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Globalization, Institutional Change, and Industrial Location: Economic Transition and Industrial Concentration in China

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HE C., WEI Y. D. and XIE X. Globalization, institutional change, and industrial location: economic transition and industrial concentration in China, *Regional Studies*. Marketization and globalization in China may stimulate industrial clustering, while decentralization may lead to protectionism and industrial dispersion. This paper examines industrial distribution in China during 1980–2003. While Chinese industries have been increasingly concentrated geographically, the study found significant temporal and sectoral variations in concentration. Least protected industries have become increasingly concentrated, and most globalized industries are clustered in the coastal region. The analysis indicates that globalization and internal scale economies have contributed to geographical concentration, while protectionism has hindered industrial specialization. While industries are more likely to locate based on comparative advantages, external scale economies have not fostered industrial concentration.

Economic transition Globalization Decentralization Agglomeration Geographic concentration China

HE C., WEI Y. D. and XIE X. 全球化,机构变更以及产业区位: 中国的经济转轨及产业集聚, 区域研究。市场化及全球化在中国可能会引发产业集群，与此同时非中心化导致了保护主义和产业扩散。本文考察了 1980 至 2003 年间中国产业扩散的状况。研究表明，中国的产业在地理空间上进一步集中的同时，呈现出时间和部门差异。受保护最少的产业逐渐聚集，而且大多数全球化产业都聚集在沿海区域。分析表明，全球化及内部尺度经济对产业地理空间聚集有很大影响，而保护主义阻碍了产业专门化趋势。产业区位多由比较优势确定，外部尺度经济并不能促使产业集聚的发生。

经济转轨 全球化 非中心化 集结 地理空间集聚 中国

HE C., WEI Y. D. et XIE X. La mondialisation, la transformation institutionnelle, et la localisation industrielle: la mutation économique et la concentration industrielle en Chine, *Regional Studies*. Il se peut que la commercialisation et la mondialisation en Chine encouragent l'établissement de grappes industrielles, alors que la décentralisation amène au protectionnisme et à la dispersion industrielle. Cet article cherche à examiner la distribution industrielle en Chine entre 1980 et 2003. Tandis que l'industrie chinoise se concentre de plus en plus, il s'avère que cette concentration varie sensiblement des points de vue temporel et sectoriel. L'industrie la moins protégée se concentre de plus en plus et l'industrie la plus mondialisée s'agglomère pour la plupart dans la zone côtière. L'analyse laisse voir que la mondialisation et les économies d'échelle internes ont contribué à la concentration géographique, alors que le protectionnisme a entravé la spécialisation industrielle. Pendant que l'industrie se localise en fonction de l'avantage comparatif, les économies d'échelle externes n'encouragent pas la concentration industrielle.

Mutation économique Mondialisation Décentralisation Agglomération Concentration géographique Chine

HE C., WEI Y. D. und XIE X. Globalisierung, institutioneller Wandel und Industriestandorte: wirtschaftlicher Wandel und industrielle Konzentration in China, *Regional Studies*. Die Marktorientierung und Globalisierung in China kann sich fördernd auf die industrielle Clusterbildung auswirken, während eine Dezentralisierung zu Protektionismus und industrieller Streuung führen kann. In diesem Beitrag untersuchen wir die industrielle Verteilung in China im Zeitraum von 1980 bis 2003. Die chinesischen Industrien haben sich geografisch zunehmend konzentriert, doch zugleich finden wir signifikante zeitliche und sektorale Schwankungen hinsichtlich der Konzentration. Die am wenigsten geschützten Industrien haben sich zunehmend konzentriert, während die am stärksten globalisierten Industrien in Clustern an der Küste angesiedelt sind. Unsere Analyse lässt darauf schließen, dass die Globalisierung und die internen Maßstabsökonomien zur geografischen Konzentration beigetragen haben, während der Protektionismus die industrielle Spezialisierung behindert hat. Zwar suchen sich Industrien ihren Standort eher aufgrund von Wettbewerbsvorteilen aus, doch externe Maßstabsökonomien haben sich nicht fördernd auf die industrielle Konzentration ausgewirkt.

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Wirtschaftlicher Übergang Globalisierung Dezentralisierung Agglomeration Geografische Konzentration China

HE C., WEI Y. D. y XIE X. Globalización, cambio institucional y localización industrial: Transición económica y concentración industrial en China, *Regional Studies*. La comercialización y globalización en China podrían estimular la aglomeración industrial y a la vez la descentralización podría llevar al proteccionismo y la dispersión industrial. En este ensayo examinamos la distribución industrial en China durante 1980–2003. Aunque las industrias chinas se han ido concentrando geográficamente, hemos observado variaciones significativas temporales y sectoriales en concentración. Las industrias menos protegidas se han acabado concentrando y las industrias más globalizadas están agrupadas en las regiones costeras. Nuestro análisis indica que la globalización y las economías a escala interna han contribuido a la concentración geográfica y el proteccionismo ha impedido la especialización industrial. Aunque las industrias tienen más probabilidad de ubicarse basándose en ventajas comparativas, las economías a escala externa no han fomentado la concentración industrial.

Transición económica Globalización Descentralización Aglomeración Concentración geográfica China

JEL classifications: O18, P25, R11, R50

INTRODUCTION

Forces at work driving industrial location in China might be different from those in developed countries since China is still a transitional and developing economy. China has experienced two fundamental changes since the late 1970s: the transition from a command economy to a market-oriented 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 (WEI, 2000), which has had profound impacts on the economic landscape and spatial development in China (e.g., MA, 2002; FAN and SCOTT, 2003; YU and WEI, 2003). 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, and the growth in foreign investment and trade has further opened China to global competition. Meanwhile, decentralization has granted local governments more authority and responsibilities in providing incentives to develop local economies and protecting local industries from inter-regional competition (LEE, 1998; YOUNG, 2000).

There are some limited studies of geographical concentration of manufacturing industries across China's provinces and regions. FAN and SCOTT (2003) noted that industrial employment is more concentrated than the number of establishments, and labour-intensive industries are more spatially concentrated. BATISSE and PONCET (2003), using 1992–1997 provincial input-output tables, found greater geographic concentration in industries with significant comparative advantages, strong supply linkages and high market potential. They also found larger location quotients for industries enjoying high protection from inter-regional competition. Using a panel dataset for 1985–1997, BAI *et al.* (2004) showed that Hoover coefficients of China's industries reversed an early drop in the mid-1990s and rose significantly in the following years. WEN (2004) calculated the Gini coefficients of 25 two-digit manufacturing industries in 1980, 1985 and 1995, and demonstrated that most manufacturing industries are highly concentrated, while chemical fibres, ferrous metal smelting and pressing, and non-ferrous metal smelting and pressing tend to disperse. WEN (2004) also found that resource-based industries are the most concentrated and many of the relatively footloose industries are concentrated in coastal regions, while most of the industries producing goods with higher transport costs are geographically dispersed.

These studies have advanced knowledge of industrial location in China. However, the extent, process, and determinants of spatial distribution of Chinese industries remain understudied. First, because the *Chinese Industry Economy Statistical Yearbooks* only document 20 manufacturing industries by provinces since 1998, most existing studies either focus on these 20 industries or are confined to the pre-1998 period, making detailed temporal comparison difficult. Also because most of the studies analyse data for only 2–3 years, the temporal trends of individual manufacturing industries have not been systematically investigated. Second, China is increasingly integrated with the global economy, but the existing studies have not paid sufficient attention to the impact of globalization and economic transition on industrial location. Finally, given the recent debates on geographical concentration, there is a need to test the theoretical literature in the context of China and discuss the theoretical implications of China's experiences.

Scholars believe that the introduction of market forces has fostered regional integration and economic liberalization, and facilitated geographical concentration of industries (FAN and SCOTT, 2003; WEN, 2004). However, economic decentralization has resulted in fierce inter-regional competition and local protectionism, which has caused the fragmentation of the domestic market and the distortion of regional

production away from comparative advantage. Local protectionism may hurdle specialization and concentration of industries in China (LEE, 1998; YOUNG, 2000). BAI *et al.* (2004) found less geographical concentration in industries with high tax-profit margins and shares of state ownership, indicating local protectionism may disperse industries. The integration with the global economy has also made foreign investment and trade increasingly influence industrial distribution.

Under economic transition, how have Chinese manufacturing industries been transformed in space? Have Chinese industries become more geographically concentrated as firms are increasingly driven by market forces and are progressively engaged in the globalization process? Has local protectionism discouraged geographical concentration of Chinese industries? What are the locational determinants of spatial patterns of the industries? These questions have not received satisfactory answers and will be investigated in this research.

This study will examine the spatial transformation of Chinese manufacturing industries during 1980–2003, and investigate and explain changing levels of geographical concentration, with a special attention to the impact of economic transition. The authors construct a panel dataset consisting of all two-digit manufacturing industries in Chinese provinces to examine the temporal trends of geographical concentration of industries during the period of 1980–2003. The paper also investigates the role of explanatory variables in the changing geographical concentration. After this introduction, the next section examines industrial location in the context of the transition economy of China. The third session defines indices to measure geographical concentration and specialization, followed by findings on changing patterns of industrial location and concentration. The authors then analyse the determinants of geographical concentration and conclude with a summary of major findings.

ECONOMIC TRANSITION, INDUSTRIAL LOCATION, AND GEOGRAPHIC CONCENTRATION

WEI (2000, 2001) conceptualized the process of China's economic transition as a triple process of decentralization, marketization, and globalization, and argued that economic landscapes in China are driven by a multiplicity of forces and agents unleashed by the triple process, the components of which have interactively and jointly produced the uneven landscapes of regional development in the country. Following the triple transition and multi-mechanism framework, the authors develop in Fig. 1 a conceptual framework for the analysis of the geographic concentration of Chinese manufacturing industries.

Marketization and industrial location

Existing studies of industrial distribution focus on Europe and North America, with particular interests in the impact of regional integration and trade liberalization on spatial patterns (KIM, 1995; HANSON, 1998; BRULHART, 2001; PALUZIE, 2001; STORPER *et al.*, 2002; AIGINGER and PFAFFERMAYR, 2004; SJOBERG and SJOHOLM, 2004). Under market economies, three broad families of models are underpinning theoretical enquires in industrial location and geographic concentration: the neoclassical trade models, new trade models and new economic geography models (BRULHART, 1998, 2001). In the neoclassical world, industrial location is driven by exogenous endowments such as technologies, labour, and natural resources, and the spatial pattern is formed through inter-industry specialization with industries settling in locations with comparative advantages. Reduction of trade barriers make regions increasingly specialize in their production based on comparative advantages (KIM, 1995).

While the neoclassical models can explain a substantial portion of inter-industry specialization, comparative advantage alone is insufficient to account for industrial specialization and geographical concentration. New trade models argue that internal scale economies provide regions with incentives to specialize even without differences in their technology or resource endowments, and make firms concentrate their production in a few locations. Economic activities concentrate in order to realize economies of scale, especially orientated towards a large consumer market to minimize transportation costs (KRUGMAN, 1980). The reduction of trade barriers allows underlying geographical advantages to play a greater role, generating a tendency to increase regional specialization and concentration (BRULHART, 1998). In the new economic geography models, geographic concentration is driven by the interaction of transportation costs and internal scale economies. Demand linkages represent incentives for producers to locate close to buyers, whereas cost linkages generate incentives for consumers to locate close to suppliers (KRUGMAN, 1991; VENABLES, 1996). High trade costs prevent the tendencies of concentration while medium trade costs allow forward and backward linkages to cause industrial agglomeration (KRUGMAN and VENABLES, 1995).

