as "promarket," and prefer the former period for its economic growth in India.

[3] There are also other reasons. The unfavorable investment climate for the whole of manufacturing is also related to the underdeveloped state of the electrical and electronics industry. Ferrari and Dhingra (2009) show problems with electricity, high taxes, corruption, and tax administration. Kojima (2002) and Uchikawa (2006) indicate inadequate infrastructure, particularly electricity shortage. Moreover, relative differences in industrial development are also related to underdevelopment. The possibility of developing India's components industry is discouraged by rapid tariff cuts and the existence of well-developed industrial agglomerations in East Asia (interview at the Electronic Industries Association of India on July 31, 2009).

started to develop since the 1980s, but local firms have faced uphill competition with foreign firms and imports.

Previous studies focus on the impact of competition in enhancing industrial development, although the features of such competition have not been explicitly studied. At least the market is not at either extreme, that is, monopoly or perfect competition; it could be that the market appears in a variety of forms between both extremes. Therefore, it is necessary to inquire into the properties of competition pursued by firms. Moreover, to understand the properties is also related with finding a factor of development in China and India's electrical and electronics industries. Competition among local firms decreases their average costs through entry (Tirole 1988). Consequently, local firms can improve their competitiveness against import and foreign firms under opening up to the world. Unless the productivity of firms is not raised adequately, openness is likely to have a negative influence on the growth of productivity and output in industries (Aghion and Howitt 2009). Therefore, in this study, we will identify the property of competition that leads to differentiation of industrial development processes and investigate their determinants.

To identify the properties of competition, we compare the market structures of China and India. Market structure is defined as the number of firms in a market and the distribution of the market share of each firm. We compare the characteristics of the market structure and extract each property in China and India. Next, to understand the determinants of the market structure, we investigate barriers to entry and size of markets. One barrier to entry is that costs are borne only by new entrants but not by incumbents. The barrier is formed by, for example, assets owned by incumbents exclusively, licenses for entry, sunk costs, etc. The market size is related to survivable space for firms when the existence of fixed costs generates a scale economy. We compare the two aspects and explore the formative factors in market structure.

Under this framework, we here consider the television (TV) set industry, to analyze particular market structures concretely. Because it has been a major sector both in China's and India's electrical and electronics industries, it would be an appropriate case study for the industry. For example, TV sets have more than 100% penetration in urban households in China and almost 100% penetration in rural ones, as discussed in section 4.3. In India, the industry accounts for 60% of the consumer electronics market (iSuppli Corporation 2008). Moreover, in the 1990s when determined the results of industrial development in China and India, Chinese and Indian domestic markets were major areas

for local Chinese and Indian firms, respectively. According to the sources of Tables 4.4 and 4.5, the export ratios in 2000 were 30.6% in China and only 1.2% in India. Although the ratio in China is not small, however the Chinese domestic market was undoubtedly an important market. A domestic market is a breeding ground for local firms, preserved by remaining protections against import and foreign firms, local knowledge for business practices and consumer tastes, etc. Therefore, it is important to analyze a domestic market for understanding industrial development.

From a comparison of the TV set market, our study leads us to conclude that homogeneity in competition serves as a key factor in industrial development. In China, reform started at the stage in which there were a few major incumbents; therefore, competition among firms with almost similar technological capabilities promotes industrial development. In addition, the rapid market expansion made room for many new entrants. Consequently, they increased their advantages through fierce competition and expanded their market share against foreign firms. On the other hand, the nature of competition in India was heterogeneous. After partial liberalization in the 1980s, the license system remained, and a stable market structure with only a few major local firms has therefore been maintained. In addition, the market did not expand very much, limiting new entries. Consequently, with limited competition, their market shares decreased as foreign firms entered after full liberalization.

The next section reviews the development of the electrical and electronics industries in both countries. In section 4.3, we show the differences in the market structures and discuss the features of competition. In section 4.4, the heights of the barriers to entry and market expansion are analyzed as determinants of the market structure. Finally, we make concluding remarks.

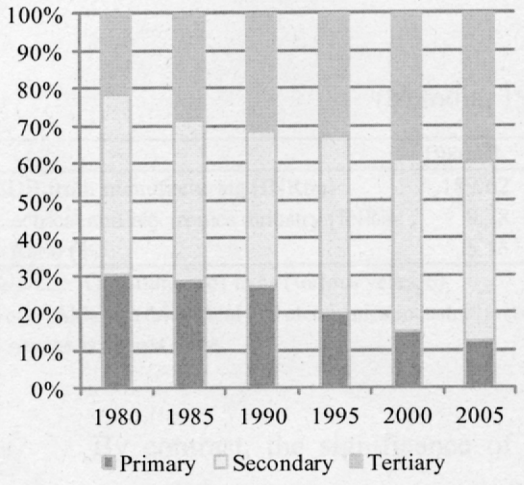
4.2 Industrial Development

Despite the rapid growth of China's and India's economies, their development patterns are different in terms of industrial structure. In China, economic reform and the open-door policy, which began in 1978, successfully promoted economic growth. Similarly, in India, partial and full liberalization, which began in the 1980s and the 1990s, also drove economic growth. However, the ratio of secondary industry, including the electrical and electronics industry, to the whole economy in China is continuously much

higher than the ratio in India (Figure 4.1). Manufacturing has been a driving force behind growth in China, whereas software and IT-enabled services, which are classified as belonging to tertiary industry, have been a leading sector in India. It is shown that the engines of growth are different between the two countries.

