

16

chapter

Industrial agglomeration and economic performance in transitional China

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According to mainstream economic theories, comparative advantages and agglomeration economies are responsible for the geographic clustering of industries (Ellison and Glaeser 1997). The forces driving industrial agglomeration in China might differ, however, because China has experienced two fundamental changes since the late 1970s: the transition from a command economy to a market-driven economy and the transformation from a closed economy to an open economy. Such a process of economic transition has been conceptualized as a triple process of decentralization, marketization, and globalization, which has had a profound impact on spatial development in China (He, Wei, and Xie 2008; Wei 2000). Industrial restructuring in China, like the process of economic transition, has been a gradual, partial, spatially, and structurally uneven process. Chinese enterprises have been gradually exposed to market forces. Liberalization of investment and trade has opened the Chinese economy to global competition. Marketization and globalization have encouraged plants to locate in areas with comparative advantages and to exploit agglomeration economies. Meanwhile, decentralization has granted local governments more authority and responsibilities to develop local economies, resulting in fierce interregional competition and giving rise to local protectionism and a rational imitation strategy in pursuing economic development. As a consequence, China is experiencing both significant centripetal forces as well as centrifugal forces of industrial agglomeration.

Sectors and regions that have undergone economic liberalization may be prone to the formation of agglomeration economies and would benefit significantly from industrial agglomeration. This chapter empirically investigates the evolution and extent of industrial agglomeration in China. To provide empirical justification for the geographic clustering of Chinese industries, it also explores the relationship between industrial agglomeration and labor productivity across and within industries.

Theoretical understanding of industrial agglomeration in China

This section presents the theories that seek to understand economic marketization, globalization, and decentralization as they apply to industrial agglomeration. The following section has detailed discussion regarding how the triple process of economic transition affects industrial agglomeration.

Economic marketization

China's economic reform seeks to build a market-oriented economy and to allow market forces to allocate resources. In the command economy, governments distributed resources. Literally, there were no well-functioning markets. Economic geography was heavily shaped by socialist ideology and national defense considerations. Industrial location failed to match comparative advantages, because governments located industries based on shifting social, political, and military considerations. The self-enclosed

nature of the economic system ruled out any horizontal economic flows or industrial specialization (Zhao and Zhang 1999). As the economic transition has proceeded, market forces have been progressively introduced, and limits on factor mobility and commodity exchanges have been gradually lifted. Nonstate capital and private firms have been playing an important role in local development.

In the context of market economies, neoclassical trade models, new trade models, and new economic geography models are the theoretical inquiries underpinning industrial location (Brühlhart 1998). In the neoclassical world, industrial agglomeration is driven by exogenous endowments such as technology, labor, and natural resources. Industries are heavily agglomerated in locations with matched comparative advantages. The reduction of trade barriers makes regions specialize in their production based on comparative advantages (Kim 1995). In new trade models, internal economies of scale provide regions with incentives to specialize even in the absence of differences in resource endowments and encourage firms to agglomerate their production in a few locations. Economic activities concentrate to realize scale economies, locating in large consumer markets to minimize transportation costs (Krugman 1980). Regional integration allows underlying geographic advantages to play a greater role, encouraging industrial agglomeration. In the new economic geography models, geographic concentration is driven by the interaction of transportation costs, internal scale economies, and labor mobility (Fujita and Thisse 1996; Krugman 1991). Demand linkages represent incentives for producers to locate close to buyers, whereas cost linkages generate incentives for consumers to locate close to suppliers (Venables 1996).

Beyond the agglomeration economies from industrial linkages, other sources of external economies are also driving plants to cluster. Marshall (1898) pointed to the pooling of markets for specialized skilled labor, the development of subsidiary trade and suppliers of intermediate inputs, and the easy flow of information and ideas among firms as forces driving industrial

agglomeration. As a consequence, industries and regions that have experienced economic liberalization will be favorable to the formation of industrial agglomeration. As the economic transition proceeds, Chinese industries, especially those driven by market forces, will be increasingly agglomerated in a few regions.

Economic globalization

China has participated in economic globalization by trading with other economies and by attracting foreign investment. Trade liberalization broadens the scope of industrial specialization along the lines of comparative advantages and enhances the importance of accessibility to international markets. Trade liberalization also provides trading firms with incentives to exploit scale economies and heighten international competitiveness. In China, labor migration resulting from relaxation of the household registration system has allowed trading establishments to cluster along the coastal region and to benefit from the best use of cheap resources (He, Wei, and Xie 2008). Moreover, Chinese trading enterprises take full advantage of backward and forward business linkages through a deeper division of labor, significantly cutting production and transaction costs (Wang 2001). Fujita and Hu (2001) find that increases in exports have reinforced industrial agglomeration in China, concentrating industries in the coastal region, which is close to international markets, has locational advantages, and enjoys the first-mover advantage of economic globalization. However, as Krugman and Elizondo (1996) argue, trade liberalization may significantly weaken the role of localized industrial linkages in promoting industrial agglomeration because trading establishments rely on external linkages. In China, many assemblers focus on labor-intensive functions, relying heavily on imported materials and intermediate goods. The localized industrial linkages may not play the expected role in industrial agglomeration.

Foreign direct investment (FDI) has significantly shaped the spatial structure of Chinese industries. First, foreign establishments are disproportionately agglomerated in the coastal region and in strong industrial bases (He 2002, 2003, 2006; Head and Ries 1996).

Second, foreign enterprises create demand for locally produced intermediate inputs and improve the efficiency of the whole sector, making domestic producers more profitable (Markusen and Venables 1999). Component sourcing in China is an important consideration for foreign firms because of local content requirements (Belderbos and Carree 2002; Head and Ries 1996). Third, major multinational corporations often bring a large number of suppliers to the host economy, facilitating industrial agglomeration.

Economic decentralization

Unlike governments in the developed market economies, central and local governments in China are still rather powerful and influential in economic development. Economic transition in China has resulted in considerable administrative decentralization from the central to local governments. As a result, local governments now have the primary responsibility and authority for local economic development (Qian and Weingast 1997).

During the period of economic reform, the government's intervention in economic development may have discouraged the geographic concentration of Chinese industries, especially at the provincial level. First, the central and local governments have established a large number of economic and technological development zones (ETDZs) and high-tech industrial development zones to attract domestic and foreign investments. There are more than 50 development zones across the major Chinese cities. The targeted industries in those zones and parks are fairly similar, including electronics, medicine, equipment, and other high-tech industries. The centrally and locally administered development zones promote the geographic agglomeration of advanced industries but discourage the industrial localization of labor-intensive industries.

Second, local governments intend to duplicate industries highlighted in the national Five-Year Plans and in the national industry-specific development plans. For instance, the Tenth Five-Year Plan stressed the development of food processing, machinery and equipment, automobile, and high-tech industries such as electronics, biological engineering, and medicine. These are also

the key industries chosen by almost all of the coastal provinces and many central provinces. The industrial duplication certainly discouraged the geographic concentration of Chinese industries. To support the development of key industries, local governments have taken serious measures to concentrate them in development zones.

Third, fiscal decentralization has triggered fierce interprovincial competition for economic and political performance, resulting in a rational imitation strategy of industrial policies (He and Zhu 2007). Competition among provinces provides incentives to replace poorly chosen strategies with strategies that appear to succeed elsewhere. The economic-oriented evaluation system for local officials and a judicious combination of local autonomy, fiscal incentives, and hard budget constraints have created a framework leading local governments to follow the leaders in industrial development. Thun (2004) observes that decentralization leads local governments to converge on successful development policies through a process of rational imitation. Rational imitation of successful industrial policies encourages local governments to attract duplicate industries that they believe could rapidly improve local revenues or promote local economic growth.

Finally, fiscal decentralization instinctively and explicitly has emphasized autarchic development because the localities have had to self-finance their own budgets and their own development (Zhou 2000). Fiscal decentralization has created conditions that encourage regionalism: disappearance of the traditional umbrella, unfairness to the poor regions, territorial segmentation and confrontation, central-local vertical confrontation, and failure of spatial programs of specialization (Zhao and Zhang 1999). At the macroeconomic level, fiscal decentralization has provided local governments with incentives to protect local industries, significantly contributing to economic and revenue growth (Lee 1998; Young 2000). As control over factor allocations has loosened, local governments have sought to capture these rents by developing high-margin industries. Continued reform and growing interregional competition among

duplicative industries threaten the profitability of these industrial structures, leading local governments to impose a variety of interregional barriers to trade (Young 2000). The Development Research Center of the State Council (DRCSC 2004) ranks the highly protected industries as follows: tobacco, food, medical and pharmaceutical products, construction, agriculture, beverages, real estate, power, gas and water production, post and telecommunications, and machinery equipment. The least-protected industry is nonmetal mineral products, followed by cultural education and sporting goods, chemical fibers, ferrous metal smelting, petroleum refining and coking, rubber and plastic products, electric machinery and equipment, instruments, meters and office machinery, nonferrous metal smelting and pressing, and leather products. Therefore, economic transition has fragmented domestic markets, distorted regional production away from the patterns of comparative advantage, and discouraged the geographic concentration of Chinese industries.

Overall, the spatial restructuring of Chinese industries is the result of interactions of centripetal forces and centrifugal forces of industrial agglomeration. On the one hand, there are driving forces for industrial agglomeration as marketization and globalization proceed. Highly liberalized and globalized industries tend to concentrate in regions with matched comparative and locational advantages and to become increasingly agglomerated in the coastal provinces. Geographic clustering of industries generates substantial cost savings and leads to higher labor productivity. On the other hand, the economic transition has created a market that preserves federalism, which provides local governments with strong incentives to protect local industries from external competition and to imitate successful industrial policies. Local protectionism and rational imitation run counter to the geographic agglomeration of Chinese industries. The geographic dispersion of industries loses scale economies and makes it difficult for related enterprises to exploit external economies, leading to lower labor productivity.

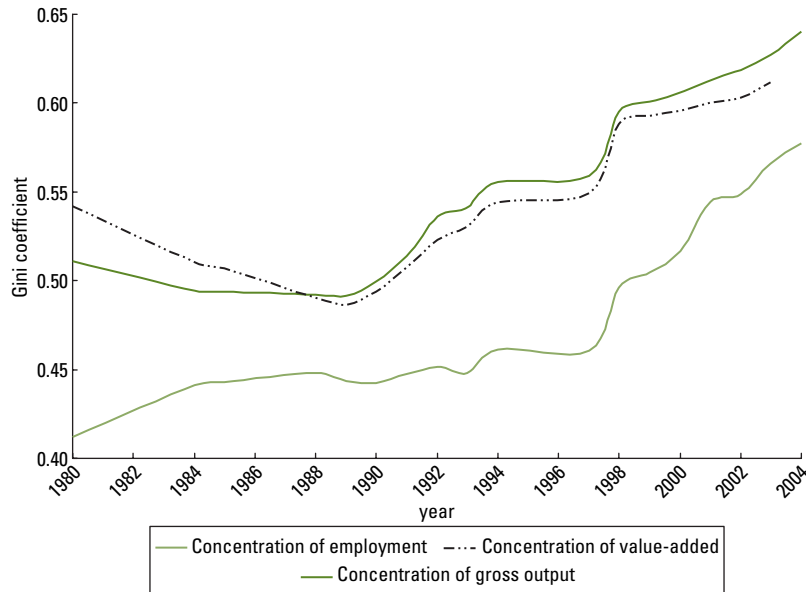
Industrial agglomeration and industrial specialization in China

Following Wen (2004), this chapter applies the widely used Gini coefficient to quantify industrial agglomeration of Chinese industries. The closer the distribution of industry i is to a uniform distribution, the smaller the index is. If an industry is equally distributed across all regions, the index will be equal to 0. An index close to 1 suggests that an industry is entirely concentrated in a region. Data on Chinese manufacturing industries are collected from various issues of *China Industry Economy Statistical Yearbook* and *Annual Report of Chinese Industrial Statistics* and from the *China Economic Census Yearbook 2004*.

