Geography of cluster-based industrial development

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chapter 2

Many successfully growing industries are based in clusters, particularly in developing countries where small and medium enterprises (SMEs) dominate. There is no question that industrial clusters stimulate industrial development by providing enterprises and their industries with advantages conducive to growth, such as information spillovers and low transaction costs (Sonobe and Otsuka 2006). Yet industrial clusters have developed disproportionately in advanced countries. Although there are industrial clusters in developing countries, very few are growing and thriving. Nonetheless, governments in developing countries as well as international organizations seldom pursue deliberate policies to promote the development of industrial clusters.

The absence of industrial development policy would not be much of a problem if there were no market failures. According to the theoretical literature on economic geography, however, the geographic imbalance in industrial development arises principally from market failures (Fujita, Krugman, and Venables 1999). Thus, a critical task boils down to identifying the market failures that have prevented poor countries and poor regions in developing countries from establishing industrial clusters. To realize geographically balanced economic development without sacrificing economic efficiency, empirical research must be carried out to identify and characterize the nature of market failures.

In this chapter, we examine the extent to which a pattern of cluster-based industrial development is common among different industrial clusters in different countries, whether the common pattern of development, if any, is induced by internally generated common economic forces, and what successful clusters have and unsuccessful ones lack. These questions are critically important, because if we can identify the common causes of successful cluster-based industrial development, we can prescribe policies that support or accelerate such processes effectively, while anticipating their future development. Another question that arises is whether and how it is possible to rectify the geographic imbalance of industrialization accompanied by the development of industrial clusters in selected areas without sacrificing industrial production and growth. To put it differently, what is the appropriate strategy to create new industrial clusters in less-developed regions?

We have conducted 12 case studies in East Asia (China; Japan; the Philippines; Taiwan, China; and Vietnam), 3 case studies in South Asia (Bangladesh, India, and Sri Lanka), and 5 case studies in Sub-Saharan Africa (Ethiopia, Ghana, and Kenya).[1] The purpose of this study is to address the issues identified above based on our own case studies in Asia and Africa. Our main conclusions are that a common pattern of industrial development is observed among successful cases and that the main difference between successful and unsuccessful cases lies in the lack of "innovations" in the latter rather than in fundamental differences in the nature of development processes. A policy implication is that

it is possible to stimulate the development of stagnant industrial clusters by injecting missing knowledge conducive to the innovations.

This study is organized as follows. It begins by presenting a stage theory of cluster-based industrial development, followed by evidence for our theory from our own case studies. It then examines the changing locations of industries in the process of economic development in China and Taiwan, China. A final section discusses policy implications of the study.

A theory of cluster-based industrial development

An industrial cluster is defined as a "concentration of enterprises producing similar or closely related products in a small area" (Sonobe and Otsuka 2006). Based on our case studies, we have conceptualized the process of cluster-based industrial development by stages: (1) initiation, (2) quantity expansion, (3) quality improvement, and (4) "eruption."[2] The distinction among these stages is important because the type of market failure is different in different stages. The major characteristics of the development stages to be discussed are summarized in table 2.1.

The initiation stage

In general, there are good reasons for a new industry to locate in a certain place, typically in an urban or suburban area. A new industry in which production is technically complicated, such as machinery industries, tends to be established initially in large cities because it tends to be led by engineers, who are more readily available in large cities. Another type of new industry, in which cheap labor is used intensively and marketing is the key to success, such as garment and footwear industries, tends to be led by merchants and to be located in the suburbs or in the vicinity of large cities, where agriculture does not have a strong comparative advantage.[3] If transport and communication costs are very high, however, merchant-led industrialization may take place in large cities because the advantages of close proximity to large markets outweigh those of cheap labor in less urbanized areas. Markets for intermediate inputs specific to the product do not yet exist, and because of the small scale of production, there is not yet any advantage in the division of labor among manufacturing enterprises and between such enterprises and merchants. Thus a pioneering enterprise must procure all of the required materials and parts directly and sell final products directly to consumers and end users.

The quantity expansion stage

The initiation of a new industry requires establishing appropriate production methods, marketing channels, and procurement sources, suitable to the given business environment. Compared with the cost of initiation, the cost of imitating the established production methods and marketing is miniscule. Once a pioneering enterprise succeeds in making a sizable profit, the massive entry of new enterprises follows. Typically, a swarm of new entrants who are former workers of incumbents, or spin-offs, appear at this stage, contributing to the formation of industrial clusters. In this process, the industry grows in terms of the volume of production but not in terms of the quality of products and productivity, because only imitation takes place. Hence