Institutionally, China's economic reform is to transform the economic system from a command economy to a market-oriented economy. In the command economy governments distributed resources, firms were executors of state orders, and there were literally no well-functioning markets of goods and factors. Production location decisions did not follow the line of comparative advantages since governments located industries based on shifting social, political and military considerations. In China, MA and WEI (1997) found that industrial location during Mao's era was heavily

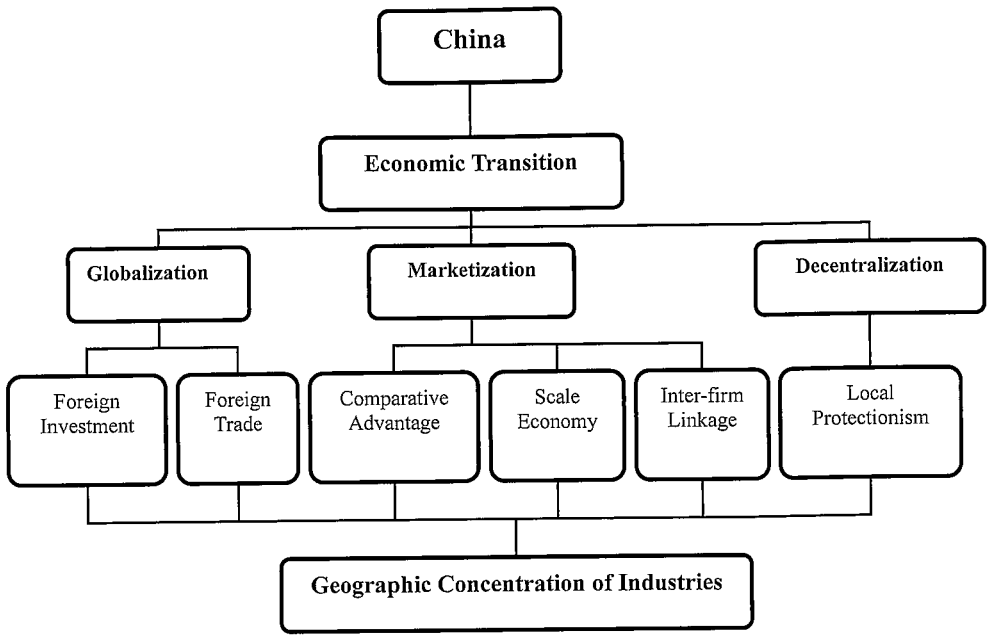

Fig. 1. *Conceptual framework for analysing the geographic concentration of Chinese industries*

influenced by sociologist ideology, national defence, and economic pragmatism. As the economic transition proceeds, market forces and competition are progressively introduced, and markets have played an increasingly important role in resource allocation. Limits on factor mobility and commodity exchanges have also been gradually lifted. Under the transitional environment, firms face increasingly fierce competition and are forced to react to costs, profits and revenues. Firms will be cost-effective if locating along the line of comparative advantages and close to suppliers or customers

The coastal region was the first to introduce market forces into its economic system and has benefited the most from the marketization process. Many industries indeed have been shifting to the coast (FUJITA and HU, 2001). Therefore, the authors can hypothesize that Chinese industries have become more concentrated since firms are motivated to exploit comparative advantages, scale economies and industrial linkages.

Decentralization and industrial location

China's economic decentralization is essentially a two-pronged process: decentralization of decision-making from governments to enterprises and households, and power decentralization from central to local governments (QIAN and WEINGAST, 1997).

The decentralization policy granted local governments greater autonomy over their economies, including the authority to grant business licenses, make investments, transfer land use rights, coordinate urban developments, restructure state-owned enterprises and resolve business disputes. The local governments now have a primary responsibility for economic and regional development in their respective jurisdictions (WEI, 2000; HE, 2006). Fiscal decentralization in particular has enhanced the importance of local budget constraints and contributed greatly to the rise of local protectionism (CANNON and ZHANG, 1996). Under the central planning system, all revenues must be remitted to the centre, which then decided the budget of each local government, and local governments had no authority over the structure of local expenditures. Since the reform, local governments acquired authority over expenditures within a broad set of guidelines set by the central government under the fiscal contracting system. Especially in 1994, the central government began a new tax-sharing system that clearly distinguished between national and local taxes, and determined that the value-added tax (VAT) would become the major indirect tax to be collected by central government and shared by local governments at a fixed ratio of 75 : 25. The new tax sharing system however does not remove local governments' major revenue sources (CAO *et al.*, 1999). In addition to the 25% of VAT, 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.

Strong fiscal incentives make local governments better promoters of market-oriented reforms. Hardening local budget constraints by the fiscal and financial reforms forced local governments to create a friendly investment environment to attract new businesses and improve the production efficiency of existing firms to increase local revenues. If the budget is soft or local governments are easily able to obtain fiscal transfers from

the central government, they will have no incentives to do so. More authorities together with hardening budgets have led to the fierce inter-regional competition for markets and materials, and also provided local governments with incentives to protect local businesses and profitable industries by shielding local firms and industries from inter-regional competition (LEE, 1998; YOUNG, 2000). ZHAO and ZHANG (1999) argued that 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. Under the name of the assistance to local economies, local governments used their heightened administrative power (in terms of trade, investment, budget and price fixation) to implement multiform protection of workers and enterprises under their authority (ZHAO and ZHANG, 1999). Local governments also have strong incentives to protect state-owned enterprises (SOEs) under their administration, which are the base of political power, as well as source of private benefits and fiscal revenues (BAI *et al.*, 2004).

YOUNG (2000) argued that as control over factor allocations was loosened, local governments sought to capture these rents by developing high margin industries. Continued reform and growing inter-regional competition between duplicative industries threaten the profitability of these industries' structures, leading local governments to impose a variety of inter-regional barriers to trade. Aside from tariff barriers (i.e. special charges levied at roadblocks), non-tariff methods, such as physical barriers, outright prohibition, lower interest loans, and other financial benefits for commercial establishments marketing local goods, fines for commercial establishments marketing non-local goods, legal restrictions on price differences between local and non-local goods sold in commercial establishments, local purchasing quotas, and administrative trivia (e.g. medical, sanitation, epidemic prevention, product quality, measurement, and other such licenses and certificates) were used to hamper trade in various products. PONCET's (2005) finding of decreasing inter-provincial trade intensity in addition to rising intra-provincial trade intensity between 1992 and 1997 also supports the statement of growing economic fragmentation in China.

The Development Research Centre of the State Council (DRCSC) (2004) in a survey study confirmed the serious existence of local protectionism and found that local protection was justified as a way to improve local fiscal revenues and to promote economic growth. PONCET's (2005) results indicate that provinces' domestic trade protection pursues the dual objectives of socio-economic stability preservation and fiscal revenues maximization. Local governments implemented a variety of measures to protect profitable and high value-added industries. Fundamental industries and those with strong industrial linkages are also heavily protected. 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 fibres, 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. The reform process led to the fragmentation of the domestic market and the distortion of regional production away from patterns of comparative advantage. Local protectionism caused by decentralization has served as a centrifugal force for Chinese industries, and the authors can hypothesize that decentralization and local protectionism may hurdle industrial specialization and geographic concentration (BAI *et al.*, 2004; YOUNG, 2000).

Globalization and industrial location

Globalization is an important catalyst for transformation in transition economies, providing financial resources, technologies, management skills and markets, which are necessary to transform and restructure the obsolete industrial systems inherited from the command economy. Scholars argue that foreign investment and trade reinforce the spatial concentration of economic activities, although the empirical literature on the relationships between trade and location is very limited (STORPER *et al.*, 2002). Evidence shows that the more globalized core areas in developing countries tend to lead foreign investment and trade, and the gaps from the peripheral regions tend to increase with globalization. However, as HENDERSON *et al.* (2001) pointed out, whether foreign trade concentrates or disperses economic activities may depend on the choice of cases.

Trade liberalization increases the scope for specialization along the lines of comparative advantage and enhances the importance of access to international markets. PALUZIE (2001) uncovered that regions with some initial advantages benefit the most from trade liberalization, a result that was reinforced in a study on Brazil (HADDAD and HEWINGS, 2001). SHELBURNE and BEDNARZIK (1993) found that American industries involved heavily in international trade are more spatially concentrated, and trade-related displacements are spatially concentrated. SJOBERG and SJOHOLM (2004) also found that trading establishments in Indonesia are much more spatially clustered than other establishments.

However, the expansion of trade may result in the deconcentration of economic activities, especially in

developing economies. KRUGMAN and ELIZONDO (1996) contended that industrial agglomeration is likely to decrease with trade liberalization, since market expansion abroad and more inputs reduce the centripetal forces, and high production costs in the industrialized centre provide incentives for firms to locate at the periphery. HANSON (1998) found that the formation of the North American Free Trade Area (NAFTA) reduced spatial concentration in Mexico because firms shifted to the border of the United States from the old industrial belt centred on Mexico City. DAS and BARUA (1996) also provided evidence due to a dispersal of economic activities from trade liberalization in India.

In China, trade liberalization has given trading firms incentives to exploit comparative and locational advantages. Labour migration resulting from economic growth and the relaxation of the household registration system make it possible for trading establishments to benefit from the best utilization of cheap labour. To gain cost competitiveness in the global market, firms agglomerate to take advantage of backward and forward linkages, fostering the formation of industrial clusters. FUJITA and HU (2001) argued that increases in exports have reinforced industrial concentration in China, particularly concentrating industries in the coastal region since it is close to the international market, has special locational advantages, and has enjoyed the first mover advantage of the globalization process.

Scholars also disagree over the effects of foreign direct investment (FDI) on industrial location. FDI is unevenly distributed, heavily concentrated in core city regions, and the extent of diffusion to the periphery is often limited (DICKEN, 2003). This tendency of geographical concentration has been found in both China and Central and Eastern Europe, building upon institutional preference, locational endowments, and production networks (HARDY, 1998; WEI, 2000; HE, 2002). Foreign investments may have facilitated the geographical concentration of Chinese manufacturing industries for the following three reasons.

First, facing an unfamiliar environment, foreign investors strongly favour the existing industrial agglomerations to take advantage of external economies. FDI concentrates in strong industrial bases and in the coastal region (HEAD and REIS, 1996; HE, 2002).

Second, the inflows of FDI into labour-intensive industries enhance the comparative advantage of the coastal provinces (SUN, 1999), and market-oriented FDI often concentrates in regions with the best market access to exploit pecuniary externalities, often the large cities on the coast as well (HE, 2003).

Third, foreign enterprises create demand for intermediate inputs produced locally and improve the efficiency of the whole sector (MARKUSEN and VENABLES, 1999). Increased efficiency of the local intermediate sectors would make domestic producers grow and become profitable, which generates a mechanism of cumulative causation leading to industrial concentration. Moreover, component sourcing in China is an important consideration for foreign firms because of China's local content requirements, indirectly restricting component and material imports (HEAD and RIES, 1996; BELDERBOS and CERREE, 2002). The introduction of major foreign firms often generates a cluster of suppliers, facilitating industrial agglomeration. In Nokia-centred Xingwang Industrial Park in the Beijing Development Area, the mobile telecommunications manufacturing cluster consists of Nokia-Capital (the assembler) and up to 30 major suppliers (LIU *et al.*, 2004).

To summarize, China's triple process of economic transition – marketization, decentralization, and globalization – has progressively introduced market forces and competition, and also resulted in economic decentralization to the local governments. In addition the open door policy has led to trade and investment liberalization in China and many manufacturing industries are heavily involved in the globalization process. The influential external forces together with market forces and decentralization have undoubtedly fostered the spatial transformation of Chinese manufacturing industries. On the one hand, market forces and competition may stimulate the spatial concentration of Chinese industries, and foreign investment and trade may also facilitate the geographical concentration.

On the other hand, economic transition decentralizes power to local authorities and causes local protectionism, which may lead to industrial dispersion. In other words, concentration will increase as a result of economic globalization and market liberalization, but will be offset by non-tariff barriers imposed by local authorities under the process of decentralization.

DATA AND MEASUREMENT

To examine the change of the geographical structure of industries, this study constructs geographical concentration indices for each industry to uncover the spatial distribution and provincial specialization. Many indices have been used in the literature, such as the Herfindhal index, Entropy index, Theil index and Gini coefficients. The authors have computed all indices, and found they are strongly correlated. This study therefore selects the Gini coefficient, the most widely used index in the literature. The Gini coefficient ranges from 0 to 1: the higher the coefficient, the more concentrated an industry and the more specialized a province. The computation of the Gini coefficient is defined as follows:

$$AG_i = \frac{1}{2N^2\mu}\sum_j\sum_k\left|\frac{x_{ij}}{X_i} - \frac{x_{ik}}{X_i}\right| \qquad (1)$$

where μ is the average provincial share of manufacturing industry i, N is the number of provinces, X_i is the total employment (or value added) of industry i, and x_{ij} and x_{ik} are the employment (or value added) of industry i in province j and k. For simplicity of computation, the following formula is used:

$$AG_i = \frac{2}{N}\sum_{j=1}^{N}\left(j * \frac{x_{ij}}{X_i}\right) - \frac{N+1}{N} \tag{2}$$

To measure provincial specialization, exchange the industry and province data in equation (2). To uncover spatial autocorrelation in the geographical distribution of industries, compute the global Moran's I:

$$I = \frac{n\sum_i\sum_j w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{(\sum_i\sum_j w_{ij})\sum_i (x_i - \bar{x})^2} \tag{3}$$

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 value of Moran's I indicates a regionalized spatial distribution.

Data on industries are compiled from various issues of the *China Industry Economy Statistical Yearbook* (SSB, 1981a–2004s) and the *Annual Report of Chinese Industrial Statistics* (SSB, 1999b–2004b), as well as SSB (1998c–2004c) and SSB (1998d–2004d). There are some adjustments in China's industrial statistics in 1998. In the pre-1998 period, industrial statistics covered all enterprises with an independent accounting system, while since 1998 SSB only counts enterprises with sales revenues over 5 million yuan. Although the changes do not disrupt the overall trend of industrial concentration, to be consistent, the authors focus on the post-1998 period in this econometric analysis. Since 1998, the *China Industry Economy Statistical Yearbooks* only report 20 industries by province, and data on the following industries are missing: clothing and other fibres, leather and fur, timber processing, furniture making, printing and copying, cultural, education and sporting goods, rubber and plastics products. Most existing studies either focus on the 20 industries or are confined to the pre-1998 period. Using the *Annual Report of Chinese Industrial Statistics*, this paper is able to expand the dataset to include all 28 manufacturing industries during the period of 1980–2003.