Industrial agglomeration of Chinese manufacturing industries

To investigate the overall temporal trend of industrial agglomeration in China, I have computed the yearly weighted average of the Gini coefficient of employment, value added, and gross output during the period of 1980–2004.

As shown in figure 16.1, Chinese manufacturing industries have undergone significant spatial transformations since the early 1980s and have been more geographically agglomerated during the period of economic transition. The weighted 1980 and 2004 Gini coefficients of gross output are 0.51 and 0.64, while the weighted Gini coefficients of employment are 0.41 and 0.58, respectively. However, industrial output experienced spatial dispersal in the 1980s and has become increasingly concentrated since the early 1990s. Industrial employment was much less agglomerated than industrial output in the 1980s but has become more concentrated since the early 1980s. Under the influence of socialist ideology and egalitarian ideas during Mao's era, China's industrialization policy favored the traditional industrial bases, tilted toward new industrial cities in the interior, and sought to achieve full employment. Consequently, at the beginning of China's economic reform, Beijing, Gansu, Heilongjiang, Hubei, Jilin, Liaoning, Shanghai, Sichuan, and Tianjin

Figure 16.1 Geographic concentration of manufacturing industries in China, 1980–2004

Sources: Author's calculations based on data in SSB (2006); SSB, *Annual Report of Chinese Industrial Statistics* (various years); and SSB, *China Industry Economy Statistical Yearbook* (various years).

were the major industrial bases of China. The top four provinces produced less than 50 percent of industrial output in most industries.

With the shift of government policies toward a market-driven economy and the opening up of the coast, Fujian, Guangdong, Jiangsu, Shandong, Shanghai, and Zhejiang have gradually taken the lead in attracting investment, labor, advanced technology, and firms. The rapid growth of the coastal region and the relative decline of old industrial bases and interior provinces brought a decrease in the Gini coefficients of industrial output. Labor migration from the interior provinces to the coastal region stimulated industrial employment to agglomerate in the coast.

Further economic reform has made the coastal region an engine of remarkable economic growth in China, resulting in strong polarization effects. Gini coefficients of industrial output and employment have been growing since the early 1990s (figure 16.1). The Gini coefficient of gross industrial output increased from 0.50 in 1990 to 0.64 in 2004, and the Gini coefficient of industrial employment grew from 0.44 to 0.58. Industrial output in most industries was concentrated in the coastal provinces,

including Fujian, Guangdong, Jiangsu, Shandong, Shanghai, and Zhejiang. For most industries, the share of industrial output of the top four provinces increased substantially. Industries such as leather and fur products, cultural education and sporting goods, chemical fiber, telecommunications and electronic equipment, instruments, and meters concentrated more than 70 percent of industrial output in the top four provinces.

The share of industrial output of the top four provinces ranged from less than 30 to 77 percent, indicating that industries differed substantially in the extent of geographic agglomeration. Table 16.1 presents the Gini coefficient of industrial output for all two-digit manufacturing industries in select years. The concentration indexes indeed differ significantly across industries. The Gini coefficient in 1980 ranged from 0.37 to 0.73, and it ranged from 0.46 to 0.83 in 2004. In 1980 the most-agglomerated industries included chemical fiber, cultural education and sporting goods, petroleum refining and coking, telecommunications and electronic equipment, ferrous metal smelting, and pressing, while the least concentrated industries were food processing and manufacturing, furniture making, printing and copying, nonmetal mineral products, leather and fur products, and paper making and paper products. The most-agglomerated industries were capital intensive and had strong internal scale economies, while the dispersed industries were resource-based or resource-processing industries. By 2004, cultural education and sporting goods, telecommunications and electronic equipment, and chemical fiber were much more agglomerated and remained as the most-agglomerated industries. The agglomeration of garments and other fiber, leather and fur products, textiles, instruments and meters, furniture making, electrical machinery and equipment, plastic products, and metal mineral products also gained momentum, with Gini coefficients greater than 0.70. Many highly agglomerated industries in 2004 were also highly globalized, exporting substantially or using a large amount of FDI. The most dispersed industries included nonferrous metal smelting and pressing, medical and

Table 16.1 Gini coefficient of manufacturing industries in China in select years, 1980–2004

Code	1980		1990		2004	
	Gini	Rank	Gini	Rank	Gini	Rank
Food processing and manufacturing	0.37	26	0.41	25	0.55	21
Beverage manufacturing	0.43	20	0.44	22	0.49	24
Tobacco processing	0.49	11	0.50	12	0.57	19
Textiles	0.58	6	0.58	5	0.75	7
Garments and other fiber	0.47	18	0.55	7	0.77	4
Leather and fur products	0.42	22	0.53	9	0.77	5
Timber processing	0.49	12	0.49	14	0.61	16
Furniture making	0.39	25	0.49	15	0.73	8
Paper making and paper products	0.42	21	0.42	23	0.68	13
Printing and copying	0.40	24	0.41	24	0.64	15
Cultural education and sporting goods	0.72	2	0.71	1	0.83	1
Petroleum refining and coking	0.70	3	0.59	4	0.54	23
Chemical materials and products	0.46	19	0.44	20	0.57	17
Medical and pharmaceutical products	0.47	17	0.45	18	0.47	25
Chemical fiber	0.73	1	0.63	2	0.79	3
Rubber products	0.49	13	0.45	19	0.69	12
Plastic products	0.53	9	0.55	6	0.72	10
Nonmetal mineral products	0.41	23	0.44	21	0.57	18
Ferrous metal smelting and pressing	0.58	5	0.51	11	0.54	22
Nonferrous metal smelting and pressing	0.54	8			0.46	26
Metal mineral products	0.48	14	0.50	13	0.71	11
General- and specific-purpose machinery	0.47	16	0.47	17	0.64	14
Transportation equipment	0.48	15	0.49	16	0.55	20
Electrical machinery and equipment	0.52	10	0.54	8	0.73	9
Telecommunications and electronic equipment	0.61	4	0.60	3	0.81	2
Instruments and meters	0.57	7	0.52	10	0.76	6

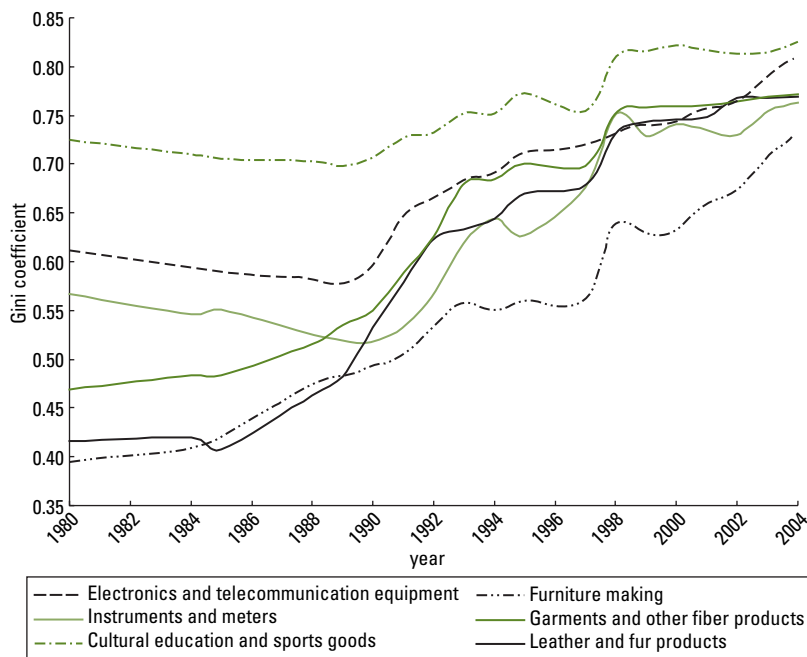
pharmaceutical products, beverage manufacturing, petroleum refining and coking, ferrous metal smelting and pressing, food processing and manufacturing, transportation equipment manufacturing, and tobacco processing, among which petroleum refining and coking and ferrous metal smelting and pressing were the most-concentrated industries in 1980. The dispersed industries were either resource based or domestic market oriented. Some were strongly favored and protected by local governments, because they are strategic and profitable, such as tobacco processing, transportation equipment, beverage manufacturing, and medical and pharmaceutical products.

I now compare the temporal trends of industrial agglomeration for different types of industries to shed light on some influential factors of industrial agglomeration. Figure 16.2 shows the temporal change in geographic agglomeration of select globalized industries. In 2004 all of these industries exported more than 55 percent of their gross output and had more than 45 percent of foreign capital. The two percentages in

telecommunications and electronic equipment and cultural education and sporting goods were greater than 60 percent. In the beginning of economic transition, the spatial pattern of the select industries was rather diverse, with some agglomerated and others dispersed, because their provincial distributions were determined by central and local governments. As the open-door policy was successfully implemented, the international market and foreign capital drove the globalized industries to the coastal provinces, particularly Fujian, Guangdong, Jiangsu, Shandong, Shanghai, and Zhejiang (see figure 16.3). Since the early 1990s, the globalized industries have been increasingly agglomerated and more concentrated than the domestic market-oriented industries, with Gini coefficients greater than 0.70.

Figure 16.4 presents the pattern of industrial agglomeration of select domestic market-oriented industries, which exported less than 10 percent of their gross output and had little foreign capital. In 1980 there were no significant differences in the spatial pattern of globalized and less-globalized

Figure 16.2 Geographic agglomeration of industrial output of globalized industries in China, 1980–2004



industries. However, spatial restructuring of domestic market-oriented industries was less significant, and some became slightly dispersed as globalized industries became more agglomerated. They were also less agglomerated than the globalized industries, with Gini coefficients less than 0.60, because they served local markets and valued the accessibility of the domestic market. As shown in figure 16.5, substantial shares of industrial output of the least-globalized industries were located in the central provinces.

