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## Abstract

China's economic geography was formerly heavily shaped by a socialist ideology that downplayed agglomeration economies. Economic transition, which could be conceptualized as a triple process of marketization, globalization and decentralization, gradually introduced market and global forces and granted local governments more authorities and responsibilities for local development. China is now a mixed economy in which socialist legacies and governmental intervene and planning exist side by side with new forces as a result of economic transition. Theoretically, market and global forces may foster the geographical clustering of Chinese industries to exploit comparative advantages and agglomeration economies while regional decentralization may discourage industrial agglomeration because of local protectionism and rational imitation strategy. Spatial restructuring of Chinese industries is the result of interactions between centripetal and centrifugal forces of industrial agglomeration.

Economic liberalization seems to have fostered both the macroeconomic and local conditions under which viable industrial agglomerations can emerge. Chinese industries have been increasingly agglomerated since the early 1990s. In 1980, the most agglomerated industries were capital-intensive and the dispersed industries were resource-based industries. In 2004, many agglomerated industries were highly globalized and privatized while the dispersed industries were either domestic-market oriented or profitable and strategic industries. Some were favored or protected by local governments. Industries and spaces that are undergone economic liberalization and globalization are those most prone to the formation of agglomeration economies.

The empirical analysis finds a positive relation between industrial agglomeration and labor productivity of industries. The positive relationship has been significantly strengthened as economic transition proceeds. In the 1980s, significant positive relations only held for a few industries, which were the first to allow non-state owned enterprises and utilize foreign investment or export. As most industries became increasingly agglomerated in the 1990s, more significant positive relationships between industrial agglomeration and productivity emerge, especially in industries that have gained prominence during economic transition. The heavily protected or state-controlled industries however have not significantly benefited from geographical agglomeration. Market and global forces have driven Chinese industries to agglomerate in the coast region and improved labor productivity of Chinese industries. Decentralization has promoted local development, but it also discouraged industrial agglomeration and sacrificed labor productivity. However, fierce inter-provincial competition would force locally protected industries to be more productive. Provincial governments have recently worked hard to promote industrial clusters within the province to improve the competitiveness of locally protected industries. The empirical investigations point to the importance of economic transition and its consequence in understanding industrial agglomeration and its relation with labor productivity in China. Market reforms and globalization has indeed pushed China's industries in the direction of efficient outcomes.

**Key words**: Industrial agglomeration, specialization, economic transition, labor productivity, Gini coefficient

# Industrial Agglomeration in the Transitional China

## 1 Introduction

The geographical agglomeration of manufacturing employments is pervasive. Plants are not distributed uniformly in space, but rather agglomerate in some places. There exist many examples of spatially clustered industries, including the often cited high-tech clusters in Silicon Valley and clusters of traditional industries such as those in the Third Italy, and the US Carpet industry in Dalton (Devereux etc., 2004). The phenomenon, however, is not confined in the developed economies. Industrial clustering has been the effective way to develop local industries in the developing economies. For instance, there have grown many successful clusters in labor intensive industries and globalized industries in Zhejiang and Guangdong provinces, significantly heightening China's industrial competitiveness (Wang, 2001).

According to mainstream economic theories, comparative advantages and agglomeration economies are responsible for geographical clustering of industries (Ellison and Glaeser, 1997). The driving forces of industrial agglomeration in China might differ since China has experienced two fundamental changes from the late 1970s, that is, 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 the spatial development in China (Wei, 2000; He et al., 2007). Industrial restructuring in China, like the process of economic transition, is a gradual, partial, and 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 stimulated plants to locate along the line of comparative advantages and to exploit agglomeration economies. Meanwhile, decentralization has granted local governments more authorities and responsibilities to develop local economies, resulting in fierce interregional competition and leading to local protectionism and rational imitation strategy in economic development. As a consequence, there are significant centripetal forces as well as centrifugal forces of industrial agglomeration in China.

Sectors and regions that are undergone economic liberalization may be prone to the formation of agglomeration economies and would significantly benefit from industrial agglomeration. This paper will empirically investigate the evolution and extent of industrial agglomeration in China. Questions of how industrial agglomeration affects industrial specialization in Chinese provinces and how provincial boundaries influence industrial agglomeration will be answered. To provide empirical justifications for the geographical clustering of Chinese industries, this paper further explores the relationship between industrial agglomeration and labor productivity across industries and within industries.

## 2 Theoretical Understanding of Industrial Agglomeration in China

China has taken an evolutionary approach to reform its economy and has experienced a triple process of marketization, globalization and decentralization. Economic landscapes in China have been driven by a multiplicity of forces and agents unleashed by the triple process. There are forces driving industrial agglomeration as well as forces discouraging industrial agglomeration. Given the nature of economic transition, an institutional and evolutionary perspective is critical to understand China's economic geography.

### 2.1 Economic Marketization and Industrial Agglomeration

China's economic reform is to build a market-oriented economy and allows 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 sociologist ideology and national defense. Industrial location failed to match comparative advantages since 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 and industrial specialization (Zhao and Zhang, 1999). As economic transition proceeds, market forces are progressively introduced, limits on factor mobility and commodity exchanges have been gradually lifted. Non-state capital and private firms have been playing an important role in local development.

Under the context of market economies, neoclassical trade models, new trade models and new economic geography models are the underpinning theoretical enquires in industrial location (Brulhart, 1998). In the neoclassical world, industrial agglomeration is driven by exogenous endowments such as technologies, labor, and natural resources. Industries would be heavily agglomerated in locations with matched comparative advantages. Reduction of trade barriers would make regions specialize in their production based on comparative advantages (Kim, 1995). In new trade models, internal scale economies provide regions incentives to specialize even in the absence of differences in their resource endowments, and stimulate firms to agglomerate their production in a few locations. Economic activities concentrate in order to realize scale economies, especially towards a large consumer market to minimize transportation costs (Krugman, 1980). Regional integration allows underlying geographical advantages to play a greater role, generating a tendency to increase industrial agglomeration. In the new economic geography models, geographic concentration is driven by the interactions of transportation cost, internal scale economies and labor mobility (Krugman, 1991; Fujita and Thisse,1996). 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 agglomeration economies from industrial linkages, there are other sources of external economies 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 between firms as forces driving industrial agglomeration. As a consequence, industries and regions which have experienced economic liberalization would be favorable to the formation of industrial agglomeration. As economic transition proceeds, Chinese industries, especially those driven by market forces, would be increasingly agglomerated in a few regions.

## 2.2 Economic Globalization and Industrial Agglomeration

China has effectively participated in economic globalization by trading with other economies and by utilizing foreign investment. Trade liberalization broadens the scope of industrial specialization along the line of comparative advantages and enhances the importance of international market accessibility. Trade liberalization also provides trading firms incentives to exploit scale economies to heighten international competitiveness. In Indonesia, Sjoberg and Sjoholm (2004) found that trading establishments were more spatially clustered than other establishments. In China, labor migration resulting from the relaxation of the household registration system allows trading establishments to cluster along the coastal region and to benefit from the best utilization of cheap resources (He et al., 2007). Moreover, Chinese trading enterprises fully take advantage of backward and forward business linkages through deeper division of labor to foster the formation of industrial clusters, significantly cutting production costs and transaction costs (Wang, 2001). Fujita and Hu (2001) found that increases in exports have reinforced industrial agglomeration in China, particularly concentrating industries in the coastal region since it is close to the international market, and has locational advantages, and has enjoyed the first mover advantage of economic globalization. However, as Krugman and Elizondo (1996) argued, trade liberalization may significantly weaken the role of localized industrial linkages in promoting industrial agglomeration since trading establishments rely on external linkages. In China, many assemblers focus on labor-intensive functions, heavily relying on imported materials and intermediate goods. The localized industrial linkages may not play the expected role in industrial agglomerations.

Foreign direct investment has significantly shaped the spatial structures of Chinese industries. Overall, foreign investments have facilitated industrial agglomeration through multiple channels. First, foreign establishments are disproportionably agglomerated in the coastal region and in strong industrial bases to exploit locational advantages and agglomeration economies, and to mitigate foreign investors' disadvantages of being foreigners (Head etc., 1996; He, 2002, 2003, 2006). Second, foreign enterprises create demand for locally produced intermediate inputs and improve the efficiency of the whole sector, making domestic producers more profitable and leading to industrial agglomerations (Markusen and Venables, 1999). Component sourcing in China is an important consideration for foreign firms because of local content requirements (Head and Ries, 1996; Belderbos and Cerree, 2002). Third, major multinational corporations often bring a large number of suppliers to the host economies, facilitating industrial agglomeration. For instance, Taiwanese electronic companies have formed successful industrial clusters in Dongguan, Guangdong and Suzhou and Kunshan, Jiangsu. In the Nokia-centered Xingwang Industrial Park in Beijing Economic and Technology Development Zone, the mobile telecommunications manufacturing cluster consists of Nokia-Capital (the assembler) and up to 30 major suppliers (Yeung et al., 2006). As a consequence, with economic transition, liberalized and globalized industries and regions would be prone to the formation of industrial agglomerations.

## 2.3 Economic Decentralization and Industrial Agglomeration

Unlike 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 government to local governments. As a result, the local governments now have a primary responsibility and authority for local economic development (Qian and Weingast, 1997). Meanwhile China introduced a revenue-sharing system called "fiscal contracting system" in 1980" and the central and provincial governments started to tap different revenue bases. In 1994, the central government initiated a new tax-sharing system, introducing a clear distinction between national and local taxes, and determining that the value added tax (VAT) would become the major indirect tax to be collected by the central government and shared by local governments at a fixed ratio of 75:25. The new tax sharing system however has not removed local governments' major revenue sources, local governments' revenue sources include business tax, income tax from local enterprises, and profits from local enterprises, personal income, urban land tax and fixed investment direction adjustment tax.

During the period of economic reform, the governmental intervene in economic development may have discouraged the geographical concentration of Chinese industries, especially at the provincial level. First, the central government and local governments have established a large number of economic and technology development zones 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, medicines, equipment, and other high-tech industries. For instance, telecommunication and electronic equipment dominated the Economic and Technology Development Zone in Beijing and Tianjin, leading to the structural convergence between Beijing and Tianjin. The centrally and locally administered development zones would promote the geographical 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 Industrial-Specific Development Plans. For instance, the National Tenth Five Year Plan stressed to develop food processing, machinery and equipment, automobile, and high-tech industries such as electronics, biological engineering and medicine. This list was also chosen as the key industries by almost all the coastal provinces and many central provinces. The industrial duplication certainly discouraged the geographical 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 serious inter-provincial competition for economic and political performance, resulting in 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) observed that decentralization would lead local governments to rapidly converge on successful development policies through a process of rational imitation in China. Rational imitation of successful industrial policies also makes local governments duplicate industries which could rapidly improve local revenues or promote local economic growth.

Finally, fiscal decentralization instinctively and explicitly emphasized autarchic development because the localities had to self-finance their 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 and corporation (Zhao and Zhang, 1999). At the macroeconomic level, fiscal decentralization has provided local governments incentives to protect local industries significantly contributing to its economic and revenue growth (Lee, 1998; Young, 2000). As control over factor allocations was loosened, local governments sought to capture these rents by developing high margin industries. Continued reform and growing interregional competition between duplicative industries threaten the profitability of these industries structures, leading local governments to impose a variety of interregional barriers to trade (Young, 2000). DRCSC (2004) ranked 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 non-metal 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, non-ferrous metal smelting and pressing and leather products. Therefore, economic transition has led to the fragmentation of the domestic market and the distortion of regional production away from the patterns of comparative advantages and discouraged the geographical 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 would concentrate in regions with matched comparative and locational advantages and become increasingly agglomerated in the coastal provinces. Geographical clustering of industries would generate substantial cost-savings and lead to higher labor productivity. On the other hand, economic transition has created a market preserving federalism, which provides local governments strong incentives to protect local industries from external competition and to mutually imitate successful industrial policies. Local protectionism and rational imitation run counter to the geographical agglomeration of Chinese industries. The geographical dispersion of industries would lose scale economies and make related enterprises difficult to fully exploit external economies, leading to lower labor productivity.