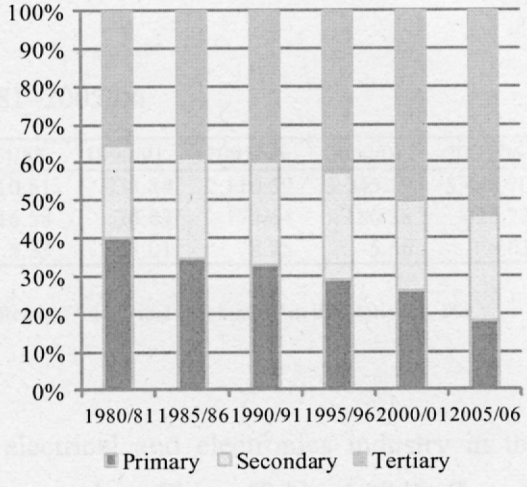
Figure 4.1 Industrial Structures: China, 1980–2005, and India, 1980/01–2005/06

(a) China



Sources: National Bureau of Statistics of China (various years).

(b) India



Sources: For 1980/81 to 2000/01, Government of India (various years,a). For 2005/06, Government of India

In China, the electrical and electronics industry has developed into one of China's leading industries (Table 4.1(a)). Although it is in nominal terms, growth after the mid-1990s has been rapid, and the industrial scale has expanded about threefold every five years. Consequently, the ratio of added value between the electrical and electronics industry and the secondary industry increased from 6.85% in 1985 to 12.88% in 2005. Within the secondary industry, the added value of the electrical and electronics industry has been growing at a faster rate than that of the entire secondary industry, contributing the rapid economic growth in China.

Table 4.1 Electrical and Electronics Industries

(a) China, 1980–2005

	1980	1985	1990	1995	2000	2005
Added value of industry (RMBbn)	164.84	276.74	509.33	1544.61	2539.48	7218.70
Electrical Industry (RMBbn)	n.a.	11.19	20.99	60.38	123.15	357.41
Ratio (%)	n.a.	4.04	4.12	3.91	4.85	4.95
Electronics industry (RMBbn)	3.15	7.78	14.62	63.50	182.43	572.21
Ratio (%)	1.91	2.81	2.87	4.11	7.18	7.93

Sources: National Bureau of Statistics of China (various years).

Note: "Added value of industry" for 1980 to 1990 is the value for the net value of output.

(b) India, 1980/81–2005/06

	1980/81	1984/85	1990/91	1995/96	2000/01	2005/06
GDP from manufacturing (INRbn)	189.62	310.81	933.84	2,116.59	3,245.19	5,448.70
Electrical and electronics industry (INRbr	9.78	16.58	74.83	174.64	180.38	328.22
Ratio (%)	5.16	5.33	8.01	8.25	5.56	6.02

Sources: Government of India (various years, b).

Note: Although "electrical and electronics industry" is used instead of "electrical machinery" in the statistics, the coverage is almost same.

By contrast, the significance of the electrical and electronics industry in the Indian economy has not grown as rapidly compared to China (Table 4.1(b)). Growth between the mid-1980s to the mid-1990s has been rapid; however, the pace slowed in the late 1990s. Consequently, the ratio of added value of the electrical and electronics industry to secondary industry increased to 5.16% in 1980/81 and to 6.02% in 2005/06, whereas, the ratio declined after peaking to 8.25% in 1995/96. Because the ratio of secondary industry to the economy in India is smaller than China's ratio in the first place, the significance of the industry is much smaller than in China. At the time in India, the electrical and electronics industry was expected to be a leading industry as in other countries, such as developed countries and developing countries in East Asia. However, the focus moved to software and IT-enabled services during the 1990s. It is known that the difference between the Chinese and Indian industrial structures emerged after the 1990s.

4.3 Market Structure

4.3.1 China

To investigate the background to the differences, we identify the properties of competition as a key driver of industrial development by market structure. The properties of competition are related with various factors, such as institution, and market size and its growth, through influencing the market structure, therefore we analyze formative factors of the market structure at the next section. As we show in this section, a significant difference in the market structure is that many major local firms with homogeneous competitiveness have kept competing in China, whereas only a few major local firms have kept their positions in India. This property is therefore homogeneous in China, but heterogeneous in India.

In the Chinese TV set market, many major local firms have continued to compete (Table 4.2).[4] We can find major firms, such as Konka, Changhong, TCL, Skyworth, Hisense, Haier, Xiamen Overseas Chinese Electronic (Xoceco), SVA, and Panda.[5] Every firm is a famous nationwide manufacturer in China's electrical and electronics industry, although most of them were established locally at first.

