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Industrial Agglomeration and Development: A Survey of Spatial Economic Issues in East Asia and a Statistical Analysis of Chinese Regions

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Abstract: In this article, we explore the issue of industrial agglomeration and its relationship to economic development and growth in the less-developed countries of East Asia. We present theoretical arguments and secondary empirical evidence as to why we should have strong expectations about finding a positive relationship between agglomeration and economic performance. We also review evidence from the literature on the roles of formal and informal institutions in East Asian regional economic systems. We then focus specifically on the case of China. We argue that regional development in China has much in common with regional development in other East Asian economies, although there are also important contrasts because of China's history of socialism and its recent trend toward economic liberalization. Through a variety of statistical investigations, we substantiate (in part) the expected positive relationship between agglomeration and economic performance in China. We show that many kinds of manufacturing sectors are characterized by a strong positive relationship between spatial agglomeration and productivity. This phenomenon is especially marked in sectors and regions where liberalization has proceeded rapidly. We consider the relevance of our comments about industrial clustering and economic performance for policy formulation in China and the less-developed countries of East Asia.

Key words: industrial clusters, agglomeration, regional development, new economic geography, East Asia, China.

In this article, we explore the issue of industrial agglomeration and its relationship to economic development and growth in the less-developed countries of East Asia, with special reference to China. Our approach involves two main lines of attack. First, we present theoretical arguments and secondary evidence as to why we should have strong expectations about finding a positive relationship between agglomeration and economic performance in the less-developed countries of East Asia, as in other parts of the world. This phase of our work is based on the emerging body of ideas that is now often loosely referred to as the "new economic geography" (cf. Scott 1988, 2002; Krugman 1991; Porter 2001). Second, we engage in a variety of statistical

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investigations that seek to document and substantiate the expected positive relationship between agglomeration and economic performance. Our discussion is focused specifically on an examination of the spatial distribution of manufacturing activity in China.

Most of the literature on industrial agglomeration and economic performance has been concerned with empirical situations in the advanced Western capitalist world. In this article, we hope to demonstrate not only that the cluster approach is as useful in the East Asian context as it is in Western situations, but that it can also shed important light on critical dilemmas of development that are specific to non-Western countries. We emphasize that theory needs to address both the economic bases of regional development and sociocultural factors, such as formal and informal institutions. In China, in particular, a history of central planning and the recent transition further complicate the applicability of economic theories that are based primarily on Western experiences. In this article, we show that in China, the positive relations between industrial agglomeration and economic performance are generally as hypothesized, but that genuine industrial clusters are more characteristic of sectors and spaces that have been most deeply transformed by economic reforms and market orientation.

In the first half of the article, we lay out a brief statement on the relations between industrial agglomeration and economic performance and consider the ways in which these relations throw light on the East Asian case, and vice versa. In the second half, we focus on regional development in China, first by giving a short account of how recent political economic changes have affected the space-economy and then by engaging in a number of statistical exercises to demonstrate that there is a significant link between agglomeration and economic performance in Chinese regions. Unfortunately, empirical work of this sort commonly encounters severe constraints resulting from the deficiencies of available industrial data. Our statistical analyses accordingly fall short of a full-blown test of the theoretical ideas laid out in the first half of the article. Nevertheless, in so far as they go, the analyses are consistent with our main conceptual claims, and the results provide an encouraging basis for moving forward into new rounds of statistical research in the future.

Locational Agglomeration and Regional Industrial Performance

The notion of the region as a nexus of critical developmental and growth processes has long been familiar to heterodox economists, such as Hirschman (1958), Jacobs (1969), Kaldor (1970), Lampard (1955), Myrdal (1959), and Perroux (1961), who took externalities and increasing returns seriously—in part because they explicitly or implicitly recognized the importance of the intellectual legacy of Marshall (1890, 1919)—and who saw that one major expression of these phenomena can be found in localized complexes of economic activity. Since the early 1980s, an enormous surge in the literature in economic geography and allied fields has greatly expanded on this earlier work. All this literature has repeatedly suggested that selected regions—especially those in which industries are organized in transactions-intensive networks—are capable of exerting powerful push effects on national economic development.

Many kinds of industrial systems are transactions intensive both in a static sense (transactions are numerous and finely grained) and in a dynamic sense (transactions are subject to constant flux because of rapidly changing production arrangements and market instabilities). These features are especially marked today in industries like electronics, communications equipment, specialized machinery and components, toys, watches, garments, furniture, software, and business services, where many small establishments with narrowly defined core competencies perform critical functions within constantly shifting and information-

intensive systems of interlinkages. Mutual proximity is often crucial to the success of the individual establishments that make these industries up, partly because it reduces the costs of transacting and partly because of a series of other factors that intensify localized positive externalities. Benefits of these sorts are identifiable more generally as *agglomeration economies*, although in certain cases, agglomeration diseconomies can also appear as regions grow in size. Agglomeration effects, in turn, are often categorized as so-called localization economies (i.e., efficiency-boosting phenomena that come from the clustering of firms in a given sector) and as urbanization economies (i.e., efficiencies that result from the agglomeration of many different kinds of activities in a given region). In the vocabulary of more recent analysts, these economies are often referred to, respectively, as Marshall-Arrow-Romer externalities and Jacobs externalities (e.g., Beardsell and Henderson 1999).

In practice, these types of externalities can be further broken down into more detailed categories. The following five points summarize the main issues:

1. Interfirm transactions that are small in scale, variable in content, and subject to frequent readjustment usually incur high costs per unit of distance. The mutual proximity of firms in networks made up of transactions like these is an important factor in preventing costs from spiraling out of control and reducing the risks of any failure to establish prompt interfirm contact (Scott 1988).
2. Dense local labor markets represent spatial concentrations of job seekers and job vacancies, and high levels of mutual proximity make it relatively easy to acquire, process, and act on information about relevant opportunities.
3. Transactional relations also involve flows of certain kinds of business information or knowledge spillovers. Untraded interdependencies of these sorts are all the more important because they tend to underpin many small-scale processes of learning and innovation whose cumulative effects greatly reinforce local competitive advantages.
4. The clustering of many different producers can significantly enhance the formation of beneficial business alliances and organizations that help to augment local competitive advantage. Equally, agglomeration promotes the development of distinctive business cultures in particular places, thus facilitating the tasks of interfirm communication and understanding.
5. Significant economies can be obtained when the consumption of infrastructural artifacts is spread out over many individuals in any one place. Large localized clusters of firms and workers make it possible to construct disproportionately dense and rich infrastructures with many positive effects on local competitive advantage.