There were some administrative changes during the study period: Hainan became a designated province in 1988 and Chongqing was upgraded to a centrally administered municipality in 1997. To keep the spatial units consistent, the authors combined Hainan and Chongqing with Guangdong and Sichuan provinces respectively, totalling 29 provinces (Fig. 2). Industries in China are categorized into two-digit, three-digit and four-digit sectors, and in statistical yearbooks, there were adjustments in sectoral disaggregation in 1993: food manufacturing and feed processing were reorganized into food processing and food manufacturing, sewing was included in clothing and other fibres, and machinery was divided into special purpose equipment and general machinery. When investigating temporal trends of geographical concentration and provincial specialization, this paper aggregated food manufacturing, food and feed processing into food industry, sewing and clothing and other fibres into clothing, and special purpose equipment and general machinery into machinery, totalling 26 manufacturing industries.

CHANGING GEOGRAPHICAL CONCENTRATION OF CHINESE INDUSTRIES

Temporal trends of geographic concentration

Under the influence of socialist ideology and egalitarian ideas during Mao's era, China's industrialization policy favoured the traditional industrial bases and also tilted towards new industrial cities in the interior (Wei, 2000). Consequently, at the beginning of China's economic reform, Shanghai, Tianjin, Beijing, Sichuan, Hubei, Liaoning, Jilin, and Heilongjiang became the major industrial bases of China. With the shift of government policies towards a market-based economy and the opening up of the coast, the coastal provinces of Guangdong, Fujian, Zhejiang, Jiangsu, and Shandong have gradually taken the lead in attracting investment, improving technology, and expanding industries. The emergence of coastal region and the relative decline of old industrial bases and interior provinces brought a decrease of Gini coefficients of industrial gross output and value added (Fig. 3).

Through further reform of the economy and the continuation of coastal development strategies, the coastal region has become an engine of phenomenal economic growth, attracting labour, investment, technology and firms, resulting in strong polarization effects and industrial concentration towards the coast. Labour intensive and export-oriented industries in particular have found the coast attractive (Fujita and Hu, 2001), and the coastal–interior divide of Chinese industries has been intensified (Wei, 1998). As shown in Fig. 3, concentration indices of value-added and gross output declined in the 1980s, and have been increasing since 1989, economic stagnation and adjustment following the Tiananman incident. Value-added and gross output is more geographically concentrated than employment, and gross output is slightly more clustered than value added. Specifically, the Gini coefficients of value added increased from 0.55 in 1980 to 0.61 in 2003. Industrial employment has been increasingly concentrated since 1980, in association with the significant temporary labour migration from inland to the coast.

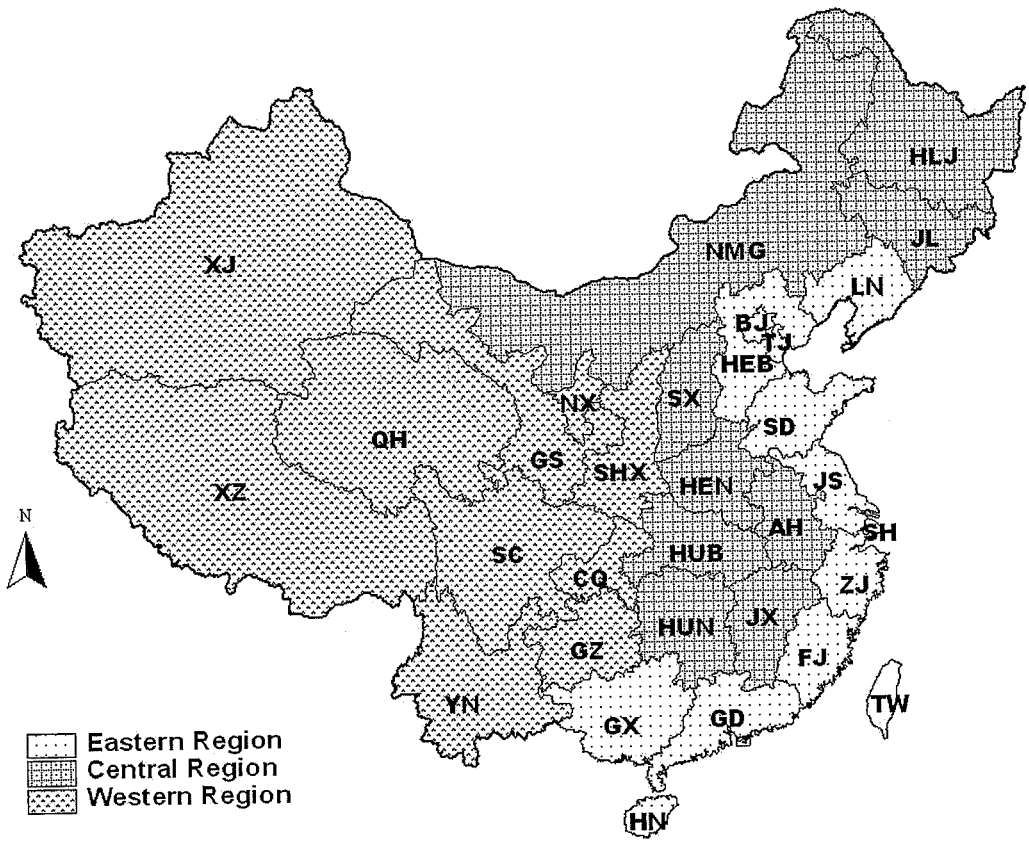

Fig. 2. *Chinese provinces and centrally administered municipalities*
Note: AH: Anhui, BJ: Beijing, CQ: Chongqing, FJ: Fujian, GD: Guangdong, GS: Gansu, GZ: Guizhou, GX: Guangxi, HEB: Hebei, HEN: Henan, HLJ: Heilongjiang, HUB: Hubei, HUN: Hunnan, JL: Jilin, JS: Jiangsu, JX: Jiangxi, LN: Liaoning,: NMG,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

Geographical concentration of industries and specialization of regions have long been treated as closely related economic phenomena. The debate over whether Chinese provinces have become more specialized or whether there is a trend of convergence can be investigated through an analysis of the change of provincial specialization indices. As shown in Figure 3, Chinese provinces have become less specialized over the last two decades, indicating an overall pattern of convergence in provincial industrial structure. Rapid development in labour-intensive and light industries is undoubtedly associated with the decreasing provincial specialization before the mid-1990s. Regional decentralization was apparent in the early stage of reforms (Wei, 2000), providing local governments with power to implement protectionism policies. Inter-regional competition and provincial protectionism are at least partially responsible for the convergence of provincial industrial structure (Young, 2000). In the early 1990s, China implemented more radical market reforms and open door policies, and since the mid-1990s the overall provincial output specialization has been slowly increasing.

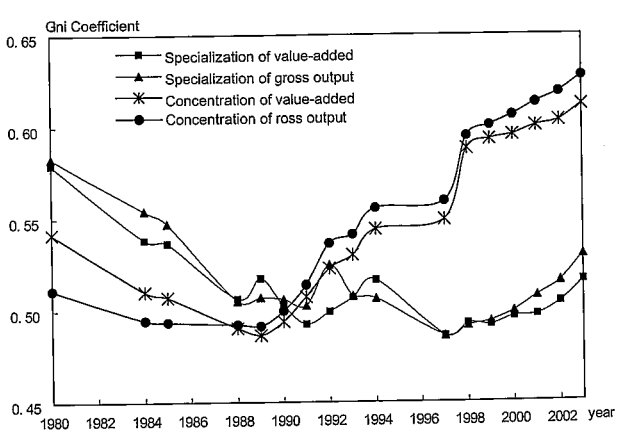

Fig. 3. *Temporal trends of geographical concentration and specialization of Chinese manufacturing industries, 1980–2003*

First, marketization and globalization have forced manufacturing firms to specialize production and compete more effectively in the markets based on geographical agglomeration and comparative advantages. The interior provinces in particular have further concentrated in resource-oriented production (Wei and Fang, 2006).

Second, the increasing specialization is also related to the heavy industrialization process in some coastal provinces, with the increasing importance of machinery, chemical materials and products, petroleum refining and coking, transportation equipment and ferrous metal smelting and pressing in such areas.

This combination of increased concentration and decreased specialization is surprising and even counter-intuitive. In models with two regions and two industries, any increase (or decrease) in specialization is tautologically replicated by a parallel increase (or decrease) in concentration (KRUGMAN, 1991). The reason is that there are only two regions and the only possible equilibrium implies either identical regions or allocations where all firms producing manufactured goods locate in one region. This model, however, cannot explain how transport costs change production in each of the goods in equilibrium where no region realizes complete specialization in production. FUJITA *et al.*'s (1999) studies of three regions explore the effects of trade costs on specialization and concentration. As trade costs decrease, agents consume fewer local products, thereby decreasing the benefits of concentration.

On the other hand, the same effect creates an incentive for firms to cluster in a particular region since firms' sales depend less on local demand. AIGINGER and DAVIES (2004) found that the member states in the European Union are becoming more structurally specialized over a recent 15-year period, but the industries are becoming more geographically dispersed. In China, since the early 1980s most industries have shifted to the coastal provinces; concurrently, many industries in the coastal provinces grew rapidly, leading to a diversifying industrial structure. Furthermore, transportation costs have significantly dropped during the last two decades, leading to a pattern of increasing concentration and decreasing specialization. Local economic and political interests duplicate the development of high value-added industries, further lowering provincial specialization (HU *et al.*, 2002).

Geographic concentration across sectors

Since Gini coefficients of value-added, employment and gross output are strongly correlated, the paper analyses in particular value added to uncover the geographical concentration of individual manufacturing industries. In 2003, the most dispersed industries include non-ferrous metal smelting and pressing (0.42), medical and pharmaceutical products (0.44), beverage manufacturing (0.49), ferrous metal smelting and pressing (0.51), petroleum refining and coking (0.52), non-metal mineral products (0.52) and food processing and manufacturing (0.53). Among the least concentrated industries, medical and pharmaceutical products, beverages and food are highly protected by provincial governments (DRCSC, 2004), and others are typical resource-intensive industries, demanding localized resource inputs. The most concentrated industry is cultural, education and sporting goods with a Gini coefficient of 0.81, followed by chemical fibres (0.79), electronics and telecommunication equipment (0.78), leather and fur (0.76), clothing and other fibres (0.76), and instruments and meters (0.74) (Table 1). Textiles, electric machinery and equipment, metal mineral products and plastic products are also very concentrated. These findings indicate that spatially concentrated industries can be both high-technology and low-technology, which is consistent with the finding that neither the popular high-tech agglomeration phenomenon nor the low-tech concentration was found in the UK (DEVEREUX *et al.*, 2004). Strongly concentrated industries like cultural, education and sporting goods, chemical fibres, instruments and meters, and plastic products are among the least protected, while electronics and telecommunication equipment, leather and fur products, clothing and other fibres are the most globalized industries in China.

Fig. 4 compares the temporal trend of spatial patterns of selected most protected and least protected industries. According to the survey of DRCSC (2004), tobacco, beverage and medical and pharmaceutical products are the most protected while rubber products, culture, education and sporting goods, and chemical fibre products are among the least protected. Overall, protected industries are more spatially dispersed than less protected industries. For instance, during the past two decades, the Gini coefficients for medical and pharmaceutical products and beverages are smaller than 0.50. Unlike the trend of aggregate industries, protected industries have not shown a trend of increasing concentration since the early 1990s. The tobacco industry enjoyed impressive growth in the 1980s and early 1990s with the support of local governments, while it witnessed provincial protectionism in the mid-1990s when the market became saturated (ZHOU, 2000). 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.

Fig. 5 contrasts the temporal trends of selected most globalized and least globalized industries. Electronic and telecommunication equipment, clothing and other fibre products, and leather and fur products are the most globalized, with substantial shares of exports and foreign capital. Non-metal mineral products, ferrous metal smelting and pressing and machinery equipment are mainly domestic market-oriented. Globalized industries in general are more spatially concentrated and have been increasingly concentrated spatially since the early 1990s. Domestically oriented industries are less concentrated, with Gini coefficients less than 0.60 since they serve localized markets and value the domestic market access.