[4] The Chinese TV market is assumed to be the color TV set market, because color TV (CTV) sets have been prevailing in both urban and rural markets after the 1990s. The Indian TV set market is assumed to be the CTV and black and white TV (B&W TV) set markets, because B&W TVs also still sell well in India, at least in the 1990s.

[5] Konka, TCL, Skyworth, Xoceco received investment by overseas Chinese and firms in Hong Kong. However, they were basically investment firms and did not have the technology or know-how to manufacture TV sets; therefore, we treat them here as local firms and a variation of Chinese firms.

Table 4.2 Market Share in China, 1993–2005 (%)

	1993	1994	1996	1997	1998	1999	2001	2003	2004	2005
Konka	13.4	11.0	12.2	15.1	13.7	15.9	12.7	16.5	15.5	15.7
Changhong	4.2	5.0	20.5	25.0	33.7	13.2	16.5	15.5	14.5	13.9
TCL	n.a.	n.a.	6.2	9.5	7.8	11.0	14.1	12.7	13.5	13.1
Skyworth	n.a.	n.a.	n.a.	4.4	2.6	4.5	8.2	10.3	12.3	11.5
Hisense	1.9	n.a.	n.a.	3.1	5.6	8.5	9.9	8.9	10.4	7.9
Haier	n.a.	n.a.	n.a.	n.a.	7.9	7.8	6.8	6.1	6.7	6.2
Sony (Japan)	n.a.	3.5	5.5	n.a.	2.3	3.6	3.3	3.0	3.2	3.5
Sanyo (Japan)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.3	3.2	3.9	3.3
Panasonic (Japan)	10.7	14.7	13.3	6.7	2.3	n.a.	1.9	1.9	2.0	2.9
Philips (Netherlands)	n.a.	n.a.	n.a.	4.5	2.4	n.a.	3.2	2.4	2.7	2.5
Xoceco	3.3	n.a.	2.7	3.8	2.0	6.5	3.0	3.0	2.9	n.a.
SVA	4.2	3.7	2.7	4.5	2.0	2.8	2.7	3.0	2.7	n.a.
LG Electronics (Korea)	n.a.	n.a.	n.a.	n.a.	3.6	n.a.	2.2	3.5	2.3	n.a.
Toshiba (Japan)	2.1	n.a.	4.2	n.a.	2.1	n.a.	3.0	2.7	2.0	n.a.
Panda	11.2	11.0	4.6	3.9	5.6	2.9	2.6	n.a.	n.a.	n.a.

Sources: For 1993 to 2004, Marukawa (2007). For 2005, Sinomonitor International (2006).

Note: Notice that the share of each year cannot be compared directly, because the source for each year is different.

By no means were they established, nor did they enter the TV set market, at the same time, and the timings vary among firms. For example, Changhong was established in 1958 and produced radars for military applications. Thereafter, they started to produce B&W TV sets in 1972 and CTV sets in 1985 and have become a leading firm in the TV set industry. By contrast, Skyworth was established in 1988 and started to produce CTV sets in the 1990s. On the other hand, the market share of Panda, which has a long history in China's electrical and electronics industry and was ranked second in 1993, dropped during the 1990s, and Panda does not currently belong to the top group. As a result, new entrants have had opportunities to enter the market and become major firms after entry.

These major local firms have competed among themselves and with foreign firms, and their market share has expanded against foreign firms. Local firms have grown in power through competition during the 1990s, as shown in Table 4.2 above. Needless to say, the product lineup and product segment heavily weighted by each firm in the TV set market are different, but it is a fact that local firms have developed the Chinese market with expansion of a nationwide sales network under fierce competition among themselves.

Although some major firms have firmly established their positions in the TV set market, they are still under fierce competition. The market concentration increased during the 1990s. The concentration ratio (CR) is the market share held by the largest firm(s). In China, the concentration ratio for the four largest firms (CR4) was 39.5 in 1993 and 54.2 in 2005. However, no local firms became dominant market leaders. During the 2000s, the

top four firms had 10% to 15% of the market share between them, and there are therefore possibilities of changes of their rank order with a small change in the business environment.

Consequently, competition is characterized as homogeneous in China. Because major local firms have maintained an almost equal competitive relationship as shown in the structure, they have grown together and expanded their market shares against foreign firms. Through this competition, they have built their unique capabilities as mentioned in the introduction of this chapter.

4.3.2 India

By contrast, the Indian market structure is not homogeneous like the Chinese one, namely, there exists a disparity between a few major firms and the others. Despite there being a multitude of companies in the TV set market, there are a few major local firms and they steadily kept their market share during the 1990s (Table 4.3(a)). The major firms are Videocon Industries (Videocon), BPL, and Mirc Electronics (Mirc).[6] They grew in the 1980s, and their position has not been shaken. Therefore, the market structure had already been formed at the beginning of the 1990s.