Regions that have some or all these attributes, combined with dynamic learning capacities, stand some chance of becoming significant articulations of value-adding activity and entrepreneurial energy in the new global economy. They are apt to exhibit strong increasing-returns effects that lead to ever-superior competitive advantages (as expressed, for example, by rising quality/cost ratios for final products) as they grow. In practice, given statistical measurement difficulties, these effects are typically analyzed by economists in the form of aggregate productivity levels per worker (operationally, value-added per worker), and in the analysis presented here, we pursue the same strategy. Much of the econometric work in this regard has been focused on cases in the more developed countries (see, e.g., Shefer 1973; Kawashima 1975; Sveikauskas 1975; Carlino 1979), and only in recent years has there been a concerted attempt to apply similar approaches to regions in less-developed countries (e.g., Henderson 1986, 1988; Y. Chen 1996; Shukla 1996; Lee and Zang 1998). We build on this latter literature with a detailed multilevel analysis of regional development across China as it moves

from central planning to an economic order that is increasingly influenced by liberalization policies.

At the same time, current theories in economic geography pay attention not only to the economic foundations of industrial agglomerations, but also to the important role played by institutional factors in promoting localized growth and development. It is generally acknowledged that these factors tend to be extremely place specific and often vary greatly from one location to another (Amin and Thrift 1995; Storper and Scott 1995). In most East Asian countries, formal and informal institutions have been critical in shaping regional economic outcomes. In addition, governments have played a notably directive role in assigning investment to different locations and in setting up export-processing zones and other local development schemes. China presents an especially interesting case in this regard because of its history of centralized economic planning. An important research and policy question raised by any investigation of industrial districts in China is whether agglomerations that begin as governmental projects are able to develop into genuine growth centers with a strong endogenous dynamic of growth. In our empirical analysis, we show that viable industrial regions have made their historical and geographic appearance in those parts of China where economic liberalization has been most prominent, but that the record is much less positive in other parts of the country. Informal and trust-based relationships, too, are important in China, all the more so since economic liberalization has relied heavily on ethnic and kinship ties with Hong Kong, Taiwan, and overseas Chinese.

Geographic Agglomeration in the Less-Developed Countries of East Asia

Although the phenomenon of industrial agglomeration has been well documented in the advanced economies, including Japan (e.g., Nakamura 1985; Patchell 1993; Kanemoto, Ohkawara, and Susuki 1996; Fujita and Tabuchi 1997), our concern here is with the less-developed parts of East Asia. As such, our effort can be seen as a contribution to knowledge about agglomeration in the non-Western world in general, and in low- and middle-income countries in particular (see also Nadvi and Schmitz 1994; and Scott 2002).

In these countries, dense industrial clusters derive from both local entrepreneurial efforts and foreign direct investment. In numerous cases, clusters can be shown to have their roots in traditional artisanal forms of production, as in the gem and jewelry industry of Bangkok, the furniture industry of the Philippines, the pottery and silk industries in China, and the shoe industry of Agra in India. At the same time, and especially in the case of East Asia, we need to remain alert to the political context and the actions of governments at various levels of authority in molding regional patterns of development. In East Asia, moreover, as in the economically developed parts of the world, large city-regions are the locations of many of the most vibrant industrial districts. Singapore, Hong Kong, Seoul, Beijing, Shanghai, and Kuala Lumpur, for example, harbor many specialized industrial districts that draw on dense local supplies of skilled labor, infrastructure, educational and research facilities, and so on. In South Korea, high-technology firms have been shown to prefer the Seoul metropolitan region because of high levels of access to technical labor (Park 1994). In addition, foreign investors tend to favor metropolitan areas that offer a diversity of infrastructural and input services, as well as a predictable regulatory environment (Scott 1987; Leung 1993, 1996; Wong and Goldblum 2000). The largest of Asia's city-regions sometimes exhibit agglomeration diseconomies because of congestion, pollution, crime, and so on, although this problem is not absolute, in the sense that appropriate policy and planning interventions can invariably clear away some of the barriers to further growth. In any case, far from seeing large-scale urbanization as an aberration, as some development theorists have done in the past (e.g., Lipton 1977), our argument is that it is one of the impor-

tant channels through which agglomeration economies are achieved and accelerated development occurs. Smaller urban centers, too, can play significant roles in the development process, especially in Asia where many traditional craft industries outside the main metropolitan areas are beginning to show signs of modern entrepreneurial energy and orientation to wider markets. We now examine more precisely how these relationships are worked out on the ground.

Industrial Linkages, Subcontracting, and Flexible Production

There is much evidence on the importance of industrial linkages as a factor in agglomeration processes in East Asia. For the case of South Korea, Park (1991) argued that polarized regional economies with a diversity of industries, information, and technical workers generate innovative firms and spin-offs, which, in turn, encourage further growth. Park (1993, 1994) further noted that vertical disintegration and the clustering of small plants increase the productivity of labor-intensive industries and that subcontracting is an important organizational strategy for lowering wages and deflecting industrial disputes. Similar arguments have been made for the case of Taiwan, where subcontracting networks and cluster-based manufacturing were found to be important strategies for increasing the competitiveness of firms (Shieh 1990; W.-H. Chen 1999). Focusing on Taiwan's footwear industry, Levy (1991) contended that the transactions-costs hypothesis provides a powerful explanation for the emergence of localized subcontracting networks.

Detailed empirical studies on industrial linkages in the more peripheral parts of East Asia are relatively scarce. In a study of the semiconductor industry in Southeast Asia, Scott (1987) showed that production units in Manila's semiconductor complex in the mid-1980s were clustered close to one another and were intricately linked to minimize transactions costs. Scott (1994) demonstrated that the gem and jewelry industry of Bangkok has been able to thrive on the basis of its vibrant transactional networks, its low wages, and the skilful political maneuvering of its representatives. Rasiah's (1994) study of the machine-tool industry in Malaysia underscored the connection between subcontracting and localization. A number of studies on Indonesia have highlighted positive externalities and productive effects of industrial clusters (Poot, Kuyvenhoven, and Jansen 1990; Smyth 1992; Sandee, Rietveld, Supratikno, and Yowono 1994; Nadvi and Schmitz 1994; Sandee 1995; Weijland 1999; Sandee and Rietveld 2001).