## 3 Industrial Agglomeration in China

This study applies the widely used Gini coefficient to quantify industrial agglomeration of Chinese industries. Following Wen (2004), the Gini coefficient for each industry *i* is computed as follows:

$$G_i = \frac{1}{2n^2 \bar{s}_i} \sum_{k=1}^{n} \sum_{j=1}^{n} | s_{ij} - s_{ik} | \qquad (1)$$

where $s_{ij}$ is the share of industry *i* in region *j*, $s_{ik}$ is the share of industry *i* in region *k*, *n* is the number of regions and $\bar{s}_i$ is the mean of shares. The industrial Gini coefficient is equal to twice the area between a 45° line and a Lorenz curve. For each industry *i*, the Lorenz curve is derived by ranking $s_{ij}$ in descending order and plotting its cumulative on the vertical axis against the cumulative of the number of provinces on the horizontal axis (with each interval having the same width, equal to 1/n). 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 zero. An index close to one suggests that an industry is entirely concentrated in a region. To measure industrial specialization in a province, I exchange the industry and province data in the above equation. Data on Chinese manufacturing industries are collected from various issues of *China Industry Economy Statistical Yearbook* and *Annual Report of Chinese Industrial Statistics* and the *China Economic Census Yearbook 2004.*

### 3.1 Industrial Agglomeration of Chinese Manufacturing Industries

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

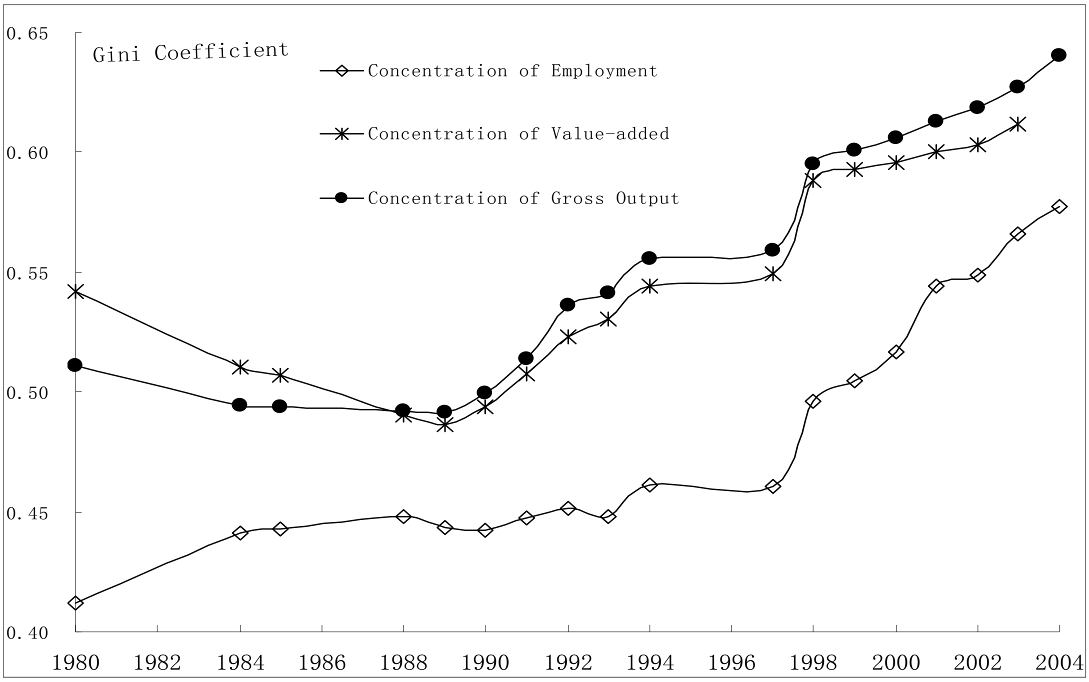



Figure 1 Temporal Trends of Geographical Concentration of Chinese Manufacturing Industries, 1980-2004

As shown in Figure 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 a spatially dispersing process 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 constantly 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 and also tilted towards new industrial cities in the interior and with a goal of full employment. Consequently, at the beginning of China's economic reform, Shanghai, Tianjin, Beijing, Sichuan, Gansu, Hubei, Liaoning, Jilin, and Heilongjiang were the major industrial bases of China. Top four provinces produced less than 50% of industrial output in most industries (Table 1).

Table 1 Share of industrial output of individual industries in top four provinces

| Code | Top four provinces in 1980 (%) | | | | | Top four provinces in 2004(%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| S13 | JS | HLJ | GD | SD | 29 | SD | GD | HEN | JS | 47 |
| S15 | ZJ | SD | SCH | HUN | 34 | SD | SCH | GD | JS | 41 |
| S16 | HEN | SD | SH | YN | 42 | YN | HUN | SH | JS | 44 |
| S17 | SH | JS | SD | HUB | 49 | JS | ZJ | SD | GD | 73 |
| S18 | SH | JS | LN | BJ | 38 | JS | GD | ZJ | SD | 69 |
| S19 | SH | SD | JS | BJ | 34 | ZJ | GD | FJ | SD | 70 |
| S20 | HLJ | SH | GD | BJ | 42 | JS | ZJ | SD | GD | 53 |
| S21 | GD | SH | SD | JS | 32 | GD | ZJ | SH | SD | 64 |
| S22 | SH | LN | SD | SCH | 31 | SD | GD | ZJ | JS | 62 |
| S23 | SH | BJ | SCH | GD | 33 | SD | ZJ | SH | JS | 55 |
| S24 | SH | BJ | TJ | GD | 69 | GD | ZJ | JS | SD | 77 |
| S25 | LN | HLJ | SD | GD | 57 | LN | SD | GD | SH | 42 |
| S26 | SH | JS | BJ | LN | 38 | JS | SD | GD | ZJ | 51 |
| S27 | SH | JS | LN | SCH | 38 | JS | SD | ZJ | GD | 38 |
| S28 | SH | LN | JS | BJ | 68 | ZJ | JS | SD | SH | 75 |
| S29 | SH | SD | LN | GD | 40 | SD | JS | ZJ | GD | 59 |
| S30 | JS | SH | GD | ZJ | 43 | GD | ZJ | JS | SH | 64 |
| S31 | JS | LN | SD | HEB | 34 | SD | GD | JS | HEN | 47 |
| S32 | LN | SH | HUB | SCH | 52 | HEB | JS | LN | SD | 46 |
| S33 | SH | LN | GS | HUN | 46 | JS | ZJ | HEN | GD | 37 |
| S34 | SH | JS | LN | TJ | 40 | GD | JS | ZJ | SH | 64 |
| S35 | SH | LN | JS | SD | 41 | JS | SD | ZJ | SH | 56 |
| S37 | LN | HUB | SH | JL | 39 | SH | JL | GD | JS | 38 |
| S40 | SH | LN | JS | GD | 44 | GD | JS | ZJ | SD | 67 |
| S41 | SH | JS | BJ | LN | 55 | GD | JS | SH | TJ | 75 |
| S42 | SH | JS | BJ | SCH | 48 | GD | JS | SH | ZJ | 71 |

Note:

1. S13&14: food processing & manufacturing); S15: Beverage manufacturing; S16: Tobacco processing; S17: Textiles; S18: Clothing and other fibers; S19: Leather and fur; S20: Timber processing; S21: Furniture making; S22: Paper making and products; S23: Printing and copying; S24: Cultural, education and sporting goods; S25: Petroleum refining and coking; S26: Chemical materials and products; S27: Medical and pharmaceutical products; S28: Chemical fibers; S29: Rubber products; S30: Plastic products; S31: Non-metal mineral products; S32: Ferrous metal smelting and pressing; S33: Non-ferrous metal smelting and pressing; S34: Metal mineral products; S35&36: general purpose and specific purpose machinery; S37: Transportation equipment; S40: Electrical machinery and equipment; S41: Electronics and telecommunication equipment；S42: Instruments and Meters.

2. AH: Anhui, BJ: Beijing, CQ: Chongqing, FJ: Fujian, GD: Guangdong, GS: Gansu, GZ: Guizhou, GX: Guangxi, HEB: Hebei, HEN: Henan, HLJ: Heilongjiang, HUB: Hubei, HUN: Hunan, JL: Jilin, JS: Jiangsu, JX: Jiangxi, LN: Liaoning, NX: Ningxia, QH: Qinghai, SD: Shandong, SHX: Shaanxi, SX: Shanxi, TJ: Tianjin, TW: Taiwan, XJ: Xinjiang, XZ: Xizang (Tibet), YN: Yunnan, ZJ: Zhejiang.

With the shift of government policies towards a market-driven economy and the opening up of the coast, Guangdong, Fujian, Zhejiang, Jiangsu, Shanghai, and Shandong have gradually taken the lead in attracting investment, labor, advanced technology and firms. The rapid growth in the coastal region and the relative decline of old industrial bases and interior provinces brought a decrease of Gini coefficients of industrial output. Labor migration from the interior provinces to the coastal region, has 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 and industrial agglomeration towards the coast region. Gini coefficients of industrial output and employment have been growing since the early 1990s (Figure 1). Gini coefficient of gross industrial output increased from 0.50 in 1990 to 0.64 in 2004 and Gini coefficient of industrial employment also grew from 0.44 to 0.58. As Table 1 shows, industrial output in most industries was concentrated in the coastal provinces, including Guangdong, Shandong, Jiangsu, Zhejiang, Shanghai and Fujian. For most industries, the industrial output shares in the top four provinces increased substantially. Industries such as leather and fur products, cultural, education and sports goods, chemical fiber, telecommunication and electronic equipment, instruments and meters concentrated more than 70% of industrial output in top four provinces.

As Table 1 shows, industrial output shares in the top four provinces ranged from less 30% to 77%, indicating that industries differed substantially in the extent of geographical agglomeration. Table 2 presents the Gini coefficient of industrial output for all two-digit manufacturing industries in selected years. The concentration indices indeed differ significantly across industries. The Gini coefficient in 1980 ranged from 0.37 to 0.73 and it changed from 0.46 to 0.83 in 2004. In 1980, the most agglomerated industries include chemical fiber, cultural, education and sports goods, petroleum refining and coking, telecommunication and electronic equipment, ferrous metal smelting and pressing while the least concentrated industries are 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 are capital-intensive and with strong internal scale economies while the dispersed industries are resource-based or resource processing industries. By 2004, cultural, education and sports goods, telecommunication and electronic equipment, and chemical fiber became much more agglomerated and remained as the most agglomerated industries. 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 in agglomeration, with Gini coefficients greater than 0.70. Many highly agglomerated industries in 2004 were also highly globalized, exporting substantially or utilizing a large amount of foreign direct investments. The most dispersed industries include nonferrous metal smelting and pressing, medical and pharmaceutical products, beverage manufacturing, petroleum refining and coking, ferrous metal smelting and pressing, food processing and manufacturing and 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 since they are strategic and profitable, such as tobacco processing, transportation equipment, beverage manufacturing, and medical and pharmaceutical products.

Table 2 Gini coefficients of manufacturing industries in selected years

| 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 sports 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 |
| Electronics and telecommunication equipment | 0.61 | 4 | 0.60 | 3 | 0.81 | 2 |
| Instruments and meters | 0.57 | 7 | 0.52 | 10 | 0.76 | 6 |

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 2 shows the temporal change of geographical agglomeration of selected globalized industries. In 2004, all included industries exported more than 55% of gross output, with more than 45% of foreign capital. The two percentages in electronic and telecommunication equipment, cultural, education and sports goods were greater than 60%. In the beginning of economic transition, the spatial pattern of the selected industries were rather diverse, with some agglomerated and others dispersed since their provincial distributions were determined by central and local governments. As the open-door policy was successfully implemented, the international market and foreign capital have driven the globalized industries to the coastal provinces, particularly Guangdong, Fujian, Zhejiang, Shanghai, Jiangsu, and Shandong (Figure 3). From the early 1990s, the globalized industries have been increasingly agglomerated and more concentrated than the domestic market oriented industries, with their Gini coefficients greater than 0.70.

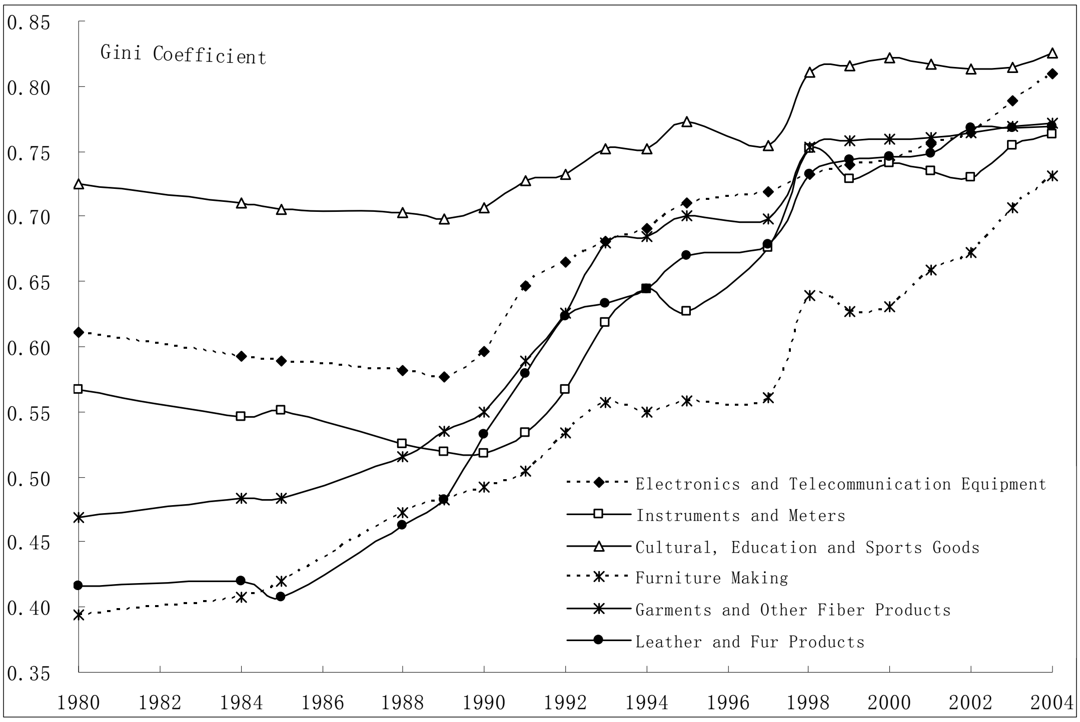



Figure 2 Geographical Agglomerations of Highly Globalized Industries

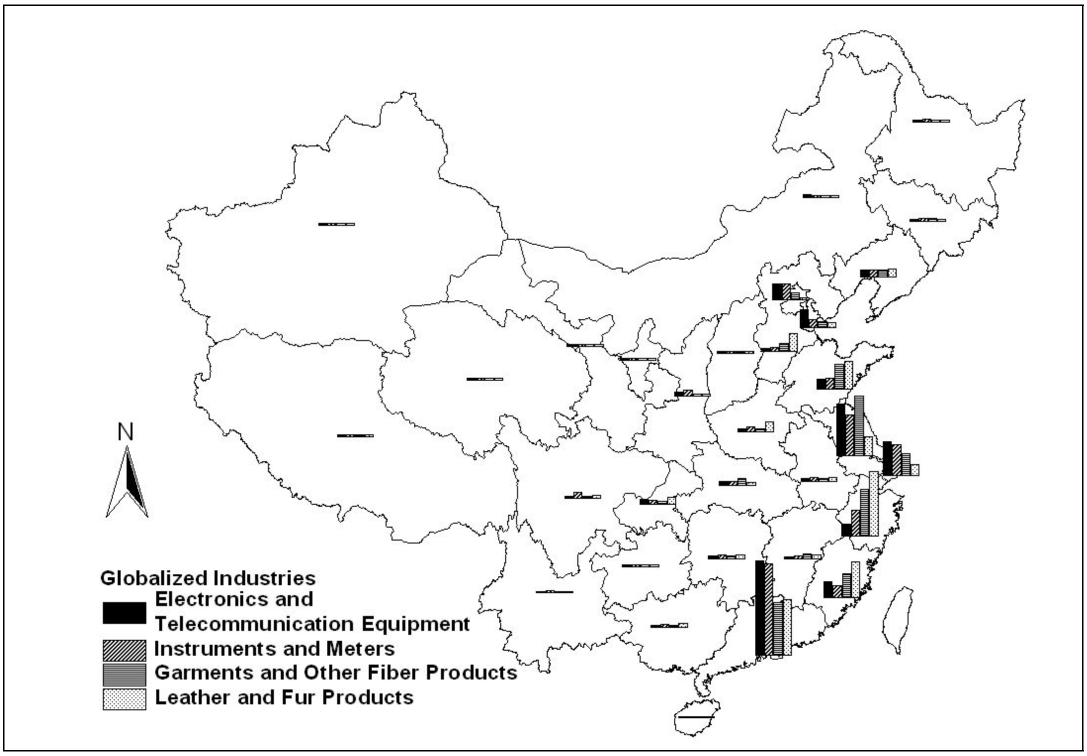


Figure 3 Provincial Distribution of Industrial Output of Globalized Industries in 2004

Figure 4 presents the pattern of industrial agglomeration of selected domestic market oriented industries, which exported less than 10% of their gross output and were also with little foreign capital. In 1980, there were no significant differences in the spatial patterns of globalized and less globalized industries. However, spatial restructuring of domestic market oriented industries had been less significant and some become slightly dispersed as globalized industries became more agglomerated. They were also less agglomerated compared to the globalized industries, with Gini coefficients less than 0.60 since they served the localized markets and valued the domestic market accessibility. As shown in Figure 5, substantial shares of industrial output of the least globalized industries were located in the central provinces.