Table 1. *Temporal trend of value-added Gini coefficients in Chinese manufacturing sectors*

Sector	Linear	Non-linear		Gini coefficient			Change in Gini coefficient, 1980–2003	Percentage of the top four provinces in 2003
	T	T	T^2	1980	1990	2003		
S13	0.008**	−0.002	0.0004**	0.40	0.39	0.53	0.13	SD, GD, HEN, JS (49)
S15	0.005**	0.002	0.0001	0.41	0.41	0.49	0.08	SC, GD, SD, ZJ (43)
S16	0.009**	0.015*	−0.0002	0.48	0.51	0.59	0.11	YN, SH, HUN, JS (49)
S17	0.008**	−0.006	0.0005**	0.57	0.53	0.70	0.13	JS, ZJ, SD, GD (67)
S18	0.015**	0.013**	−0.0001	0.48	0.57	0.76	0.28	GD, ZJ, JS, SH (67)
S19	0.020**	0.019**	−0.0001	0.39	0.52	0.76	0.37	GD, ZJ, FJ, JS (68)
S20	0.004**	−0.009**	0.0005**	0.50	0.49	0.56	0.06	JS, GD, ZJ, SD (46)
S21	0.014**	0.006	0.0003**	0.37	0.47	0.68	0.31	GD, SD, ZJ, FJ (57)
S22	0.011**	−0.010**	0.0008**	0.44	0.42	0.65	0.21	SD, GD, JS, ZJ (59)
S23	0.008**	−0.007**	0.0006**	0.40	0.40	0.58	0.18	GD, SH, ZJ, BJ (49)
S24	0.005**	−0.005	0.0004**	0.74	0.71	0.81	0.07	GD, ZJ, JS, SH (74)
S25	−0.010**	−0.014**	0.0002	0.73	0.63	0.52	−0.21	SD, LN, SH, GD (40)
S26	0.002	−0.016**	0.0007**	0.53	0.45	0.55	0.02	JS, GD, SD, ZJ (50)
S27	−0.002*	−0.003	−0.0001	0.51	0.45	0.44	−0.07	JS, GD, ZJ, SD (36)
S28	0.0001	−0.019**	0.0007**	0.80	0.66	0.79	−0.01	JS, ZJ, SD, FJ (74)
S29	0.008**	−0.016**	0.0009**	0.52	0.46	0.68	0.16	SD, JS, ZJ, GD (57)
S30	0.008**	−0.002	0.0004**	0.56	0.55	0.68	0.12	GD, ZJ, JS.SD (60)
S31	0.006**	−0.000	0.0002**	0.41	0.41	0.52	0.11	SD, GD, HEN, JS (44)
S32	−0.005**	−0.011**	0.0002*	0.66	0.53	0.51	−0.15	HB, SH, JS, LN (43)
S33	−0.008**	−0.021**	0.0005**	0.59		0.42	−0.17	HEN, JS, GD, SD (33)
S34	0.010**	−0.009*	0.0007**	0.51	0.49	0.69	0.18	GD, JS.ZJ, SH (62)
S35	0.007**	−0.009**	0.0006**	0.51	0.46	0.61	0.10	JS, SD, ZJ, SH(54)
S37	0.005**	−0.002	0.0003**	0.50	0.48	0.58	0.08	SH, JL, GD, JS (45)
S40	0.009**	−0.006	0.0006**	0.56	0.51	0.69	0.13	GD, JS, ZJ, SD (65)
S41	0.009**	−0.009	0.0007**	0.64	0.59	0.78	0.14	GD, JS, SH, BJ (70)
S42	0.008**	−0.009	0.0006**	0.60	0.54	0.74	0.14	GD, JS, SH, ZJ (70)

Note: $^{**}p < 0.01$, $^{*}p < 0.05$.

S13: Food processing and manufacturing; S15: Beverage manufacturing; S16: Tobacco processing; S17: Textiles; S18: Clothing and other fibres; 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 fibres; 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: Machinery; S37: Transportation equipment; S40: Electrical machinery and equipment; S41: Electronics and telecommunication equipment; S42: Instruments and Meters.

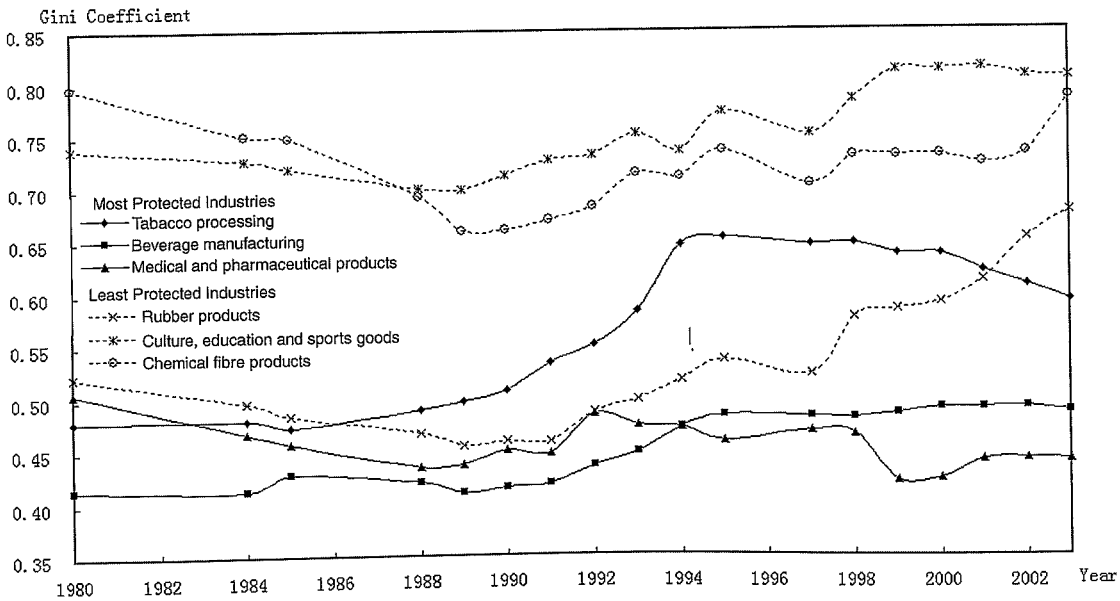

Fig. 4. *Temporal trends of geographic concentration based on level of protection*

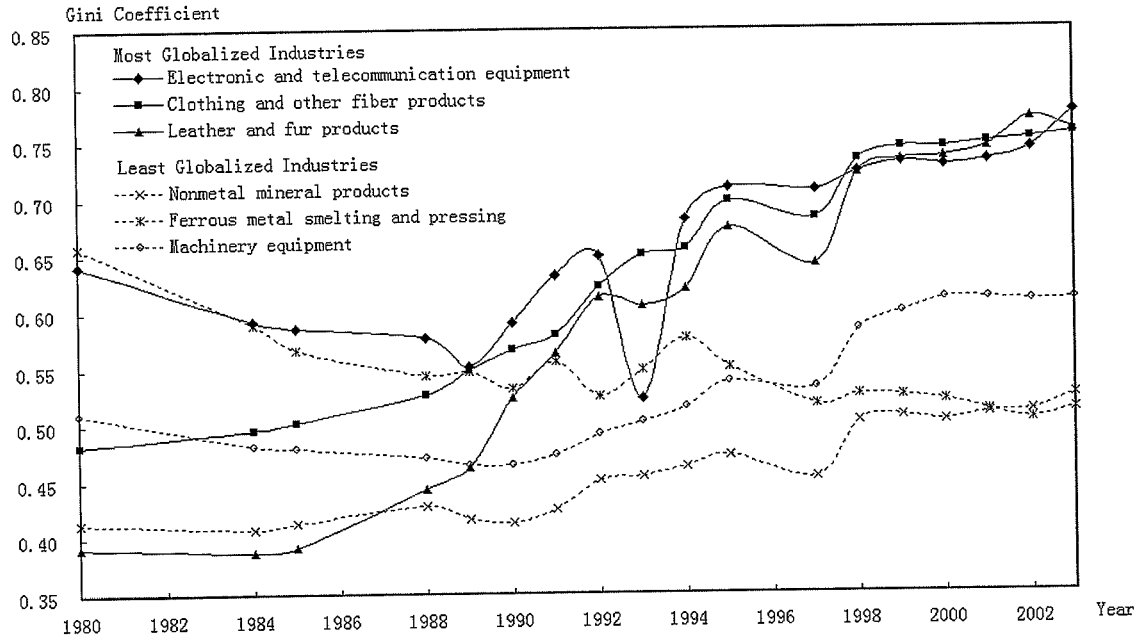

Fig. 5. *Temporal trends of geographic concentration based on level of globalization*

To investigate the temporal trends of industrial distribution further, the authors regress the Gini coefficients on time and squared time. TIME can be used as an overall indicator of the degree of market liberalization and the extent of the integration with the global economy. As the paper analysed previously, market competition encourages firms to pursue efficiency and to take advantage of comparative advantages, and as economic transition proceeds, it is expected that manufacturing industries become more concentrated in places which are endowed with comparative advantages. The second column in Table 1 reports the results of simple regressions, and shows that most of the industries have become more spatially concentrated since the early 1980s, with increasing shares in the coastal provinces. Among 26 manufacturing industries, only petroleum refining and coking, medical and pharmaceutical products, ferrous metal smelting and pressing, and non-ferrous metal smelting and pressing experienced drops in Gini coefficients. Leather and fur, clothing and other fibres, and furniture making have concentrated faster than others, as revealed by larger standardized regression coefficients on TIME. These results imply that market forces and globalization may have fostered industrial concentration in China.

Results from the nonlinear regressions indicate that no significant nonlinear trends exist for the two highly protected industries, beverages and medical and pharmaceutical products. The tobacco industry experienced a concentration process but is showing signs of dispersion due to local protectionism. Petroleum refining and coking have been increasingly dispersed during the last two decades. Moreover, two highly globalized industries, clothing and other fibre products, and leather and fur products are increasingly clustered.

A group of industries has experienced significant spatial dispersion in the 1980s but concentration in the 1990s, and includes timber processing, paper making and paper products, printing and copying, chemical materials and products, chemical fibres, rubber products, ferrous metal smelting and pressing, non-ferrous metal smelting and pressing, metal mineral products, and machinery. They are resource-based or capital intensive, and have also become more concentrated in the coastal provinces.

Another group of industries also experienced some spatial dispersion in the 1980s but has become increasingly concentrated since the 1990s, and includes food, textiles, furniture, cultural, education and sporting goods, plastic products, non-metal mineral products, transportation equipment, electrical machinery and equipment, electronics and telecommunication equipment, instruments and meters. These industries are either labour intensive or highly globalized.

Spatial patterns of industrial distribution

Most highly concentrated industries are located in Guangdong, Jiangsu, Zhejiang, Shanghai and Shandong. The top four provinces produced more than 60% of value added in these industries. For instance, 74% of cultural, education and sporting goods were produced by Guangdong, Zhejiang, Jiangsu and Shanghai, and 74% of chemical fibres produced in Jiangsu, Zhejiang, Shandong and Fujian (Table 1).

The least protected industries are more likely to choose locations in line with comparative and competitive advantages, and also those that are more geographically concentrated. Meanwhile, such industries have been increasingly clustered in fewer provinces. Figs 6

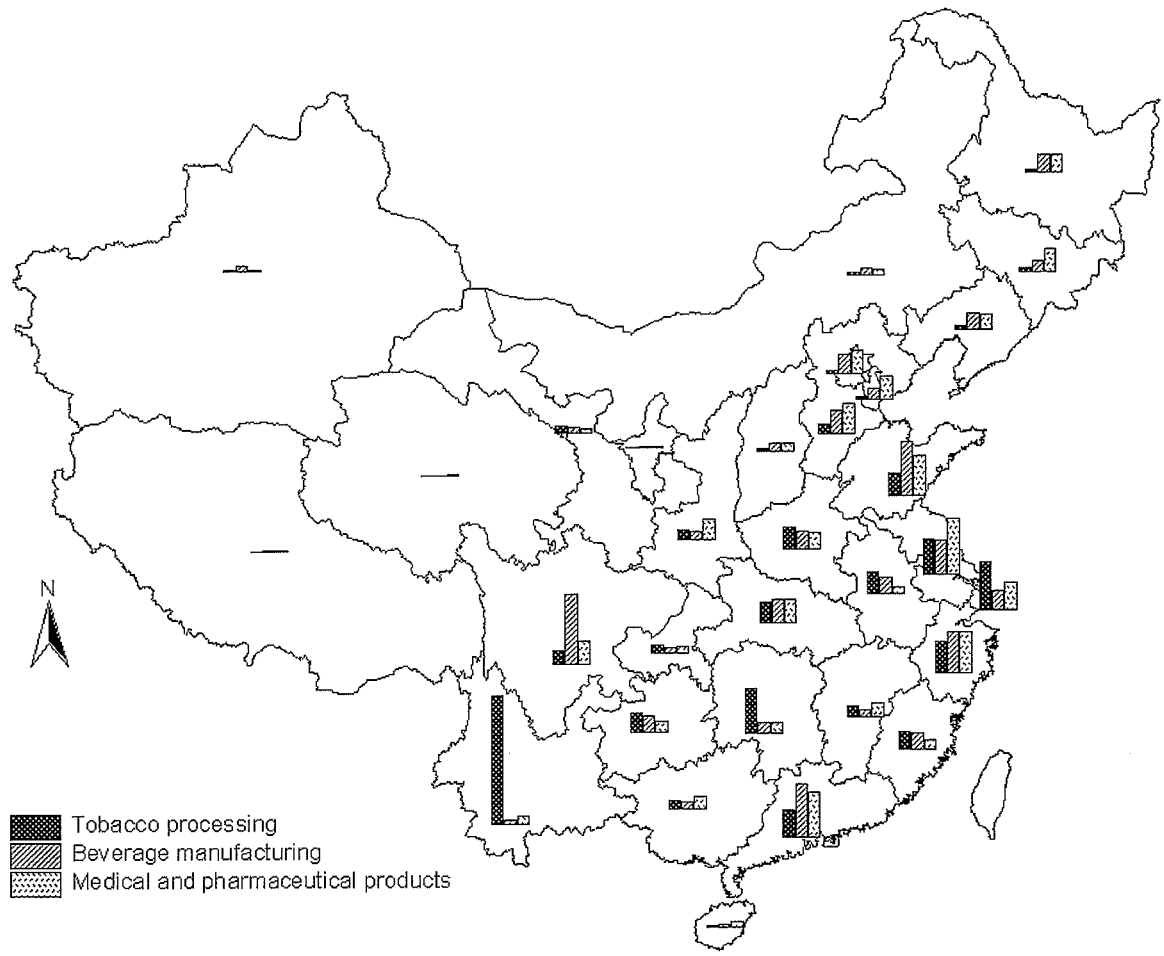

Fig. 6. Spatial distribution of most protected industries, 2003

and 7 compare the spatial distribution of two types of industries. Clearly, protected industries are further spread out while least protected industries are largely concentrated in the coastal provinces, including Guangdong, Jiangsu, Zhejiang, Shanghai and Shandong. Local protectionism may have discouraged industrial specialization in China.