Learning and Knowledge

Many studies have pointed to the importance of the relation between learning and proximity in the cities of developing countries in general, and East Asia in particular. At the same time, formal learning institutions, such as universities and research infrastructures, are located mostly in large urban areas in Asia. In Taiwan, the close spatial relations between the Industrial Technology Research Institute and firms that produce integrated circuits in the Hsinchu Science-Based Industrial Park are widely regarded as a major factor in the latter's success (Chang and Hsu 1998). In a comprehensive article, Bell and Albu (1999) argued that "knowledge systems" are central to the long-term dynamism of industrial clusters and stressed that the diffusion of innovation within clusters, as well as the openness of clusters to flows of knowledge from outside, are important in developing countries. Liu (1998) concluded that learning capability and human capital will determine the durability of Taiwan's industrial success. Concomitantly, the absence of these qualities in any region means that barriers to development are likely to be rapidly encountered, even if the region possesses other kinds of assets. Sandee (1995) demonstrated how collaboration in a rural industrial cluster in Indonesia fosters the diffusion of innovation and the deepening of technological capabilities. Johansson and Nilsson (1997) showed that clustering in export processing zones in Malaysia stimulates local firms to

learn from foreign investors how to produce, market, sell, and distribute manufactured goods on the world market.

Cluster Development and the International Division of Labor

For the most part, East Asia has been at the receiving end of the decentralization of manufacturing production from advanced industrialized economies to developing countries. For example, until the mid-1970s, the four newly industrializing economies of South Korea, Taiwan, Hong Kong, and Singapore accounted for the bulk of the offshore assembly work of U.S. electronics corporations (Scott 1987). As these economies developed, branch plants in search of cheap labor moved to yet more peripheral parts of East Asia, including Malaysia, the Philippines, Indonesia, Thailand, and China (Tsay 1993; Ho 1994; Park 1994; Tang 1996; Eng 1997; Wong and Goldblum 2000). In the same way, considerable subcontracting now occurs from North America and Western Europe to East Asian producers in such sectors as clothing, furniture, and machinery. It is important to note that large urban centers in East Asia are especially attractive as locations for this kind of manufacturing decentralization. Such development typically draws on the cheap, surplus labor in cultural and political settings where workers are willing to tolerate long hours, accelerated rhythms of work, and round-the-clock manufacturing schedules. As manufacturing decentralization to East Asian cities occurs, moreover, local input industries often spring up in the local environment, providing backup services and strengthening local agglomeration economies.

Institutions and Regulation in East Asian Regional Development

Formal and informal institutions play a prominent role in the structuring of East Asian economies. Indeed, as we have indicated, many proponents of the new economic geography have sought to extend the theory of agglomeration by emphasizing the institutional bases of regional economic development, particularly the role of public agencies in regulating local market failures and other impediments to rapid forward momentum (e.g., Peck 1992; Amin 1999). This approach has been greatly influenced by institutional and evolutionary economics and economic sociology, which stress that economic activity is always socially embedded and therefore context specific and path dependent (Granovetter 1985; Hodgson 1988).

Governance Structures and Regional Development

East Asian governments have had significant impacts on economic development through the adoption of export-oriented industrialization policies and the establishment of industrial parks and export-processing zones. Kaohsiung in Taiwan, Masan in South Korea, Penang and Johore in Malaysia, and Shenzhen in China were among the first generation of government-sponsored industrial zones for fostering export-oriented industrialization. Yuan and Eden (1992), in their comparative study of Taiwan, South Korea, and China, underscored the role of governmental policy in determining the performance of export-processing zones. Governments in Taiwan and Singapore have played particularly critical roles in fostering technological advancement in these zones (Yuen 1991; Ho 1994; Xue 1997).

In many cases, however, government-initiated development zones have not yet really taken off, in the sense that they generate limited agglomeration economies. In contrast to the Marshallian formulation, in which endogenously driven growth and local embeddedness sustain agglomerations, these clusters are more often than not "hub and spoke" or "satellite platform" industrial districts (Markusen, Lee, and DiGiovanna 1999). For example, in South Korea, Pohang is anchored by a steel company, and Ulsan

is anchored by a petrochemical plant and an automobile plant, whereas Kumi, Changwon, and Ansan are satellite districts with branch plants whose external linkages are mostly extralocal (Markusen and Park 1993; Park 1996). Park (1993) observed that the South Korean government has increased support for collaboration between large firms and small or medium-sized firms so that satellite clusters can benefit from the formation of local networks and linkages. Furthermore, Park (1996) showed that as firms begin to lose the advantages that accrue from governmental incentives, they tend to pursue strategies such as the formation of local linkages, cooperative interfirm relations, and contracting-out activities, while spin-off activities and new start-ups also tend to increase (e.g., in Taeduck Science Town). Through this process, Park contended, initial satellite and hub-and-spoke industrial districts begin to evolve toward systems marked by local networks and embeddedness, as illustrated by the case of Kumi.

Informal Bases of the Local Economy

Trust-based business relationships are of great significance in many East Asian cultures and are reflected not only in local transactions, but also in the intricate ties based on the Asian diaspora that exist between East Asia and other parts of the world (Hamilton 1991; Smart 2000; Yeung and Olds 2000). Since the 1990s, an emerging body of work on East Asia has sought to highlight the role of interpersonal relations and ethnic and kinship ties in regional economic development. Thus, Olds (2001) argued for a relational geography that focuses on networks and flows, linkages, interdependence, connections, and mutuality. This kind of relational geography is characteristic of "Chinese capitalism" and of the operations of large Chinese-controlled international conglomerates.

The importance of interpersonal relations in East Asia further reinforces the notion that economic behavior is embedded, in part, in social networks that are defined by mutuality, trust, and cooperation. Ties of proximity and association are especially important in promoting learning effects and the diffusion of know-how (Amin and Thrift 1995; Sunley 1996; Storper 1997). Face-to-face contacts, in particular, help to engender relational assets or untraded interdependencies in the form of information, reputational capital, economically useful sensibilities and forms of habituation, and so on. Economic agents and firms in regions with rich traditions of reciprocity benefit from the sharing of know-how and expertise, and by doing so, they increase the local stock of competitive advantages (Cooke and Morgan 1998). Transactions, therefore, are to be evaluated not only in terms of their costs, but also in terms of their qualitative social characteristics (Harrison 1992).

Geographic Agglomerations in China

China has much in common with other East Asian economies, from the many big cities scattered across its landscape to the prominent roles of governments and social networks in economic life. However, its development history has also been heavily shaped by socialist ideology and, more recently, by the trend toward economic liberalization.

China has a mixed economy, one in which the government's role and institutional legacies from the former command economy have had profound effects on the geography of production. Prior to the 1980s, the Chinese government's blueprint for national economic development, with its stress on large-scale vertically integrated units of production, was not especially conducive to the formation of dynamic industrial districts rich in positive externalities. The socialist economy was focused on state-owned enterprises, domestic investment and markets, and a locational rationale that emphasized political goals more than economic efficiency. From the 1950s to the early 1970s, the Chinese government deliberately discouraged investment in

coastal areas and promoted the growth of inland cities. It also selected remote inland sites for key sectors, such as cars and iron and steel, but discouraged spatial clustering (Huang 1999; Naughton 1988). Sit and Lu (2000) showed how the geography of China's car industry is still strongly influenced by these past locational decisions. This influence is reinforced by regulatory structures that restrict foreign investments in the car industry to joint ventures with domestic firms.