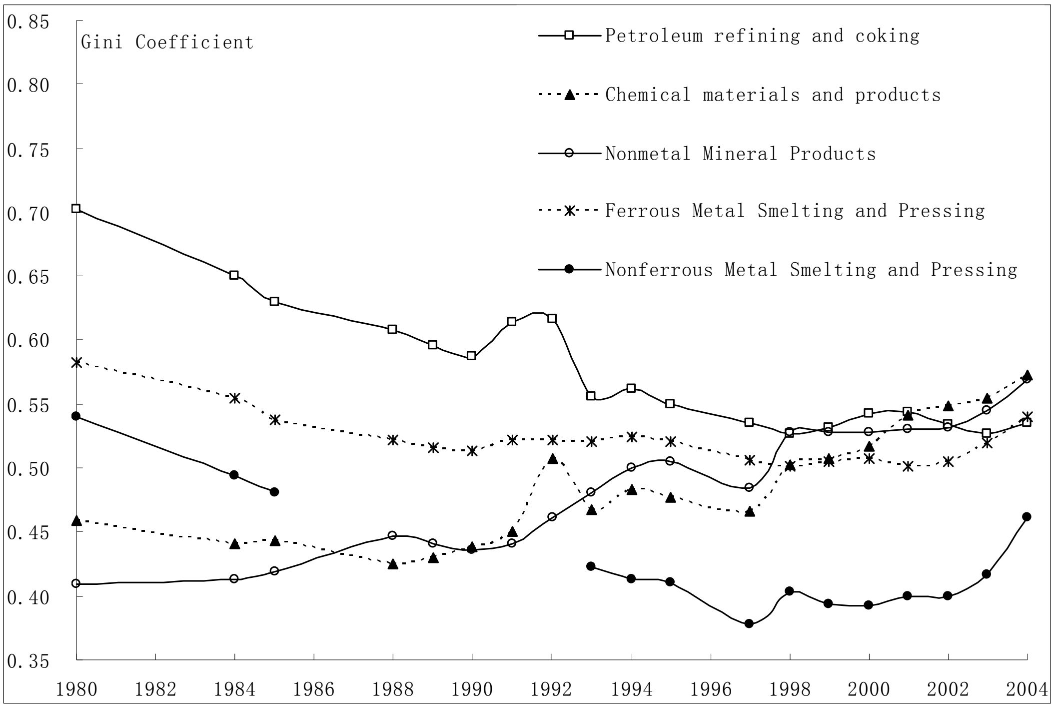



Figure 4 Geographical Agglomerations of Domestic Market Oriented Industries

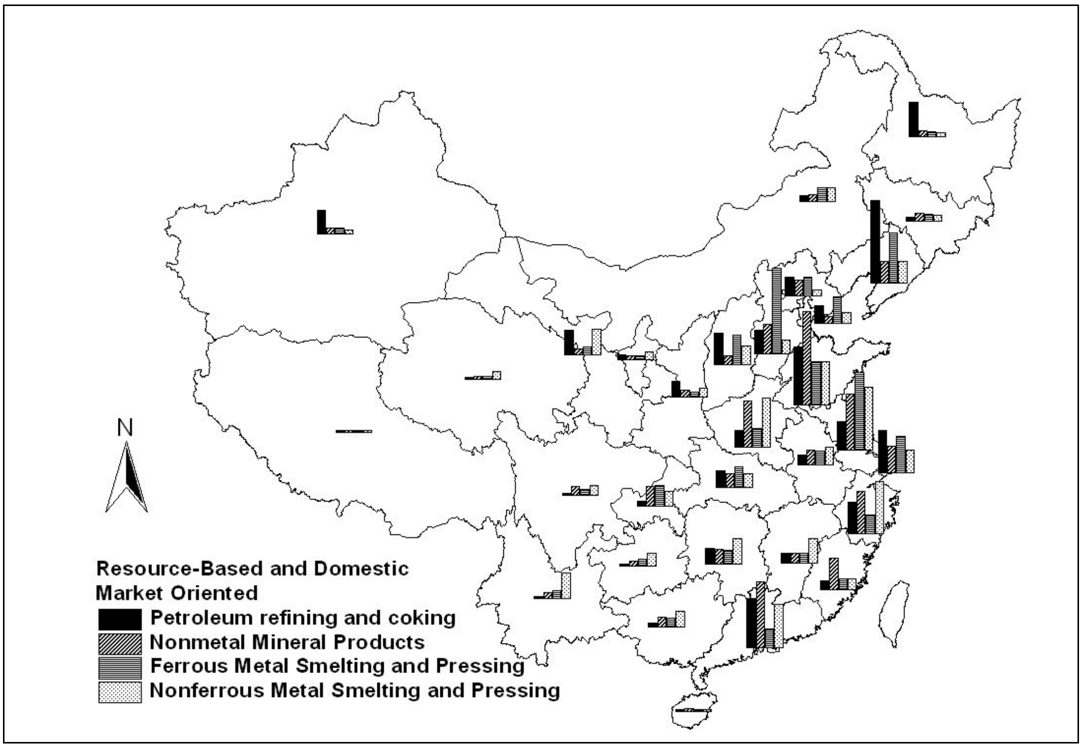



Figure 5 Provincial Distribution of Industrial Output of Domestic Market Oriented Industries in 2004

During the economic transition, industrial agglomeration in China is also associated with how governments treat the industries. Figure 6 presents the spatial patterns of industries favored or protected by local governments, including food, beverage, tobacco, medical and pharmaceutical products, and machinery and transportation equipment. Figure 7 shows the spatial pattern of industries not particularly protected and favored by local governments, including chemical fibers, rubber and plastic products, cultural, education and sports 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 significantly increases in industrial agglomeration since the early 1990s. The tobacco industry experienced a significant concentration process before the mid-1990s but it started to disperse from 1994, when the central government introduced the new tax sharing system, which further hardened the local fiscal budgets (Zhou, 2000). Machinery industry characterized by strong scale economies and strong industrial linkages has been agglomerated during the 1990s but has remained a relatively low level of agglomeration compared with the least protected industries.

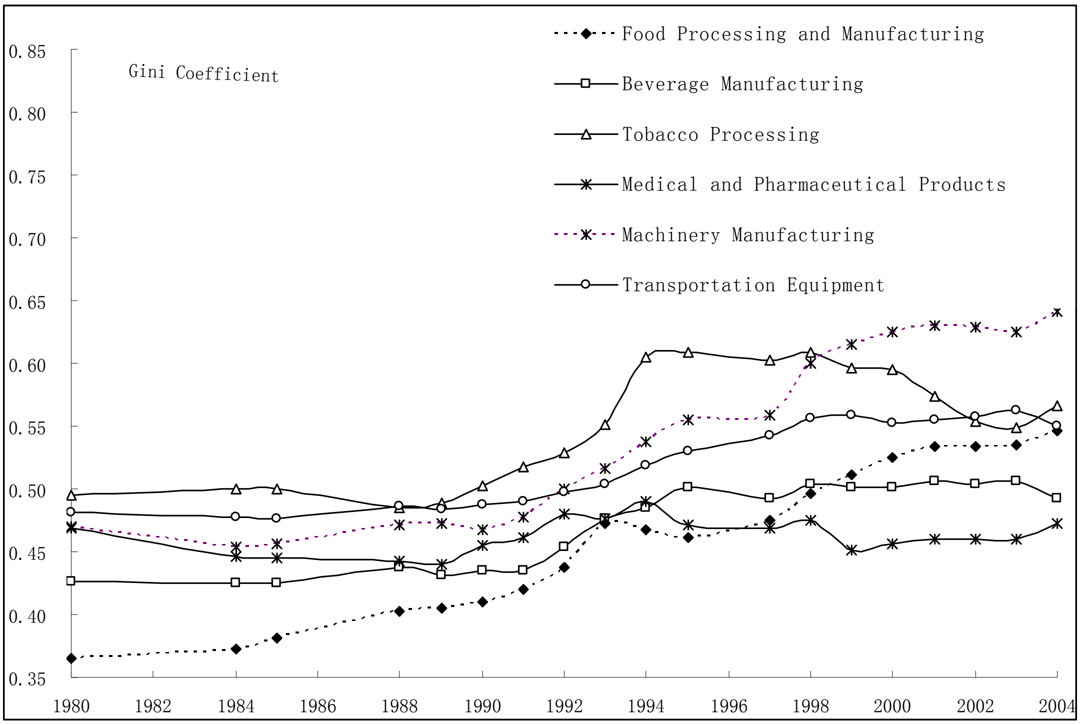



Figure 6 Geographical Agglomeration of Favored and Protected Industries by Local Governments

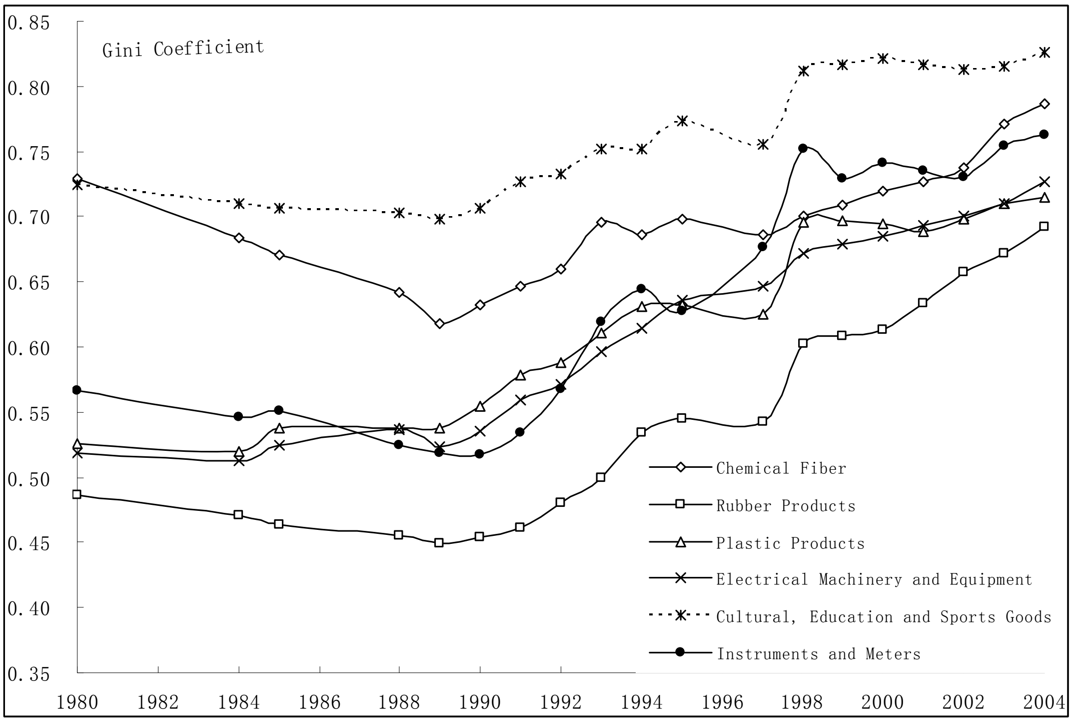



Figure 7 Geographical Agglomerations of Less Protected and Favored Industries

Locations of least favored and protected industries were driven by market forces and they had experienced a significant polarizing process since the 1990s. Cultural, education and sports goods had a Gini coefficient of 0.81 in 2004, with top four provinces of Guangdong, Zhejiang, Jiangsu and Shandong contributing 77% of gross industrial output. The Gini coefficient of Chemical fiber in 2004 was 0.79, with top four provinces of Zhejiang, Jiangsu, Shandong and Shanghai responsible for 75% 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 region (Figure 8 and Figure 9).