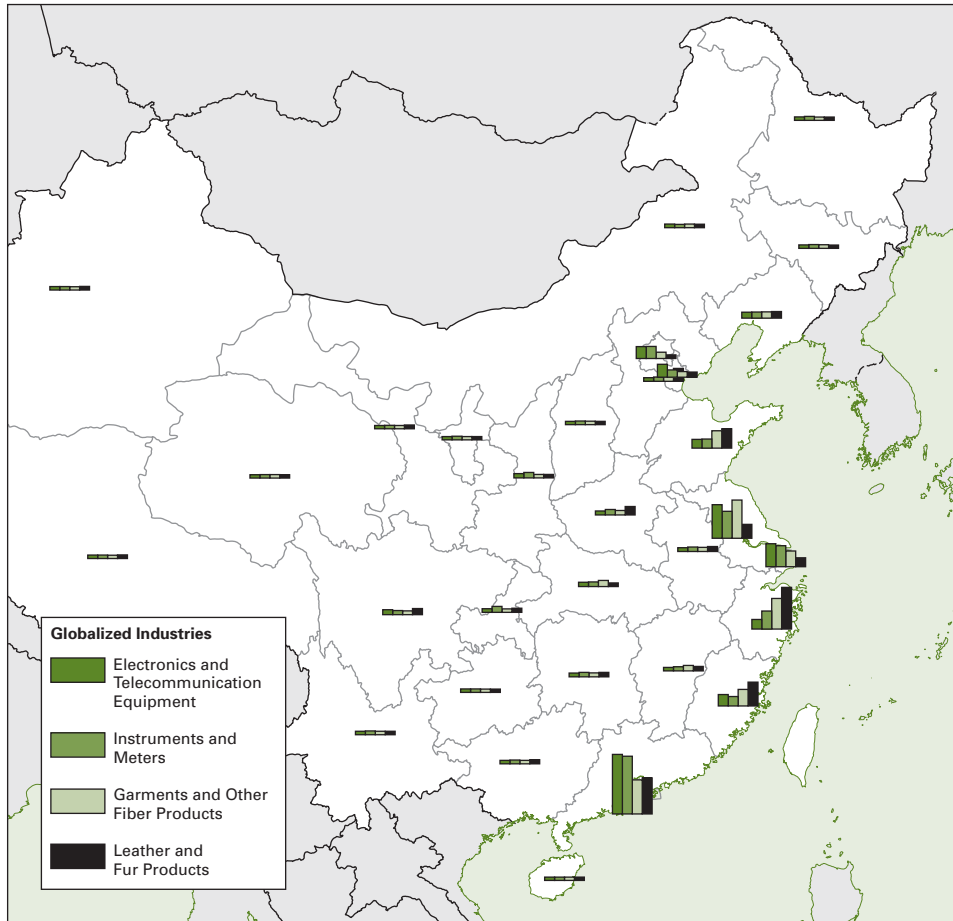
During the economic transition, industrial agglomeration in China has been associated with how governments treat the industries. Figure 16.6 presents the spatial pattern of industries favored or protected by local governments, including food, beverage, tobacco, medical and pharmaceutical products, and machinery and transportation equipment. Figure 16.7 shows the spatial pattern of industries not particularly protected or favored by local governments, including chemical fibers, rubber and plastic products, cultural education and sporting goods, electrical machinery and equipment, and instruments and meters. Overall, protected and favored industries were more geographically dispersed than less-favored and -protected

industries. For example, during the past two decades, the Gini coefficients for medical and pharmaceutical products and beverages were smaller than 0.50. Unlike the trend of aggregate industries, favored and protected industries have not experienced significant increases in industrial agglomeration since the early 1990s. The tobacco industry experienced significant concentration before the mid-1990s, but it started to disperse in 1994, when the central government introduced the new tax-sharing system, which further hardened the local fiscal budgets (Zhou 2000). The machinery industry, characterized by strong scale economies and strong industrial linkages, was agglomerated during the 1990s but remains at a relatively low level of agglomeration compared with the least-protected industries.

The location of least-favored and -protected industries was driven by market forces, and they have experienced a significant polarizing process since the 1990s. Cultural education and sporting goods had a Gini coefficient of 0.81 in 2004, with the top four provinces of Guangdong, Jiangsu, Shandong, and Zhejiang contributing 77 percent of gross industrial output. The Gini coefficient of chemical fiber in 2004 was 0.79, with the top four provinces of Jiangsu, Shandong, Shanghai, and Zhejiang responsible for 75 percent of gross industrial output. As expected, the spatial distribution of favored and protected industries was much more dispersed, with significant presence in the central and coastal provinces, while the least-favored industries were heavily agglomerated along the coast (see figures 16.8 and 16.9).

Causes of industrial agglomeration in China

Chinese manufacturing industries have experienced a U-shape spatial restructuring process, which is consistent with the temporal pattern of interregional income inequality. I argue that the spatial shift of Chinese manufacturing industries toward the coastal region has led to widening interregional inequality. The accelerating agglomeration of Chinese industries since the 1990s has been the result of economic transition. Specifically, the triple process of marketization, globalization, and decentralization has

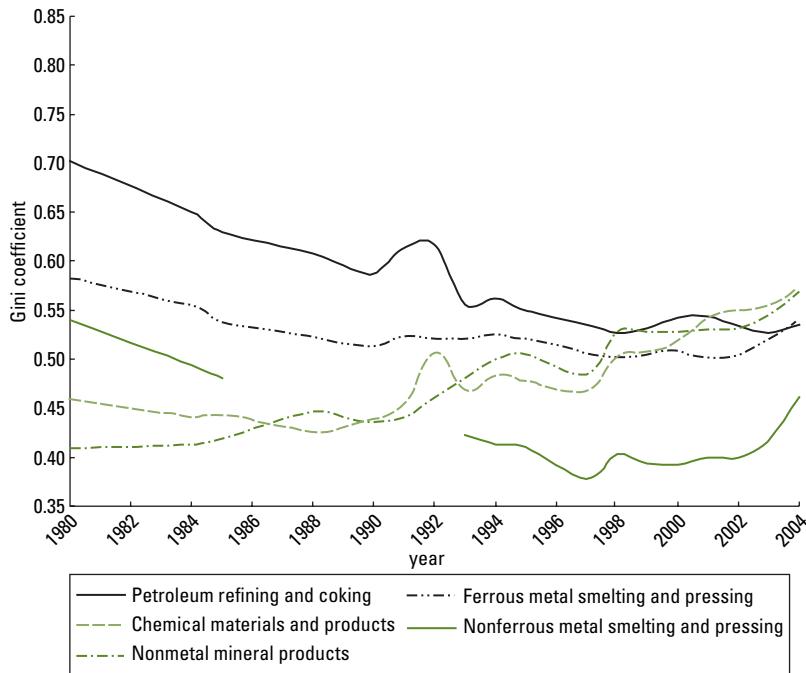
Figure 16.3 Provincial distribution of industrial output of highly globalized industries in China

driven the spatial reorganization of Chinese industries.

First, the accelerating marketization process since 1992 has lifted the limits on factor mobility and commodity exchanges and stimulated labor and capital mobility and interregional trade, providing incentives for Chinese enterprises to follow the line of comparative and locational advantages. A large number of workers migrated to the coastal provinces of Fujian, Guangdong, Jiangsu, Shandong, Shanghai, and Zhejiang, promoting industrial agglomeration in the coastal region. Meanwhile, interprovincial trade of commodities also stimulated Chinese provinces to specialize in production based on local resources. For instance, Fan and Scott (2003) relate the concentration indexes of Chinese manufacturing industries to capital per labor and find that labor-intensive industries are more agglomerated.

Industries dependent on agricultural and mining resource inputs are significantly dispersed, indicating that industries based on immobile resources follow the resources (He, Wei, and Xie 2008). Marketization also allows Chinese enterprises to exploit scale economies. For example, Bai and others (2004) find that industries with large average firm size were significantly more concentrated during 1985–97, suggesting that internal scale economies drive industrial agglomeration in China. In addition, strong interindustrial linkages are also positively associated with industrial agglomeration, indicating the importance of pecuniary externalities in industrial agglomeration (He, Wei, and Xie 2008). In a word, market forces have been a fundamental force in reorganizing China's economic geography by allowing comparative advantages and agglomeration economies to drive industrial

Figure 16.4 Geographic agglomeration of domestic market-oriented industries in China, 1980–2004



location and stimulate competitive industries to agglomerate.

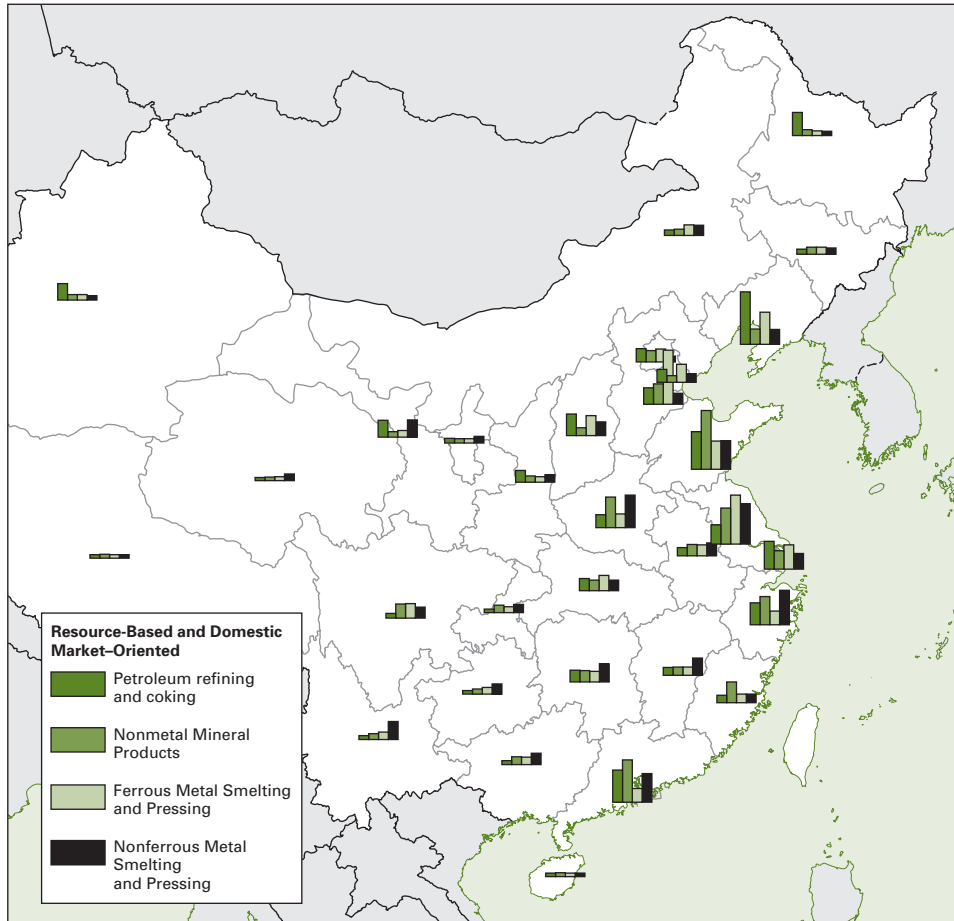
Second, China has successfully integrated its economy with the international market in recent decades, and global forces have been critical to reshaping China's industrial geography. Two-digit industries with more exports and foreign capital are more agglomerated and concentrated in the coastal region. Figure 16.10 provides additional evidence to support the argument that economic globalization leads to more industrial agglomeration in China. Panel A presents the relationship between the share of exports in industrial gross output and the Gini coefficient of three-digit manufacturing industries in 2004; panel B shows the relationship between the ratio of foreign capital in total capital and the Gini coefficient of three-digit manufacturing industries. The Pearson's correlation coefficients are 0.71 and 0.55, respectively, suggesting that more globalized industries are more agglomerated.

Third, as discussed theoretically, decentralization results in local protectionism and an imitation strategy in industrial policies, which is to promote local economic growth

and fiscal revenues. Industries characterized by high tax rates and profit margins are favored and protected by local governments, resulting in low levels of industrial agglomeration. Studies find less geographic concentration in two-digit industries where the past tax rates, profit margins, and share of state capital are high (Bai and others 2004; He, Wei, and Xie 2008). The negative relationship between industrial agglomeration and profit margins and tax rates also holds for three-digit manufacturing industries (see figure 16.11). The Gini coefficients of three-digit industries are significant and negatively related to the ratio of income tax and value added tax to sales revenues, with a Pearson's correlation coefficient of -0.45 . The Pearson's correlation coefficient for the ratio of gross profits to sales revenues is -0.35 . Due to interregional competition, local governments often duplicate profitable and strategic industries that are successful in other provinces. In addition, local governments have strong incentives to protect state-owned enterprises under their administrations, which are their base of political power and their source of private benefits as well as fiscal revenues (Bai and others 2004). Industries with a high share of state-owned capital are also less agglomerated (see figure 16.12). The correlation coefficient between industrial Gini coefficients and share of state-owned capital is -0.37 and significant. These results provide indirect evidence to support the finding that local governments act to discourage industrial agglomeration of Chinese industries at the provincial level.