Since the economic reforms of the 1980s, however, the Chinese government has actively pursued alternative policies that are directed to economic liberalization. It promoted export-oriented industrialization programs by designating special economic and open zones, most notably in the eastern coastal zone (Fan 1995, 1997). New policy incentives, infrastructural investments, and social relationships that include ties with overseas Chinese (Hsing 1996; Leung 1993) have paved the way for the eastern coastal zone to be integrated quickly with Western capitalist production. Fan (2001, 2002) contended that the government has used socialist-type policies to foster rural-urban migration and, by doing so, has engendered a migrant labor regime and increased the supply of cheap rural labor to coastal areas. In contrast to industries that are heavily influenced by Maoist legacies, the consumer electronics and garments industries, which tend to dominate in these areas, are characterized by high levels of foreign investment, export orientation, and functional flexibility. We argue that it is in these spaces, where economic reforms and market orientation are the most deeply rooted, that agglomeration economies appear most forcefully in China.

Some government-sponsored industrial areas in China's open economic zones initially resembled satellite platforms of the South Korean type, where many firms were tied to overseas markets but had only weak local linkages. Tong and Wang's (2002) study of the personal computer industry in Dongguan, Guangdong, for example, showed that during the 1980s, printed-circuit assembly plants with foreign capital investment depended on parts brought from Taiwan. Since the mid-1990s, however, strong local networks underpinning the production of printed circuits have emerged, with interrelated factories constituting a growing spatial agglomeration. As a result, a complete computer can now be assembled from parts made entirely in factories located within 50 kilometers of one another. Park (1996) also noted that small firms in satellite industrial districts in China, such as Shenzhen, are becoming increasingly integrated into local network structures.

In contrast to the socialist period, when the government had strict control over economic activities, economic liberalization since the 1980s has boosted the role of the market and has been conducive to industrial linkages that respond to market signals. Perhaps the most vivid example is the hosiery cluster in Zhejiang province, where more than 10,000 village households in 120 villages in and near Datang have become China's biggest center of the production of socks and stockings and cluster development is now strongly under way (Wang 2001). Each enterprise specializes in a particular aspect of production, including manufacturing, machinery, marketing, and services, and this networked organization is considered to be the primary reason for the success of the cluster (Guo and Cai 2000). The intricate division of labor and face-to-face networking in the system enable enterprises to respond quickly to changes in the market and to ensure high levels of efficiency and minimization of risks. This system is strongly embedded in local social relationships in that interfirm linkages depend on trust and social capital. Wang (2001) argued that the close and specific relations among enterprises, the low barriers to entry and exit, and external economies that are due to interlinkages create a situation that is similar to the Third Italy model of flexible specialization. Similarly, flexible production systems in the garment, textile, toy, and footwear/leather industries in south China permit fast turnover and quick response to market changes—key factors in firms' competitiveness in the global market (Christerson and Lever-Tracy 1997). Also prominent in

south China are firms in the computer industry that have attained to high levels of competitiveness because agglomeration enables them to ensure that their products are high quality through rapid access to information and inputs (Tong and Wang 2002). Even many small rural areas in the Pearl River Delta have grown considerably because of subcontracting orders from overseas. Here, as in some other parts of East Asia, industrialization has blurred the distinction between the urban and the rural, giving rise to the *desakota* phenomenon described by McGee (1991) and Lin (2001).

Another case is the agglomeration of high-technology firms in Zhong'guancun, Beijing, which benefits not only from a local pool of skilled labor, but also from the proximity of a large number of research establishments, such as Beijing University and Qinghua University (Wang and Wang 1998). Many firms in Zhong'guancun are spin-offs from state-owned enterprises and continue to receive strong support from parent institutions or universities. Wang (2001) observed that a club culture has emerged in the area, which further stimulates interaction among entrepreneurs, managers, engineers, and professionals and promotes a climate of entrepreneurship, innovation, and risk taking. This case suggests that locally embedded cultures, norms, and social relations are major factors in the dynamism of agglomerations in China.

Similarly, the strong ethnic and kinship ties of China with Hong Kong, Taiwan, and overseas Chinese in other countries have heavily shaped spatial patterns of foreign direct investment and have been a crucial factor in the development of new industrial agglomerations in the eastern and southern coastal areas. Labor-intensive industrial clusters in Fujian and the Pearl River Delta in Guangdong, for example, are strongly dependent on such ties. Much of the growth of these regions has been due to the relocation of manufacturing production from Taiwan and Hong Kong and to subcontract orders from manufacturers of Chinese origin in the United States (cf. Bonacich and Appelbaum 2000). Leung (1993, 1996) stressed the same point in an analysis of subcontracting activities in the Pearl River Delta that highlighted the role of cultural and kinship ties between distant investors and local producers (see also Hsing 1995, 1996, 1998). Christerson and Lever-Tracy (1997), who also focused on Fujian and the Pearl River Delta, argued that the family and social relationships of overseas Chinese investors have been of major importance in the growth of the garment industry in south China.

Y. Chen (1996) made a major econometric contribution to the study of industrial agglomeration in China. He estimated sectoral value added as a function of capital, labor, and a regional factor multiplier that consists of five components, including agglomeration. The impact of agglomeration on productivity was found to be positive and high for the machinery industry but lower for less technology-intensive industries such as food manufacturing. In the next section, we propose a framework similar to Chen's and on this basis seek to push the study of industrial agglomeration in China forward one more notch. Even though our analysis was greatly hampered by the lack of data, we have nevertheless been able to bring a variety of different perspectives and scales of analysis to bear on the central problem.

Agglomeration and Industrial Productivity in China

We begin our analysis by probing generally into the relations between industrial location and productivity in China. One way of measuring the broad locational characteristics of an industry is to compute a Herfindahl index (hereafter H-index) to assess the industry's overall level of spatial agglomeration or dispersal. Thus, for Sector i, let p_{ij} be the proportion of total activity located in the jth region or province. The term p_{ij} is defined more explicitly as x_{ij} / X_i, where x_{ij} is the amount of activity in industry i in province j and X_i is the total amount of activity in industry i in China as a whole (i.e., $X_i = \Sigma_j x_{ij}$). The H-index for Sector i is then computed as $H_i = \Sigma_j p_{ij}^2$. When all the activity in Sector i is concentrated in one province, the index is equal to one; when all activity

is evenly dispersed, the index converges asymptotically to zero for a sufficiently large number of provinces; intermediate locational patterns are represented by values of the index between these two extremes. We computed two sets of H-indexes for all two-digit manufacturing sectors in China (except armaments, for which the published statistics are heavily censored), using the number of establishments and employment as raw data inputs. Data for this purpose were taken from the statistical yearbooks of the Chinese provinces for 2000. In most instances, the number of establishments and employment figures for two-digit sectors could be obtained for all 31 provinces in China, although for 10 sectors, data were available for only 30 provinces, and for 2 sectors, they were available for 29 provinces. The quality of these data leaves much to be desired, but the results we obtained appear, with certain reservations, to be reasonably reassuring.