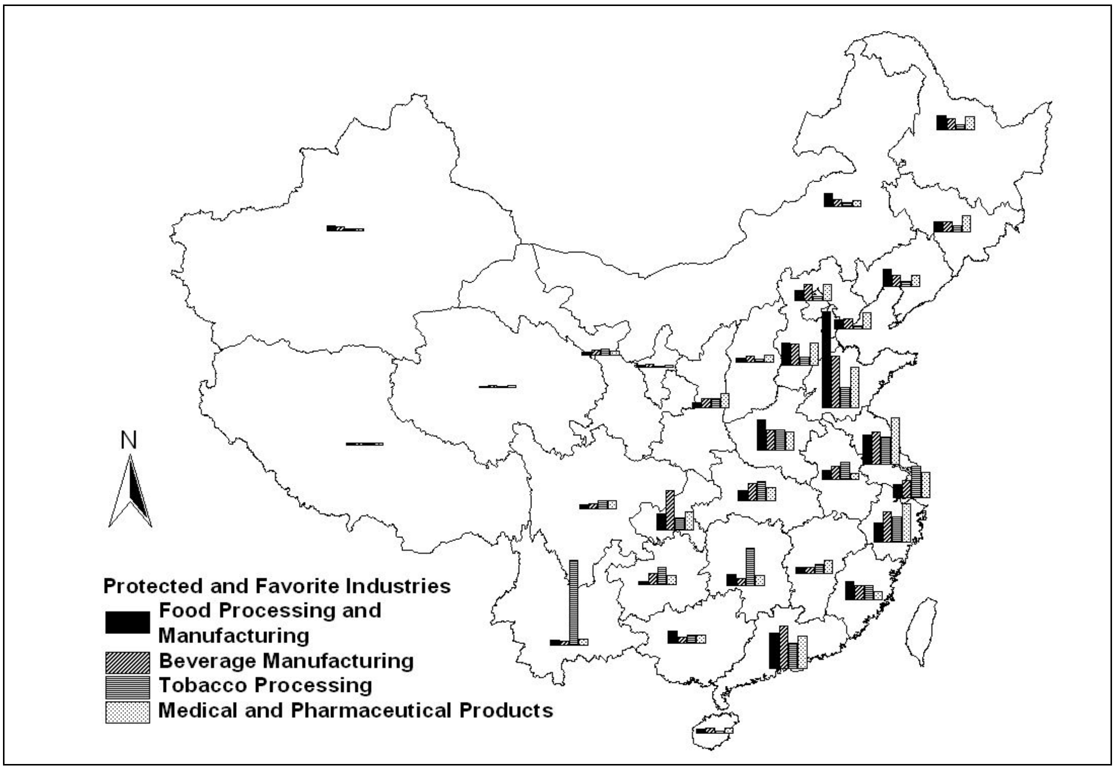



Figure 8 Provincial Distribution of Favored and Protected Industries by Local Governments

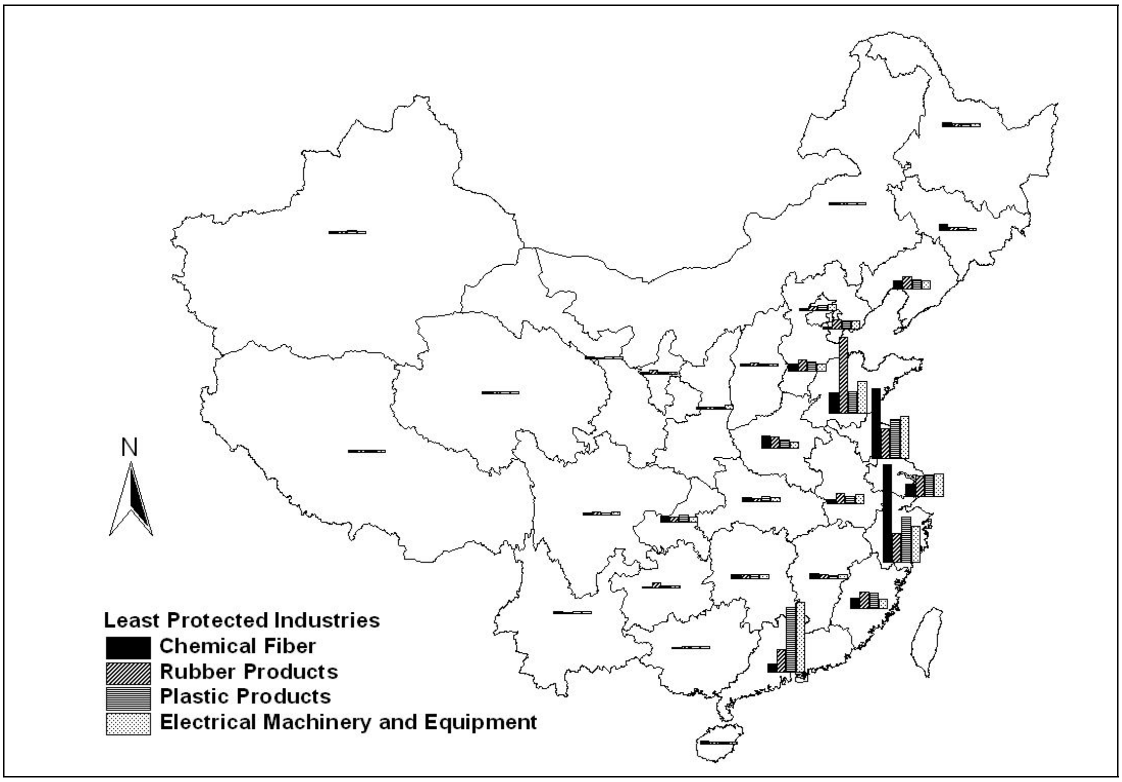


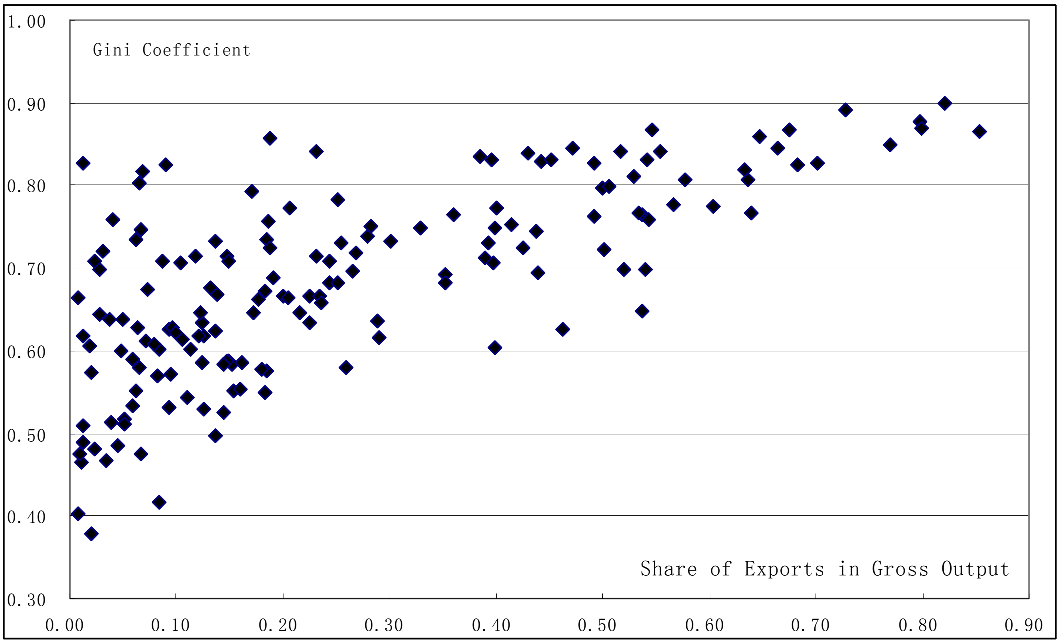

Figure 9 Provincial Distributions of Least Favored or Protected Industries

## 3.2 Explain Industrial Agglomeration in China

Chinese manufacturing industries have experienced a U shaped spatial restructuring process, which is consistent with the temporal pattern of interregional income inequality. I argue that the spatial shift of Chinese manufacturing industries towards the coastal region has led to the 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 driven the spatial reorganization of Chinese industries.

First, the accelerating marketization process since 1992 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 advantages and locational advantages. A large number of workers migrated to the coastal provinces of Guangdong, Fujian, Jiangsu, Zhejiang, Shandong and Shanghai, promoting industrial agglomeration in the coastal region. Meanwhile, inter-provincial trade of commodities has also stimulated Chinese provinces to specialize in production based on localized resources. For instance, Fan and Scott (2003) related the concentration indices of Chinese manufacturing industries to capital per labor and found that labor-intensive industries are more agglomerated. Industries dependent on agricultural and mining resource inputs are found significantly dispersed, indicating that immobile resource based industries have followed resources (He et al., 2007). Marketization also allows Chinese enterprises to exploit scale economies. For example, Bai et al. (2004) found industries with large average firm size were significantly more concentrated during 1985-1997, suggesting the internal scale economies drive industrial agglomeration in China. In addition, strong inter-industrial linkages are also positively associated with industrial agglomeration, indicating the importance of peculiarity externality in industrial agglomeration (He et al., 2007). In a word, market forces have been a fundamental force to reorganize China’s economic geography by allowing comparative advantages and agglomeration economies drive industrial location and stimulate competitive industries to agglomerate.

Second, China has successfully integrated its economy with the international market in the last decades. Global forces have been critical to reshape China’s industrial geography. Two-digit industries with more exports and foreign capital are found more agglomerated and concentrated in the coastal region. Figure 10 provides additional evidence to support the argument that economic globalization leads to more industrial agglomeration in China. The left graph presents the relationship between the share of exports in industrial gross output and Gini coefficient of three digit manufacturing industries in 2004 and the right graph shows the relationship between the ratio of foreign capital in total capital and 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.



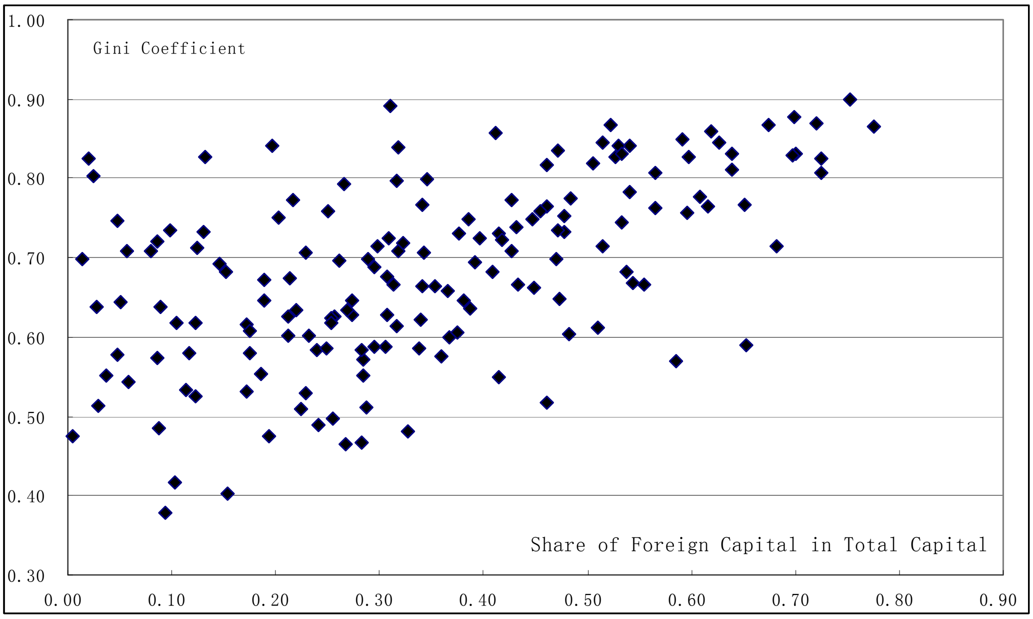
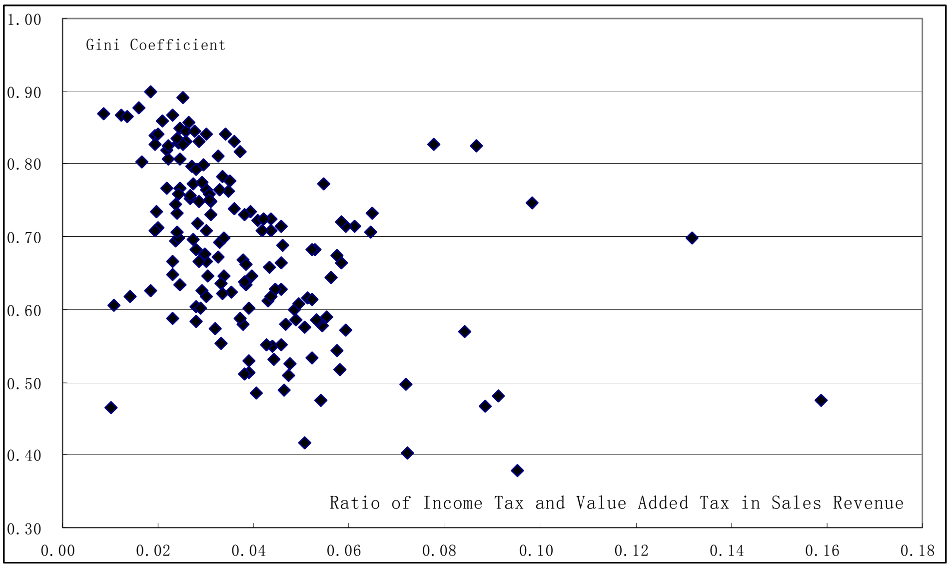




Figure 10 Relations between Exports (upper) and Foreign Capital (bottom) and Industrial Agglomerations in 2004

Third, as discussed theoretically, decentralization results in local protectionism and imitation strategy in industrial policies, which is to promote local economic growth and fiscal revenues. Industries characterized by high tax rates and profit margins would be favored and protected by local governments, resulting in low levels of industrial agglomeration. Studies found less geographic concentration in two digit industries where the past tax-plus profit margins and the shares of state capital are high (Bai et al., 2004; He et al., 2007). The negative relation between industrial agglomeration and profit margins and tax rates also hold for three-digit manufacturing industries (Figure 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 with the ratio of gross profits in sales revenues is -0.35. Due to the interregional competition, local governments often duplicate profitable and strategic industries which are successful in other provinces. In addition, local governments also have strong incentives to protect state-owned enterprises under their administrations, which are their base of political power, their source of private benefits as well as fiscal revenues (Bai et al., 2004). Industries with high shares of state-owned capital are also less agglomerated (Figure 12). The correlation coefficient between industrial Gini coefficients and shares of state-owned capital is -0.37 and significant. The above results provide indirect evidence to support that local governments act to discourage industrial agglomeration of Chinese industries at the provincial level.