Table 4.3 Market Share in India, 1992/93–2006/07 (%)

(a) 1992/93–2000/01

	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Videocon	17.97	17.5	21.0	25.4	24.9	20.6	20.7	23.6	23.2
BPL	13.07	15.2	20.3	22.4	21.2	18.3	16.9	17.7	14.6
LG (Korea)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	3.3	7.2	9.6
Mirc	5.38	7.0	10.5	10.5	8.4	9.1	10.0	10.0	9.0
Samsung (Korea)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6.1	7.0	8.2
Philips (Netherlands)	5.21	6.7	10.9	7.6	9.5	6.6	5.6	5.5	3.3
Hotline Wittis	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.1	2.8	2.8
Sharp (Japan)	3.45	4.5	5.6	3.4	3.6	2.8	2.8	3.1	2.7
Dixon	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		2.4	2.6
Panasonic (Japan)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.7	2.0	2.3
Import	0.1	0.1	0.6	1.1	0.3	0.4	0.7	0.3	0.2

Sources: Centre for Monitoring Indian Economy (various years).

Notes: The item includes spares and kits for TV sets. The number of firms for shares before 2000/01 and after 2001/02 are different in the statistics, so the tables are split. Note that some major foreign firms are not listed in the statistics.

[6] The brand name of the TV set provided by Mirc is "Onida."

(b) 2001/02–2006/07

	2001/02	2002/03	2003/04	2004/05	2005/06
LG (Korea)	10.8	13.6	16.7	20.5	20.4
Videocon	21.7	20.3	21.2	23.2	19.9
Samsung (Korea)	8.6	11.9	14.0	12.0	12.5
Mirc	9.5	10.8	9.4	9.5	9.2
Philips (Netherlands)	4.0	4.1	3.5	4.5	4.7
Trend	2.0	1.9	1.9	2.1	3.3
Panasonic (Japan)	1.5	1.1	1.1	1.2	1.3
Indo Count	n.a.	n.a.	n.a.	0.7	1.2
Sharp (Japan)	2.4	1.9	1.3	1.0	0.9
Salora	1.5	1.7	0.9	0.7	0.5
BPL	12.8	5.2	4.8	1.5	0.4
Import	0.3	0.4	2.0	4.6	7.8

Source: Same as those for Table 4.3(a).

Notes: Same as those for table 4.3(a). In addition to the top 10 in 2005/06, the table also includes BPL.

The market in the 1980s was more competitive, but the market concentration increased during the 1990s. Except for BPL established in 1963, Videocon and Mirc were established in 1979 and 1982, respectively, and started producing TV sets in the 1980s. In the Indian market, too, the incumbent—here BPL—did not have dominant power against new entrants after the partial liberalization. However, once they established their positions in the market, they maintained them during the 1990s. In particular, Videocon is a giant firm in India's industry. They manufacture cathode-ray tubes (CRT) as a key component for their TV sets. The CR4 in the Indian market embodies this aspect. The CR4 was 46.4 in 1993/94 and it increased to 62.1 in 2005/06. The ratios in both countries increased during these periods, indicating that competitiveness has weakened. The ratios of both years in China are, however, lower than those in India, showing greater competitive in the Chinese market.

Consequently, competition is characterized as heterogeneous in India. From the stable market structure, it is considered that competition in the 1990s was limited among local Indian firms. In fact, major firms did not compete with each other in terms of market share, as in China, and local new entrants that would subsequently become major companies have not appeared. The effect of competition shown in China has not appeared in India.

Evidence of the limited effect of competition is shown in the market structure

after the late 1990s. After the structure stabilized, new entrants were foreign rather than domestic after the full liberalization of the 1990s (Table 4.3(b)). Entries of foreign firms and imports have shaken the structure for major local incumbents. In particular, the market share of BPL dropped considerably. The net profit margin of BPL also fell, because they expanded a lot of business rapidly (Asaka 2007). In the 1990s, South Korean firms, Samsung and LG, expanded their shares. The whole Korean share was 9.4% in 1998/99, increasing however to 32.8% in 2006/07. Korean firms achieved successful outcomes by various business strategies, such as developing models based on Indian consumer preferences, extensive advertising to strengthen the value of their brand names, and so forth (Bae 2007; Verma 2007). The entry of Korean firms with a lot of experience in international competition had a major impact on the lasting oligopolistic market. In addition, decreasing import duty and competitive pressure by imports also increased, particularly after 2004/05.[7] Incumbents faced fiercer competition before they could build their own competitive power.

4.4 Determinants of Market Structures

4.4.1 China

4.4.1.1 Barriers to Entry Formed Historically

In this section, we will examine barriers to entry and market expansion in order to investigate the market structure. First, to understand barriers to entry, we explore a brief history of institutional changes in the electrical and electronics industry.[8] China and India have been through a process of liberalization, so the market structures have been influenced by the institutional changes. We show that the barriers to entry have been lower in China compared to India.