Most globalized industries have been increasingly concentrated in the coastal region given its special locational advantages (Fig. 8). In 2003, some 58% of value added in clothing was generated from Guangdong, Jiangsu and Zhejiang, while Guangdong, Fujian and Zhejiang were responsible for 57% of value added in leather and fur products. Electronics and telecommunication equipment is the most concentrated, with 65% of value added from Guangdong, Jiangsu and Shanghai. Globalized industries agglomerate in the coastal region to take advantage of favourable policy treatment, good access to international markets and developed infrastructure. On the contrary, spatial restructuring of domestically oriented industries has been less significant. They are also less concentrated, with Gini coefficients less than 0.60 since they serve the localized markets and value the domestic market access. Many of the least globalized industries have a substantial presence in the central region (Fig. 9).

To test whether industries are spatially clustering around neighbouring provinces, the authors computed the global Moran's *I* for each industry in 1980, 1990, and 2003, and tested their significance using value-added data (Table 2). Geographical factors, including intra-industrial linkages, resources and market sharing, and the spatial division of labour along value chains, lead to spatial autocorrelation or clustering of industries. This analysis indicates that spatial autocorrelations occur in the following industries: machinery equipment, metal mineral products, non-metal mineral products, plastic products, chemical materials and chemical products, paper making and paper products, timber processing, leather and fur, clothing and other fibres, and textiles. Chemical fibres, rubber products, electrical machinery and equipment, ferrous metal smelting and pressing have also been regionalized since the 1990s. Many of these industries are resource-intensive, demanding regionalized resource inputs; others may share good market access or locations.

Machinery has the highest Moran's *I* (0.36), clustering in the Yangtze Delta, followed by timber processing

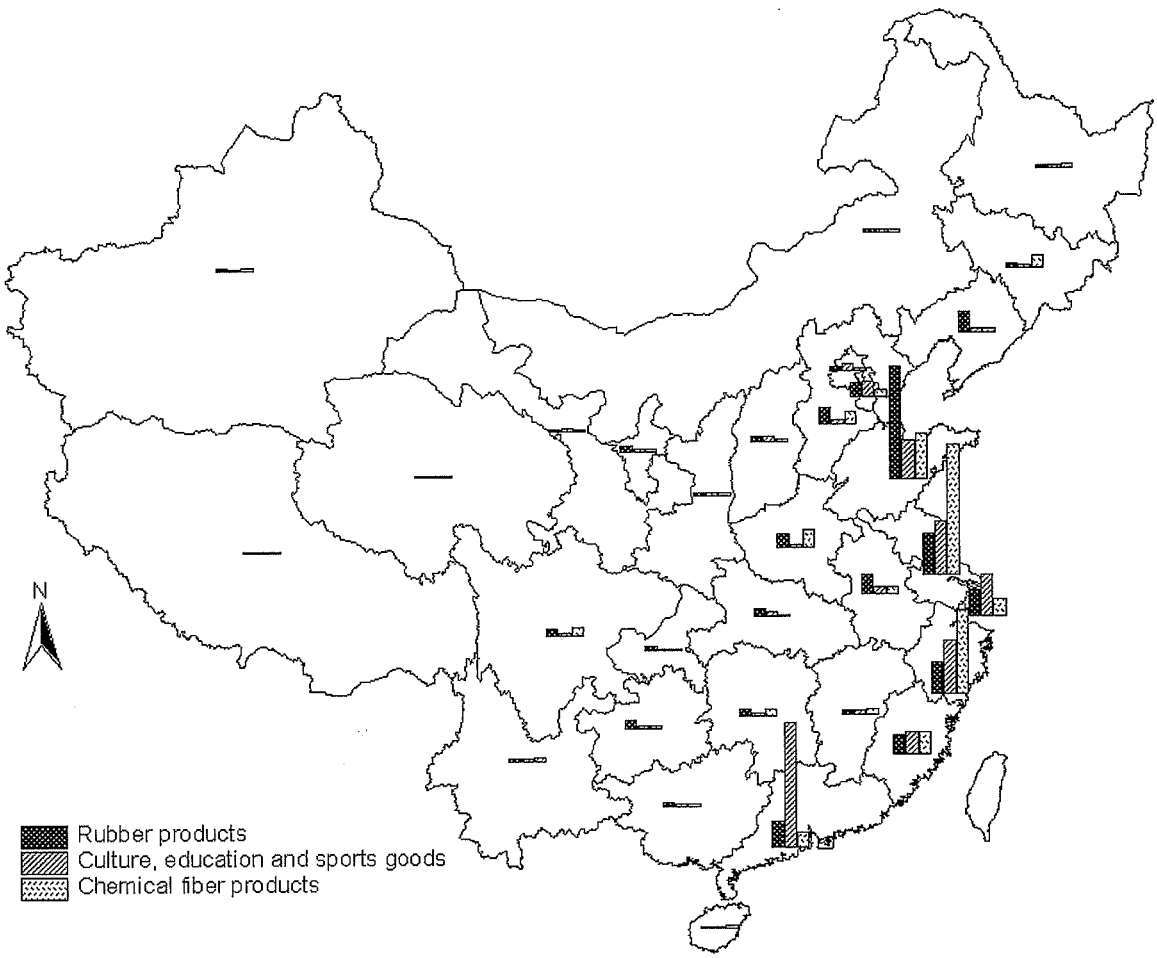

Fig. 7. Spatial distribution of least protected industries, 2003

with a Moran's *I* of 0.31, agglomerating in the north-east China and the Yangtze Delta. On the other hand, industries like food, beverages, tobacco, furniture, electronics and telecommunication equipment, and instruments and meters have shifted from significantly regionalized spatial patterns to randomly concentrated patterns. In addition, printing and copying, cultural, education and sporting goods, petroleum refining and coking, medical and pharmaceutical products, non-ferrous metal smelting and pressing, and transportation equipment have never been spatially autocorrelated. Highly protected industries such as food, beverages, tobacco, medical and pharmaceutical products, and transportation equipment are not clustered around neighbouring provinces since they spread out in many provinces.

MODELLING DETERMINANTS OF GEOGRAPHIC CONCENTRATION

Variables and models

To understand further the significant industrial variations in the geographical concentration of industries, the authors perform a systematic test of the determinants of geographical concentration. As discussed previously, foreign investment and exports may have reinforced China's comparative advantages, hence leading to the spatial concentration of Chinese industries. To test the globalization effects, this paper constructs two variables: the ratio of gross output by foreign enterprises in each industry (**FDI**) and the ratio of export to total sales (**EXPT**). *China Industry Economy Statistical Yearbooks* (SSB, 2002a–2004a) report exports by industry only from 2001. The authors expect positive significant coefficients on both variables.

Local protectionism is difficult to proxy since local governments exercise a variety of measures to protect local industries. According to DRCSC (2004), local governments protect local industries to improve tax revenues and promote economic growth. We apply three variables to proxy the extent of local protectionism. An industry's ratio of value-added to gross industrial output (**VAL**) assesses its contribution to gross regional product. The ratio of value-added tax to value added (**TAX**) and ratio of sales profit to gross industrial output (**PRFT**) provides measures of an industry's

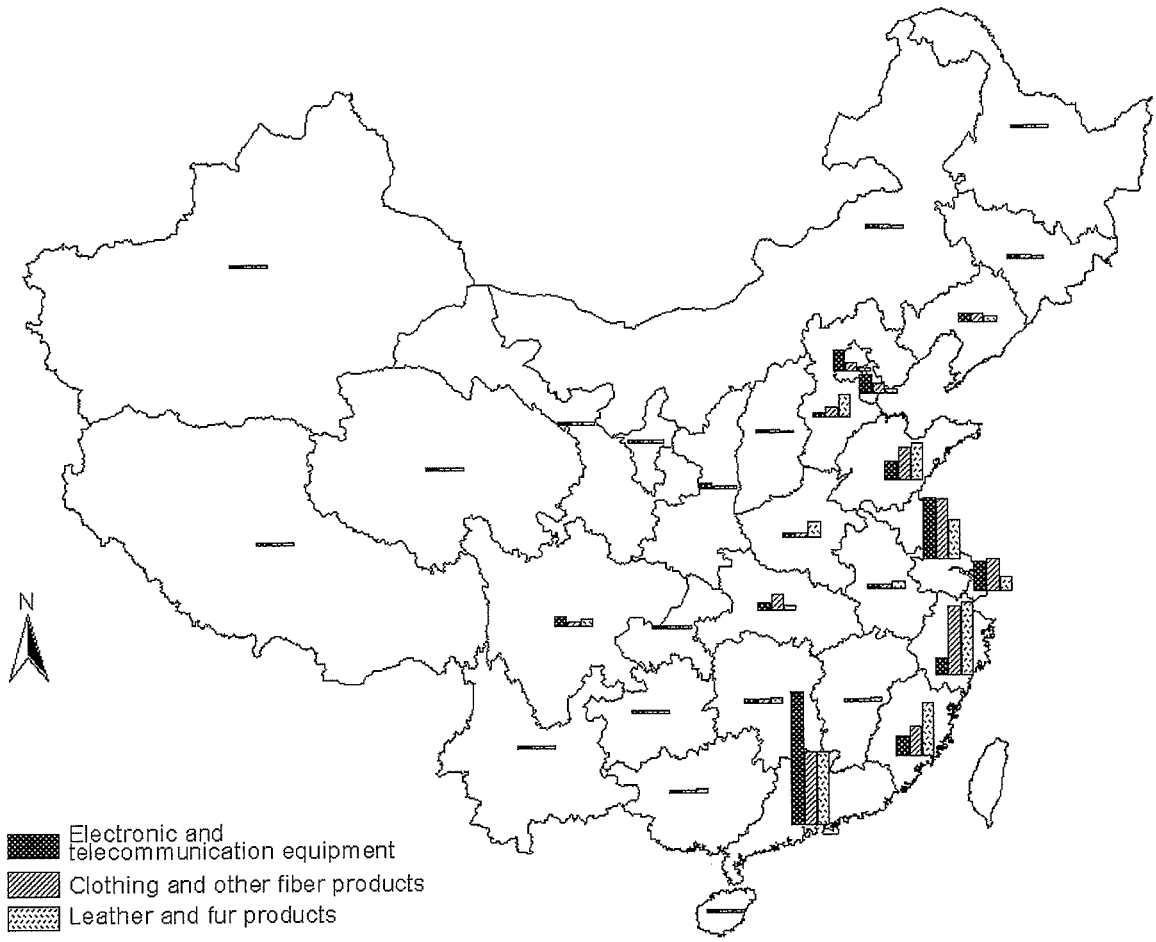

Fig. 8. *Spatial distribution of most globalized industries, 2003*

contribution to local revenues. High value-added industries with larger profit and tax margins are highly protected. For instance, tobacco and alcohol products rank as the most protected, and the ratios of value added for tobacco processing and beverage manufacturing were 70% and 36% respectively in 2003, ranking as the top two. Their profit margins and tax contributions were also among the highest. Indeed, DRCSC (2004) found significant and positive relationships between the extent of being protected and the above three variables.

As argued in the literature, local governments also have strong incentives to protect SOEs, since they have many more ways of milking them. For example, local government officials can arrange employment for their relatives, friends and political supporters in the SOEs; local governments can also divert money from the SOEs to public works at best and personal use at worst. Advertising and sponsorship by SOEs in government-led activities are considered politically correct and actively encouraged (Bai *et al.*, 2004). SOEs therefore may indirectly influence the three protectionism variables. To consider the indirect influence of SOEs, this study applies the share of gross output of SOEs in an industry (STATE) to represent the significance of SOEs, and introduce the interactions of STATE and each of the three protectionism variables. The authors expect the highly protected to be more geographically dispersed and would expect negative coefficients on these variables.