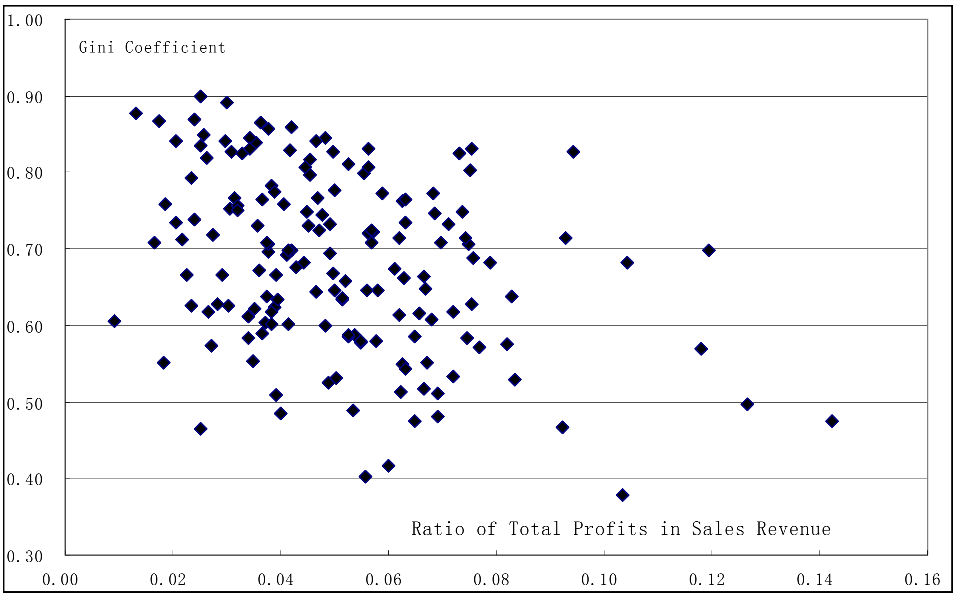




Figure 11 Relations between ratio of income tax and value-added tax to sales revenue (upper) and ratio of total profits in sale revenues (bottom) and Gini coefficient of three digit industries in 2004

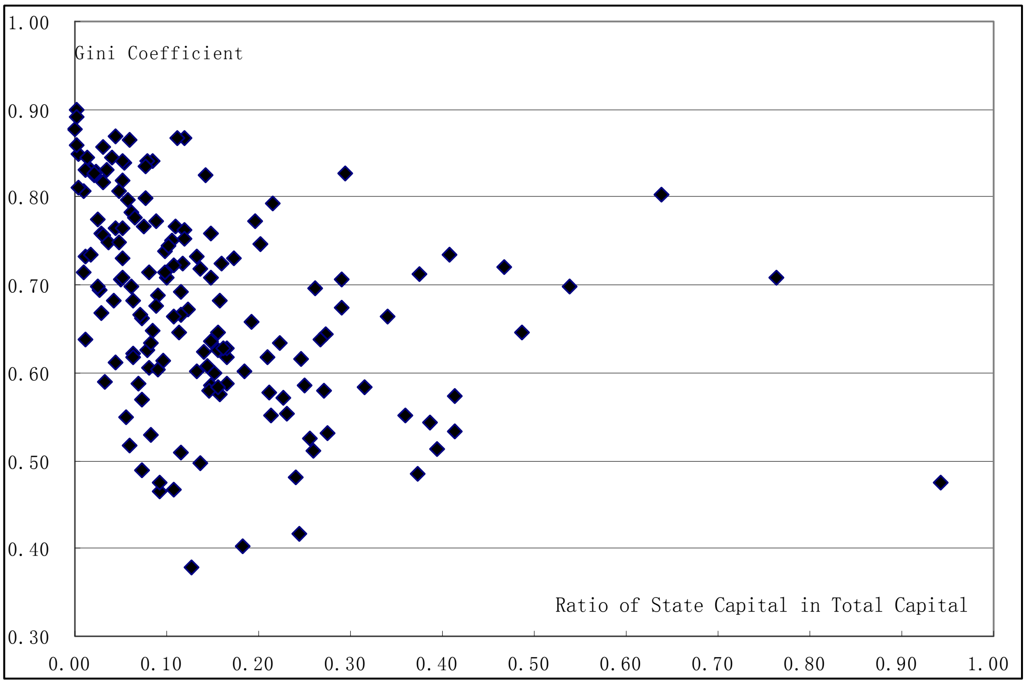



Figure 12 Relation between Ratio of State Capital in total capital and Gini coefficients of three digit industries in 2004

There are some other channels leading 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) found that provinces with similar economic and political status and with common borders are more likely to imitate each other and converge in the industrial structure. Table 3 collects the key industries chosen in the ninth and tenth five-year plans in the coastal and central provinces. Machinery equipment, medicines, food, automobile, construction materials, chemicals and petrochemicals and high-tech industries are listed as key industries in most provinces in both of the five-year plans. Many local governments have granted financial and policy supports for the development of selected key industries, leading to less industrial agglomeration. As discussed, the selected industries are fairly dispersed with their Gini coefficients smaller than the weighted average Gini coefficient of 0.64. For instance, food and transportation equipment each had a Gini coefficient of 0.55, chemical materials and products, and nonmetal mineral products had a Gini coefficient of 0.57 in 2004.

In summary, Chinese industries have been more geographically agglomerated as economic transition proceeds. 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 geographical advantages to play a greater role, generating a stronger tendency to increase industrial agglomeration. Market and global forces have constantly driven Chinese industries to agglomerate in the coastal provinces. Spatial disparities in China would be widening as industries shift to the coastal provinces.

Table 3 Key manufacturing industries in the Ninth-Five Year and the Tenth Five Year Plan in the coastal and central Provinces

| Province | **The Ninth Five Year Plan** | **The Tenth Five Year Plan** |
|---|---|---|
| Beijing | Food, automobiles, electronics, machinery, construction and high tech industries | Electronics, biological engineering, medicines、machinery, and new materials |
| Tianjin | Machinery, electronics, chemicals and metal smelting and pressing | Electronics, automobile, biological technology and medicines, metal mineral products、petrochemicals |
| Hebei | Chemicals, medicines, machinery, automobile, electronics, metal smelting and pressing, construction materials, textile and food | Metal smelting and pressing, energy, medicines, chemicals, machinery and equipment, construction materials, food, textile and high-tech industries |
| Shanxi | Energy, metal smelting and pressing, machinery and electronics, chemicals, construction materials, textiles, food and medicines | Coal, metal smelting and pressing, chemicals, machinery, construction materials, electronics, and medicines |
| Neimenggu | Wool textile, leather, food, medicines, energy , metal smelting and pressing, machinery and electronics | Food, wool textile, energy, metal smelting and pressing, chemicals, machinery, construction materials and high-tech industries |
| Liaoning | Petrochemicals, metal smelting and pressing, electronics and machinery | Automobile, petrochemicals, electronics, steel making, machinery, medicines and high-tech industries |
| Jilin | Automobile, petrochemicals, food, medicine and electronics | Automobile, integrated materials and fine chemicals、medicines, electronics |
| Heilongjiang | Automobile, chemicals, food, electronics and medicine | Equipment, petrochemicals, medicine, food and high-tech industries |
| Shanghai | Automobile, telecommunication equipment, machinery and Electrical machinery, petrochemicals, steel, computer and integrated circuit and medicines | Automobile, equipment, biological medicines, new materials and environmental protection |
| Jiangsu | Machinery, electronics, chemicals, automobile, light industries | Electronics, biological engineering and medicines, new materials, machinery and equipment, petrochemicals, automobile, steel making |
| Zhejiang | Textile, food, construction materials, machinery, electronics, chemicals and medicines | Textile and garments, food, machinery, petrochemicals, construction materials, metal smelting and pressing, biological engineering and medicines, new materials, high-tech industries |
| Anhui | Machinery, electricity equipment, electronics, automobile, petrochemicals and fine chemicals | Food processing, machinery and equipment, electronics and electricity equipment、metal products, medicines, new materials |

| | | |
|---|---|---|
| Fujian | Petrochemicals, machinery, electronics, wood processing, construction materials, food and textile | Textile, construction materials, metal smelting and pressing, electronics, machinery, petrochemical, biological engineering and medicine, new materials and new energy |
| Jiangxi | Automobile, machinery, electronics, chemicals, metal smelting and pressing, construction materials and food | Food, automobile, nonferrous metal smelting and pressing, petrochemicals, electronics, biological engineering and new materials |
| Shandong | Chemicals, power generating, transportation equipment, textile, food and paper making | Electricity equipment, automobile, machinery and equipment, textile, chemicals, construction materials, paper making, food, electronics, biological engineering and new materials |
| Henan | Textile, food, metal smelting and pressing, machinery, construction materials, electronics, petrochemicals | Food, nonferrous metal smelting and pressing, coal and petro-chemicals, machinery and equipment, textile, electronics, biological industries and new materials |
| Hubei | Automobile, machinery and electronics, metal smelting and pressing, chemicals, construction materials, textile, garments and food | Automobile, machinery and equipment, steel, chemicals, construction materials, textiles, electronics and biological engineering |
| Hunan | Metal smelting and pressing, machinery and electronics, construction materials, chemicals, food, textile, medicines | Metal smelting and pressing, machinery, chemical, food, medicines, construction materials, textile and garments, electronics, new materials, and biological engineering |
| Guangdong | Automobile, chemical, machinery, electronics, textiles, construction materials, medicines, metal smelting and pressing | High-tech industries including information, biology and new materials; electronics, electricity machinery, petrochemicals, textile and garments, food, beverage, construction materials, automobile, medicine, paper making |
| Guangxi | sugar processing, nonferrous metal smelting and pressing, automobile and machinery, construction materials | Automobile, machinery, sugar-making, construction materials, chemicals, textiles, high-tech industries including electronics, biological engineering, new materials |
| Hainan | Chemicals, automobile, beverage, food, chemical fiber, medicine, paper pulp, construction materials and metal smelting and pressing | Biological engineering, medicines |

Source: Complied by the author based upon the Ninth and Tenth Five Year Plans in Chinese Provinces

## 3.3 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 geographical distribution of Chinese industries. The global Moran's I can be defined as

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

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

I computed the value of Moran's I for all two digit manufacturing industries in selected years (Table 4). Figure 13 shows the relationship between Gini coefficient and Moran's I for all two-digit manufacturing industries in 2004. Table 4 and Figure 13 reveal some interesting patterns. First, some highly agglomerated industries have insignificant values of Moran's I, indicating that geographical agglomerations of these industries are confined within provincial boundaries and no spillover effects occur across province. The industries include cultural education and sports goods, electronics and telecommunication 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. For instance, foreign electronic assemblers highlight the importance of local suppliers of components and parts when choosing locations in China (Yeung et al., 2006).

Second, some agglomerated industries have significant and positive values of Moran's I, suggesting that the geographical agglomeration of these industries are beyond the provincial boundaries and there are significant spillover effects across province. 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 such industries 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. The 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 Jiangsu, Zhejiang and Anhui. Development of transportation equipment in Beijing has also stimulated the industry of auto components and parts in Hebei (Thun, 2006).

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, petroleum refining and coking. Provincial governments are able to successfully exercise local protectionism because Chinese provinces have large markets, sufficient authorities and favorable resource combinations to develop most industries. Local protectionism thereby prevents spillover effects beyond provincial boundaries.

Table 4 Moran's I for Chinese manufacturing industries (1980-2004)

| Industries | Code | 1980 | 1990 | 1995 | 2000 | 2004 |
|---|---|---|---|---|---|---|
| Food processing and manufacturing | C13&14 | **0.23**** | **0.12** | **0.18**** | **0.18**** | **0.14**** |
| Beverage manufacturing | C15 | 0.20** | 0.13 | 0.09 | -0.01 | 0.02 |
| Tobacco processing | C16 | 0.26*** | 0.10 | 0.03 | 0.11 | 0.10 |
| Textiles | C17 | **0.28***** | **0.39***** | **0.34***** | **0.29***** | **0.29***** |
| Garments and other fiber | C18 | **0.23**** | **0.18*** | **0.26**** | **0.17**** | **0.32***** |
| Leather and fur products | C19 | **0.25**** | **0.13** | **0.22**** | **0.13*** | **0.18**** |
| Timber processing | C20 | **0.17*** | **0.29***** | **0.27**** | **0.26**** | **0.41***** |
| Furniture making | C21 | 0.23** | 0.09 | 0.03 | 0.01 | 0.07 |
| Paper making and paper products | C22 | **0.18**** | **0.20**** | **0.15*** | **0.14*** | **0.15*** |
| Printing and copying | C23 | 0.11 | 0.16* | 0.08 | 0.03 | 0.03 |
| Cultural education and sports goods | C24 | 0.07 | 0.14 | 0.16** | 0.06 | 0.09 |
| Petroleum refining and coking | C25 | -0.05 | -0.03 | -0.03 | -0.07 | -0.08 |
| Chemical materials and products | C26 | **0.15*** | **0.20**** | **0.28***** | **0.24**** | **0.25**** |
| Medical and pharmaceutical products | C27 | 0.13 | 0.10 | 0.19** | 0.06 | 0.25** |
| Chemical fiber | C28 | 0.06 | **0.25**** | **0.46***** | **0.56***** | **0.26**** |
| Rubber products | C29 | 0.08 | **0.27***** | **0.37***** | **0.27***** | **0.26***** |
| Plastic products | C30 | **0.35***** | **0.27***** | **0.16**** | **0.08** | **0.15*** |
| Nonmetal mineral products | C31 | 0.27*** | 0.26 | 0.19** | 0.11 | 0.23** |
| Ferrous metal smelting and pressing | C32 | -0.01 | 0.01 | **0.23**** | **0.30***** | **0.33***** |
| Nonferrous metal smelting and pressing | C33 | -0.18 | | 0.08 | 0.08 | 0.17** |
| Metal mineral products | C34 | **0.18*** | **0.21**** | **0.19*** | **0.10** | **0.18**** |
| General and specific purpose machinery | C35&36 | **0.17*** | **0.25***** | **0.42***** | **0.44***** | **0.44***** |
| Transportation equipment | C37 | 0.09 | 0.08 | **0.23**** | **0.17*** | **0.14*** |
| Electrical machinery and equipment | C40 | 0.13 | 0.13 | **0.20**** | **0.10*** | **0.11*** |
| Electronics and telecommunication equipment | C41 | 0.21** | 0.11 | -0.04 | 0.00 | 0.03 |
| Instruments and meters | C42 | 0.17* | 0.25** | 0.23* | 0.00 | 0.02 |

Note： *: P<0.1; **: P<0.05; ***:P<0.01.