Before economic reform, the government restricted entry, because China was a planned economy and the industry was developed as a defense industry for national security reasons. Therefore, greater emphasis was placed on military goods, such as

[7] Shiino (2009) indicates that many electronics goods have been imported by Indian traders recently.
[8] In addition, whether firms can purchase core components or not also constitutes an entry barrier factor. In China, however, because many local firms could purchase CRT, this factor has not become a barrier (Marukawa 1996).

radars, wireless communication equipment, etc., over consumer products. In particular, the germ of the electronics industry, which was developed worldwide after World War II, was brought by the government, and early production capacity was formed with support mainly from the former Soviet Union during the First Five-Year Plan (1953–57). Thereafter, the policy continued and production bases for military goods were established throughout China, including inland areas.

However, in the 1970s, the Chinese government began encouraging the production of consumer goods because of the problem of excess production capacity for military goods. As described above, Changhong entered the consumer-goods market at that time. Through transformation of production from military goods to consumer goods, new product lines, particularly TV sets, were developed in the electrical and electronics industry and it appears that these transformed firms have dominated the industry since then.

In the 1980s, however, Chinese local governments set up firms one after another and, in addition to firms transformed from defense-industry companies, many new firms entered the TV set market after the economic reform. They set up production lines with technological introduction and support from overseas firms. In the top four firms occupying more than a 10% share as of 2005, shown in Table 4.2 above, all except Changhong were established in the 1980s. The Chinese central government tried to allow a few registered firms to manufacture TV sets; however, firms led by local government introduced many production lines from abroad (Marukawa 1996). Although not all types of firm could enter, nevertheless, all of the above factors led to the development of fierce competition as a result. Although market entry was mainly led by local government rather than by the private sector, conditions for a competitive market were set through such investment.[9]

In addition, they were homogeneous in technological know-how for manufacturing TV sets. They had equally insufficient experience in assembling TV sets and facilities for internalizing CRT. Therefore, although some firms might have experience of manufacturing certain electrical and electronics parts, they are equally near newcomers as manufacturers of TV sets. In other words, there was no significant technological gap among local firms. Consequently, under the economic liberalization, many local firms imported production lines and received technical transfers from firms in

[9] Although we need to review the impact of entries led by local governments on Chinese long-term economic growth, these entries were at least promoting industrial development at this time.

developed countries.

Against the backdrop of market expansion in the 1990s as mentioned below, there was competition among local firms and foreign firms, and they formed competitive power through fierce completion. In China, although led by local government, many homogeneous firms have "freely" entered; therefore, there is now adequate competition promoting the formation of competitive power.

4.4.1.2 Market Expansion

Market size is also an important determinant of market structure. The urban market in China expanded especially in the 1990s; consequently, according to *China Statistical Yearbook*, the penetration rate of CTV sets has increased from 59.0% in 1990 to 116.6% in 2000. As the urban market matured, the rural market also started to expand in the late 1990s, from 16.9% in 1995 to 84.1% in 2005.

The huge market reduced the influence of incumbents in China allowing many new entrants to enter and expand their production capacity. Competition among them consequently decreased the prices of TV sets. Moreover, the decline in prices stimulated further market expansion, that is, there was interaction between competition and market expansion.

Concerning market size, the size of local Chinese firms is also large (Table 4.4). In China, the production volume of TV sets in 1991 was more than 25 million sets and the volume in 1998 was more than 42 million sets. About 100 manufacturers entered the market, and each firm produced 140 thousand sets on average in 1993 and 268 thousand sets on average in 1997. The biggest manufacturer was Changhong; they produced about one million sets in 1992 and about 10 million sets in 1998. Although many firms entered the market, there was space for many firms to survive because of the large market, including the foreign market. Even after new entry stopped in the mid-1990s, competition continued (Table 4.2). In addition, some major local firms entered foreign markets to expand their business. Market expansion has prevented market inflexibility and made room for competition, through which local-firm advantages, such as sales networks, can be established.

Table 4.4 Firm Size in China, 1991–1998

	1991	1992	1993	1994	1995	1996	1997	1998
Total production (10 thousand units)	2516.9	2586.6	2615.7	2913.3	3441.7	2892.2	3244	4276
Number of firms (Firms)	n.a.	n.a.	140	147	147	140	125	n.a.
of which CVT set (Firms)	n.a.	n.a.	92	98	98	99	93	n.a.
of which B&W TV set (Firms)	n.a.	n.a.	116	121	118	n.a.	n.a.	n.a.
Average size of firms (10 thousand units)	n.a.	n.a.	18.7	19.8	23.4	20.7	26.0	n.a.
CTV set (10 thousand units)	n.a.	n.a.	14.2	16.7	19.5	21.2	26.8	n.a.
B&W TV set (10 thousand units)	n.a.	n.a.	11.3	10.5	13.0	n.a.	n.a.	n.a.
Color TV set (10 thousand units)	1174.8	1269.8	1307.3	1637.1	1912.1	2094.9	2496	3643
Largest firm	Konka	Changhong	Changhong	Changhong	Changhong	Changhong	Changhong	Changhong
Production (10 thousand units)	96.8	100.9	140.4	195.5	305.2	480.6	580	935
Share of CTV set (%)	8.2	7.9	10.7	11.9	16.0	22.9	23.2	25.7

Source: Ministry of Electronics Industry of China (various years).