Economic transition introduces market forces and competition, providing firms with incentives to act rationally and independently, and this paper hypothesizes that under marketization, industries would choose locations with comparative advantages. Differing factor intensities across industries may induce regional specialization and geographical concentration of industries. Assuming a lumpy distribution of factor endowments, the more intensive an industry is in the use of a certain factor, the more concentrated it would be. This analysis introduces the intensity of agricultural input (**AGR**), input from mining industries (**MIN**), Labour intensity (**LAB**) and technology intensity (**TECH**) to test the impact of comparative advantages on the geographical concentration of Chinese industries. Data from the 1997 national input output table has been collected to quantify the intensity of agricultural input and mineral resource input. AGR is the ratio of intermediate input from the primary industries in total input, and MIN the ratio of intermediate inputs from mining industries in total input. Following

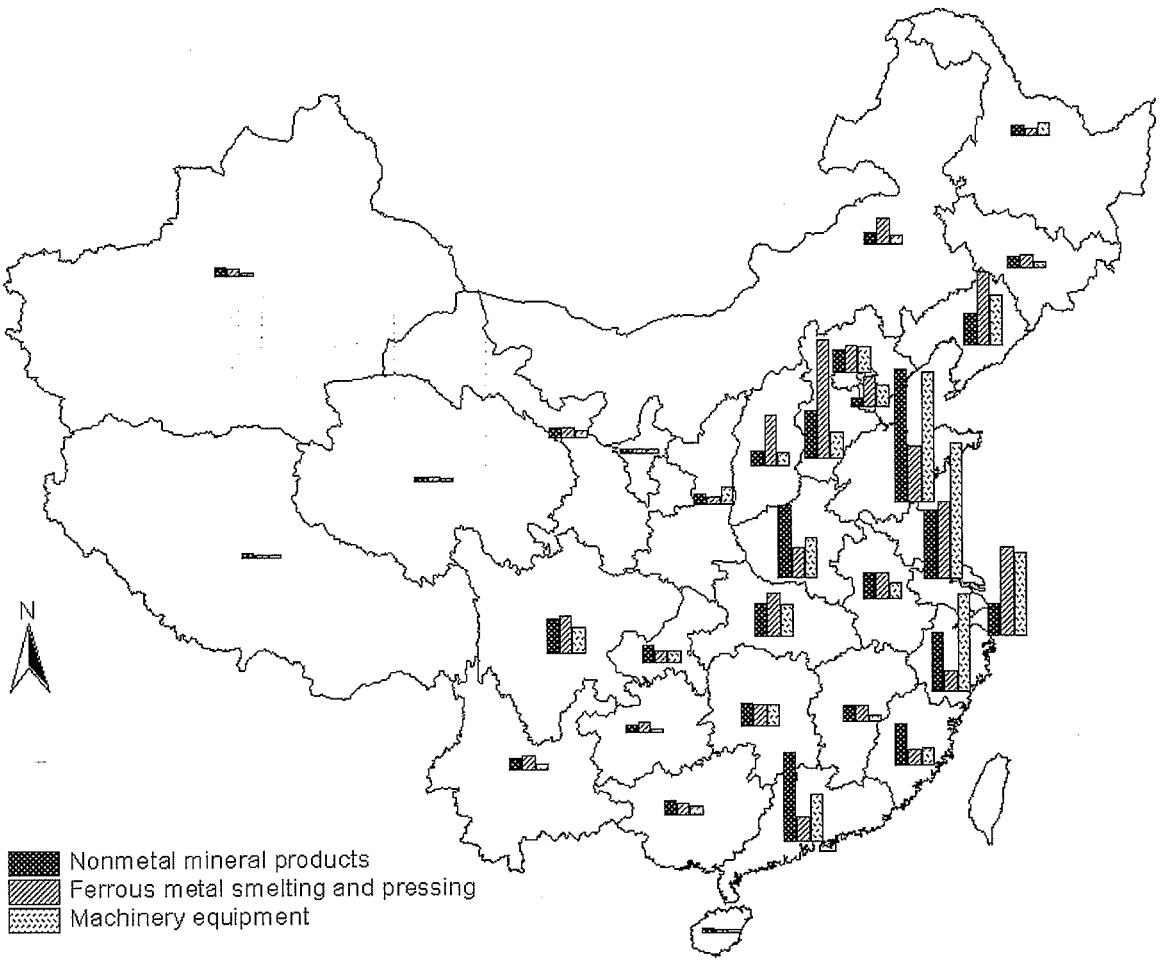

Fig. 9. Spatial distribution of least globalized industries, 2003

AMITI (1999), this study measures labour intensity of industry i as follows:

$$LAB_i = \left| \frac{\sum_j E_{ij}}{\sum_j VA_{ij}} - \frac{\sum_j \sum_i E_{ij}}{\sum_j \sum_i VA_{ij}} \right| \quad (4)$$

where E and VA are the employment and value-added. A high value of LAB signals that the industry in question differs from the average industry in terms of labour use. The authors proxy differences in technology by differences in labour productivity, defined as value added per worker. Following TORSTENSSON (1996), define the technology intensity index is defined as follows:

$$TECH_i = \sqrt{\frac{1}{n}\sum_j \left(\frac{VA_{ij}/E_{ij}}{1/n\sum_j VA_{ij}/E_{ij}} - \frac{\sum_i VA_{ij}/E_{ij}}{1/n\sum_j \sum_i VA_{ij}/E_{ij}} \right)^2} \quad (5)$$

where E and VA are the same as in equation (4), n is the number of provinces. Positive coefficients on the intensity variables are anticipated.

Internal and external scale economies may stimulate spatial clustering of industries. Typically, industries equipped with sophisticated technology bear strong internal scale economies. The authors apply an additional size variable to proxy the degree of internal scale economies, the average plant size, defined as the total employment divided by the number of enterprises (**SIZE**). To realize internal scale economies, industries may cluster in locations with large market potential. The authors expect a positive coefficient on SIZE.

Industrial linkages are used to proxy pecuniary externalities. VENABLES (1996) noted the importance of industrial linkages in stimulating industrial agglomeration. A large number of downstream firms attract upstream firms due to demand linkages, while upstream firms are encouraged to locate close to downstream firms for cost reasons. KRUGMAN and VENABLES (1996) argued that input-output linkages between firms in the same sector are stronger than between firms in different sectors. Using the 1997 input-output table, the intra-industry linkage (**INTRA**) and

Table 2. Moran's I for Chinese manufacturing industries

Sector	1980	1990	2003	1980–2003 Change
S13	0.23**	0.12	0.14	−0.09
S15	0.20**	0.13	−0.10	−0.30
S16	0.26***	0.10	0.07	−0.19
S17	0.28***	0.39***	0.29***	0.01
S18	0.23**	0.18*	0.28***	0.05
S19	0.25***	0.13	0.27***	0.02
S20	0.17*	0.29***	0.31***	0.14
S21	0.23**	0.09	0.04	−0.19
S22	0.18**	0.20**	0.18*	0.00
S23	0.11	0.16*	0.11	0.00
S24	0.07	0.14	0.14	0.07
S25	−0.05	−0.03	0.01	0.06
S26	0.15*	0.20**	0.17*	0.02
S27	0.13	0.10	0.10	−0.03
S28	0.06	0.24**	0.29***	−0.23
S29	0.08	0.27***	0.24**	0.16
S30	0.35***	0.27***	0.19**	−0.16
S31	0.27***	0.26***	0.23**	−0.04
S32	−0.01	0.01	0.26***	0.25
S33	−0.18		0.03	0.21
S34	0.18*	0.21**	0.17*	−0.01
S35	0.17*	0.25***	0.36***	0.19
S37	0.09	0.08	0.12	0.03
S40	0.13	0.13	0.16*	0.03
S41	0.21**	0.11	0.04	−0.17
S42	0.17*	0.25**	0.08	−0.09

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

inter-industry linkage (**INTER**) are defined as follows:

$$INTRA_i = 100 * \frac{X_{ii}}{X_{i.}}$$

$$INTER_i = \frac{1}{2} \times 100 \left(\sum_{i=1, \neq j} X_{ij}/X_{i.} + \sum_{j=1, \neq i} X_{ij}/X_{.i} \right) \quad (6)$$

where X_{ij} is the value flow from industry i to industry j, and X_i represents the total output and total input of industry i. Industrial linkages with primary, construction, and tertiary industries are not included. The input-output table is widely applied to quantify industrial technological linkages, and is assumed to be stable during five-year time periods. It is acceptable to measure intra- and inter-industry linkages using the 1997 input–output table since it is the most recent publicly available data. Strong intra-industry and inter-industry linkages are assumed to cause a geographical concentration of Chinese industries.

External economies may also arise from technological externalities, which are extremely difficult to measure directly. The share of engineers and technicians in an industry's employment (**RND**) may offer a proxy for both labour market pooling and knowledge spillovers. To test whether knowledge spillovers contribute to the spatial clustering of Chinese industries, this study introduces the variable of RND and anticipates a positive coefficient.

Finally, as discussed, the geographical concentration of industries differs significantly in inland and coastal provinces. The paper introduces a regional variable to distinguish the inland and coastal provinces, and define the controlling variable as the share of industrial value added in the coastal provinces for each industry (COAST). The coastal region is more integrated into the globalization process, and is also the first to exercise power decentralization and experiment with a market economy. The concentration of industrial activities towards the coast represents the extent to which industry has benefited from the economic transition. The controlling variable is expected to have a significant positive coefficient. The definitions of variables are present in Table 3.

Since Gini coefficients have values ranging between 0 and 1, the authors conduct a logistic transformation of the dependent variable and consider the following panel structure because there are several industry-specific variables:

$$\begin{aligned} Ln\frac{GINI_{it}}{1 - GINI_{it}} = {} & \beta_0 + \beta_1 FDI_{it-1} + \beta_2 EXPT_{it-1} \\ & + \beta_3 VAL_{it} + \beta_4 TAX_{it} \\ & + \beta_5 PRFT_{it} + \beta_6 AGR_i \\ & + \beta_7 MIN_i + \beta_8 LAB_{it} \\ & + \beta_9 TECH_{it} + \beta_{10} LSIZE_{it} \\ & + \beta_{11} INTRA_i + \beta_{12} INTER_i \\ & + \beta_{13} RND_{it} + \beta_{14} COAST_{it} \\ & + \lambda_t + \varepsilon_{it} \end{aligned} \quad (7)$$

where i denotes industry, t denotes time from 1998 to 2003, λ_t is the unobservable time effect, and ν_{it} is the remainder stochastic disturbance term. Note that λ_t is industry-invariant and accounts for any time-specific effect that is not accounted for by the regression. This is particularly important for the analysis because of the increasing trend of geographical concentration of industries after the 1990s. Failing to account for time-specific effects may result in a biased assessment of geographical concentration of industries. Data on AGR, MIN, INTRA and INTER are compiled from the 1997 national input and output and are assumed to be industrial specific and timely constant. To mitigate the potential endogeneity problem associated with foreign investment and export, both FDI and EXPT are lagged by one year.

There are three statistical models for a pooled time-series and cross-sectional data set: the ordinary least squares (OLS) model, random effect model (REM) and fixed effect model (FEM). The choice between OLS and FEM/REM is made based on the traditional

Table 3. Definitions of dependent and explanatory variables

Variable	Definition		Expected sign
GINI	Gini coefficients of value added and employment	(Dependent)	
FDI	Ratio of gross output by foreign-invested enterprises	Globalization	+
EXPT	Ratio of exports in gross sales value (only with three year data)	Globalization	+
VAL	Ratio of value added in gross industrial output	Decentralization	−
PRFT	Ratio of sales profit to gross industrial output	Decentralization	−
TAX	Ratio of value added tax to value added	Decentralization	−
STATE	Share of gross industrial output of state own enterprises	Decentralization	−
AGR	Ratio of intermediate inputs from the primary industry	Marketization	+
MIN	Ratio of intermediate inputs from mining industries	Marketization	+
LAB	Relative labour intensity	Marketization	+
TECH	Relative technology intensity	Marketization	+
SIZE	Average employees per enterprise	Marketization	+
INTER	Ratio of intermediate sale to and purchase from other industries	Marketization	+
INTRA	Ratio of intermediate inputs from own industry	Marketization	+
RND	Number of engineers and technicians per 10,000 employees	Marketization	+
COAST	Share of industrial value added in the coastal provinces	Globalization	+

Lagrange multiplier (LM) test, while selection between FEM and REM is based on Hausman's test.

Results

Table 4 presents the correlation coefficients between explanatory variables. It is not surprising that FDI and EXPT are strongly correlated with a coefficient of 0.81, given the fact that more than half of exports in China are conducted by foreign enterprises. The variable COAST is also strongly related to FDI and EXPT, with a correlation coefficient greater than 0.75. To avoid the collinearity problem and consider the shorter period of data for EXPT, the study only includes the variable of FDI in the models. The authors also introduce the interaction of FDI and COAST into the models to confirm the impact of globalization on the geographical concentration of Chinese industries. The variable STATE is significantly correlated with several variables, including FDI, EXPT, TAX, SIZE and COAST. To test the significance of provincial protectionism, the analysis also includes the interactions of STATE and each of the three protectionism variables in the different model specifications.

Table 5 reports three sets of model specifications, with each of the three protectionism variables in different models. Model 1 is the benchmark model; model 2 replaces FDI with the interaction of FDI and COAST; model 3 substitutes each of the three protectionism valuables with their interactions with STATE. The dependent variable is the Gini coefficient of industrial value-added. Lagrange multiplier tests suggest no necessities of FEM or REM estimations. Breusch-Pagan tests indicate the existence of heteroscedasticity, and we corrected the estimated results using the White's heteroscedasticity method.