Table 1 shows H-indexes for this exercise, ordered from high to low values. The index for establishments is usually smaller than the index for employment, a statistical effect that seems to arise because of the occurrence of large establishments in many sectors (and all the more so given the labor-hoarding propensities of state-owned enterprises in

Table 1

H-Index Values for Two-Digit Industrial Sectors in Chinese Provinces[a]

	Values of H-Index	
Industrial Sector	Establishments	Employment
Stationery, education, and sporting goods	0.1381	0.3316
Electronics and telecommunications	0.1274	0.1970
Furniture manufacturing	0.1259	0.1183
Garments and other fiber products	0.1225	0.1849
Metal products	0.1182	0.1074
Instruments, meters, educational and office machinery	0.1180	0.0926
Leather, furs, down, and related products	0.1044	0.2612
Chemical fibers	0.1016	0.1082
Other manufacturing	0.0974	0.1551
Electric equipment and machinery	0.0959	0.1178
Plastic products	0.0933	0.1476
Textiles	0.0885	0.1095
Printing and record pressing	0.0859	0.0770
Ordinary machinery manufacturing	0.0846	0.0925
Petroleum processing and coking products	0.0800	0.0977
Special-purpose equipment	0.0763	0.0877
Rubber products	0.0755	0.0925
Transportation equipment manufacturing	0.0721	0.0689
All manufacturing	0.0676	0.0810
Papermaking and paper products	0.0646	0.0934
Chemical raw materials and chemical products	0.0639	0.0742
Timber processing, bamboo cane, palm fiber, and straw products	0.0592	0.0798
Smelting and pressing of nonferrous metals	0.0585	0.0658
Tobacco processing	0.0574	0.0828
Nonmetallic minerals	0.0560	0.0756
Food manufacturing	0.0548	0.0784
Smelting and pressing of ferrous metals	0.0544	0.0910
Food processing	0.0507	0.0869
Medical and pharmaceutical products	0.0468	0.0638
Beverage manufacturing	0.0450	0.0778

[a] Analysis based on data from Chinese provincial yearbooks.

China), thus causing a spurious increment to apparent agglomeration when the employment measure is used. It is spurious, at least, in the sense in which the term *agglomeration* is used in this investigation (i.e., to designate a dense geographic clustering of functionally interrelated producers or establishments, in contrast to large concentrations of employment that are due simply to the existence of one or two giant plants). However, the simple correlation between the indexes for establishments and employment is 0.73, which means that each can be approximately substituted for the other.

The information in Table 1 provides the first analytical glimpse of the geography of manufacturing industries in China. At the top of the list are sectors that are relatively agglomerated; at the bottom are industries that are much more dispersed. A rough first assessment of the main structural features of these two groups suggests that the former comprises relatively labor-intensive small-plant industries with a proclivity to form vertically disintegrated networks (electronics, furniture, garments, and so on); the latter seems to be much more focused on capital-intensive, large-plant sectors, often with a market- or resource-oriented locational logic and with significant levels of state ownership (smelting and pressing of ferrous metals, nonmetallic minerals, beverages, and so on). Note, however, that food manufacturing and food processing, which have relatively low H-indexes, are actually labor intensive in terms of their actual capital-labor ratios. Presumably these industries are at least oriented, to some degree, to more dispersed, rural locations.

In an attempt to flesh out these first impressions, we examined the relations between various measures of industrial structure and the H-indexes presented in Table 1. Given the small number of two-digit sectors (which constitute the observations in this analysis) and the paucity of available data, this exercise proved to be of limited value, but one set of simple regressions emerged as being of particular interest. The relevant information is displayed in Table 2, where H-indexes for establishments and employment are regressed against an independent variable (K/L), defined operationally as total gross investment per worker, measured in units of 100 million yuan. All variables are transformed into natural logarithms. The regression coefficient attached to K/L is negative and highly significant. This finding confirms the idea that labor-intensive producers tend to be relatively agglomerated (despite the anomalous cases of food manufacturing and food processing), while capital-intensive producers are relatively dispersed in their overall locational structure. From what we know of industrial organization processes in general, we speculate that there is some likelihood in principle that producers in the former group are characterized by tighter, more variable, and more finely grained interindustrial networks than are those in the latter group. As it happens, both H-indexes are also negatively and significantly correlated with average size of establishment, though the weight of this variable is entirely swamped when we also add K/L to the analysis as an independent variable. Clearly, there are likely to be many other forces at play in structuring locational

Table 2

Regression Analysis of H-Indexes for Two-Digit Industries in Chinese Provinces

	Values of Regression Statistics	
	H (Establishments)	H (Employment)
Constant	–2.6192	–0.3584
Coefficient of K/L	–0.2214**	–0.2619**
Adjusted R^2	0.2323	0.2256

Note: Dependent variables are the H-indexes.
** $p < .01$.

outcomes in these industries (including, in China, forms of ownership), but what is of interest at this point is that our results so far suggest that in a general sense, differential patterns of agglomeration and dispersal may, indeed, have some fundamental relationship to the shape and form of industrial activity as we proposed earlier. We now need to inquire more explicitly whether there are productivity effects that flow from the locational structure of Chinese industry as expressed in the H-indexes. Productivity is measured as value added per worker, and the hypothesis to be tested is that agglomeration (for all the complex reasons discussed earlier) has a significantly positive impact on this variable.

To begin with, we conducted a statistical analysis based on a simple production-function approach (with two-digit industries as observations), as indicated in Table 3. The dependent variable is defined as VA/L (i.e., value added divided by employment), and the independent variables are K/L and the H-index. In Regression 1, the H-index is defined for establishments; in Regression 2, it is defined for employment. Again, all variables are transformed into natural logarithms. As in Table 2, both regressions run more or less parallel to one another. In each case, there is a (perhaps suspiciously) low but positive and extremely significant coefficient attached to K/L. The H-indexes perform as expected. They indicate that significant productivity effects emerge as industries become increasingly clustered. If we add average size of establishment to these two regressions, we find that the associated coefficient is positive but not significant. However, the simple correlation between average size of establishment and K/L is 0.61, a finding that encourages us to infer that agglomerated industries are marked by comparatively smaller plant sizes on average than are more dispersed industries. In other words, despite the admittedly crude and aggregate nature of the analysis thus far, we suggest that agglomerated industrial clusters in China tend to be made up of small, labor-intensive establishments and that it is these kinds of industries whose productivity is enhanced by the convergence of producers around their own centers of gravity.