Table 2.1 An endogenous model of cluster-based industrial development

Stages	Prior experience of managers	Education	Innovation, imitation, and productivity growth	Institutions
Initiation	Merchants, engineers	Low	Imitate foreign technology directly or indirectly	Internal production of parts, components, and final products
Quantity expansion	Spin-offs and entry from various fields	Mixed	Imitate imitated technology; stagnant productivity; declining profitability	Interenterprise transactions and formation of industrial cluster
Quality improvement	Second generation of founders and newcomers with new ideas	Very high	Multifaceted innovations; exit of many enterprises; increasing productivity	Reputation and brand names; direct sales; subcontracts or vertical integration; emergence of large enterprises
Eruption	The same as in quality improvement	Very high	Sustained multifaceted innovations and productivity growth	Relocation of leading enterprises from congested cluster to less-developed areas

this stage is termed the quantity expansion stage. Industrial clusters facilitate transactions between assemblers and parts suppliers and between producers and merchants because the geographic proximity among enterprises in industrial clusters reduces not only transportation costs but also opportunistic behavior and other types of transaction costs. In a sense, the industrial cluster is an artificially created "community" intended to reduce transaction costs to make markets work. It is important to emphasize that different industries in different countries share striking similarities in the pattern of cluster-based industrial development, at least up to this quantity expansion stage.

Toward the end of this stage, the industrial cluster sets the stage for quality improvement. First, a variety of useful human resources, such as engineers, designers, merchants, parts suppliers, and skilled workers, have been attracted to the cluster. Second, because of the active entry of followers, the price of products falls and, consequently, the profitability of producing low-quality products declines. Under such conditions, the profitability of producing high-quality products by employing useful human resources is high.

The quality improvement stage

If the entrepreneurs in the sense of Joseph Schumpeter (1912) are available in the cluster, they tend to innovate at this stage by carrying out "new-combination," which is another name for innovation. Then the industrial cluster graduates from the quantity expansion stage and enters the quality improvement stage (Sonobe and Otsuka 2006). The innovative enterprises improve the quality of products by employing designers, engineers, and skilled workers. Such enterprises establish a reputation and brand name and develop their own distribution network to solve the problem of the "market for lemons" that arises from asymmetric information as to whether the product is really an improvement. The enterprises offer long-term subcontracts to dependable parts suppliers to procure specially designed parts or undertake a vertically integrated production system. The innovative enterprises expand the scale of operation to take advantage of established brand names and possibly embark on exports. Such "multifaceted innovations" are carried out by highly educated managers who are able to learn from the experience of more-developed countries. If such managers are not available, the multifaceted innovations usually do not take place. As a result, industrial clusters either do not grow or eventually are overwhelmed by cheap imports. In our view, the critical difference in industrial development between Asia and Africa lies in the presence and absence of innovations. A number of industrial clusters have succeeded in the transition to the quality improvement stage, not only in East Asia but also in South Asia,[4] whereas few have succeeded in doing so in Africa (Akoten and Otsuka 2007; Akoten, Sawada, and Otsuka 2006; Iddrisu and Sonobe 2007).

Ideas embodied in imported high-quality parts and components are often useful for the "imitative innovations." In this sense, a liberal trade system facilitates the transition to the quality improvement phase. Also useful are ideas brought about by global buyers and foreign direct investments. However, learning from abroad is not a panacea: the knowledge acquired from the experience gained in the quantity expansion stage is often necessary to assimilate and adapt new knowledge to the local production environment.

As aptly pointed out by Marshall (1920), the advantages of industrial clusters are (a) information spillovers or imitation, (b) division of labor among enterprises, and (c) development of skilled labor markets. Sonobe and Otsuka (2006) argue that the availability of useful human resources for innovation is another advantage of industrial clusters. This is critically important, because the first advantage of the industrial cluster cited by Marshall—that is, imitation—cannot be of any significance without innovation. Two negative externalities, however, are generated in the developed cluster: one is congestion, and another is rampant imitation of innovative ideas, which reduces the private returns to innovation below the social returns. Thus the quality improvement stage may be followed by the eruption stage.

The eruption stage

If we draw the map of an industrial cluster at the end of the quality improvement stage, while showing production "isoquant" contours, what emerges would look like a volcano in which the amount of production is the largest in the center of the cluster and declines as the distance from the center increases. The pioneering enterprises, which initiated the industry, are naturally located in the center. They tend to be more innovative than others because their founders had foresight and their children tend to be highly educated. Indeed, there are many cases in which educated sons of the founding entrepreneurs are the first to attempt quality improvement (Sonobe and Otsuka 2006). Their successful quality improvement boosts the scale of their production, thereby increasing the "altitude of the volcano." Such innovations give rise to further congestion in the central area of the cluster. Moreover, innovative enterprises expect to suffer losses from imitation by local enterprises that are not innovative. Thus, partly because of congestion and partly because of the fear of imitation by rivals, innovative enterprises tend to relocate their production base outside the existing cluster. This relocation may be termed an eruption, in which lava (or innovative enterprises) flows out from the crater (or the center of the cluster) and lands at the foot of the mountain or farther away.