4.4.2 India

4.4.2.1 Barriers to Entry Formed Historically

Next, we see in turn that barriers to entry in India were higher than in China.[10] First, during the early stages of India's electrical and electronics industry in the 1960s, foreign firms dominated the Indian market.[11] For example, Royal Philips Electronics (Netherlands) dominated the TV set market and IBM (the United States) dominated the computer market.

In the latter half of the 1960s and in the 1970s, however, the industry in India also started to develop as a defense industry. In 1966, the Bhabha Committee, commonly known as the Electronics Committee, recommended emphasizing the development of the local public and small-scale sectors. On the other hand, to restrict entry and growth of large-scale firms and foreign firms, the Monopolies and Restrictive Trade Practice Act (MRTPA) and Foreign Exchange Regulation Act (FERA) were established in 1969 and in 1973, respectively. For the development of the electrical and electronics industry, the government established the Department of Electronics for administration in 1970, the Electronics Commission for policymaking in 1971, and a mid- and long-term plan for the electronics industry in 1975. Under these policies and institutions, large-scale investments were not freely allowed.

In the 1980s, Indira Gandhi and Rajiv Gandhi implemented partial liberalization

[10] As mentioned above, purchase of CRT is important for barriers to entry. Gupta (2006) indicates that "suppliers enjoy high bargaining power." Videocon and BPL have integrated to manufacture CRT, and it is necessary to evaluate internalization of core components in competitive power.

[11] On the development of the Indian electrical and electronics industry, see Esho (1988) and Joseph (2004).

at last. In the early 1980s, preferential treatment for incumbents and large-scale investments started. In 1981, a components policy was launched, and the Indian government partially de-licensed components manufacturers. Although the licensing system was maintained in the TV set industry and a color TV policy was launched in 1983, restriction of production capacity was liberalized.[12] During the late 1980s, in addition to this preference, alliance with foreign firms was also partially allowed. Some major local Indian firms realized to align with overseas firms, such as Japanese TV set manufacturers. In the 1980s, the TV set industry was not fully liberalized, with consequent unevenness in the growth of local firms under the licensing system and a preference for incumbents and large-scale investment.

After the 1990s, Narasimha Rao implemented full-scale liberalization. This started with the new industrial policy in 1991, although the electrical and electronics industry was not permitted at that time. The white goods industry was de-licensed in 1993, and CTV sets among entertainment electronics were finally de-licensed in 1996.

Although entry by local firms was de-licensed in 1996, as shown in Table 4.2, the ranking of major local firms has remained stable. For local new entrants, it is considered that the partial liberalization gave incumbents and large-scale firms preferential treatment as a kind of barrier to entry. Moreover, major local firms, such as Videocon and BPL, have tended to integrate manufacturing of components, so it is possible that new entrants have had to integrate to the same degree to gain the competitiveness necessary to enter and grow in the Indian TV market.[13] On the other hand, the entry of foreign firms and imports shook the structure of major local incumbents. Consequently, it is considered that the effects of competition felt in China have not appeared in India. Moreover, after the entry of foreign firms, the shares of local firms dropped.

4.4.2.2 Market Expansion

Despite the large population of India, the size of the market is only half that of China's. In addition, product penetration of electrical and electronics goods is not very high in comparison to China. The rate of CTV sets both in urban and rural areas was just 17% in

[12] Other policies include a policy to promote industrial electronics development in 1983 and a telecommunications policy in 1984. Also, a computer policy and computer software policy were implemented to partially liberalize the industries in 1985 and in 1987, respectively. In addition, the licensing system was also partially liberalized by the integrated policy of 1987.

[13] Ray (2001) shows the vertical integration of BPL as their business strategy.

2001/02.[14] According to income class, the penetration rates in the rich class (more than 1 million INR) accounting for 0.4% of households and the middle class (0.2–1 million INR) accounting for 5.7% are 99% and 73%, respectively. However, the rates of the aspiring class (90,000–200,000 INR) accounting for 21.9% and the deprived class (less than 90,000 INR) accounting for 71.9% are 40% and 5%, respectively. Households of the lower-income class tend not to own a TV set, although they make up the majority of households in India. This low penetration is also related to the price of CTV in India. The price was twice the price in China in 1997, therefore most households could not purchase (Ray 2001).

Consequently, in India, space for growth of new entrants, by contrast with the Chinese case, was smaller. Therefore, it is possible that the market size is becoming a restriction for new entrants. In particular, growth of production volume decreased remarkably during the early 1990s compared with the 1980s. It was influenced by significant recession around 1990 in India (Department of Electronics, Government of India 1992). It is considered that the sluggish growth had significant influence on the market structure and industrial development.