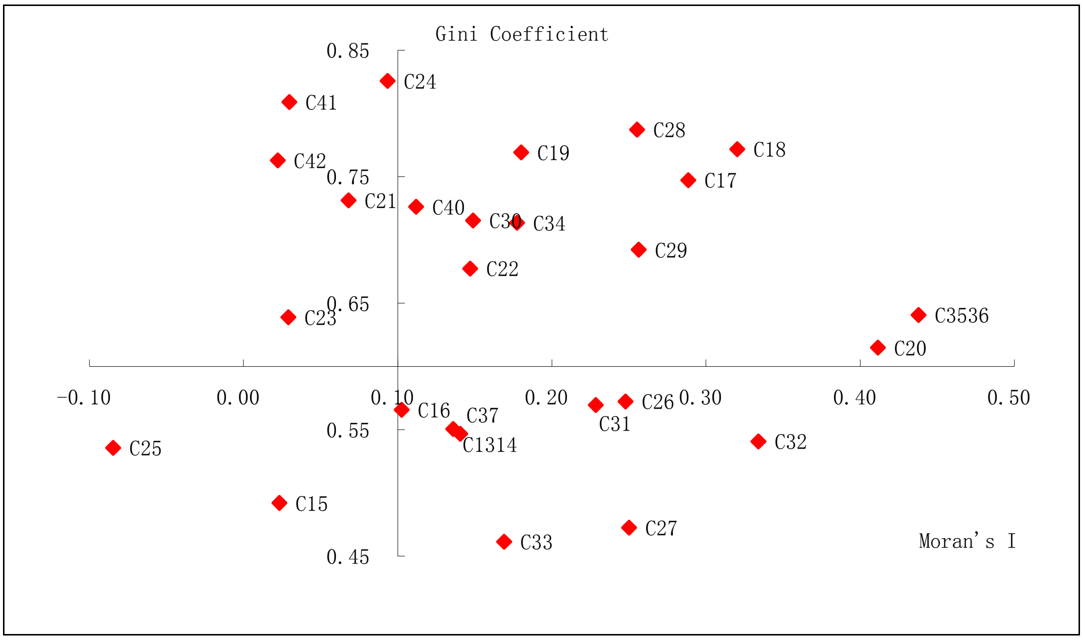



Figure 13 Relationship between Gini coefficient and Moran's I of Chinese Manufacturing Industries in 2004

Note: Industrial code is in Table 4.

## 4 Industrial Agglomeration and Labor Productivity in China

Theoretically, as Porter (2000) argued, industrial agglomeration would increase the productivity of constituent firms, upgrade the capacity of cluster participants 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.

To begin with, I conducted 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 Gini coefficient of gross industrial output. Considering the evolutionary nature of marketization and globalization process in China, I expect an increasingly stronger 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 in Table 5, there is an extremely significant coefficient attached to K/L and capital per worker has occurred more important since the 1990s. As expected, the variable of Gini coefficient has a positive coefficient, indicating that labor productivity effects would emerge as industries become increasingly agglomerated. The variable of 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 Gini coefficient and labor productivity also provides economic justifications for the formation of industrial cluster in China.

Table 5 Regression analysis of the relationship between productivity and industrial agglomeration for two digit industries

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

Note: *, p<0.10, **, p<0.05, ***, p<0.01. Number of cases =26. Results are corrected with heteroscedasticity.

The results in Table 4 represent a highly aggregated level of investigations. It is also critical to see whether the relationship between industrial agglomeration and labor productivity hold for all individual industries. To do so, I evaluated models based on a production-function approach for two digit manufacturing industries with the observations defined in terms of provinces. I applied the location quotient to measure the geographical agglomeration of industry *j* in province *i*, defined as

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

where $OUTPUT_{ij}$ represents the gross output of industry *j* in province *i*, $OUTPUT_i$ is the gross industrial output in province *i*. I then assume that the labor productivity is a function of internal scale economies, localization economies and urbanization economies controlling for capital per worker, defined as follows,

$$\frac{Q_{ij}}{L_{ij}} = f\left(\frac{K_{ij}}{L_{ij}}, LnSIZE_{ij}, LnUPOP_i, LQ_{ij}\right) \qquad (4)$$

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 industrial *j* in province *i*, $SIZE_{ij}$ is the average employment per enterprise of industrial *j* in province *i*, $LQ_{ij}$ is the location quotient of gross output of industry *j* in province *i*, $UPOP_i$ is the total nonagricultural population in province *i*.

I perform the regression analysis for each two digit manufacturing industry in each year during the period of 1980-2004. 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 product to 0.93 for tobacco processing in 2004. All industries but leather and fur products, cultural education and sports goods, chemical fiber and garments-making industries, have a $R^2$ greater than 0.50 in the models. I am particularly interested in the significance of location quotient (LQ), which captures the effect of localization economies. To save space, I report the regression coefficients on the locational quotients (LQ) in each regression in Table 6 and Table 7. The year 1992 marked an accelerating process of marketization and globalization in China. As Table 6 and Table

7 indicate, there are wide variations in the significance and magnitude of the regression coefficients on LQ. The relations between industrial agglomeration and labor productivity differ 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 relations only held for textiles, tobacco processing, cultural education and sports goods, petroleum refining and coking, chemical fiber, plastic products, electrical machinery and equipment, telecommunication 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 non-state owned enterprises and to utilize foreign investment. Marketization and globalization therefore stimulated the spatial agglomeration of these industries because geographical clustering was rewarding. Petroleum refining and coking 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 geographical concentration did not bring higher labor productivity since they were tightly controlled by state-owned enterprises.

Table 6 Regression coefficients on location quotient for individual industries (1980-1992)

| Code | 1980 | 1984 | 1985 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|
| S13&14 | −0.33*** | −0.26*** | −0.23** | −0.32*** | −0.26*** | −0.19*** | −0.16*** | −0.06 |
| S15 | 0.17** | −0.00 | −0.22 | 0.06 | 0.10 | 0.06 | 0.06 | 0.13 |
| S16 | 0.07* | 0.11** | 0.04 | 0.04** | 0.03* | 0.04*** | 0.04*** | 0.06* |
| S17 | 0.46*** | 0.40*** | 0.34*** | 0.35*** | 0.30*** | 0.31*** | 0.31*** | 0.41*** |
| S18 | 0.06 | 0.05 | 0.08 | 0.06 | 0.05 | 0.10 | 0.11 | 0.25** |
| S19 | −0.07 | −0.05 | −0.08* | −0.02 | 0.10 | 0.10 | 0.16 | 0.24* |
| S20 | −0.01 | −0.02 | −0.00 | −0.03 | 0.08 | 0.12 | 0.09 | 0.10 |
| S21 | −0.02 | 0.00 | 0.01 | −0.03 | 0.06 | −0.04 | −0.11 | −0.04 |
| S22 | 0.04 | 0.14* | 0.15** | 0.04 | 0.10 | −0.03 | −0.11 | 0.03 |
| S23 | −0.09*** | −0.07** | −0.13*** | −0.33** | 0.03 | 0.01 | −0.23 | −0.07* |
| S24 | 0.32*** | 0.20** | 0.18** | 0.24** | 0.18** | 0.27** | 0.45*** | 0.31*** |
| S25 | 0.27** | 0.35*** | 0.24** | 0.64** | 0.58** | 0.51* | 0.53* | 0.55** |
| S26 | 0.52** | 0.33 | 0.38* | 0.26 | 0.36 | 0.19 | 0.45 | 0.37** |
| S27 | 0.28** | 0.33*** | 0.26** | 0.21* | 0.13 | 0.04 | 0.12 | 0.17 |
| S28 | 0.61*** | 0.50*** | 0.36*** | 0.15*** | 0.15*** | 0.05** | 0.20*** | 0.26*** |
| S29 | 0.26*** | 0.29*** | 0.28*** | 0.12 | 0.09 | 0.00 | 0.15*** | 0.20*** |
| S30 | 0.16 | 0.20** | 0.16** | 0.26*** | 0.33*** | 0.03 | 0.36*** | 0.45*** |
| S31 | −0.17*** | −0.04 | −0.03 | 0.11*** | 0.07 | 0.01 | 0.13*** | −0.01 |
| S32 | 0.34*** | 0.09 | −0.06 | 0.06 | 0.05 | −0.02 | 0.08 | 0.08 |
| S33 | 0.04 | −0.02 | 0.03 | | | | | |
| S34 | −0.04 | 0.11 | 0.20 | 0.29* | 0.29 | 0.24 | 0.49*** | 0.48*** |
| S35&36 | 0.11 | 0.07 | −0.00 | 0.02 | 0.24 | 0.12*** | 0.06 | 0.14 |
| S37 | 0.04 | 0.04 | 0.06 | 0.12 | 0.06 | N/A | 0.20* | 0.20** |
| S40 | 0.58*** | 0.59*** | 0.38*** | 0.47*** | 0.42*** | 0.11* | 0.47*** | 0.41*** |
| S41 | 0.23** | 0.39*** | 0.44*** | 0.42*** | 0.42*** | 0.11* | 0.39*** | 0.41*** |
| S42 | 0.21** | 0.17** | 0.18*** | 0.19** | 0.17** | 0.19** | 0.22* | 0.27*** |

Note: * p< 0.10, ** p<0.05, *** p<0.01; resulted are corrected with heteroscedasticity.

The 1990s saw an optimal picture on the relationship between industrial agglomeration and labor productivity as most industries become increasingly agglomerated and many more industries are 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 hold a significant and positive relationship between industrial agglomeration and labor productivity. The exceptions are heavily protected and strongly favored by local governments or controlled by the state-owned enterprises and are fairly geographically dispersed. Regression coefficients on location quotients in petroleum refining and coking and tobacco processing have turned from significant and positive to be insignificant or negative since the 1990s. The results suggest that governmental intervene and local protectionism run account to the improvement of labor productivity and industrial competitiveness.

Table 7 Regression coefficients on location quotient for individual industries (1993-2004)