Other channels also lead to industrial dispersion in China. On the one hand, local governments duplicate industries highlighted in the national Five-Year Plans. On the other hand, local governments also imitate each other when choosing key industries. He and Zhu (2007) find that provinces with similar economic and political status and with common borders are more likely to imitate each other and to converge in the industrial structure. Machinery equipment, medicine, food, automobiles, construction materials, chemicals and petrochemicals, and high-tech industries are listed as key industries in most provinces in both of the

Figure 16.5 Provincial distribution of industrial output of domestic market-oriented industries in China in 2004



Five-Year Plans. Many local governments have granted financial and policy supports for the development of key industries, leading to less industrial agglomeration. As discussed, the select industries are fairly dispersed, with Gini coefficients smaller than the weighted average Gini coefficient of 0.64.

In summary, Chinese industries have become more geographically agglomerated as the economic transition proceeds. The agglomeration forces of industries dominate the dispersion forces. Marketization allows comparative advantages and scale economies to play their roles in driving industrial agglomeration, and globalization allows underlying geographic advantages to play a greater role. Market and global forces have constantly driven Chinese industries to agglomerate in the coastal provinces, and

spatial disparities in China are widening as industries shift to the coastal provinces.

Spatial boundaries of industrial agglomeration in China

To investigate the spatial boundaries of industrial agglomeration in China, I apply the global Moran's I to uncover the spatial autocorrelation of the geographic distribution of Chinese industries. The global Moran's I can be defined as follows:

$$I = \frac{n \sum_i \sum_j w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\left(\sum_i \sum_j w_{ij} \right) \sum_i (x_i - \bar{x})^2} \quad (2)$$

where n represents the number of provinces, $w_{ij} = 1$ if provinces i and j share a

Figure 16.6 Geographic agglomeration of favored and protected industries by local governments in China, 1980–2004

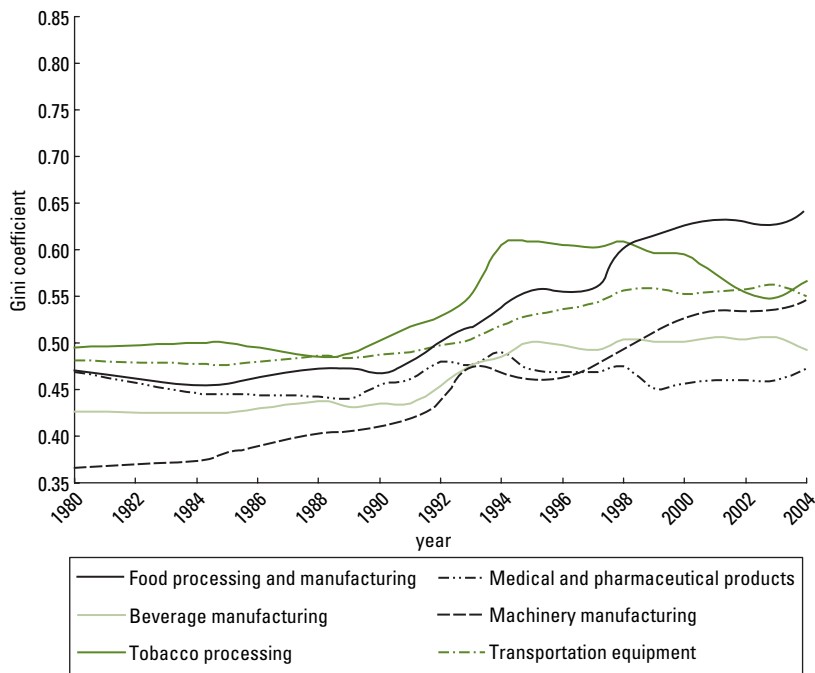
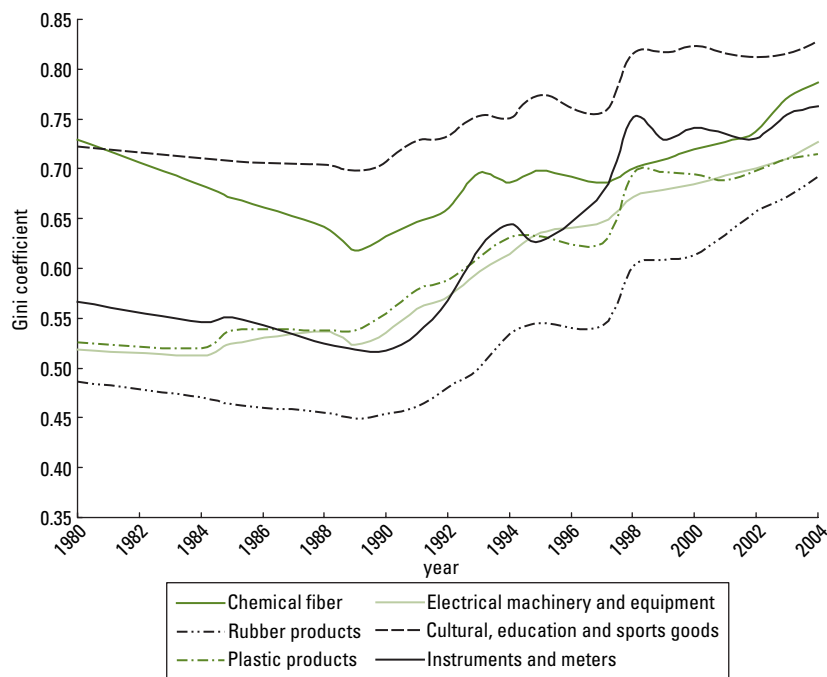


Figure 16.7 Geographic agglomeration of less-protected and -favored industries in China, 1980–2004



common border, otherwise $w_{ij} = 0$, and x_i and x_j are the provincial share of an industry. A positive and significant value of Moran's I indicates that industrial agglomeration is beyond the provincial boundary

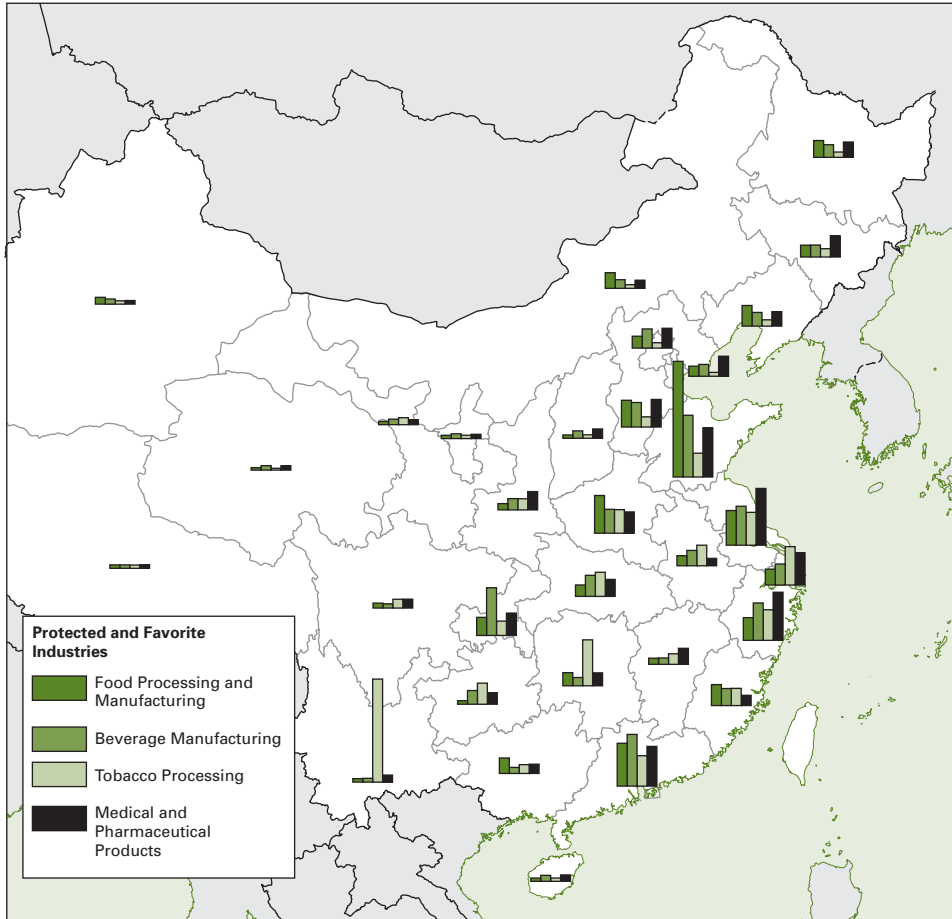
and there may be spillover effects across provinces.

I have computed the value of Moran's I for all two-digit manufacturing industries in select years. First, some highly agglomerated industries have insignificant values of Moran's I, indicating that geographic agglomerations of these industries are confined within provincial boundaries and that no spillover effects occur across provinces. The industries include cultural education and sporting goods, telecommunications and electronic equipment, instruments and meters, furniture making, and printing and copying. Related companies in these industries often seek suppliers from highly localized sources, limiting their spillover effects within a province.

Second, some agglomerated industries have significant and positive values of Moran's I, suggesting that the geographic agglomeration of these industries is beyond the provincial boundaries and that there are significant spillover effects across provinces. The industries include chemical fiber, paper making and products, garments and other fiber, leather and fur products, textiles, rubber and plastic products, metal mineral products, general- and specific-purpose machinery, electrical machinery and equipment, and timber processing. Most of these industries are labor intensive and market driven, facilitating the spillover effects beyond provincial boundaries. Business linkages in industries such as general- and specific-purpose machinery, electrical machinery and equipment, metal mineral products, and rubber and plastic products could easily go beyond the provincial boundaries.

Third, a couple of less-agglomerated industries have positive and significant values of Moran's I. These industries include food processing and manufacturing, chemical materials and products, transportation equipment, and nonmetal mineral products. Business linkages beyond provincial boundaries in these industries are the reason for spillover effects. For instance, Shanghai has provided substantial auto components and parts to the auto-related industries in Anhui, Jiangsu, and Zhejiang. Development of transportation equipment in Beijing has also stimulated the industry of auto components and parts in Hebei (Thun 2006).

Figure 16.8 Provincial distribution of favored and protected industries by local governments in China



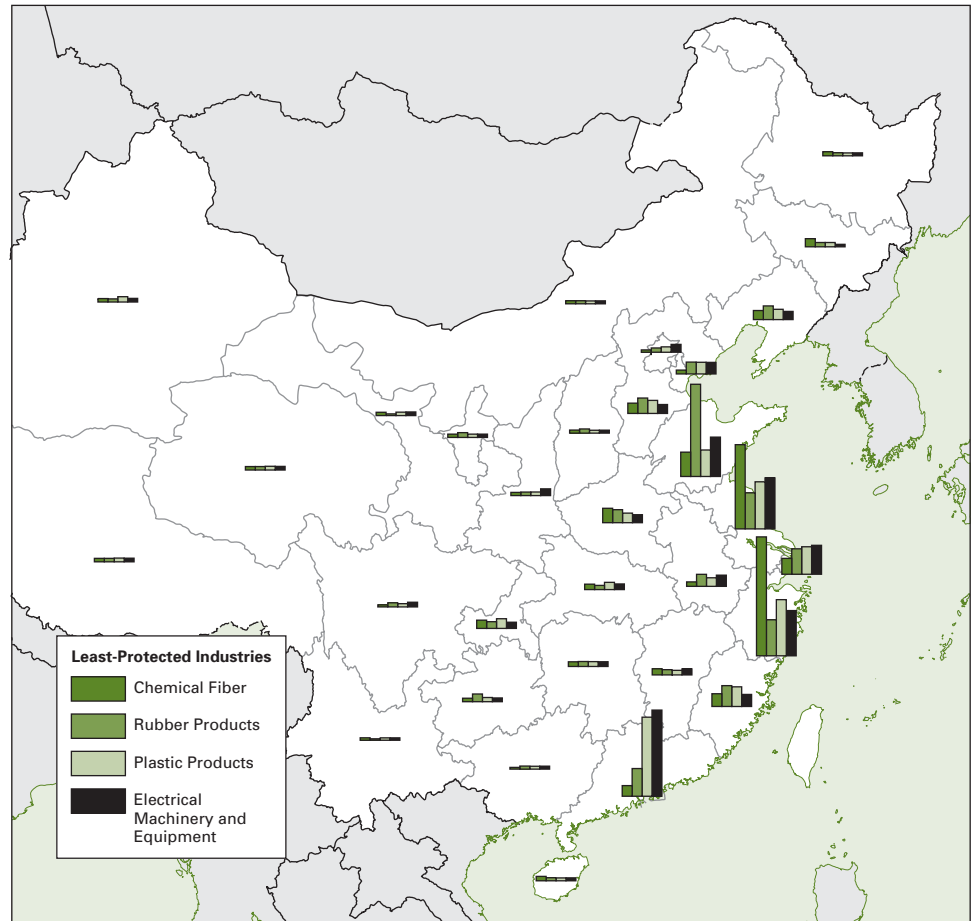
Finally, protected and favored industries are spatially dispersed and experience no spillover effects across provincial boundaries. The industries include beverage manufacturing, tobacco processing, medical and pharmaceutical products, and petroleum refining and coking. Provincial governments are able to exercise local protectionism because Chinese provinces have large markets, sufficient authority, and a favorable combination of resources with which to develop most industries. Local protectionism thereby prevents spillover effects beyond provincial boundaries.