Regarding the market and size of production, local firms also tends to be smaller in comparison with China. In India, the production volume of TV sets in 1990 was 4.8 million sets and 1996 just 8.4 million sets; this volume is much smaller than that of China at that time (Tables 4.4 and 4.5). In addition, the volume in India includes a large amount of B&W TV set production, compared to production in China. On the size of local firms, the biggest manufacturer was Videocon in the Indian market, with about five million sets in 2000 (Table 4.6). The volume was, however, just half that of the biggest Chinese manufacturer, Changhong. Nevertheless, the production share of Videocon was bigger than Changhong's, demonstrating that the top manufacturer had significant presence in the Indian market.

[14] Cited from the website of the National Council of Applied Economic Research (http://www.ncaer.org/downloads/PPT/TheGreatIndianMarket.pdf), accessed on October 16, 2008.

Table 4.5 Production Volume in India, 1979–1996 (10 thousand units)

	1979	1980	1981	1982	1983	1984	1985	1986	1987
TV set	31.1	37	43.5	n.a.	n.a.	128	248	300	430
of which CTV	n.a.	n.a.	n.a.	n.a.	n.a.	28	68	85	110
of which B&W TV	n.a.	n.a.	n.a.	n.a.	n.a.	100	180	215	320
	1988	1989	1990	1991	1992	1993	1994	1995	1996
TV set	570	520	480	398	423	517	653	775	840
of which CTV	130	120	120	88	83	107	133	185	240
of which B&W TV	440	400	360	310	340	410	520	590	600

Sources: Department of Electronics, Government of India (various years).

Table 4.6 Firm Size in India, 1992/93–2000/01 (Thousand units)

	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Total production	4,230.0	5,170.0	6,530.0	7,750.0	8,600.0	9,240.0	10,260.0	11,330.0	12,000.0
Videocon	1,008.2	1,314.2	2,970.2	2,378.8	2,574.2	2,607.0	3,811.6	4,763.6	5,058.6
BPL	276.3	415.0	524.9	641.4	598.0	681.9	833.2	1,039.6	886.4
Mirc	93.5	122.9	156.3	182.7	166.0	185.6	296.9	385.3	345.4
Total for the sample	2634.2	3442.75	5568.2	5709.7	5499.7	5374.6	7614.9	10504.0	10952.3
Average	61.3	84.0	126.6	105.7	101.8	99.5	141.0	194.5	202.8

Sources: Centre for Monitoring Indian Economy (various years).

4.5 Conclusion

In this study, we showed the relationship between the properties of competition and their determinants in China and India. After an overview of the development of the electrical and electronics industries, we first identified the properties of competition in the TV set market. By market structure, competition was homogeneous in China, but heterogeneous in India. Consequently, these yielded different results in industrial development and structure.

Next, we explored the factors. In China, economic reform started at the stage in which there were not very many major incumbents established in the planning period. Moreover, the market expanded rapidly during the 1990s in particular. Therefore, these factors made room for many new entrants. Their continuous entries enhanced competition and their own competitive advantages increased through fierce competition.

On the other hand, India's TV set industry had already established local firms prior to full liberalization, thereby creating a much higher barrier to entry for new entrants. Moreover, the market did not expand much in comparison to the Chinese case.

Under this market structure, the impact of competition on fostering and strengthening local firms was limited. As a result, foreign firms entered the market after full liberalization in the 1990s, and their market shares have expanded. The lack of competition, or heterogeneous competition, did not promote industrial development very much in comparison with the Chinese industry.

In conclusion, the development of local firms against foreign firms depends on the effect of competition among local firms. Although local firms lacked technological capability in comparison to foreign firms, local Chinese firms were able to form their own advantages through competition amongst themselves. Consequently, it was found that homogeneous competition, formed by a low barrier to entry and/or the market expansion, would lead to industrial development.

We discussed development of the TV set industry mainly in the 1980s and the 1990s above. However, the industry in China and India is currently in the midst of major changes. First and foremost, the market is making a transition from CRT to flat-panel displays, such as liquid-crystal and plasma. The transition is bringing a new phase of competition. Moreover, in India, the middle-income group grew remarkably in the 2000s. Along with the change in the electrical and electronics industry, that is, the hardware industry is also growing. For example, many global players such as Nokia, Dell, Samsung, Flextronics International, Foxconn Electronics, etc. decided to invest in production bases. [15] Consequently, the Indian electrical and electronics industry entered a high-growth phase in the 2000s (Uemura and Iwadare 2007).

It is possible that these fundamental movements change the determinants of market structure. Therefore, we have to know what impacts local Chinese and Indian firms have experienced. In particular, it is necessary to clarify whether the recent changes lead to market expansion and industrial development, and whether local Indian firms can seize the opportunity to grow brought by these changes. We must continue to pay attention to the relationship between market structure and its determinants, in order to understand the industrial development process of each country.

[15] Yoshimoto et al. (2006) study the recent business development of Japanese firms in the Indian market. There is also growth of local Indian firms, such as Moser Baer India, a storage media and photovoltaic cell manufacturer, NeST Technologies, an electronics manufacturing service, etc.