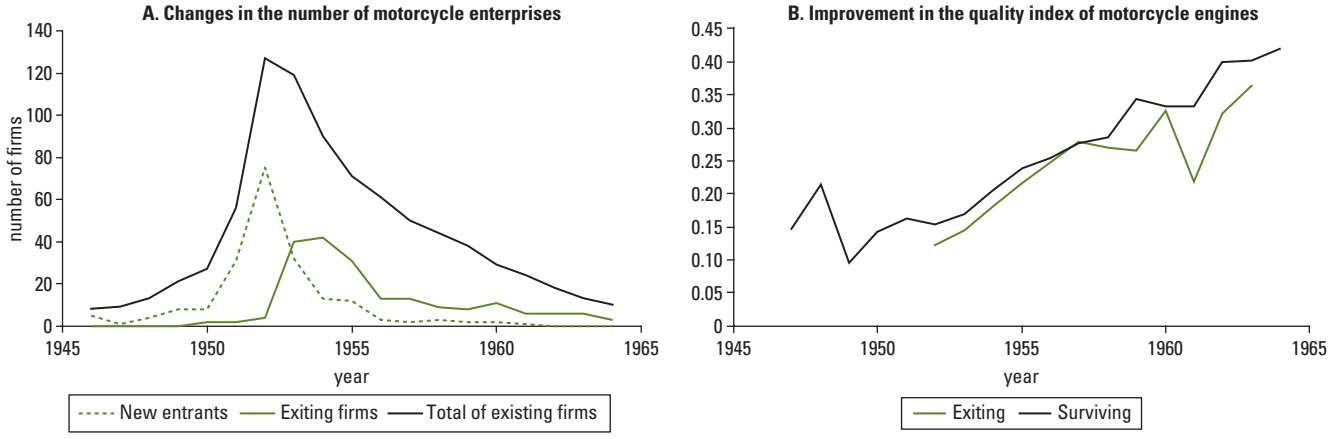
The eruption is likely to be "big" or "long distance" to the extent that new innovations are major, because motivations to expand the scale of production in remote areas where congestion is absent and to escape from the imitation are large. Behind such eruption would be superior new technological ideas and superior management and marketing abilities of enterprise managers. The eruption is also likely to be big if the main purpose of the relocation is to seek cheap labor abroad. In our view, the relocation of industry from developed to developing countries envisaged by Vernon's (1966) product cycle theory is an example of a big eruption. Although a big eruption may eliminate industrial clustering in the original location, it may create a new one abroad. Furthermore, the original cluster may remain as a technology and marketing center, even though the scale of production declines. Another key factor inducing the relocation of industries to remote areas where the industry has not developed is the policies of local governments to attract new industries in underdeveloped areas. In contrast, the eruption is "small" or "short distance" if the innovations are minor, the subcontracting with suppliers or the transactions with local merchants are important, or local government provides new and spacious industrial zones nearby. At this stage, industrial policies in the less developed region may be able to attract innovative enterprises so as to reduce the geographic imbalance of industrialization.

Evidence from case studies

To substantiate our arguments, we attempt to provide supportive evidence taken from our case studies of the motorcycle industry in Japan (Yamamura, Sonobe, and Otsuka 2005), the machine tool industry in Taiwan, China (Sonobe, Kawakami, and Otsuka 2003), and the electric machinery industry in China (Sonobe, Hu, and Otsuka 2004).

Figure 2.1 (panel A) shows the change in the number of motorcycle enterprises in Japan from 1946 to 1964. Clearly the number of enterprises increased sharply up to the early 1950s, because of the sizable entry of new enterprises. Roughly speaking, the annual growth rate of the total number of motorcycles produced was as high as 100 percent in the early 1950s. According to figure 2.1 (panel B), the engine quality index, computed by Taylor's formula, did not rise until 1953, indicating that this period corresponded to the quantity expansion stage. After the mid-1950s, however, the quality index rose steadily, and a number of enterprises that used lower-quality engines exited. While the growth rate of production decreased to less than 50 percent a year, the average size of the surviving enterprises grew approximately 10 times in the six-year period in the late 1950s. A key role in this quality improvement stage was played by Soichiro Honda, the founder of the Honda Motor Company. Indeed, Hamamatsu city,

Figure 2.1 Development of the motorcycle industry in Japan, 1945–65



Source: Yamamura, Sonobe, and Otsuka (2005).