A More Disaggregated Analysis

The regressions presented in Table 3 represent an extremely aggregated level of investigation. It is therefore important to inquire whether similar relationships can be found using a more spatially disaggregated approach. To do so, we evaluated models based on a production-function approach for two-digit sectors with the observations defined in terms of individual provinces.

A synoptic view of the results of this approach is presented in Table 4 for 29 two-digit manufacturing sectors. The dependent variable is VA/L as previously defined. The

Table 3

Regression Analysis of the Relations between Productivity and Locational Structure for Two-Digit Industries in Chinese Provinces

	Values of Regression Statistics	
	Regression 1	Regression 2
Constant	2.6729	3.1164
Coefficient of K/L	0.3231**	0.5067**
Coefficient of H	0.3828*	0.5691**
Adjusted R^2	0.4131	0.5123

Note: VA/L is the dependant variable in both regressions.
* $p < .05$, ** $p < .01$.

Table 4

Industrial Productivity in Chinese Provinces by Two-Digit Sectors, 2000: Regression Results[a]

Sector	Constant Value	Capital-Labor Ratio	Average Size of Establishment	Location Quotient	Population of Largest City	Adjusted R^2	Number of Observations
Food processing	–0.3239	0.1327	–0.1425	0.1283	0.3608*	0.2075	20
Food manufacturing	–1.8230**	0.2767	0.1838	–0.0003	0.2439**	0.6513	20
Beverage manufacturing	–1.6009	0.8387	0.0372	0.3124	0.2173	0.7622	20
Tobacco processing	3.6634	1.1595**	–0.4419*	0.0817	–0.2363	0.7257	18
Textiles	–2.7573	1.1235**	0.0649	0.5400**	0.1296	0.7842	20
Garments and other fiber products	–5.3746**	0.9050*	0.4770	0.2540	0.4296**	0.5221	20
Leather, furs, down, and related products	–4.4040	0.9757	0.5464	0.6901*	0.1522	0.2071	20
Timber processing, bamboo cane, palm fiber, and straw products	–4.6338	1.3171	0.6262	–0.0211	–0.1275	–0.0565	18
Furniture manufacturing	–4.5040*	1.1043**	0.5099*	–0.1337	0.1440	0.2775	20
Papermaking and paper products	1.6282	0.6970**	–0.3589*	0.2133	–0.0599	0.6112	19
Printing and record pressing	–3.4975**	0.9663**	0.3086	–0.0659	0.1752**	0.6779	20
Stationery, education, and sporting goods	1.0806	0.0355	–0.3524	0.5355*	0.2576	0.1973	19
Petroleum processing and coking products	0.4736	1.1248**	–0.2590*	–0.1424	–0.1176	0.8791	19
Chemical raw materials and chemical products	1.7837	0.4556	–0.3370*	0.0618	0.0039	0.3185	20
Medical and pharmaceutical products	3.1377*	0.7768*	–0.5881**	0.4320*	0.0036	0.5644	20
Chemical fibers	2.1169	0.4993**	–0.3672	–0.2420	0.0074	0.6052	18
Rubber products	–2.4372	1.8424**	0.3138	0.1720	–0.4425	0.6650	19
Plastic products	–7.0235**	1.8577**	0.7580**	0.2615	0.0462	0.8247	20
Nonmetallic minerals	–0.5699	0.9257**	–0.1631	0.2159	0.0268	0.4548	19
Smelting and pressing of ferrous metals	–2.9597*	0.6599*	0.0844	0.2504	0.2979	0.4663	20
Smelting and pressing of nonferrous metals	4.9269	0.3853	–0.4360**	–0.0598	–0.3699	0.4779	19
Metal products	–1.7505	1.0496*	–0.0840	–0.0953	0.1861	0.2076	19
Ordinary machinery manufacturing	1.5330	0.7400	–0.1452	0.5390	–0.2971	0.0965	20
Special purpose equipment	–2.4027	0.8387	0.0372	0.3124	0.2173	–0.0016	19
Transportation equipment manufacturing	–2.8779	1.3677**	–0.0652	0.1103	0.1969	0.7255	20
Electric equipment and machinery	–3.9346	1.6158**	0.4266	0.7617**	–0.1162	0.8191	19
Electronics and telecommunications	2.5839	0.6029	–0.2988	0.4982*	–0.0942	0.5411	18
Instruments, meters, educational and office machinery	7.8152**	–0.4436	–0.2513	1.1143*	–0.7878	0.3578	19
Other manufacturing	–2.3789	0.6215**	0.1657	–0.0023	0.2678	0.6484	19
All manufacturing	0.0268	1.0047**	0.0290	2.4893*	–0.2223	0.4932	20

[a] Analysis based on data from Chinese provincial yearbooks.

* $p < .05$, ** $p < .01$.

independent variables are the capital-labor ratio (K/L, as before), the average size of establishments, the location quotient, and the population of the largest city in each province. The location quotient for any industry, i, in any province, j, is defined as π_{ij}/Π_i, with $\pi_{ij} = x_{ij}/\Sigma_i x_{ij}$ and $\Pi_i = X_i/\Sigma X_i$, where x_{ij} is the number of establishments in industry i in province j and X_i is the number of establishments in industry i in the whole of China (i.e., $X_i = \Sigma_j x_{ij}$). The location quotient (which can take on any value greater than zero) thus identifies the degree to which any given province is specialized in any given industry. In view of the specific concept of agglomeration proposed earlier, the location quotients used in this phase of the investigation are defined for establishments, rather than for employment. In principle, location quotients are supposed to capture the effects (if any) of so-called localization economies. The variable represented by the population of the largest city in each province is a putative measure of the effects of urbanization economies. These two variables are conceptually unsatisfactory, but in the absence of more adequate data, they are the best we have to work with. The largest-city variable used here is especially inadequate, given that it does not account for the full extent of urbanization in each province. We experimented with a corresponding variable defined as the percentage of the total provincial population living in cities, but this variable performed badly as an explanation of agglomeration, as we might anticipate, given that it does not express a mass but a ratio. Complete sets of data for each industry are not always available, and hence the number of observations (provinces) underlying each regression differs from sector to sector, as shown in Table 4. Unfortunately, the number of degrees of freedom is restricted in all cases. All variables are measured in terms of natural logarithms.