Industrial specialization of Chinese provinces

Overall, Chinese industries have been increasingly agglomerated, which has changed the industrial structure of Chinese provinces. Figure 16.13 shows the relation-

ship between industrial agglomeration and industrial specialization. As panel A shows, the industrial structure within Chinese provinces became more diversified in the 1980s, as Chinese industries became geographically dispersed, indicating an overall pattern of convergence in provincial industrial structure. Rapid development of labor-intensive and light industries was undoubtedly associated with the decreasing provincial specialization before the mid-1990s. Regional decentralization was apparent in the early stage of reforms (Wei 2000), providing local governments with power to implement protectionist policies. Interregional competition and provincial protectionism are at least partially responsible for the convergence of provincial industrial structure (Young 2000). Beginning in the late 1990s, the increasing agglomeration of Chinese industries has caused the gradual increase in

Figure 16.9 Provincial distribution of least-favored or -protected industries in China



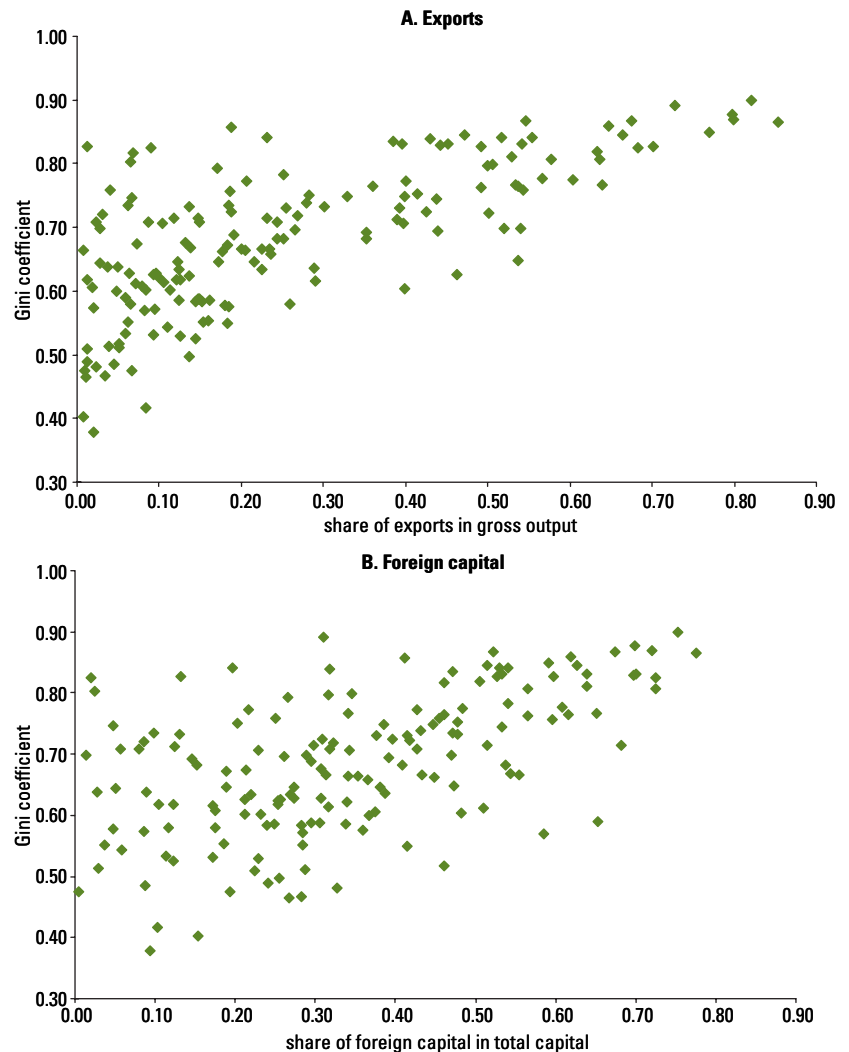
industrial specialization, as shown in panel B of figure 16.13. First, marketization and globalization have forced manufacturing firms to specialize in production and to compete more effectively in the markets based on geographic agglomeration and comparative advantages. The interior provinces, in particular, have specialized further in resource-oriented production. Second, the increasing specialization is also related to the heavy industrialization strategy initiated by local governments in some coastal provinces such as Fujian, Guangdong, Jiangsu, and Zhejiang. With the increasing importance of machinery, chemical materials and products, petroleum refining and coking, transportation equipment, and ferrous metal smelting and pressing, some coastal provinces have gradually become more specialized. Therefore, the recent industrial agglomeration has resulted in industrial specialization in China.

There are substantial provincial variations in industrial specialization in China. In 1980 the specialization coefficient ranged from 0.77 in Xizang to 0.47 in Guangdong. All provinces except Guizhou, Xizang, and Yunnan were less specialized in the 1980s. The three western provinces were specialized due to the development of resource-based industries, including tobacco processing, chemical materials and products, nonferrous metal smelting and pressing, and nonmetal mineral products. The coastal provinces significantly diversified their industrial structures as industries were driven to the coastal region by global and market forces. As most Chinese industries increasingly agglomerated in the coastal provinces, the central and western provinces became more specialized while the coastal provinces became more diversified. Recently, the inland provinces have become even more specialized, while

the coastal provinces have begun to specialize. Due to marketization and globalization, the inland provinces are able to fully exploit their comparative advantages based on natural resources, leading to a higher level of industrial specialization. For instance, in 2004, the top four industries in inland provinces included typical resource-based or resource-processing industries such as ferrous metal smelting and pressing, nonferrous metal smelting and pressing, nonmetal mineral products, food processing, petroleum refining and coking, chemical materials and products, and tobacco processing. The coastal provinces have upgraded their industrial structures and begun to specialize in more advanced industries, including telecommunications and electronic equipment, transportation equipment, general- and specific-purpose machinery, petroleum refining and coking, electrical machinery and equipment, chemical industries, and ferrous metal smelting and pressing. Therefore, geographic agglomeration of labor-intensive industries in the coastal region caused industrial diversification in the coastal provinces in the 1990s, while the agglomeration of advanced industries has caused industrial specialization along the coast recently. With the upgrading of industrial structures in the coastal provinces and the implementation of heavy industrialization strategies, the coastal region probably will experience more industrial specialization.

To further probe the relationship between industrial agglomeration and industrial specialization, I compare the temporal evolution of industrial specialization in select Chinese provinces. Figure 16.14 shows the changes in industrial specialization in three centrally administered municipalities. The three municipalities diversified their industries with the development of light industries in the 1980s. Since the early 1990s, Beijing and Tianjin have become increasingly specialized, as telecommunications and electronic equipment, transportation equipment, ferrous metal smelting and pressing, and chemical materials and products have gained prominence. Shanghai has been less specialized than Beijing and Tianjin, and industrial agglomeration in Shanghai has caused industrial diversification. Only

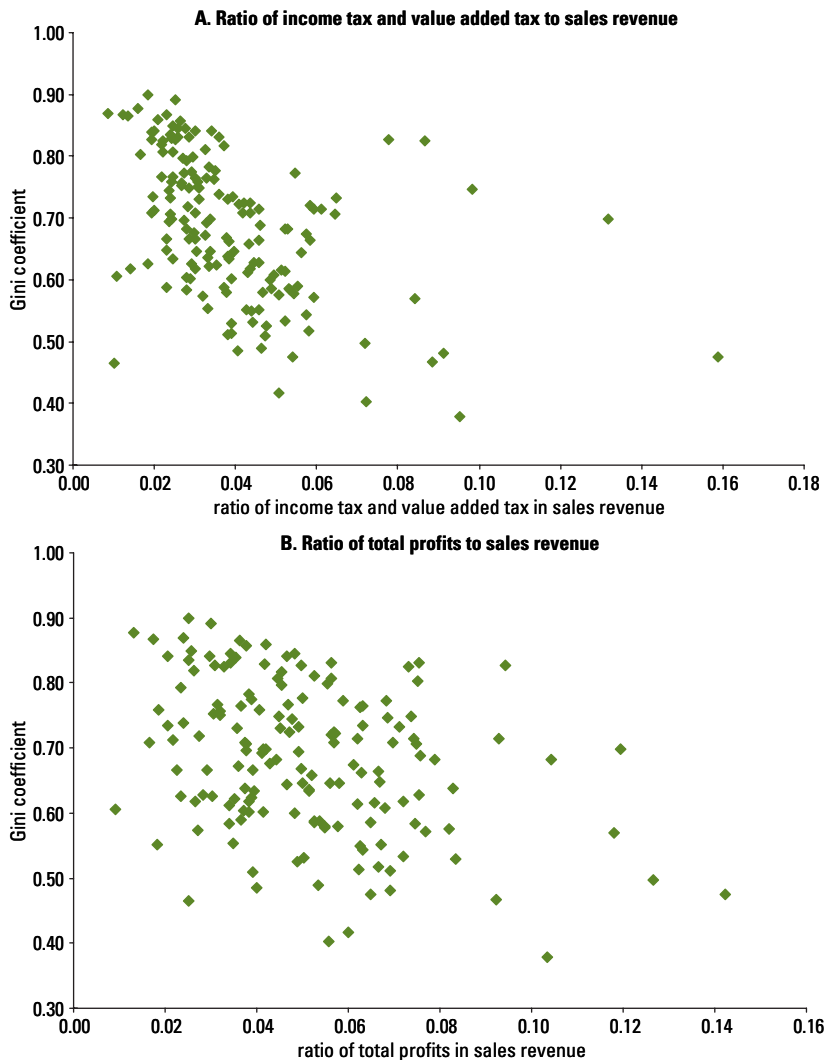
Figure 16.10 Relations between exports (panel A) and foreign capital (panel B) and industrial agglomerations in China in 2004



recently has industrial agglomeration in Shanghai resulted in increasing industrial specialization as capital- and technology-intensive industries, including telecommunications and electronic equipment, transportation equipment, machinery, and ferrous metal smelting and pressing, have topped the industrial structure.

Figure 16.15 presents the temporal changes in industrial specialization in select coastal provinces, which have agglomerated many industries during economic transition. All coastal provinces underwent significant industrial diversification as industries increasingly agglomerated in the coastal provinces in the 1980s and the early 1990s.