Statistical results provide strong evidence to support the argument that trade and investment liberalization has promoted the geographical concentration of industries in China. This is shown by the highly significant and positive coefficients on FDI. It is also confirmed that exporting elevates the spatial clustering of Chinese industries since FDI is strongly correlated to EXPT. In model 2, the interaction of FDI and COAST is also highly significant in all model specifications. The replacement of FDI with FDI*COAST makes the models fit better, with greater values of R-squares, and the coefficients on FDI*COAST are also larger. Utilization of foreign investments and exploitation of international markets strengthen the comparative advantages based on cheap labour and reinforce the locational advantages derived from easy access to international markets in the coastal provinces.

Ratio of value added (VAL) is not significant although it holds the expected sign, but significant negative coefficients on PRFT and TAX indicate that provincial protectionism has discouraged industrial concentration. Industries with high profit and tax margins are more dispersed, suggesting that provincial governments protect these industries to improve revenues. The introduction of STATE*VAL, STATE*PRFT and STATE*TAX into model 3 does not change the results. The coefficients on STATE*PRFT and STATE*TAX are still negative and highly significant, confirming the impact of provincial protectionism on the geographical dispersion of Chinese industries.

Power decentralization discourages industrial specialization since provincial governments compete economically and politically (Lee, 1998), while introducing market forces may foster industrial specialization in line with comparative advantages. However, the variables of resource intensity (AGR, MIN and LAB) have unexpected negative signs. No positive relationship between resource intensities and geographical concentration of industries is found because this study uses

Table 4. Correlation coefficients among explanatory variables

	FDI	EXPT	VAL	PRFT	TAX	STATE	AGR	MIN	TECH	LAB	LSIZE	INTRA	INTER	RND	Coast
FDI	1.00														
EXPT	**0.81****	1.00													
VAL	−0.34**	−0.29**	1.00												
PRFT	−0.20**	−0.34**	**0.59****	1.00											
TAX	**−0.69****	−0.76**	0.30**	0.49**	1.00										
STATE	−0.68**	−0.66**	0.48**	0.31**	0.69**	1.00									
AGR	−0.09	−0.20	0.12	−0.20**	−0.14	0.04	1.00								
MIN	−0.43**	−0.30**	−0.21**	−0.30**	0.41**	0.45**	−0.19*	1.00							
TECH	0.18*	0.16	−0.018	−0.10	−0.23**	−0.07	−0.05	0.09	1.00						
LAB	0.15*	0.61**	−0.37**	−0.23**	−0.27**	−0.51**	−0.13	−0.24**	−0.43**	1.00					
LSIZE	−0.33**	−0.06	0.28**	0.05	0.38**	0.66**	−0.25**	0.33**	0.06	−0.21**	1.00				
INTRA	−0.04	−0.06	−0.17*	−0.07	0.07	0.11	−0.20*	−0.02	−0.02	−0.05	0.31**	1.00			
INTER	−0.12	−0.09	−0.47**	−0.23**	0.14	**−0.05**	**−0.54****	0.37**	0.13	0.06	0.09	0.05	1.00		
RND	−0.15	−0.30**	−0.04	0.32**	0.37**	0.52**	−0.33**	0.20**	0.04	−0.43**	**0.53****	0.38**	0.17*	1.00	
Coast	0.75**	0.77**	−0.57**	−0.35**	−0.65**	−0.74**	−0.28**	−0.31**	0.17	0.40**	**−0.30****	−0.07	0.27**	−0.21**	1.00

Notes: **Significant at the 0.01 level; *significant at the 0.05 level.

Table 5. Determinants of geographical concentration of Chinese industries

Variables	Model 1			Model 2			Model 3		
Constant	−2.81***	−0.79**	−1.57***	−2.53***	−0.89**	−1.53***	−2.90***	−2.99***	−3.43***
FDI	1.61***	1.04***	0.90***				1.93***	1.14***	1.23***
FDI*COAST				2.05***	1.37***	1.20***			
VAL	−0.75			−0.03					
PRFT		−8.19***			−6.78***				
TAX			−7.80***			−6.49***			
STATE*VAL							0.40		
STATE*PRFT								−5.86***	
STATE*TAX									−5.26***
AGR	−0.42	−1.33***	−0.61***	−0.03	−0.10***	−0.44***	−0.13	−0.56**	−0.33
MIN	−1.37***	−2.29***	−0.93***	−0.95***	−1.97***	−0.88***	−0.95***	−1.56***	−0.74**
LAB	−0.12	−0.36*	−0.32*	0.14	−0.31	−0.27*	0.47	−0.51**	−0.49*
TECH	0.13**	0.12***	0.003	0.12**	0.10**	0.003	0.17***	0.08	0.04
LSIZE	0.56***	0.40***	0.52***	0.43***	0.37***	0.48***	0.44***	0.65***	0.71***
INTER	0.53**	0.06	0.67***	0.69***	0.16	0.66***	0.83***	0.31*	0.50***
INTRA	−0.59***	−1.07***	−0.59***	−0.37**	−0.91***	−0.52***	−0.37*	−0.70***	−0.70***
RND	−0.09***	−0.03**	−0.05***	−0.06***	−0.3**	−0.05***	−0.06***	−0.06***	−0.62***
Observed	168	168	168	168	168	168	168	168	168
Adjusted R^2	0.68	0.78	0.81	0.75	0.82	0.83	0.68	0.72	0.71
F-value	36.91	60.69	71.17	51.79	75.88	81.31	36.70	43.11	42.78
Breusch-Pagan χ^2	25.57	26.06	67.33	24.60	29.36	65.87	24.95	31.73	45.17
D-W	1.80	1.77	2.04	1.79	1.78	2.00	1.83	1.79	1.83

Notes: $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Results are corrected with heteroscedasticity; numbers in parenthesis are *t* values.

province as the spatial unit of analysis, and mineral resources and agricultural products are fairly distributed in most provinces. The negative and significant coefficients on the intensity of agricultural inputs (AGR) and the intensity of mining industries (MIN) imply that Chinese industries have followed the less mobile resources. Labour intensity (LAB) has a negative impact but is weakly significant, which might relate to provincial protectionism since local governments have strong incentives to protect industries with high intensity of employment. At the provincial levels, resource intensive industries are indeed geographically dispersed. In 2003, the least concentrated industries include non-ferrous and ferrous metal smelting and pressing, medical and pharmaceutical products, petroleum refining and coking, non-metal mineral products, food processing and manufacturing, and beverage manufacturing. Most of these dispersed industries heavily rely on the consumption of resources.

Technology intensity has a positive and significant effect on the geographical concentration of industries. Other things being equal, industries equipped with sophisticated technologies typically bear strong internal scale economies, and are more concentrated. The significant and positive coefficients on LSIZE suggest that industries with larger enterprises are more geographically concentrated. Dual significance of TECH and LSIZE supports the argument that internal scale economies lead to geographical concentration of industries.

Intra-industry and inter-industry linkages are applied to proxy for pecuniary externalities while research and development employees (RND) are proxy for technological externalities.

INTER has a significant positive coefficient when controlling for the ratio of value added (VAL) or tax rate (TAX), indicating that strong inter-industrial linkages may foster industrial concentration. However, INTRA has a significant unexpected negative sign, suggesting that strong intra-industry linkages discourage geographical concentration. It is also found that industries with larger numbers of engineers and technicians (RND) are more spread out. This confirms the fact that SOEs, which tend to have more engineers and technicians than non-state enterprises, are more dispersed across China. Overall, pecuniary and technological externalities have not contributed to the geographical concentration of industries at the provincial level. These results seem surprising, but are consistent with new economic geography models which argue that input-output linkages in promoting agglomeration might be weakened by the opening up of a closed economy to international trade (KRUGMAN and ELIZONDO, 1996). When the economy is closed, firms located in industrial cores have the best access to both domestically produced inputs and the domestic market, while opening the economy by allowing firms to import inputs and sell goods abroad weakens the linkage advantages of core locations. In China, many manufacturing industries, even capital- and technology-intensive industries such as automobile manufacturing and electronics, focus on labour-intensive assemblies, heavily relying on imported materials and intermediate goods.

Furthermore, provincial governments have strong incentives to protect industries with strong intra-industrial linkages because those industries are both strategic and key industries to realize industrialization, such as transportation equipment and mineral smelting and pressing (DRCSC, 2004). Provincial governments also compete or imitate mutually to attract so-called high-technology industries to upgrade local industrial structure. Provincial protection and competition may have caused industries with strong industrial linkages and high-tech industries to disperse in space. The dispersion forces associated with provincial protectionism and inter-regional competition have dominated the centralization forces resulting from the technological and pecuniary externalities.

Another important reason why those variables hold unexpected signs might be associated with this paper's larger spatial unit of analysis – province. MAUREL and SEDILOT (1999) argued that when the information spillover effects decline rapidly with distance, the choice of the geography level should matter in determining the degree of industrial agglomeration. ROSENTHAL and STRANGE (2001) found that proxies for knowledge spillovers are significant only at zip code level in the United States. Given the imperfect market conditions in China, knowledge spillover across provinces may not be significant.

To check the robustness of the regression results, the authors classified 28 manufacturing industries into two categories: Labour and resource intensive industries and capital and technology intensive industries.[1] We classify Chinese industries based on ZHANG (1993) and CATIN *et al.* (2005). The estimated results from the two sub-samples confirm the findings discussed above (Table 6). Globalization forces and internal scale economies have driven the spatial concentration of both types of industries while provincial protectionism indeed serves as a centrifugal force. Research-oriented industries are more dispersed and industries have followed the less mobile resource inputs. Ratio of value added (VAL) has a highly significant negative coefficient for labour and resource intensive industries, while also showing an unexpected positive coefficient for capital and technology intensive industries. This indicates that provincial governments protect labour and resource intensive industries not only to improve provincial revenues but also to promote economic growth. Both intra- and inter-industrial linkages do not significantly influence spatial patterns of labour and resource intensive industries, while stronger intra-industrial linkages significantly discourage the geographical concentration of capital and technology intensive industries. Provincial governments have strong incentives to protect industries strongly linked to other industries, offsetting the centripetal force associated with industrial linkages. Compared with capital and technology intensive industries, labour and resource intensive industries are more involved with globalization and heavily rely on external linkages, reducing the importance of local industrial linkages.

CONCLUSION

China's economic transition has gradually introduced global and market forces into the economic system,

Table 6. Determinants of geographical concentration of Chinese industries by sector

	Labour and resource-intensive industries			Capital and technology-intensive industries		
Variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	−0.67	−0.99	−0.54	−2.05***	−0.60	−1.64***
FDI	0.98***	1.19***	1.30***	1.87***	1.27***	1.25***
VAL	−5.85***			0.34		
PRFT		−6.10***			−6.22***	
TAX			−7.48***			−5.38***
AGR	−1.07***	−0.92***	−0.73***	−4.46***	−4.09***	−2.63***
MIN	−3.03***	−4.05***	−1.77***	−1.38***	−2.20***	−1.27***
LAB	−1.08**	−0.28	0.15	−0.63*	−0.81***	−0.74***
TECH	0.04	0.06	−0.04	0.06	0.07	−0.02
LSIZE	0.57***	0.38***	0.28***	0.52***	0.46***	0.57***
INTER	−0.0005	0.28	0.12	0.17	−0.32*	0.44
INTRA	−0.25	−0.07	0.44**	−1.72***	−2.00***	−1.71***
RND	−0.19**	−0.15*	0.05	−0.15***	−0.10***	−0.09**
Observed	84	84	84	84	84	84
Adjusted R^2	0.86	0.84	0.90	0.77	0.84	0.80
F value	50.01	43.01	72.98	28.55	42.09	33.77
Breusch-Pagan χ^2	24.00	30.37	17.20	8.15	9.58	14.80
D-W	2.17	2.28	2.60	2.19	2.28	2.30

Notes: $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Results are corrected with heteroscedasticity; numbers in parenthesis are t-values.

and through decentralization local governments are granted authorities and responsibilities for local economic development. This paper hypothesizes that marketization and globalization may stimulate the spatial clustering of industries to exploit locational and comparative advantages, while decentralization leads to provincial protection and competition, causing industries to disperse. Using industrial-provincial data gathered during 1980–2003, this paper has systematically examined the geographical concentration of Chinese manufacturing industries.

Overall, the country's manufacturing employment has been increasingly concentrated since the early 1980s, while industrial output experienced a decentralization process in the 1980s but a centralization process since the early 1990s. Chinese provinces have also become less specialized, with more diversified industrial structures. The authors also found significant industrial variations in the trend and level of geographical concentration. Highly protected industries such as tobacco, beverages and medical and pharmaceutical products are more dispersed and show no significant trend of centralization, while less protected industries such as rubber products, chemical fibres and cultural, education and sporting goods are much more concentrated and have become increasingly concentrated. Moreover, the distribution of many globalized industries and resource-intensive industries such as textiles, clothing, leather and fur, timber processing, chemical fibres, rubber, plastics, non-metal mineral products and ferrous metal smelting and pressing are spatially autocorrelated, with regional clusters in the Yangtze Delta.