Table 2.2 Major features of the machine tool enterprises in Taichung, Taiwan, China

Characteristic	Pioneers	Early imitators	Innovators	New imitators
Number of samples	7	24	2	10
Year of establishment	1957	1979	1979	1994
Year of numerically controlled production	1,980	1,990	1,980	1,995
Years before machine tool production	12.6	0.7	0	0
Prior job of founders (percent)				
Machine tool enterprises	0	59	100	90
Other machinery enterprises	88	13	0	10
Schooling of founders (percent)				
Primary	71	13	0	0
Secondary	0	12	0	0
High or vocational schools	29	54	0	60
University or graduate school	0	21	100	40
Total	100	100	100	100
Number of parts suppliers	19	30	41	39

Source: Authors' calculations.

where Honda was originally located, became the leading cluster of this industry, dominating the clusters in Tokyo and Nagoya. But Honda "erupted" to Suzuka city, far from Hamamatsu, to begin vertically integrated mass production of high-quality products in huge factories.

Table 2.2 shows the characteristics of managers of machine-tool enterprises in Taiwan, China, by type of enterprise (that is, innovator or imitator), which roughly correspond to the establishment periods. Among the 43 sample enterprises, 7 are identified as pioneers of the industry, which attempted to produce machine tools for the first time through trial-and-error processes in the 1950s and 1960s. Six of the 7 pioneers used to work at other machinery-producing enterprises, and 5 had only a primary education. It took them 12.6 years, on average, to commence the production of machine tools after founding their enterprises. By contrast, most enterprises established in the 1970s and the early 1980s were spin-offs and began producing machine tools immediately after their establishment. During this period, a large number of specialized parts suppliers emerged, and both final products and parts were highly standardized. To keep profitability from declining, the founders of the industry began attempting to produce numerically

controlled machines, again through trial-and-error processes.

The major innovation, however, was carried out in the early 1980s by two new enterprises, which table 2.2 refers to as innovators. Before founding their enterprises, the managers completed graduate studies and worked for the pioneering enterprises. They were innovative not only because they were among the first to produce numerically controlled machines in Taiwan, China, but also because they introduced a new business model of outsourcing all of the parts to suppliers through long-term subcontracting arrangements, which drastically reduced the costs of producing numerically controlled machines. As soon as they began mass production and instituted drastic price cuts, the innovators overwhelmed the pioneers and the early imitators. A number of spin-offs from the innovators imitated the production methods, but they were not as successful as the innovators. The pioneers turned out to be efficient imitators, while the worst imitators in the quality improvement phase were the early imitators.

In the machine tool industry in Taichung, only a short-distance eruption to suburban areas took place, partly because access to a large number of subcontractors in the cluster was critically important and partly because city governments in the Taichung area set up new industrial zones to attract innovative enterprises.

The last example comes from the electric machinery industry in Wenzhou (see table 2.3). According to our interviews with experienced managers, firms began to compete on the basis of quality in the second half of the 1980s, when a few enterprises began using machines to inspect product quality and attempted to establish brand names. In 1990 the importance of engineers was comparatively low, a long-term subcontracting system did not exist, and final products were commonly marketed through anonymous marketplaces and local merchants. These are precisely the characteristics present in the quantity expansion stage. Indeed, the number of enterprises increased in the early 1990s.[5] Throughout the decade, particularly in the late 1990s, the size of enterprises expanded in terms of real value added and number of employees. Also, the ratio of engineers to employees and the number of subcontractors increased dramatically. Moreover, direct marketing by means of sales agencies and own retail outlets became much more important than indirect marketing through wholesalers and other intermediate merchants. Because large enterprises that established brand names merged with unsuccessful enterprises, the number of independent enterprises decreased 25 percent from 1995 to 2000. The average value added shown in table 2.3 excludes that of subsidiaries, and, if that were included, the average value added of independent enterprises in 2000 would be 1.6 times higher than the number shown in this table. In this growth process, successful enterprises moved to nearby industrial zones constructed by local governments.

Table 2.3 Transition to quality improvement: Average enterprise size and marketing channels in Wenzhou, China, 1999, 1995, and 2000

Characteristic	1990	1995	2000
Number of sample enterprises	66	102	112
Number of independent enterprises	66	96	73
Real value added (Y 10,000 in 2000 prices)	123.7	375.8	3,671.4
Number of workers	46.7	104.1	338.3
Ratio of engineers (percent)	1.5	2.7	4.2
Number of long-term subcontractors	0	2.8	34.8
Marketing channels (percent)			
Market places	23.5	20.4	3.6
Local Wenzhou traders	26.5	23.8	5.7
Agents	22.0	30.7	50.6
Own retail shops	9.5	12.6	27.1
Others	18.5	12.5	13.0

Source: Authors' interviews.

While the figure and tables shown in this section are merely suggestive, the three cases discussed are consistent with the predictions of the endogenous model of cluster-based industrial development formulated in the previous section. The other five cases in East Asia that are not discussed here are equally supportive of our arguments (Sonobe and Otsuka 2006).