Figure 16.11 Relations between ratio of income tax and value added tax to sales revenue (panel A) and ratio of total profits in sales revenue (panel B) and Gini coefficient of three-digit industries in 2004



By the middle of 1990s, Fujian and Guangdong provinces had the most diversified industrial structures, with specialization coefficients smaller than 0.50. Further industrial agglomeration in the coastal provinces has caused more industrial specialization, particularly in Guangdong, Jiangsu, and Liaoning. Shandong and Zhejiang, however, show no significant increase in industrial specialization. Guangdong and Jiangsu are two critical manufacturing provinces and are among the top four provinces for many industries. Due to the recent development of heavy machinery and equipment industries, which has been initiated by local governments, the two provinces have become

significantly more specialized. As marketization and globalization progress, advanced industries will be increasingly concentrated in the coastal provinces, which will also become more industrially specialized.

The inland provinces provide a rather simple picture of the temporal changes in industrial specialization. Figure 16.16 illustrates the evolution of industrial specialization in select western provinces. Most western provinces have been more specialized than the coastal region and also have experienced significant industrial specialization. The specialization coefficient for Yunan, for instance, increased from 0.56 in 1980 to 0.72 in 2004. The coefficient for Qinghai increased from 0.64 to 0.79 in the same period. As the economic transition has proceeded, labor and capital in the west have moved to the coast, generating strong incentives for local governments to develop industries based on natural resources. Rapid growth of resource-based or resource-processing industries in the western provinces has made them increasingly specialized. This is also true for central provinces, including Heilongjiang, Neimenggu, and Shanxi (see figure 16.17). The recent increase in the specialization coefficients of the central provinces of Hubei and Jilin is largely owing to the agglomeration of transportation equipment. Anhui, Henan, Hunan, and Jiangxi have not been the core manufacturing bases and have experienced no significant increase in industrial specialization. Recently, as labor and resource costs have skyrocketed in the coastal region, some labor- and resource-intensive industries, such as garments, shoe and hat making, and leather and fur products, started to relocate to the inland region. The coming spatial restructuring of traditional industries will possibly lower the level of industrial specialization in the inland provinces, especially those near the coastal provinces.

To summarize, as Chinese industries became geographically dispersed in the 1980s, Chinese provinces began to experience industrial diversification. Increasing industrial agglomeration since the late 1990s has caused more industrial specialization. As Chinese industries increasingly agglomerate in the coastal provinces, the inland

provinces gain opportunities to develop resource-intensive industries due to market forces, leading to more industrial specialization. Recently, the coastal provinces have also become increasingly specialized as more capital- and technology-intensive industries shift to the coast.

Industrial agglomeration and labor productivity in China

Theoretically, as Porter (2000) argues, industrial agglomeration would improve the productivity of constituent firms, upgrade the capacity of participants in clusters for innovation and productivity growth, and stimulate new business formation that supports innovation and expands the cluster. To justify the increasing industrial agglomeration in China, it is necessary to inquire more explicitly whether there are productivity effects of industrial agglomeration.

I conduct a statistical analysis based on a simple production-function approach with two-digit manufacturing industries as observations. The dependent variable is the log of gross industrial output per worker, and the independent variables include the log of capital per worker and the Gini coefficient of gross industrial output. Considering the evolutionary nature of marketization and globalization in China, I expect to find an increasingly strong and significant relationship between industrial agglomeration and labor productivity, controlling for capital per worker. I run the regression analysis for years in which provincial-industrial data are available. As shown in table 16.2, there is an extremely significant coefficient attached to K/L , and capital per worker has become more important since the 1990s. As expected, the variable of the Gini coefficient has a positive coefficient, indicating that labor productivity effects will emerge as industries become increasingly agglomerated. The variable of the Gini coefficient turned from insignificant to significant in the middle 1990s, implying that the increasing industrial agglomeration since the middle 1990s has driven up labor productivity in Chinese industries. The positive relationship between the Gini coefficient and labor productivity also provides

Figure 16.12 Relation between ratio of state capital to total capital and Gini coefficient of three-digit industries in 2004

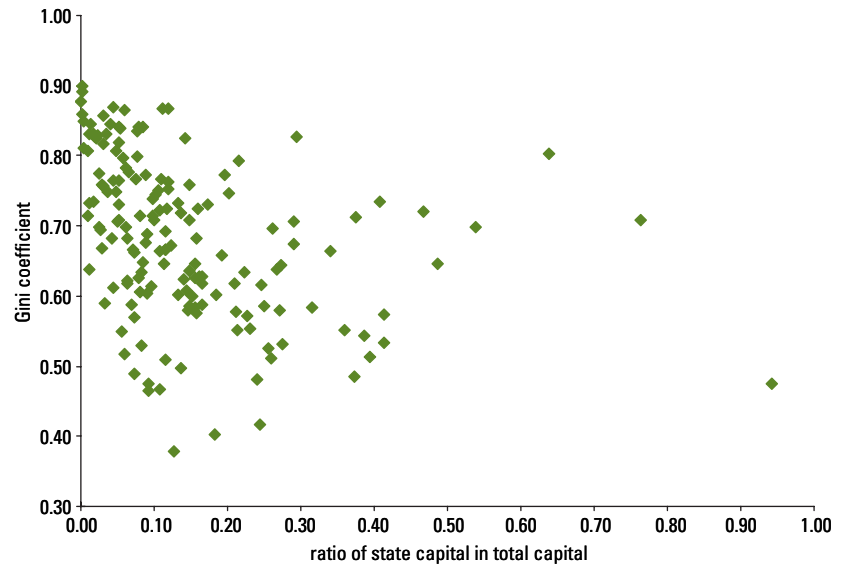
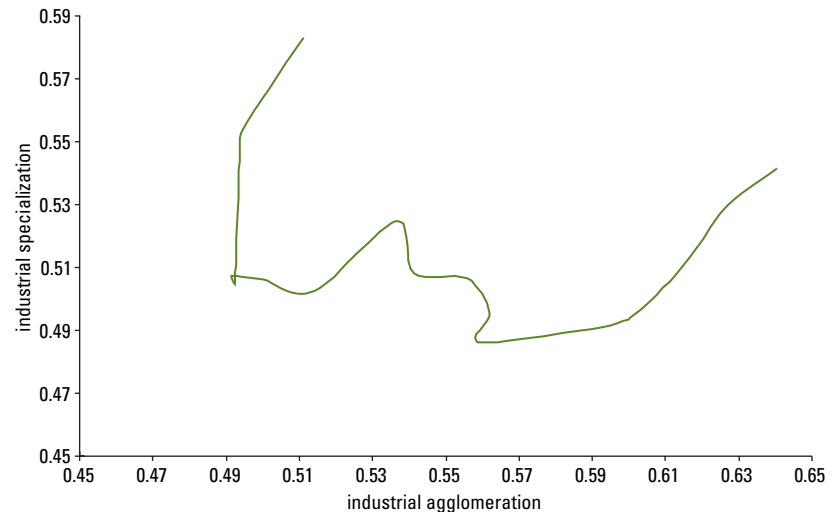


Figure 16.13 Relationship between industrial agglomeration (weighted Gini coefficients across industries) and industrial specialization (weighted Gini coefficients across provinces)



economic justification for the formation of industrial clusters in China.

The results in table 16.2 represent a highly aggregated level of investigation. It is also critical to see whether the relationship between industrial agglomeration and labor productivity holds for all individual industries. To do so, I evaluate models based on a production-function approach for two-digit manufacturing industries, with the observations defined in terms of provinces. I apply the location quotient to measure the geographic agglomeration of industry j in province i , defined as

Figure 16.14 Temporal changes of industrial specialization in centrally administered municipalities of China, 1980–2004

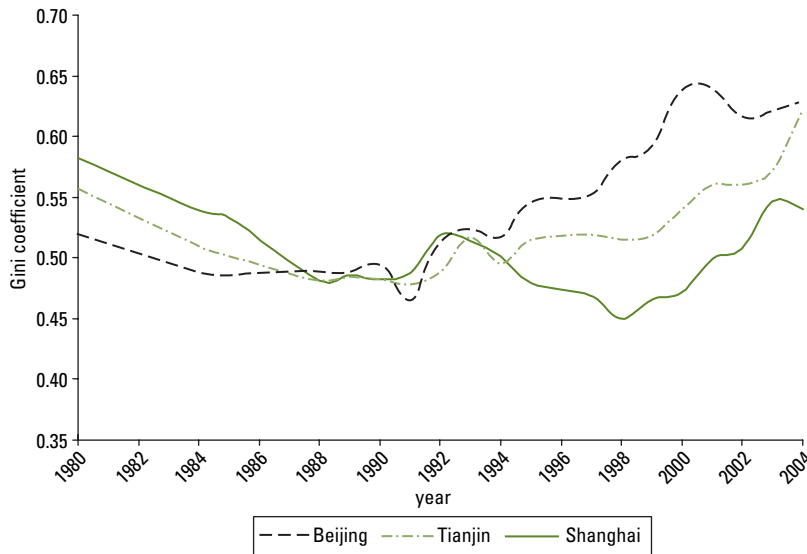
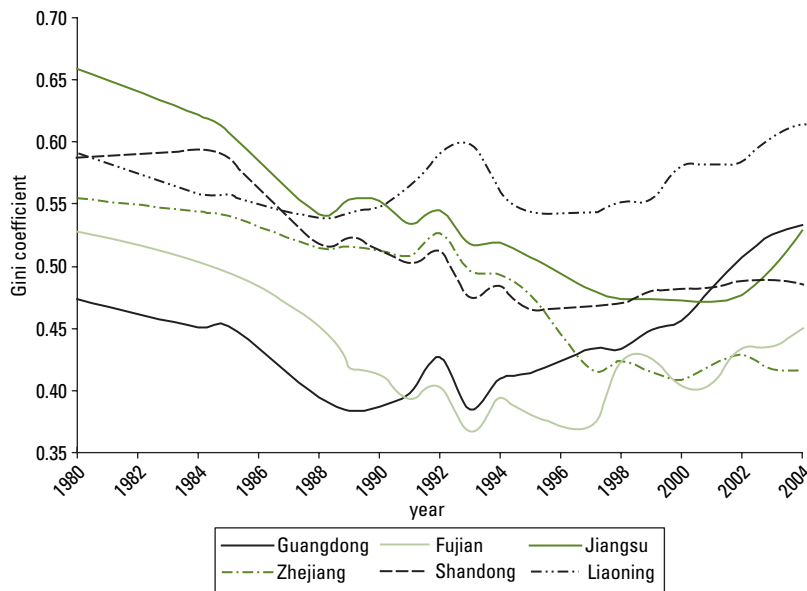


Figure 16.15 Temporal changes of industrial specialization in select coastal provinces of China, 1980–2004



$$LQ_{ij} = \frac{OUTPUT_{ij}/OUTPUT_i}{\sum_i OUTPUT_{ij}/\sum_i OUTPUT_i}, \quad (3)$$

where $OUTPUT_{ij}$ represents the gross output of industry j in province i and $OUTPUT_i$ is the gross industrial output in province i . I then assume that labor productivity is a function of internal scale

economies, localization economies, and urbanization economies, controlling for capital per worker, defined as follows:

$$\frac{Q_{ij}}{L_{ij}} = f\left(\frac{K_{ij}}{L_{ij}}, \text{LnSIZE}_{ij}, \text{LnUPOP}_i, LQ_{ij}\right), \quad (4)$$

where Q_{ij} is the gross output of industrial j in province i , K_{ij} and L_{ij} represent the total capital and employment of industry j in province i , $SIZE_{ij}$ is the average employment per enterprise of industry j in province i , LQ_{ij} is the location quotient of gross output of industry j in province i , and $UPOP_i$ is the total nonagricultural population in province i .