Industries with larger shares of foreign enterprises and exports are found more concentrated than others, and statistical results indicate that globalization forces have significantly affected the coastal shift of Chinese industries. The authors also found strong evidence to support the argument that provincial protectionism has hurdled industrial specialization. Intensities of agricultural and mineral inputs have had negative effects on the concentration index, implying that Chinese industries have followed the less immobile resources to capitalize the comparative advantage embedded in natural resource endowments.

Industries equipped with sophisticated technologies are fairly clustered. Those industries usually have significant internal scale economies, which cause industrial concentration. Inter-industry linkage also stimulates the spatial concentration of Chinese industries. But strong intra-industrial linkages have encouraged the spatial dispersion of industries. The research-oriented industries are also less clustered. Such an influence of technology and pecuniary externalities could be due to the large spatial scale used in this study. Provincial governments have strong incentives to protect high-tech industries and industries with strong linkages.

This study shows the limits and power of the theoretical models in explaining geographic concentration of industries. This work indicates that whether theoretical models work or not depends on country-specific contexts, reflected in institutional change, geographical structure, and even 'the effects of history' (STORPER *et al.*, 2002). Economic transition and its consequences are critical in understanding the spatial patterns of Chinese industries. New economic geography models, which assume away the role of institutions and policies, may have limited explanatory power for industrial location in transitional economies. These finding on the significance of globalization forces in reinforcing geographic concentration seems consistent with many other findings on the effects of globalization (SHELBURNE and BEDNARZIK, 1993; SJOBERG and SJOHOLM, 2004). Such a finding has also been confirmed by case studies on finer geographical scales in China, particularly in Guangdong and Jiangsu provinces (e.g., GU *et al.*, 2001; WEI, 2004).

Future studies should investigate the locational patterns of industries on finer spatial scales. Also further effort should be made to examine how geographically concentrated the disaggregated industries are and what factors are affecting their geographical patterns. Since two digit industries aggregate three digit and four digit industries, it is possible that industrial aggregation might influence findings. For instance, four digit industries usually are distributed along a value chain, resulting in much stronger industrial linkages and much more industrial concentration. Moreover, local governments typically protect particular products in a two-digit industry. For example, beverage manufacturing is highly protected because of beer and alcohol production. Industrial aggregation therefore might conceal substantial inter-sub-industry differences, and an investigation of disaggregated industries will advance knowledge of the geographical concentration of Chinese industries.

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NOTE

1. Labour and resource intensive industries include food processing, food manufacturing, textiles, clothing and other fibre products, leather and fur products, wood processing and wood products, furniture making, paper making and paper products, publishing and copying, cultural, education and sporting goods, plastic products, rubber products, non-mineral metal products and mineral metal products. The capital and technology intensive industries cover beverage manufacturing, tobacco processing,

petroleum refining and coking, chemical materials and products, chemical fibre products, ferrous and non-ferrous metal smelting and pressing, general machinery, special purpose machinery, transportation equipment, electrical machinery and equipment, electronics and telecommunication equipment, and instruments and meters.

REFERENCES

AIGINGER K. and PFAFFERMAYR M. (2004) The single market and geographical concentration in Europe, *Review of International Economic* **12**, 1–11.

AIGINGER K. and DAVIES S. (2004) Industrial specialization and geographic concentration: two sides of the same coin? Not for the European Union, *Journal of Applied Economics* **7**, 231–248.

AMITI M. (1999) Specialization patterns in Europe, *Weltwirtschaftliches Archiv* **135**, 573–593.

BAI C., DU Y., TAO Z. and TONG S. (2004) Local protectionism and regional specialization: evidence from China's industries, *Journal of International Economics* **63**, 397–417.

BATISSE C. and PONCET S. (2003) Protectionism and industry localization in Chinese Provinces. Paper presented at the 43rd European Congress of the Regional Science Association.

BELDERBOS R. and CARREE M. (2002) The location of Japanese investments in China: agglomeration effects, Keiretsu, and firm heterogeneity, *Journal of the Japanese and International Economies* **16**, 194–211.

BRULHART M. (1998) Economic geography, industry location and trade: the evidence, *World Economy* **21**, 775–801.

BRULHART M. (2001) Evolving geographical concentration of European manufacturing industries, *Weltwirtschaftliches Archiv* **137**, 215–243.

CANNON T. and ZHANG L. (1996) Inter-region tension and China's reforms, in COOK I. G., DOEL M. A. and LI R. (Eds) *Fragmented Asia*, pp. 75–101. Ashgate, Aldershot.

CAO Y., QIAN Y. and WEINGAST B. (1999) From federalism, Chinese style to privatization, Chinese style, *Economics of Transition* **7**, 103–131.

CATIN M., LUO X. and VAN HUFFEL C. (2005) *Openness, Industrialization and Geographic Concentration of Activities in China*. World Bank Policy Research Working Paper 3706, Washington, DC.

DAS S. and BARUA A. (1996) Regional inequalities, economic growth and liberalization: a study of the Indian economy, *Journal of Development Studies* **32**, 364–390.

DEVELOPMENT RESEARCH CENTRE OF THE STATE COUNCIL (DRCSC) (2004) A report on local protection in China, *References for Economic Research* **18**, 31–38 (in Chinese).

DEVEREUX M. P., GRIFFITH R. and SIMPSON H. (2004) The geographic distribution of production activity in the UK, *Regional Science and Urban Economics* **34**, 533–564.

DICKEN P. (2003) *Global Shifts*. Guilford, New York.

FAN C. and SCOTT A. (2003) Industrial agglomeration and development: a survey of spatial economic issues in East Asia and a statistical analysis of Chinese regions, *Economic Geography* **79**, 295–319.

FUJITA M. and HU D. (2001) Regional disparity in China, 1985–1994: the effects of globalization and economic liberalization, *Annals of Regional Science* **35**, 3–37.

FUJITA M., KRUGMAN P. and VENABLES A. (1999) *The Spatial Economy: Cities, Regions and International Trade*. MIT Press, Cambridge, MA.

GU C. L., SHEN J. F., WONG K. Y. and ZHEN F. (2001) Regional polarization under the socialist – market system since 1978. *Environment and Planning A* **33**, 97–119.

HADDAD E. A. and HEWINGS G. J. D. (2001) Trade and regional development: international and inter-regional competitiveness in Brazil, in JOHANSSON B., KARLSSON C. and STOUGH R. R. (Eds) *Theories of Endogenous Regional Growth*, pp. 181–208. Springer, Heidelberg.

HANSON G. (1998) North American economic integration and industry location, *Oxford Review of Economic Policy* **14**, 30–44.

HARDY J. (1998) Cathedrals in the desert? Transnationals, corporate strategy and locality in Wroclaw, *Regional Studies* **32**, 639–652.

HE C. (2006) Regional decentralization and the location of foreign direct investment in China, *Post-Communist Economies* **18**, 33–50.

HE C. (2003) Location of foreign manufacturers in China: agglomeration economies and country of origin effects, *Papers in Regional Sciences* **82**, 351–372.

HE C. (2002) Information costs, agglomeration economies and the location of foreign direct investment in China, *Regional Studies* **36**, 1029–1036.

HEAD K. and RIES J. (1996) Inter-city competition for foreign investment: static and dynamic effects of China's incentives areas, *Journal of Urban Economics* **40**, 38–60.

HENDERSON J., SHALIZI Z. and VENABLES A. (2001) Geography and development, *Journal of Economic Geography* **1**, 81–105.

HU R., ZHANG X. and SU M. (2002) Local interests and gaming behaviour in industrial restructuring, *Economic Review* **4**, 99–102 (in Chinese).

KIM S. (1995) Expansion of markets and the geographic distribution of economic activities: the trends in US regional manufacturing structure, 1860–1987, *Quarterly Journal of Economics* **110**, 881–908.

KRUGMAN P. (1980) Scale economies, product differentiation, and the pattern of trade, *American Economic Review* **70**, 950–959.

KRUGMAN P. (1991) Increasing returns and economic geography, *Journal of Political Economy* **99**, 483–499.

KRUGMAN P. and ELIZONDO L. (1996) Trade Policy and the third world Metropolis, *Journal of Development Economics* **49**, 137–50.

KRUGMAN P. and VENABLES A. (1995) Globalization and the inequality of nations, *Quarterly Journal of Economics* **110**, 857–880.

KRUGMAN P. and VENABLES A. (1996) Integration, specialization and adjustment, *European Economic Review* **40**, 959–967.

LEE P. K. (1998) Local economic protectionism in China's economic reform, *Development Policy Review* **16**, 281–303.
LIU W., DICKEN P. and YEUNG H. (2004) New information and communication technologies and local clustering of firms: a case study of the Xingwang Industrial Park in Beijing, *Urban Geography* **25**, 390–407.
MA L. J. C. (2002) Urban transformation in China, 1949–2000, *Environment and Planning A* **34**, 1545–1569.
MA L. J. C. and WEI Y. H. (1997) Determinants of state investment in China, *Tijdschrift voor Economische en Sociale Geografie* [Journal of Economic and Social Geography] **88**, 211–225.
MARKUSEN J. and VENABLES A. (1999) Foreign direct investment as a catalyst for industrial development, *European Economic Review* **43**, 335–356.
MAUREL F. and SEDILOT B. (1999) A measure of the geographic concentration in French manufacturing industries, *Regional Science and Urban Economics* **29**, 575–604.
PALUZIE E. (2001) Trade policy and regional inequalities, *Papers in Regional Science* **80**, 67–85.
PALUZIE E., PONS J. and TIRADO D. (2001) Regional integration and specialization patterns in Spain, *Regional Studies* **35**, 285–296.
PONCET S. (2005) A fragmented China: measure and determinants of Chinese domestic market disintegration, *Review of International Economics* **13**, 409–430.
QIAN Y. and WEINGAST B. (1997) Federalism as a commitment to market incentives, *Journal of Economic Perspectives* **11**, 83–92.
ROSENTHAL S. S. and STRANGE W. C. (2001) The determinants of agglomeration, *Journal of Urban Economics* **50**, 191–229.
SHELBURNE R. and BEDNARZIK R. (1993) Geographic concentration of trade-sensitive employment, *Monthly Labour Review*, 3–13.
SJOBERG O. and SJOHOLM F. (2004) Trade liberalization and the geography of production: agglomeration, concentration and dispersal in Indonesia's manufacturing industry, *Economic Geography* **80**, 287–310.
STATE STATISTICAL BUREAU (SSB) (1981a–2004a) *China Industry Economy Statistical Yearbook*. State Statistical Press, Beijing.
STATE STATISTICAL BUREAU (SSB) (1999b–2004b) *Annual Report of Chinese Industrial Statistics*. State Statistical Press, Beijing.
STATE STATISTICAL BUREAU (SSB) (1998c–2004c) *China Statistical Yearbooks*. State Statistical Press, Beijing.
STATE STATISTICAL BUREAU (SSB) (1998d–2004d). *China Science and Technology Statistical Yearbooks*. State Statistical Press, Beijing.
STORPER M., CHEN Y., and PAOLIS F. D. (2002) Trend and the location of industries in the OECD and European Union, *Journal of Economic Geography* **2**, 73–107.
SUN H. (1999) DFI, foreign trade, and transfer pricing, *Journal of Contemporary Asia* **29**, 362–382.
TORSTENSSON J. (1996) Technical differences and inter-industry trade in the Nordic countries, *Scandinavian Journal of Economics* **98**, 507–524.
VENABLES A. (1996) Equilibrium locations of vertically linked industries, *International Economic Review* **37**, 341–359.
WEI Y. H. D. (1998) Regional inequality of industrial output in China, 1952–90, *Geografiska Annaler B* **80**, 1–15.
WEI Y. H. D. (2000) *Regional Development in China: States, Globalization, and Inequality*. Routledge, London.
WEI Y. H. D. (2001) Decentralization, marketization, and globalization: the triple processes underlying regional development in China, *Asian Geographer* **20**, 7–23.
WEI Y. H. D. (2004) Trajectories of ownership transformation in China: implications for uneven regional development, *Eurasian Geography and Economics* **45**, 90–113.
WEI Y. H. D. and FANG C. L. (2006) Geographical and structural constraints of regional development in western China: a study of Gansu Province, *Issues and Studies* **42**, 131–170.
WEN M. (2004) Relocation and agglomeration of Chinese industry, *Journal of Development Economics* **73**, 329–347.
YOUNG A. (2000) The razor's edge: distortions and incremental reform in the People's Republic of China, *Quarterly Journal of Economics* **115**, 1091–1135.
YU D. L. and WEI Y. H. D. (2003) Analyzing regional inequality in post-Mao China in a GIS environment, *Eurasian Geography and Economics* **44**, 514–534.
ZHANG X. (1993) Economic liberalization, dualism and the international trade pattern of China: theory and evidence. PhD dissertation, University of Adelaide.
ZHAO X. B. and ZHANG L. (1999) Decentralization reforms and regionalism in China: a review, *International Regional Science Review* **22**, 251–281.
ZHOU H. (2000) Fiscal decentralization and the development of the tobacco industry in China, *China Economic Review* **11**, 114–133.