Conclusion

This study analyzed the growth of local Chinese firms under globalization. As the presumption of boundary heterogenization of local firms, we began by verifying that technologies are not necessarily diffused from developed countries to China's electrical and electronics industry through FDI. To do it, Chapter 1 analyzed whether or not FDI have a negative impact on the growth of local firms. Our results showed that FDI have a negative influence on sectors facing large disparities in technology and less experience in business. Consequently, despite rapid industrial development under globalization, technologies have not diffused to China completely. Therefore, local firms relatively focus on sales activities than development ones to compensate technology disparities in competition against foreign firms as shown in Chapter 2.

Based on the presumption, we continued by exploring the boundary heterogenizaiton of local Chinese firms. The decision-making behavior is analyzed in a case study of the mobile industry and a model analysis in Chapters 2 and 3, respectively. We showed that local firms facing technology disparities do not decide to integrate activities which require technological abilities, such as development activities and manufacturing of core components; on the other hand, they integrate activities which they can exert their advantage, such as sales activities.

Finally, we showed that the Chinese market is competitive by a comparison with the Indian market in Chapter 4. Local Chinese firms have improved their sales activities through fierce competition and built their common competitiveness in sales; therefore it is necessary to verify the market property. Both the China's and India's electrical and electronics industries share the similar initial condition and the early phase of industrial development, however the properties of their markets are really different. According to their TV markets, the Chinese market is more competitive than the Indian one. We found that the reasons are the lower barriers to entry and the market expansion in China.

In this way, we showed the heterogenization mechanism of firms in developing

countries through a case study of China's electrical and electronics industry. This has some significances for the previous studies shown in Introduction. One is related with the survey in 2.1 of Introduction. The previous studies on the relations between developed and developing countries have focused almost exclusively on technological homogenization and its conditions to realize technology diffusion. Local firms, however, do not simply follow the boundaries of foreign firms; on the other hand, they try to overcome technology deficit by engaging in sales activities as shown in this study. The organizations of local Chinese firms depend on the technological disadvantage and the home advantage. Therefore, organizations of local firms are heterogenized by the limitation of technological homogenization. Local firms can generally catch up to developed countries by utilizing the advance of backwardness (Gerschenkron 1962); however they cannot catch up to technological levels of firms in developed countries in a moment completely. Consequently, growth processes of local firms are characterized by a balance of a disadvantage and an advantage in comparison to foreign firms' advantage and disadvantage.

Another of the significances is relevant to the survey in 2.2 of Introduction. The previous studies on industrial development in China have focused on the heterogenization of Chinese firms. Since they, however, have not investigated the relation with competitors, that is, foreign firms, therefore the balance of cost and benefit between heterogeneity and homogeneity has not been shown explicitly. Based on the views of homogenization and heterogenization, we can show three possibilities for growth processes of firms in development countries in terms of the boundaries of the firm. The first is to select homogenized boundaries by eliminating technology gaps between foreign and local firms through technology diffusion from developed to developing countries and technology formulation by local firms themselves. In this case, local firms follow boundaries of foreign firms as a model to grow. If local firms do not face the problem of technological gaps, then they can grow rapidly and become like firms in developed countries. On the other hand, the second option is to select heterogenized boundaries that offset technology gaps. This was our focus in this study. Local Chinese firms in the electrical and electronics industry decide to buy development services and core components from outside firms and to make sales networks. The make-or-buy decision is fulfilled by the existence of outside firms and modularized product structures, and the vast and the diversified market of China. In other words, advantages and workarounds of disadvantages used by local firms would be different, based on their country, age, and

industry. The third growth process occurs when local firms cannot enter a market due to significant technology gaps or difficulties offsetting those gaps through heterogenization. In this case, industrial development would be inhibited by the existence of developed countries as shown in Young (1991). In this way, comparing to firms in developed countries, we can relativize and generalize the heterogenization of industrial development in China.

Although shown the diversification dynamism in this study, however, it was based only on the case of China's electronic and electronics industry. Therefore, it is necessary to generalize the experience to make a theory on the relation between homogenization and heterogenization of firms in developing countries after this. To give a clue for generalization on this topic, we show characteristics in the Chinese market. It is that the Chinese market is large and diversified, and grows rapidly. As is well known, China has the world's largest population at over 1.3 billion. In addition to the population, China has diversified markets in terms of areas and income classes (Chapter 2). The domestic consumption of home electric appliances and consumer electronics has been increasing in China and had a fundamental role for growth of local firms. Although the population of India rose to more than one billion by the end of 2000, however the Indian home appliance market did not so expanded in the 1990s (Chapter 4). On the other hand, the Chinese market has kept growing, not hitting the ceiling of market expansion. The Chinese urban market has expanded since the 1980s, then, the rural one also has grown since the 1990s. As a result, a lot of local firms have been able to build own sales networks and fully enjoy the home advantage in China.

Therefore, to consider more generalized relations between homogeneity and heterogeneity of firms in developing countries, it is required to find various similarities and differences between foreign and local firms in various developing countries. Accumulating a lot of experiences that how local firms in developing countries compensate for the technological disadvantage, we can further understand various patterns of growth of local firms.

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