I perform the regression analysis for each two-digit manufacturing industry in each year from 1980 through 2004. (More detailed data are available from the author.) All models are fairly significant, with relatively high values of R^2 . For instance, the R^2 ranged from 0.24 for leather and fur products to 0.93 for tobacco processing in 2004. All industries but leather and fur products, cultural education and sporting goods, chemical fiber, and garment-making industries, have an R^2 greater than 0.50 in the models. I am particularly interested in the significance of the location quotient (LQ), which captures the effect of localization economies. There are wide variations in the significance and magnitude of the regression coefficients on LQ . The relationship between industrial agglomeration and labor productivity differed significantly in the 1980s and in the 1990s. Similarly, industrial agglomeration was not significantly associated with labor productivity in a number of industries in the 1980s. Significant positive relationships only held for textiles, tobacco processing, cultural education and sporting goods, petroleum refining and coking, chemical fiber, plastic products, electrical machinery and equipment, telecommunications and electronic equipment, and instruments and meters, which were also the most agglomerated industries in the 1980s and mainly specialized in labor-intensive functions. They were also the first group of industries to allow nonstate-owned enterprises and to use foreign investment. Marketization and globalization therefore stimulated the spatial

agglomeration of these industries because geographic clustering was rewarding. The petroleum refining and coking industry was highly agglomerated and also productive in the 1980s because of internal scale economies. Ferrous and nonferrous metal smelting and pressing were also highly concentrated in the 1980s, but geographic concentration did not bring higher labor productivity because this industry was tightly controlled by state-owned enterprises.

The 1990s saw an optimal picture of the relationship between industrial agglomeration and labor productivity, as most industries became increasingly agglomerated and many more industries became liberalized and globalized. First, all industries but food processing, beverage manufacturing, tobacco processing, petroleum refining and coking, medical and pharmaceutical products, and ferrous metal smelting and pressing had a significant and positive relationship between industrial agglomeration and labor productivity. The exceptions are heavily protected, strongly favored by local governments or controlled by the state-owned enterprises, and fairly geographically dispersed. Regression coefficients on location quotients in petroleum refining and coking and tobacco processing have turned from significant and positive to insignificant or negative since the 1990s. The results suggest that government intervention and local protectionism account for the improvement in labor productivity and industrial competitiveness.

Second, the relations between industrial agglomeration and labor productivity remained positive and significant for labor-intensive industries such as textiles, cultural education and sporting goods, chemical fiber, and rubber and plastic products in the 1990s. Many more traditional labor-intensive industries have benefited from geographic agglomeration since the early 1990s, with a significant and positive relationship between industrial agglomeration and labor productivity. These industries include food manufacturing, garments, shoe and hat making, leather and fur products, timber processing and furniture making, rubber and plastic products, and nonmetal and metal mineral products. There are several critical reasons

Figure 16.16 Temporal changes of industrial specialization in select western provinces of China, 1980–2004

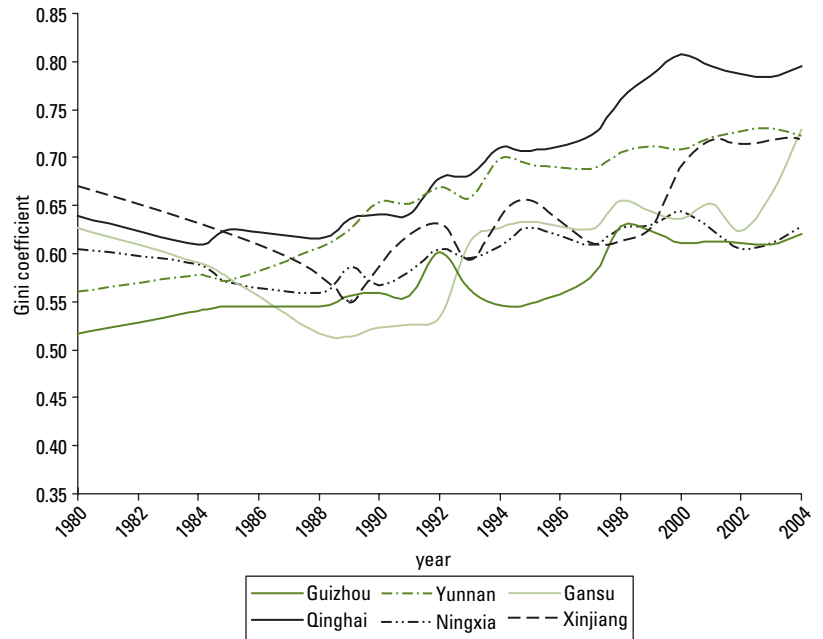
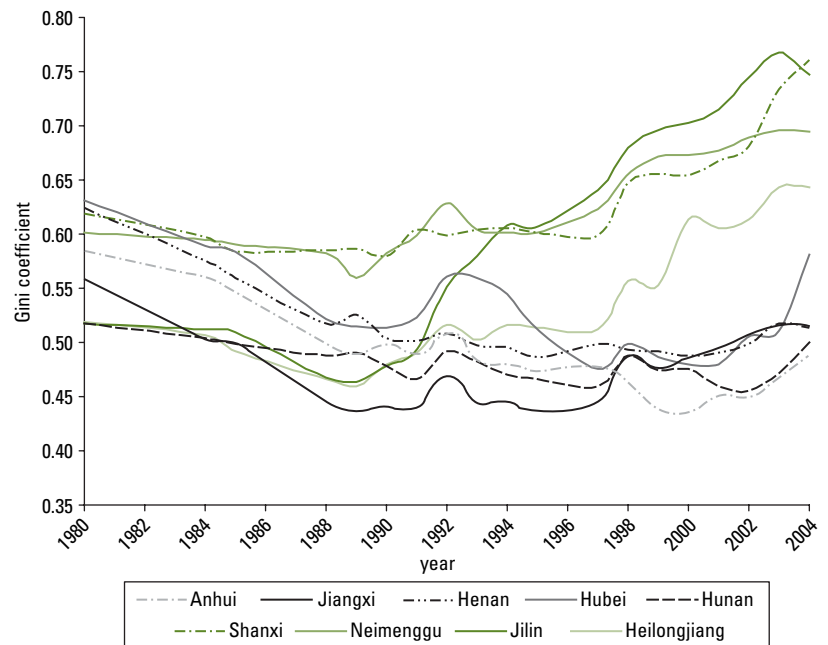


Figure 16.17 Temporal changes of industrial specialization in central provinces of China, 1980–2004



why labor-intensive industries could benefit from geographic clustering. The clusters of labor-intensive industries in the coastal region are characterized by a deeper division of labor across enterprises, which significantly cuts production costs and increases

Table 16.2 Regression analysis of the relationship between productivity and industrial agglomeration for two-digit industries in China, 1980–93

Year	Constant	Gini	Ln K/L	R ²	F	B-P
1980	5.43***	0.99	0.40***	0.28	4.57	0.08
1984	7.74***	2.00	0.09	0.15	1.99	0.43
1985	3.76***	0.79	0.63***	0.528	12.88	1.66
1988	1.02***	0.12	0.71***	0.60	16.79	5.57
1989	3.20***	0.30	0.75***	0.65	20.13	4.95
1990	3.20**	0.42	0.74***	0.58	15.42	1.40
1991	2.47**	0.90*	0.79***	0.75	33.26	4.83
1992	3.60**	1.52	0.63***	0.27	4.06	9.18
1993	2.73	0.63	0.80***	0.76	36.87	13.57
1994	2.26	1.04	0.83***	0.78	40.49	11.72
1997	2.15	1.61**	0.79***	0.76	36.66	10.11
1998	0.97	1.47	0.89***	0.37	6.77	5.50
1999	1.03	1.18**	0.83***	0.82	51.41	0.68
2000	0.49	1.38***	0.88***	0.80	45.81	0.85
2001	0.72	1.22***	0.87***	0.84	59.84	1.62
2002	0.50	1.10**	0.90***	0.87	74.62	1.60
2003	0.46	0.97**	0.91***	0.87	76.64	3.05
2004	0.51	0.67*	0.93***	0.88	83.22	4.48

Source: Author's calculations.

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.10$.

Note: Number of cases = 26. Results are corrected with heteroskedasticity.

labor productivity of related enterprises. The majority of workers in the coastal industrial clusters are migrants, who are productive and hard working, which boosts labor productivity. The labor pool in the coastal region also lowers labor-related costs and improves labor productivity. The industrial clusters in the coastal region are particularly attractive to foreign investment, which brings capital, management, and advanced technology, resulting in higher labor productivity. In addition, state capital has largely withdrawn from the labor-intensive industries, stimulating fierce market competition and forcing related enterprises to be more competitive. Overall, market forces and globalization effects have driven labor-intensive industries to concentrate in a few coastal provinces due to the productivity effects of geographic clustering.

Third, capital- and technology-intensive industries such as general- and specific-purpose machinery, transportation equipment, telecommunications and electronic equipment, electrical machinery and equipment, and instruments and meters have significantly benefited from geographic agglomeration. The regression coefficients on the location quotient of machinery and transportation equipment have changed

from insignificant to highly significant since the middle 1990s. The magnitude of regression coefficients on telecommunications and electronic equipment, electrical machinery and equipment, and instruments and meters has increased significantly since the 1990s. During 1980–2004, all these industries became more agglomerated.

The productivity effects of industrial agglomeration in these capital- and technology-intensive industries are derived from strong localized business linkages and the use of foreign investments. Upstream firms are close to downstream firms, as this is their main source of demand, while downstream firms want to be close to a large number of upstream firms, because this is where intermediate inputs are cheaper. The geographic proximity of related firms raises industrial labor productivity by speeding the process of matching downstream and upstream firms and by lowering transaction costs. The capital- and technology-intensive industries have also used a significant amount of foreign investments, facilitating industrial agglomeration. For instance, foreign capital accounted for 62 and 48 percent of total capital in telecommunications and electronic equipment and in instruments and meters, respectively; almost all major

auto producers in China are foreign joint ventures. Many studies find foreign-invested enterprises to be more productive than domestic-owned enterprises. As economic transition proceeds, market and global forces will play a larger role in driving industrial agglomeration and allocating resources more effectively. This simple statistical analysis suggests that industrial agglomeration has been pervasive because industrial agglomeration has productivity effects. However, industrial localization will not necessarily bring higher labor productivity if industries are heavily protected or controlled by governments.

Industrial clusters in China: a county-level analysis

I now use employment data from the first economic census conducted at the end of 2004 to examine some typical industrial clusters in China. I first aggregate the industrial employment by county and map the county distribution of aggregate manufacturing employment (see figure 16.18).

Overall, manufacturing industries are concentrated in the coastal region, including Fujian, Guangdong, Hebei, Jiangsu, Liaoning, Shandong, Shanghai, and Zhejiang provinces. Inland provinces such as Henan, Hubei, Jilin, and Sichuan are also important locations for manufacturing industries. From the northeastern province of Heilongjiang to the southwestern province of Yunnan, I could draw a line to separate the whole nation into two parts, with manufacturing employment heavily concentrated in the right part. To the northwest of the line, most counties have large and medium-size enterprises with fewer than 5,000 manufacturing workers, while those that have enterprises with more than 5,000 manufacturing workers are resource based. Several clusters of manufacturing employment are located along the coastal region, including the Yangtze River delta, the Pearl River delta, the Shandong peninsula, and the Beijing-Tianjin area. There are also some scattered industrial clusters in the central provinces, such as in Henan, Hubei, and Sichuan.