The first thing to note about the results presented in the table is the wide variation in the values of the coefficients attached to the capital-labor ratio; in some cases, these values are so low as to be close to unbelievable (even when the inefficiencies of state-owned and collective-owned industries are taken into account). These low values may stem from measurement errors in the data used. In about half the cases, however, the coefficients have values that range from 0.7 to 1.3, and these values seem to be more credible, at least in comparison with econometric studies carried out in other parts of the world. At the same time, most of the statistically significant coefficients attached to the average-size-of-establishment variable (which is intended to capture internal economies and diseconomies of scale that are due to plant size) are negative, which may not be unreasonable in more labor-intensive sectors, such as furniture, but seems anomalous in more capital-intensive sectors, such as tobacco processing, chemical raw materials, or nonferrous metals. Again, in the absence of further investigation, we cannot know whether this apparent anomaly is due to data errors, to genuine inefficiencies (e.g., in the state-owned sector), or to some other cause.

We now turn to the specifically geographic content of the regressions laid out in Table 4. This content is represented by the effects of the location-quotient variable and the largest-city variable on value added per worker. As expected, the location-quotient variable has significant positive impacts on productivity in a number of sectors where capital-labor ratios are relatively low and values of the H-index high, namely, textiles, leather, stationery, electric equipment and machinery, electronics and telecommunications, and instruments. In turn, the largest-city variable has a significant and positive impact on productivity in garments and printing, which is in line with what we know about the economic geography of these two sectors in other countries. The same independent variable is significantly and positively correlated with productivity in food processing and food manufacturing. In all four cases, the positive impact of the largest-city variable may be explained not only by the basic organizational features of these four industries, but also by the orientation of a significant number of firms within

them to market locations. If we now correlate K/L for each two-digit sector (at the level of the Chinese economy as a whole) with the entire set of regression coefficients attached to the location-quotient and largest-city variables, we find that in the former case, the simple correlation is –0.18, which has the expected sign but is not significant, and in the latter case, it is –0.50, which is significant at the .01 level. This outcome suggests strongly that labor-intensive industries, in addition to their inclination to intrasectoral agglomeration, have a particular predilection for locations in large cities.

Thus, in a rough way, the analysis indicates that localization and urbanization economies are indeed at work in the Chinese space-economy and that they have statistical profiles that conform broadly to theoretical expectations. That said, we are sharply aware that the analyses presented here are characterized by many statistical shortcomings and interpretative ambiguities and that further probing of the issues is obviously in order. In the next section, therefore, we attempt to explore further many of the ideas we developed earlier with the aid of much more detailed information on industrial production. This exploration involves, first, a shift from a provincial geographic base to a more finely grained county base and second, a search for statistical correlations between spatially and functionally related sectors.

Industrial Clusters in Chinese Counties

The data set we explored in this phase of the investigation consisted of information for 510,381 firms that are defined as independent accounting units registered at or above the township level of authority,[1] as recorded in China's 1995 Industrial Census. These firms accounted for 68.2 percent and 59.7 percent of the output and employment, respectively, of all China's industries. Note that the locations of a number of firms could not be ascertained, and when we excluded these and nonmanufacturing firms (in mining and public utilities), we were left with a total of 459,108 firms.

Data on all firms with known locations were aggregated by county. We defined location quotients as before, except that the index i now runs over 534 four-digit industrial sectors and j runs over 2,325 counties,[2] as opposed to provinces. Again, we focus on establishments rather than employment. With a full set of location quotients in hand, we computed correlation coefficients representing the spatial association between pairs of four-digit sectors. Then, we used simple cluster analysis in an attempt to identify spatial complexes of industrial activity.

The correlation matrix we worked with is large, defined as over 543 different four-digit sectors, and a great many different industrial clusters can be extracted from it. In what follows, we focus on one large and multifaceted cluster, which dominates the entire analysis and provides important representation of both sectoral and spatial trends in the new Chinese economy (see Figure 1). In fact, this dominant cluster breaks down into two overlapping

[1] The definitional criteria are specific to the Chinese industrial statistics system. Firms that are independent accounting units are not financed by or ancillary to any other institutions. Firms are also identified in terms of the administrative rank of the places in which they are registered. The data set used here excludes firms identified as being below the township level, such as those established by villages. In addition, firms registered at or above the township level include the bulk, if not all, of state-owned and share-holding enterprises and joint ventures between Chinese and overseas investors. Collective-owned enterprises and private- and individual-owned enterprises are less highly represented in the data set. As such, the data set is probably biased toward larger firms. In total, the 510,381 firms in the data set accounted for 86.2 percent of all firms at or above the township level.

[2] County-level units include counties, county-level cities, and urban districts of prefecture-level and provincial-level cities. In this article, we refer to all county-level units as counties.