It is no exaggeration to say that microenterprises and SMEs in developing countries in general and Sub-Sahara Africa in particular are all located in industrial clusters. In our view, this is because transportation costs and transaction costs are too high for microenterprises and SMEs outside industrial clusters. The vast majority of these firms are microenterprises, which have just

a few workers and are operated by artisans who received apprentice training but no formal training. The scope and depth of their understanding of management, marketing, and technology tend to be highly limited. Thus industrial clusters have been generally stagnant and remain in the quantity expansion stage.

A notable exception is the leather-shoe industry in Addis Ababa, Ethiopia (Sonobe, Akoten, and Otsuka 2007). This industry began about 70 years ago with a factory established by an Armenian merchant. The workers of this factory started their own workshops, which in turn produced a number of new entrepreneurs. The repetition of spin-offs created a large cluster consisting of more than 1,000 shoe-making workshops in the city. The long history of the industry also produced another type of important human resource: the highly educated, young entrepreneurs, who are the sons and grandsons of the owners of the long-established shoe enterprises. These new entrepreneurs have recently been carrying out multifaceted innovations.

Multifaceted innovations are also being attempted by relatively highly educated entrepreneurs in a few other industrial clusters in Sub-Saharan Africa, including a small cluster of metal-processing enterprises in Nairobi, Kenya, after a period in the quantity expansion stage, during which the profitability of producing low-quality products declined. These firms are adopting new marketing and new procurement strategies and trying to improve their products. Some of them have already erupted to more spacious industrial areas to expand their production and take full advantage of the favorable effect of their attempts. These cases from Africa lend support to the endogenous model of cluster-based industrial development.

Evidence of changing industrial locations

It is difficult to trace the birth, formation, and subsequent development of an industrial cluster, as well as its eventual relocation. Because the industrial cluster is usually located in a geographically small area, township-level data with fine classification of industrial subsectors are needed, which are rarely available in many countries. This is why many studies on this subject rely on episode or case studies. Our review is based on case studies in the western side of Taiwan, China, and the Yangtze River region in China conducted by the authors in collaboration with local experts (Sonobe and Otsuka 2006).[6]

Taiwan, China, is known for the importance of industrial clusters and the prevalence of subcontracting systems, but it is also known for its geographically dispersed pattern of industrial development (Otsuka 2007). This section examines how the geographic concentration and dispersion of industries took place. In China in the 1980s, one of the most successful models of industrial development was the "Sunan model,"[7] in which collective township-and-village enterprises supported by the township-and-village governments grew rapidly based on cooperation with state-owned enterprises and learned from them through the recruitment of engineers and managers (Otsuka, Liu, and Murakami 1998). This section advances and examines the broad hypothesis that, since the 1990s, the formation of industrial clusters has been one of the critical factors underlying the sustained, rapid growth of the Chinese economy.

Development of suburban clusters in Taiwan, China

We now examine how industrial locations and the division of labor evolved in five manufacturing industries in Taiwan, China, from the mid-1970s to the mid-1990s.

For this study, we obtained data on the production and employment of manufacturing establishments, aggregated up to the township level, by industry, for 1976, 1986, and 1996, from the Director-General of Budget, Accounting, and Statistics of the Executive Yuan, Taiwan, China.[8] A township is an administrative unit below the county level (and county-level city) and above the village level. The areas under study are limited to the western part of Taiwan, China, which consists of the northern, central, and southern regions. The mountainous eastern region is excluded from our analysis because it accounts for only 5 percent of total manufacturing employment in Taiwan, China. From 1976 to 1996, there were several

subdivisions and mergers of townships. After adjusting for these changes, we obtained the consistent data of 275 "townships" for this study.

Until the mid-1980s, the manufacturing sector of the Taiwanese economy enjoyed relatively favorable growth led by expanding export markets. The wages of unskilled workers, however, rose sharply in the late 1980s, and the currency appreciated abruptly against the U.S. dollar in 1986 and 1987. The contribution of net exports to the economic growth rate declined from 50 percent in the mid-1980s to 20 percent in the mid-1990s, and exported products became increasingly intensive in the use of skilled labor, according to Chan, Chen, and Hu (1999).

We chose five major manufacturing industries in Taiwan, China: apparel, plastic products, machines, electric appliances, and computers. The production processes of these industries can be divided into a number of subprocesses, and the extent of vertical disintegration varies across enterprises, areas, and industries as well as over time. The five industries correspond roughly to the two-digit classification adopted in Taiwan, China's, census data. To represent a new and growing industry, however, we selected the computer industry from the two-digit electric machinery industry. Moreover, the electric appliances industry does not include the subsector producing audio and visual equipment and parts, as data for this subsector are not available for 1976. Likewise, the computer industry in 1976 is not included in our analysis because of the lack of data.