| Code | 1993 | 1994 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| S13 | -0.11 | -0.24 | 0.06 | -0.06 | 0.06 | 0.02 | -0.02 | -0.07 | -0.16 | -0.10 |
| S14 | 0.18$^{***}$ | 0.10$^{***}$ | 0.35$^{***}$ | 0.34$^{**}$ | 0.17$^{**}$ | 0.26$^{***}$ | 0.22$^{**}$ | 0.07 | 0.11 | 0.16$^{***}$ |
| S15 | 0.21 | 0.09 | 0.10$^{*}$ | 0.03 | -0.01 | -0.01 | -0.04 | -0.09$^{*}$ | -0.04 | 0.03 |
| S16 | 0.03$^{**}$ | 0.35$^{***}$ | 0.03$^{**}$ | 0.03$^{**}$ | 0.02$^{*}$ | 0.00 | -0.41 | -0.02$^{**}$ | -0.01 | -0.99 |
| S17 | 0.33$^{***}$ | 0.36$^{***}$ | 0.39$^{***}$ | 0.31$^{***}$ | 0.32$^{***}$ | 0.27$^{***}$ | 0.21$^{**}$ | 0.35$^{***}$ | 0.37$^{***}$ | 0.41$^{***}$ |
| S18 | 0.25 | 0.35$^{***}$ | 0.42$^{**}$ | 0.58$^{***}$ | 0.50$^{***}$ | 0.69$^{***}$ | 0.42$^{***}$ | 0.47$^{***}$ | 0.35$^{***}$ | 0.25$^{***}$ |
| S19 | 0.28$^{**}$ | 0.33$^{***}$ | 0.38$^{***}$ | 0.43$^{***}$ | 0.73$^{***}$ | 0.61$^{***}$ | 0.41$^{*}$ | 0.25 | 0.03 | 0.06 |
| S20 | 0.13$^{***}$ | 0.06 | 0.17$^{**}$ | 0.15$^{**}$ | 0.26$^{***}$ | 0.17$^{**}$ | 0.12 | 0.05 | N/A | 0.06 |
| S21 | -0.00 | 0.21$^{***}$ | 0.26$^{***}$ | 0.15$^{***}$ | 0.35$^{***}$ | 0.37$^{**}$ | 0.44$^{**}$ | 0.55$^{***}$ | 0.54$^{***}$ | 0.47$^{***}$ |
| S22 | 0.18$^{*}$ | 0.02 | 0.21 | 0.23$^{***}$ | 0.20$^{**}$ | 0.29$^{***}$ | 0.31$^{***}$ | 0.40$^{***}$ | 0.28$^{***}$ | 0.39$^{***}$ |
| S23 | -0.08$^{*}$ | 0.33$^{***}$ | 0.20$^{***}$ | 0.16$^{*}$ | 0.14$^{*}$ | 0.13$^{**}$ | -0.04 | -0.01 | 0.14 | 0.08 |
| S24 | 0.37$^{**}$ | 0.37$^{*}$ | 0.60$^{***}$ | 0.39$^{**}$ | 0.44$^{**}$ | 0.23 | 0.26$^{*}$ | 0.28$^{**}$ | 0.25$^{**}$ | 0.30$^{*}$ |
| S25 | -0.03 | -0.05 | -0.08 | -0.00 | -0.09$^{**}$ | N/A | -0.08$^{**}$ | -0.11$^{***}$ | -0.53 | -0.04 |
| S26 | 0.11 | 0.20 | 0.07 | 0.43$^{***}$ | 0.34$^{***}$ | 0.37$^{***}$ | 0.37$^{***}$ | 0.54$^{***}$ | 0.27$^{*}$ | 0.36$^{***}$ |
| S27 | 0.81 | N/A | 0.25$^{***}$ | 0.06 | 0.05 | 0.05 | 0.04$^{**}$ | 0.00 | 0.00 | 0.03$^{*}$ |
| S28 | 0.56$^{***}$ | 0.52$^{***}$ | 0.26$^{**}$ | 0.54$^{***}$ | 0.40$^{**}$ | 0.45$^{***}$ | 0.40$^{***}$ | 0.44$^{***}$ | 0.46$^{***}$ | 0.30$^{***}$ |
| S29 | 0.14$^{***}$ | 0.12$^{**}$ | 0.17$^{***}$ | 0.46$^{***}$ | 0.43$^{***}$ | 0.33$^{***}$ | 0.25$^{***}$ | 0.23$^{***}$ | 0.22$^{***}$ | 0.35$^{***}$ |
| S30 | 0.43$^{***}$ | 0.46$^{***}$ | 0.55$^{***}$ | 0.53$^{***}$ | 0.42$^{***}$ | 0.40$^{***}$ | 0.31$^{***}$ | 0.52$^{***}$ | 0.25$^{*}$ | 0.34$^{***}$ |
| S31 | -0.02 | 0.03 | 0.12$^{**}$ | 0.08$^{**}$ | 0.86$^{***}$ | 0.08$^{**}$ | 0.10$^{**}$ | 0.06 | 0.09$^{***}$ | 0.11$^{***}$ |
| S32 | 0.02 | -0.01 | 0.07 | 0.27 | 0.06 | 0.00 | 0.02 | -0.03 | 0.03 | 0.01 |
| S33 | 0.10 | 0.14$^{***}$ | 0.05 | 0.09$^{***}$ | 0.09$^{***}$ | 0.08$^{***}$ | 0.07$^{***}$ | 0.13$^{***}$ | 0.09$^{***}$ | 0.11$^{***}$ |
| S34 | 0.46$^{***}$ | N/A | 0.79$^{***}$ | 0.80$^{***}$ | 0.57$^{***}$ | 0.58$^{***}$ | 0.61$^{***}$ | 0.81$^{***}$ | 0.57$^{***}$ | 0.51$^{**}$ |
| S35 | 0.24$^{**}$ | 0.33$^{***}$ | 0.46$^{**}$ | 0.65$^{***}$ | 0.67$^{***}$ | 0.63$^{***}$ | 0.57$^{***}$ | 0.59$^{***}$ | 0.49$^{***}$ | 0.41$^{***}$ |
| S36 | 0.17 | 0.46$^{**}$ | 0.36$^{***}$ | 0.43$^{**}$ | 0.43$^{***}$ | 0.44$^{***}$ | 0.38$^{***}$ | 0.48$^{**}$ | 0.41$^{***}$ | 0.48$^{***}$ |
| S37 | 0.24$^{**}$ | 0.38$^{**}$ | 0.22$^{**}$ | 0.22$^{**}$ | 0.15$^{**}$ | 0.13$^{***}$ | 0.15$^{***}$ | 0.15$^{***}$ | 0.15$^{**}$ | 0.11$^{***}$ |
| S40 | 0.80$^{***}$ | 0.71$^{***}$ | 0.61$^{***}$ | 0.84$^{***}$ | 0.66$^{***}$ | 0.65$^{***}$ | 0.69$^{***}$ | 0.66$^{***}$ | 0.62$^{***}$ | 0.60$^{***}$ |
| S41 | 0.54$^{***}$ | 0.44$^{***}$ | 0.58$^{***}$ | 0.57$^{***}$ | 0.44$^{***}$ | 0.43$^{***}$ | 0.48$^{***}$ | 0.53$^{***}$ | 0.55$^{***}$ | 0.56$^{***}$ |
| S42 | 0.53$^{***}$ | 0.56$^{***}$ | 0.59$^{***}$ | 0.84$^{***}$ | 0.74$^{***}$ | 0.99$^{***}$ | 0.70$^{***}$ | 0.24$^{*}$ | 0.59$^{***}$ | 0.57$^{***}$ |

Note: * p< 0.10, ** p<0.05, *** p<0.01; resulted are corrected with heteroscedasticity.

Second, labor-intensive industries such as textiles, cultural education and sports goods, chemical fiber, rubber and plastic products keep positive and significant relations between industrial agglomeration and labor productivity in the 1990s. Many more traditional labor-intensive industries have benefited from geographical agglomeration since the early 1990s, with a significant positive relationship between industrial agglomeration and labor productivity. These industries include food manufacturing, garments, shoes and hats making, leather and fur products, timber processing and furniture making, rubber and plastic products, nonmetal and metal mineral products. There are several critical reasons why labor-intensive industries could benefit from geographical clustering. The clusters of labor-intensive industries in the coastal region are characterized by deeper division of labor across enterprises, which significantly cut production costs and increase labor productivity of related enterprises. The dominant workers in the coastal industrial clusters are migrants, who are more productive and hard working, contributing additionally to the improvement of labor productivity. The labor pool in the coastal region also lowers labor-related costs and also contributes to the improvement of labor productivity. The industrial clusters in the coastal region are particularly attractive to foreign investments, which bring capital, management, and advanced technology, resulting in higher labor productivity. In addition, state capital has largely withdrawn from the labor-intensive industries, stimulating the fierce market competition, 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 geographical clustering.

Third, capital and technology-intensive industries such as general- and specialized-purpose machinery, transportation equipment, telecommunication and electronic equipment, electrical machinery and equipment, and instruments and meters have significantly benefited from geographical agglomeration. The regression coefficients on location quotients of machinery and transportation equipment changed from insignificant to highly significant since the middle 1990s. The magnitude of regression coefficients on telecommunication and electronic equipment, electrical machinery and equipment and instruments and meters has significantly increased since the 1990s. During 1980-2004, all these industries have been more agglomerated. For instance, Gini coefficient for telecommunication and electronic equipment increased from 0.61 to 0.81 while instruments and meters also raised its Gini coefficient from 0.57 to 0.76. The productivity effects of industrial agglomeration in these capital and technology intensive industries are derived from strong localized business linkages and the utilization 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 since this is where intermediate inputs are cheaper. For example, car components and parts firms locate close to car assembly firms due to demand linkages and car assembly firms are close to car components firms due to cost linkages (Amiti, 1998). The geographical proximity of related firms raises industrial labor productivity by speeding the matching process of downstream and upstream firms, and by lowering transaction costs. The capital and technology intensive industries have also utilized a significant amount of foreign investments, facilitating industrial agglomeration. For instance, foreign capital accounted for 62% and 48% of total capital in telecommunication and electronic equipment and in instruments and meters, respectively; almost all major auto producers in China are foreign joint ventures. Foreign invested enterprises are found in many studies more productive than domestic-owned enterprises. As economic transition proceeds, market and global forces would play an increasingly role in driving industrial agglomeration and allocate resources more effectively. Our simple statistical analysis suggests that industrial agglomeration has been a pervasive phenomenon because industrial agglomeration has productivity effects. However, industrial localization would not necessarily bring higher labor productivity if industries are heavily protected or controlled by governments.

## 5 Industrial Clusters in China: A County Level Analysis

I use the 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 the aggregate manufacturing employment (Figure 14). Overall, manufacturing industries are concentrated in the coastal region, including Guangdong, Jiangsu, Zhejiang, Shandong, Liaoning, Hebei, Shanghai and Fujian provinces. Inland provinces such as Hubei, Sichuan, Henan and Jilin 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 fewer than 5000 manufacturing workers in large- and medium-sized enterprises, while those with more than 5000 manufacturing workers are resource-based. From the county map, it is easy to identify several clusters of manufacturing employment along the coastal region, including the Yangtze 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.

I map the county distribution of employment in three industries with successful clusters. They are telecommunication equipment, computer and other electronic equipment, garments, shoes and hats making, and transportation equipment. As analyzed above, geographical agglomeration of the three industries has generated significant productivity effects. As Figure 15 shows, employments in telecommunication equipment, computer and other electronic equipment are clustered in the Pearl River Delta and in areas near Shanghai, Beijing and Tianjin, but there are also clusters in Dalian, Wuhan, Xi'an, Chongqing and Jinan. The electronic industry typically agglomerates in cities which host Economic and Technology Development Zones 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 electronic and telecommunication equipment. However, the expansion and development of electronic equipment clusters in coastal provinces are largely driven by foreign firms. Taiwanese electronic companies are mainly clustered in the Pearl River Delta and recently moved to Suzhou and Kunshan, Jiangsu. Japanese electronic companies strongly favor the Yangtze River Delta and Liaoning province. Korean electronic firms heavily invest in Shandong, Beijing and Tianjin. The Xingwang Industrial Park in Beijing Economic and Technology Zone houses a manufacturing cluster of mobile telecommunications equipment centered on Nokia with more than 30 component suppliers (Yeung et al., 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. Wang and Wang (1998)'s work on the Zhongguancun electronic clusters in Beijing also pointed to the importance of higher labor quality, research and development and universities in electronic clusters.

Garments, shoes and hats making industry is a typical labor intensive and highly globalized industry, which heavily relies on foreign direct investment and exports. Employments in garments, shoes and hats making are disproportionably clustered in the Yangtze River Delta, the Pearl River Delta, the Peninsulas of East Liaoning and Shandong, and the Beijing and Tianjin area (Figure 16). The clustering of garments, shoes and hats making industry is largely driven by market and global forces. Related enterprises agglomerate to cut production costs to gain international competitiveness through deeper division of labor. Firms specialize in specific functions along the industrial value chain and supply to several enterprises and realize strong scale economies. Strong business linkages hold related enterprises within a certain distance. The specialized labor pool further helps to expand and sustain industrial clusters. For instance, the city of Ningbo in Zhejiang province has a long tradition of garment-making and has developed many specialized garment-making clusters, including the Western-style clothing and shirt production base in Fenghua and Yinzhou, knitted clothing clusters in Xiangshan and Beilun, knitted sweater and child clothing clusters in Ninghai, women and fashion clothing production bases in Haishu. In 2006, the city of Ningbo produced some 1.5 billion sets of garments and exported to more than 100 countries and regions, realizing exporting values of 11.13billion Yuan. Ningbo owns six nationally famous brands in garment-making including Yager, Binbin, Luomeng, Tangshi, Taipingwu and Luoci and has thirteen China Brands. Large and branded garment-making enterprises indeed are the organizers of industrial clusters. Many SMEs are the key suppliers of components and parts in garment making. The garment-making industry is export-oriented, labor-intensive, with specialized labor pool and deep division of labor, facilitating the formation of industrial clusters.

Industrial clusters in China are not only in the traditional and labor-intensive industries but also in capital and technological intensive industries. Transportation equipment is also marked by dense spatial concentration. As a strategic key industry, transportation equipment has been favored and protected by local governments, and related clusters develop in many places, especially in areas around the Yangtze River Delta, the Pearl River Delta, Beijing and Tianjin, and in areas around Shiyan and Wuhan in Hubei, Chongqing in the southwest, Changchun in the northeast, Xi'an in Northwest (Figure 17). During the 1950s, the First Auto Works was located in Changchun so as to be close to the former Soviet Union. Because of efforts to build key industries in inland "third front" locations, Shiyan in Hubei was selected as the site of the Second Auto Works and the nation's first independent auto manufacturing complex. New car manufacturing clusters in the coastal regions around Guangzhou, Shanghai, Tianjin and Beijing emerged as the result of market forces and globalization forces (Sit and Liu, 2000). Foreign investment and policy supports from local governments are essential to form automobile manufacturing clusters in China. For example, the Guangzhou Honda Automobile Company was established in 1998 and

Toyota and Nissan established Guangzhou Toyota Automobile Company and Dongfeng-Nissan Automobile Company recently. Three Japanese automakers have attracted a large number of foreign auto components and parts producers to cluster in the city of Guanzghou and expand the automobile industry rapidly. In Beijing, the Shunyi district has attracted more than 30 suppliers of car components and parts since the entrance of the Korean Hyundai in 2002. Some are from South Korea and have established strong business linkages with the Korea Hyundai for a long time. As Thun (2006) argued that China's auto industry has changed its lanes, stressing the importance of foreign investment since the 1990s. Foreign joint ventures in China's auto industry now dominate and have been the key reasons for the formation and expansion of auto clusters in many cities.

The motorcycle industry in Chongqing has recorded remarkable growth. Sonobe et al. (2006) found the success of the motorcycle industry in Chongqing is attributable to a combination of positive features from the Wenzhou model in the 1990s, in which industrial development is based on clustering of private enterprises and the Sunan model in the 1980s, in which industrial development is based on the effective use of human resources recruited from existing state-owned enterprises. Learning by collective enterprises from SOEs in Chongqing coupled with the growth of the private enterprise sector fostered cluster based industrial development. There are more than 1000 enterprises providing a variety of components and parts for motorcycle manufacturing. Beyond the labor pool effects, learning and business linkages, there is also a huge local market for motorcycles in Chongqing.

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 for those in traditional labor-intensive industries. Related firms cluster together because clustering helps and is rewarding. Central and local governments have also played critical roles in facilitating industrial clustering in China 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 for those in advanced industries such as telecommunication and electronic equipment, transportation equipment, machinery and electrical machinery and equipment.