Figure 16.18 Spatial distribution of manufacturing employment in China, by county, 2004

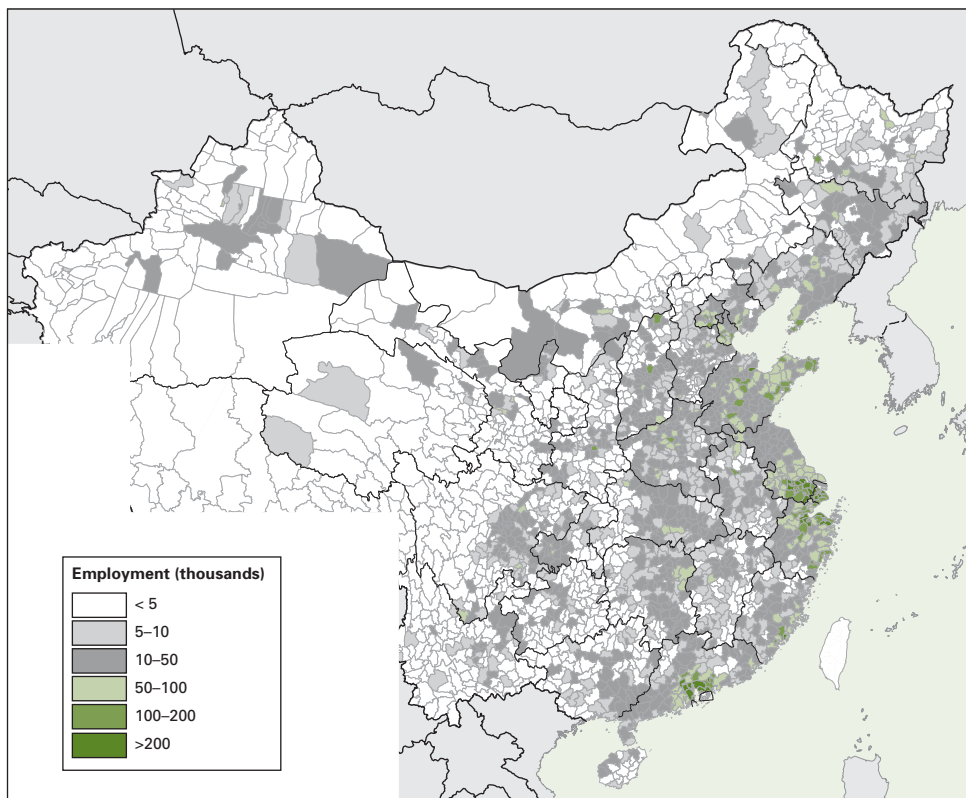
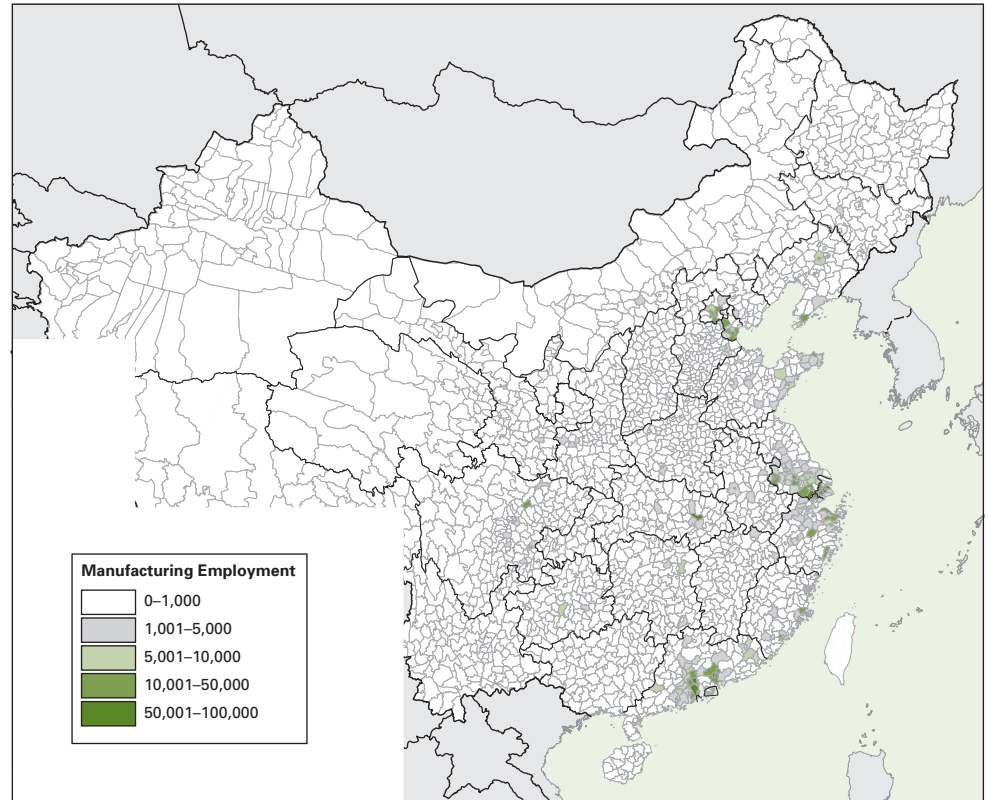


Figure 16.19 Spatial distribution of employment in telecommunications equipment, computers, and other electronic equipment in China, by county, 2004



For illustrative purposes, I map the county distribution of employment in one of the more successful clusters: telecommunications equipment, computers, and other electronic equipment. As figure 16.19 shows, employment in telecommunications equipment, computers, and other electronic equipment is clustered in the Pearl River delta and in areas near Beijing, Shanghai, and Tianjin, but there are also clusters in Chongqing, Dalian, Jinan, Wuhan, and Xi'an. The electronic industry typically agglomerates in cities that host ET Dzs or high-tech industrial development zones set by the central and local governments. There are favorable financial incentives and policies to attract electronic-related companies to these development zones. The industrial policies have played an essential role in facilitating the formation of industrial clusters in telecommunications and electronic equipment. However, the expansion and development of electronic equipment clusters in coastal provinces are driven largely by foreign firms. Taiwanese electronic com-

panies are mainly clustered in the Pearl River delta and recently moved to Kunshan and Suzhou in Jiangsu. Japanese electronic companies strongly favor the Yangtze River delta and Liaoning province. Korean electronic firms invest heavily in Beijing, Shandong, and Tianjin. The Xingwang Industrial Park in the Beijing economic and technology zone houses a manufacturing cluster of mobile telecommunications equipment centered on Nokia, with more than 30 component suppliers (Yeung and others 2006). The strong supplier-buyer relations and business networks are essential to the success of electronic clusters. The downstream and upstream firms in the electronic industry locate closer to each other and form the successful clusters. The existence of electronic clusters in some inland cities can be partially related to the combined effects of market forces and the past locational policies of the Chinese government in promoting the growth of inland cities.

Industrial clustering has been the critical source of industrial competitiveness and has

significantly stimulated industrial development in China. Market and global forces are responsible for the formation and success of industrial clusters, particularly in traditional labor-intensive industries. Related firms cluster together because clustering is rewarding. Central and local governments in China have also played critical roles in facilitating industrial clustering by concentrating companies in development zones, which are set up by the central government or local governments at different levels. Governments set up investment platforms to attract new companies, while market and global forces underpin the expansion of industrial clusters, especially in advanced industries such as telecommunications and electronic equipment, transportation equipment, machinery, and electrical machinery and equipment.

Conclusions

China's economic geography used to be heavily shaped by a socialist ideology that downplayed agglomeration economies. Industrial location was planned by the government. China's economic transition has gradually introduced global and market forces into the economic system, while decentralization has granted local governments the authority and responsibilities for local economic development. Therefore, China now is a mixed economy in which socialist legacies and government intervention and planning exist side by side with global and market forces. Theoretically, global and market forces may foster the geographic clustering, which allows Chinese industries to exploit locational and comparative advantages and agglomeration economies, while decentralization may result in local protectionism and a rational imitation strategy, which discourages industrial agglomeration.

Economic liberalization during the last decades in China seems to have fostered both the macroeconomic and local conditions under which viable industrial agglomerations can emerge. The empirical investigations show that Chinese manufacturing industries have become increasingly agglomerated since the early 1990s. I find significant industrial variations in the trend and level of industrial agglomerations. In 1980 the most agglomerated industries were capital-intensive

industries with strong internal scale economies, while the dispersed industries were resource-based or resource-processing industries. In 2004 many agglomerated industries were highly globalized, while the dispersed industries were localized, resource-based, domestic market-oriented industries or profitable, strategic industries that were favored and protected by local governments. As expected, the globalized industries with the least intervention, such as telecommunications and electronic equipment, instruments and meters, cultural education and sporting goods, garments, shoe and hat making, leather and fur products, chemical fiber, and rubber and plastic products, have become increasingly and significantly more agglomerated since the early 1990s, while domestic market-oriented and protected industries have shown no significant trend of centralization. The globalized and market-driven industries have shifted to the coastal provinces, including Fujian, Guangdong, Jiangsu, Shandong, Shanghai, and Zhejiang. The empirical results indicate that sectors and spaces that have undergone economic liberalization are the most prone to the formation of agglomeration economies. Geographic agglomeration of many labor-intensive industries such as garments and other fiber, leather and fur products, and rubber and plastic products, has gone beyond provincial boundaries and promoted regional industrial development. Some capital-intensive industries such as transportation equipment, machinery, electrical machinery and equipment, and chemical materials and products, which rely on regional business linkages, have significant spillover effects beyond provincial boundaries. However, industries dependent on localized business linkages or protected by local governments are confined within a province.

Industrial agglomeration appears to have caused the change in industrial structure in Chinese provinces. In the 1980s, as Chinese industries became dispersed, Chinese provinces experienced industrial diversification. Increasing industrial agglomeration has resulted in gradual industrial specialization since the late 1990s. With labor and capital flowing to the coast, the inland provinces have been forced to develop industries based

on natural resources, leading to a higher level of industrial specialization. The agglomeration of labor-intensive industries in the coastal provinces before the middle 1990s allowed these provinces to diversify their industrial composition, while the recent geographic agglomeration of advanced industries has resulted in industrial specialization in the coast.

The empirical analysis of Chinese industries also supports the argument that a positive relationship can be found between industrial agglomeration and labor productivity in economies that were formerly dominated by central planning. The relationship has been increasingly significant as the economic transition proceeds, suggesting that economic reform has created the conditions for industrial agglomeration. There are substantial industrial variations in the relationship. As most industries became increasingly agglomerated in the 1990s, stronger and more significant positive relationships between industrial agglomeration and productivity emerged, especially in industries that have gained prominence since economic transition. The heavily protected or state-controlled industries have not significantly benefited from industrial agglomeration. Market and global forces not only have driven Chinese industries to agglomerate in the coastal provinces but also have improved labor productivity. Although decentralization has promoted local economic development, it has discouraged industrial agglomeration and sacrificed the labor productivity of Chinese industries. However, as the economic transition proceeds and domestic markets become more integrated, interprovincial competition will become more fierce and force locally protected industries to be more productive. As a matter of fact, provincial governments have worked hard to promote the formation of industrial clusters to improve the competitiveness of local industries. Protected industries are fairly concentrated in some counties or cities within a province. Provincial governments have also competed fiercely with each other to attract foreign investments into locally protected industries and make them more productive. Overall, market reforms and globalization have indeed pushed China's industries in the

direction of efficiency in spite of provincial protectionism.

Note

Canfei He is associate professor in the Department of Urban and Regional Planning, College of Urban and Environmental Sciences, Peking University, Beijing. The author wishes to thank Dr. Yukon Huang, Dr. Indermit Gill, Professors Masahisa Fujita, Keijiro Otsuka, Ming Lu, and others who participated in the World Bank workshop on the *World Development Report 2009* in Tokyo on November 29–30, 2007, for constructive comments and suggestions.

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