As table 2.4 shows, these five industries had sharply contrasting growth records over the last few decades. The apparel industry is in decline: it accounted for nearly 12 percent of total manufacturing employment in 1976, but less than 4 percent in 1996. Its extremely large negative growth rate of employment in the period from 1986 to 1996 is explained mainly by the relocation of production from Taiwan, China, to mainland China (Tu 2000), which is a big eruption, according to our theory. The other industries, except the machinery and computer industries, were also increasingly affected by competition from low-wage countries. The machinery industry lost employment share slightly in the first period, but it regained employment share in the second period, presumably because it succeeded in shifting from standardized and conventional machines to high-quality numerically controlled machines, as discussed earlier. The highest growth rate in the second period was recorded by the computer industry.

To examine from where and to where the spatial dispersion and concentration took place, table 2.5 exhibits changes in the share of employment in urban, suburban, and rural areas in total employment of each industry. The classification of areas is based on the administrative classification as follows: (a) urban areas consist of the 44 wards of Taipei and Kaohsiung municipalities and Keelung, Taichung, and Tainan cities; (b) suburban areas consist of 104 townships that are either adjacent to the urban areas defined above or designated as (township-level) cities; and (c) rural areas consist of the remaining 127 townships.

Table 2.4 Share of manufacturing employment and annual growth rates of employment in Taiwan, China, by industry
percent

Indicator and year	Apparel	Plastic products	Machinery	Electric appliances	Computer
Share of manufacturing employment					
1976	11.7	9.1	4.8	1.3	—
1986	9.1	11.6	4.5	1.4	1.2
1996	3.9	7.5	7.9	1.4	4.2
Annual growth rate of employment					
1976–86	1.1	6.1	2.9	3.9	—
1986–96	–9.2	–5.1	4.9	–0.1	11.3

Source: Authors' calculations based on the employment data for the areas under study.
— Not available.

Table 2.5 Changes in employment shares in Taiwan, China, by area and industry, 1976, 1986, and 1996
percent

Location and year	Apparel	Plastic products	Machinery	Electric appliances	Computer
Urban areas					
1976	30.9	24.8	42.4	30.3	—
1986	27.7	16.6	26.7	20.9	25.8
1996	29.0	15.9	20.9	22.0	25.2
Suburban areas					
1976	53.8	54.3	51.5	61.1	—
1986	56.3	56.9	63.0	68.8	62.2
1996	57.6	65.1	65.1	70.7	69.4
Rural areas					
1976	15.3	21.0	6.1	8.5	—
1986	16.0	26.6	10.3	10.2	11.9
1996	13.4	19.0	14.0	7.2	5.4

Source: Authors' calculations. For each year, urban + suburban + rural = 100 percent.
— Not available.

From this table, it is clear that the employment share of the suburban areas increased steadily throughout the two periods in every industry under study. Furthermore, the employment share of suburban areas tended to increase when the industry was growing. This seems to support the hypothesis of eruption, which argues that the industrial cluster tends to move to suburban areas when the industry grows. In contrast, the share of the urban areas decreased in the first period in every industry, but it increased slightly in the second period in the apparel and electric appliances industries. The share of the rural areas increased in every industry in the first period but decreased in the second period in every industry except the machinery industry. These observations indicate that, due to the eruption, the center of manufacturing sectors moved from urban areas to suburban areas, but not to rural areas, most likely because of the disadvantages associated with remoteness.

New industries generally are born in urban environments that have well-developed transportation and communication facilities and favorable access to new information, a variety of intermediate inputs, and skilled labor (see, for example, Henderson, Kuncoro, and Turner 1995). Although the computer industry was new in Taiwan, China, in the mid-1980s, its location was concentrated in the suburban areas between Taipei and Taoyuan rather than in urban areas, because the base of the electric and electronics industries had been established in these suburban areas by the late 1970s (Chang 1992). Furthermore, the Industrial Technology Research Institute, which facilitated international technology transfer to Taiwanese enterprises, is located near Taoyuan (Hong and Gee 1993). Thus suburban areas had a high share of employment in the computer industry from its inception, and this share continued to rise, which is consistent with our contention that the center of manufacturing is often established in suburban areas.

Development of clusters in the southern Yangtze River region

Southern China, such as Guangdong province, grew most rapidly in the 1980s, producing relatively low-quality products using unskilled young migrant workers. As the Chinese economy began the quest for quality improvement and started shifting from unskilled labor–intensive to more skilled labor–intensive industries in the early 1990s, the center of economic development shifted from the south to the lower Yangtze River region, such as southern Jiangsu. In Jiangsu, industrial clusters did not develop in the 1980s, as the location of collective enterprises was determined largely by township-and-village governments. Although it is not recognized in the literature on the Chinese economy, once the collective township-and-village enterprises were privatized and the development of private enterprises was promoted in Jiangsu

province, enabling the establishment and location of enterprises to be determined by profit incentives, clustering began in this province.[9] This seems to provide the prima facie evidence that industrial clusters have clear advantages over stand-alone enterprises in production and management efficiency. Here we compare the experience of Jiangsu with that of Zhejiang, where industrialization began at poor farmers' houses and was supported by the development of dense SME-based industrial clusters in a countless number of locations.