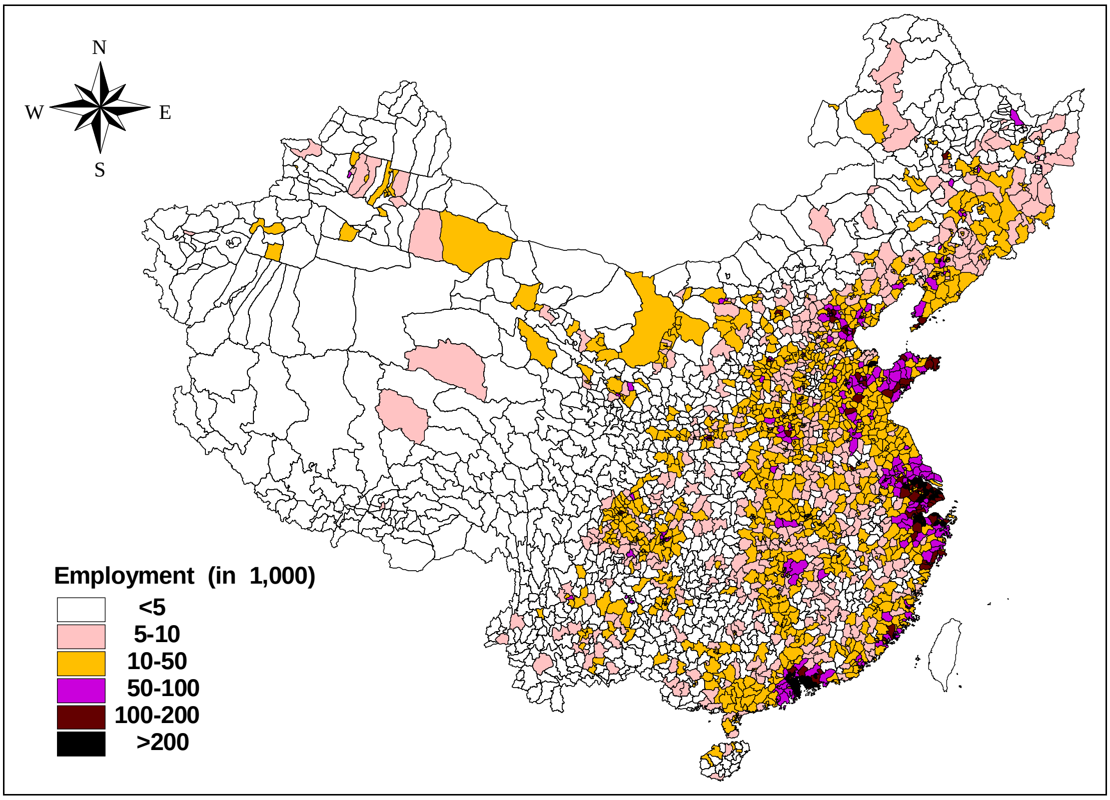



Figure 14 Spatial distribution of manufacturing employment by county in China (2004)

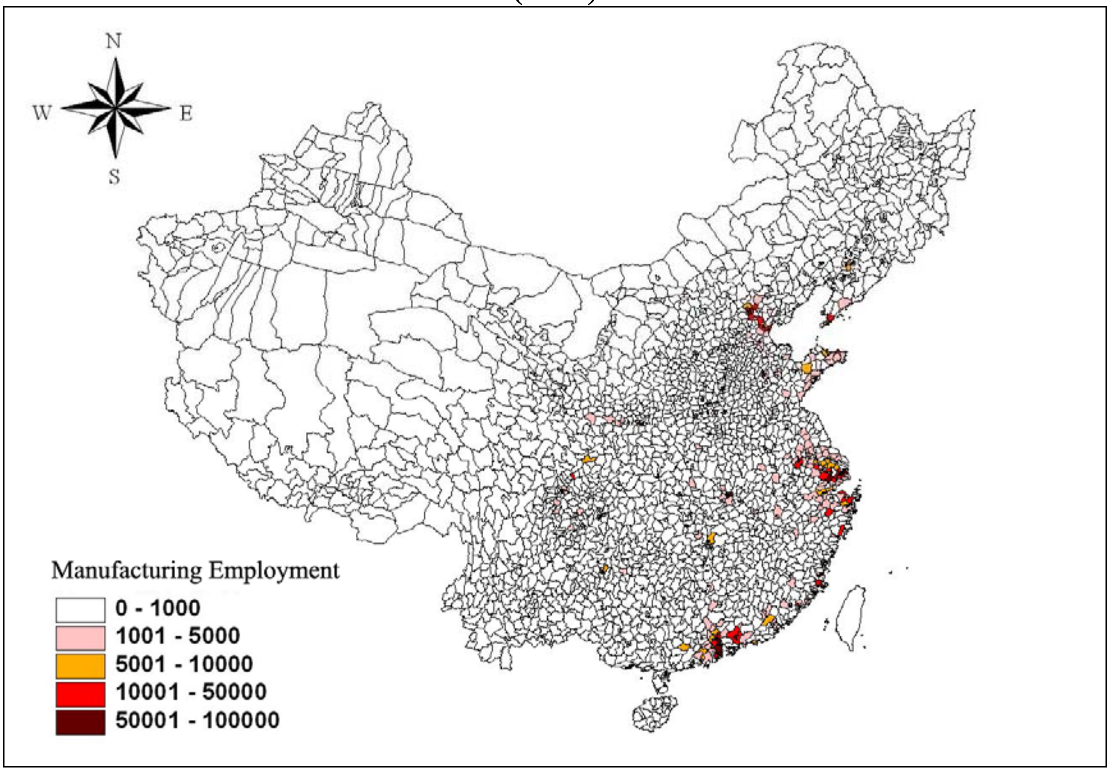



Figure 15 Spatial distribution of employment in telecommunication equipment, computer and other electronic equipment by county (2004)

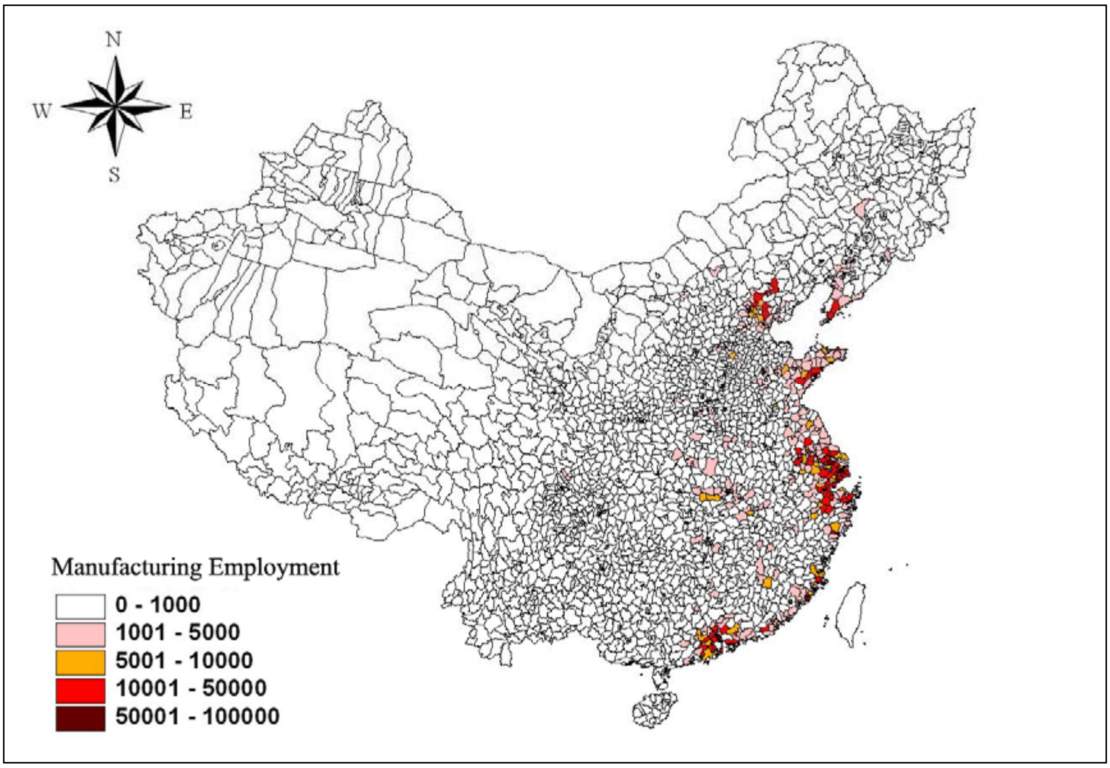



Figure 16 Spatial distribution of employment in garments, shoes and hats making by county (2004)

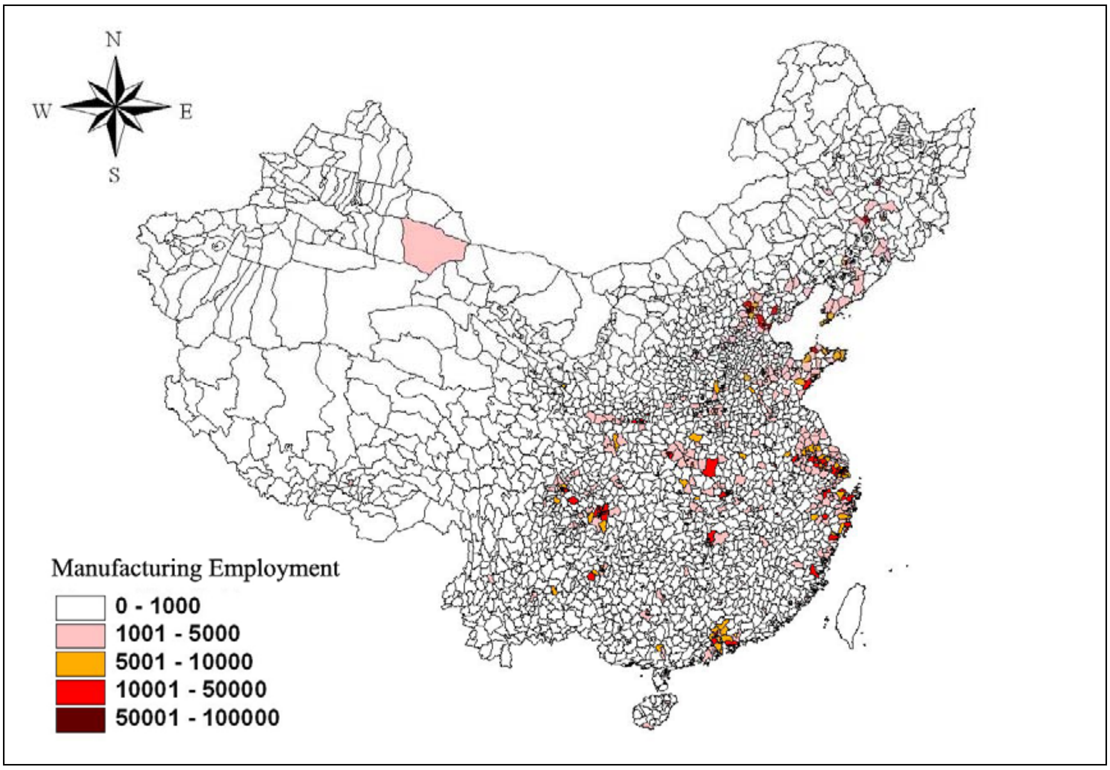



Figure 17 Spatial distribution of employment in transportation equipment by county (2004)

## 6 Conclusions and Discussions

China’s economic geography was formerly 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 local governments are granted authorities and responsibilities for local economic development through decentralization. Therefore, China now is a mixed economy in which socialist legacies and governmental intervene and planning exist side by side with new developmental forces as a result of economic transition. Theoretically, global and market forces may foster the geographical clustering of Chinese industries to exploit locational and comparative advantages and agglomeration economies while decentralization results in local protectionism and rational imitation strategy and thereby discouraging 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 highlight that Chinese manufacturing industries have been 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 and 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 either localized resource-based, domestic-market oriented or profitable and strategic industries and also were favored and protected by local governments. As expected, globalized and least intervened industries such as telecommunication and electronic equipment, instruments and meters, cultural education and sports goods, garments, shoes and hats making, leather and fur products, chemical fiber, rubber and plastic products have been increasingly and significantly more agglomerated since the early 1990s while domestic-market oriented and protected industries show no significant trend of centralization. The globalized and market driven industries have been shifted to the coastal provinces, including Guangdong, Fujian, Zhejiang, Shanghai, Jiangsu and Shandong. The empirical results indicate that sectors and spaces that are undergone economic liberalization are those most prone to the formation of agglomeration economies. Geographical agglomeration of many labor-intensive industries such as garments and other fiber, leather and fur products, rubber and plastic products, has gone beyond provincial boundaries and has promoted the regional industrial development. Some capital-intensive industries such as transportation equipment, machinery, electrical machinery and equipment, chemical materials and products, which rely on regional business linkages, have significant spillover effects beyond provincial boundaries. Industries dependent on localized business linkages or protected by local governments are however confined within province.

Industrial agglomeration appears to have caused the change of industrial structures 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 are 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 had diversified their industrial compositions while the recent geographical 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 the central planning. The relationship has been increasingly significant as economic transition proceeds, suggesting that economic reform has created conditions for industrial agglomeration. There are substantial industrial variations in the relationship. In the 1980s, significant positive relations only hold for textiles, tobacco processing, cultural education and sports goods, petroleum refining and coking, chemical fiber, plastic products, electrical machinery and equipment, telecommunication and electronic equipment, and instruments and meters, many of which were the first group of industries to allow non-state owned enterprises and to utilize foreign investment and to export. As most industries become increasingly agglomerated in the 1990s, stronger and more significant positive relationships between industrial agglomeration and productivity emerge, especially in industries that have gained prominence since economic transition. The heavily protected or state-controlled industries however have not significantly benefited from industrial agglomeration. Market and global forces have not only driven Chinese industries to agglomerate in the coastal provinces but also brought up labor productivity. Although decentralization has promoted the local economic development, it has discouraged industrial agglomeration and sacrificed labor productivity of Chinese industries. However, as economic transition proceeds and domestic market becomes more integrated, the inter-provincial competition would become fiercer and would force locally protected industries to be more productive. As a matter of fact, provincial governments have recently worked hard to promote the formation of industrial clusters within the province to improve the competitiveness of local industries. Protected industries are fairly concentrated in some counties or cities within the province. Provincial governments have also competed fiercely with each other to attract foreign investments into locally protected industries to make them more productive. Overall, market reforms and globalization has indeed pushed China's industries in the direction of efficient outcomes in spite of provincial protectionism. The empirical investigations point to the importance of economic transition and its consequence in understanding industrial agglomeration and its contribution to the improvement of labor productivity.

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