We attempted to collect unpublished data at the township level for 1990, 1996, and 2002. Typically, townships in the areas under study have a population of about 50,000. The following sampling scheme was adopted. We randomly selected 50 counties each in Zhejiang and Jiangsu provinces and then chose 2 townships from each county. Because there are approximately 40 townships in each county, applying a random selection technique might have yielded many townships where major industrialization did not take place. Therefore, we asked the county governments to choose the 2 most important industries in the county and then chose 2 townships with the most prosperous industries. The collection of appropriate data was difficult primarily because large efforts were required to prepare the detailed data requested and also because past data are not well kept in the government offices. Thus we received data from 135 townships, out of 200, for 2002 and only 97 for 1990. The response rate was much lower from Zhejiang province, where the distinction between collective and private enterprises, which we asked them to report, might be difficult to draw because of the so-called "red-cap" enterprises.[10]

According to official statistics, gross domestic product (GDP) per capita in Zhejiang and Jiangsu provinces is about twice as high as the average in China, and it is about 15 percent higher in Zhejiang than in Jiangsu. The income figure in Jiangsu province, however, includes poor areas north of the Yangtze River, which account for two-thirds of the area in this province. According to our interviews with government officials at various levels, southern Jiangsu was more prosperous than Zhejiang in the 1980s, but the latter caught up with the former in the 1990s by taking advantage of the dominance of private industries and the development of industrial clusters.

Table 2.6 exhibits the number of sample townships from which we obtained data, the average number of enterprises, and the average number of workers and real value of production by location (that is, northern Jiangsu, southern Jiangsu, and Zhejiang) and year. We do not include the data for state-owned enterprises or urban collective enterprises. As shown in the table, rapid industrialization clearly took place in all three regions. Compared with the other two regions, Southern Jiangsu had a substantially smaller number of enterprises per township, although they were larger in size or had slightly less employment and production value, which indicates that large-scale enterprises originally supported by township-and-village governments were prevalent in southern Jiangsu. In this region, the real value of production increased six-fold over the 12-year period, whereas the number of workers increased only 50 percent, which implies that labor productivity increased explosively. The fact that the number of workers almost doubled from 1990 to 2002 in northern Jiangsu indicates that the enterprises were catching up with those in southern Jiangsu. The number of workers and the value of production were higher in Zhejiang than in southern Jiangsu partly because we do not include state-owned enterprises and urban collectives, which are much more common in the latter region and partly because we failed to obtain data from the southern regions of Zhejiang, which were less developed.

Almost all of the enterprises were private in Zhejiang from the beginning, and half of them were private in northern Jiangsu in 1990. Despite the prohibition of private enterprises, the share of the private sector was comparatively high in northern Jiangsu, because small family-based enterprises operated by farmers and ex-farmers with seven workers or fewer, which were considered legal, were included in the number of private enterprises. In southern Jiangsu, privatization began in the early 1990s and was almost completed by the early 2000s.

Table 2.6 Average number of enterprises and workers and real value of production per sample township in Jiangsu and Zhejiang provinces, China, by location, 1990, 1996, and 2002

Location and indicator	1990	1996	2002
Northern Jiangsu			
Number of sample townships	48	59	66
Average number of enterprises	237	366	558
Average number of workers	3,807	5,680	8,495
Real value of production[a]	123.5	424.6	1,136.5
Southern Jiangsu			
Number of sample townships	16	21	23
Average number of enterprises	83	147	262
Average number of workers	6,160	6,254	8,995
Real value of production[a]	268.4	762.6	1,649.8
Zhejiang province			
Number of sample townships	33	39	46
Average number of enterprises	320	663	950
Average number of workers	10,894	16,489	23,350
Real value of production[a]	663.3	1,256.5	2,739.7

Source: Authors' calculations.
a. Million yuan in 2002 prices. The factory shipment price index reported by the State Statistical Bureau (2003) was used as deflator.

Table 2.7 Share of production and employment of the most important industry in the township in Jiangsu and Zhejiang provinces, China, by area, 1990, 1996, and 2002
percent

Location and indicator	1990	1996	2002
Northern Jiangsu			
Employment share	25.8	30.5	32.2
Production share	31.9	34.6	37.3
Southern Jiangsu			
Employment share	27.3	28.9	33.4
Production share	35.8	33.7	44.8
Zhejiang province			
Employment share	33.9	35.8	36.4
Production share	31.5	30.0	36.8

Source: Authors' calculations based on township data.

To explore the role of industrial clusters in regional development, we obtained data on the most important industry of each township in accordance with the two-digit industrial classification, which consists of approximately 200 subsectors. For example, the subsector of the transportation equipment industry includes the automobile, motorcycle, and ship-building industries. We computed the production and employment shares of the most important industry in total production and employment in the township, which are intended to capture the extent of specialization. These shares, called "specialization rates," are shown in table 2.7 by location and year.

While the regional average of the specialization rates varies from 30 to 40 percent, the figure at the township level ranges from less than 5 percent to more than 90 percent. One difficulty in interpreting the specialization rate arises from the production of intermediate inputs. When parts and components are produced internally by enterprises in the most important industry, they are counted as the production of this industry. They are not counted, however, if they are produced by specialized parts suppliers. Because the collective enterprises tend to produce parts internally, the specialization rate tends to be higher where collective enterprises dominate. This may explain why the specialization rate is not necessarily higher in Zhejiang province, where collective enterprises are relatively few and private enterprises rarely adopt a vertically disintegrated production system. Yet the specialization rate in terms of employment share was higher in Zhejiang province than in Jiangsu province, which

strongly suggests that small labor-intensive industries tend to form dense industrial clusters in this province.

The specialization rate increased over time particularly in the two Jiangsu regions, which indicates that industrial clusters were established and strengthened over time. This is likely to reflect the impacts of privatization because it allows industries a free choice of location. In our own observation, spin-offs are common as privatization progresses. A major effect of privatization may well be to enhance the efficiency of industrial production by promoting the formation of industrial clusters in specialized areas (Sonobe and Otsuka 2003).

Judging from the fact that the formation of industrial clusters began less than a decade ago, it is likely that a greater number of industrial clusters will be formed, strengthened, and refined in the southern Yangtze River region. It is also noteworthy that private enterprises in this region seldom move to inland areas where wages are lower.[11]

Policy implications

It is a mistake to assume that geographic disparity is always undesirable from the social point of view, because industrial clusters have the advantages of reducing transaction costs and providing expanded opportunities for innovation. Because of lower transaction costs, markets work in industrial clusters, and ample job opportunities can thereby be created for the poor. Because innovation possibilities are enlarged, sustainable growth of industries becomes possible. Because in the early stage of development, industrial clusters develop primarily in urban and suburban areas, these social benefits can be obtained by sacrificing geographic balance. Since a number of industrial clusters already exist in large cities in developing countries and since they are generally stagnant, we strongly advocate policies to stimulate multifaceted innovations in these clusters by providing appropriate training programs for managers of enterprises. This is particularly relevant in Sub-Saharan Africa, where both the supply of entrepreneurs and the access to advanced technologies, management know-how, and marketing strategies are severely limited.

Another important policy implication of this study is the desirability of promoting a "big eruption" by setting up production environments conducive to the operation of large factories in less-developed areas, by constructing industrial zones, and by providing training for the future cadre of the industry. It may also be possible to establish new industrial clusters by constructing model plants and technology transfer centers. Currently, however, our knowledge is far from adequate to select appropriate industries in appropriate locations while using appropriate technologies. In other words, we have to seek development strategies that ensure that the benefits of correcting "market failures" and "geographic imbalance" exceed the costs of "government failures."

Notes

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1. Although we have completed the data collection in these studies, the analysis is currently under way in several cases.

2. Since we are interested in development, we do not elaborate on the declining stage of industries.

3. For example, the Bingo Working Clothes Cluster in Hiroshima prefecture in Japan used to be a major production area of traditional Japanese casual wear, called *mompe*. When the demand for *mompe* declined, traders selling *mompe* throughout Japan brought in the idea of producing new types of garments (Yamamura, Sonobe, and Otsuka 2003).

4. See case studies of the garment and motorcycle clusters in China (Sonobe, Hu, and Otsuka 2002, 2006) and the garment cluster in Bangladesh (Mottaleb and Sonobe 2007).

5. However, some enterprises might have exited in this period.

6. Sonobe and Otsuka (2006) also report the case of Kanto, in the vicinity of Tokyo, during the postwar period, where the geographic dispersion far outweighed the geographic concentration.

7. Sunan literally means southern Jiangsu.

8. In Taiwan, China, manufacturing firms with multiple establishments are the exception.

The number of establishments per firm was less than 1.05 during the periods under study.

9. These changes in industrial location have been discussed in the recent empirical literature on economic geography. See, for example, Fujita, Krugman, and Venables (1999).

10. Fake collectives or red-cap enterprises were essentially private but disguised themselves as township-and-village enterprises (Oi 1999). Their formation of industrial clusters in Wenzhou in the early 1980s was facilitated by the establishment of specialized local markets for products and materials by local governments, and when these clusters made inroads into national and international markets later, important roles were played by traders who migrated out from Wenzhou (Xu and Tan 2001).

11. In our observations, the wage gap between the coastal and inland regions in China is not so large as a result of the active migration of workers, despite the restrictions placed on the migration to urban areas.

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