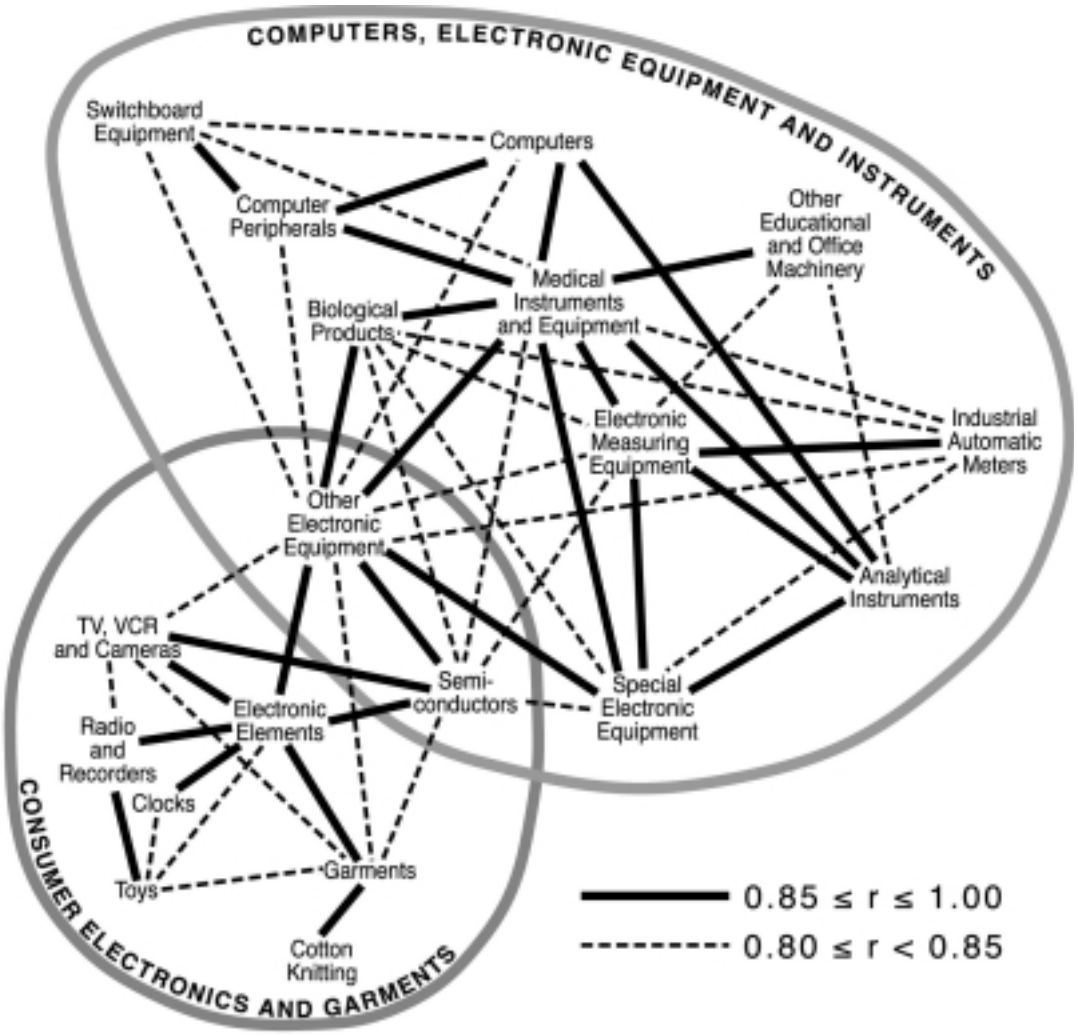

Figure 1. Cluster analysis of establishments in the consumer electronics and garments industries and the computers, electronic equipment and instruments industries, China, 1995. Figure based on four-digit data by county from the 1995 Industrial Census provided by the State Statistical Bureau, People's Republic of China.

subgroups. The first subgroup is comprised of consumer electronics and garments (including cotton knitting) industries, with the former breaking further down into sectors like radios, television sets, cameras, toys, and clocks; these are among the most prominent export-oriented industries in China. The second subgroup consists of computers, electronic equipment and instruments industries, including semiconductors and medical equipment. Unfortunately, our data do not allow us to identify functional linkages between the sectors under examination, but there is strong prima facie evidence, based on our general knowledge of how these industries work, that at least some of them are both transactionally interconnected and strongly associated with one another in geographic terms. In Figures 2 and 3 we map out values of the number of establishments and location quotients for establishments in the two subgroups. The agglomerative tendencies of these industries are clearly evident.

The consumer electronics and garments group is concentrated in the Pearl River

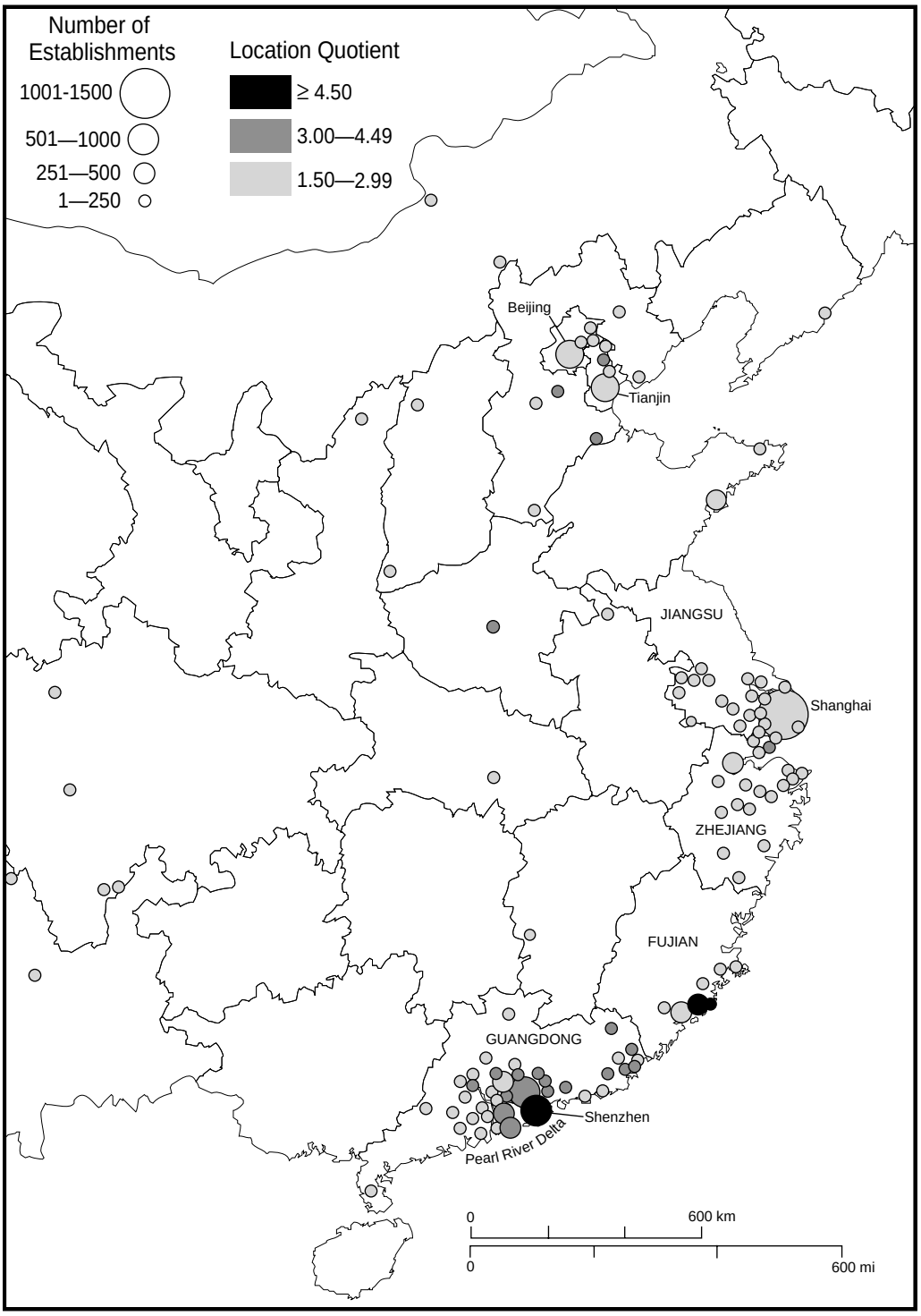

Figure 2. Distribution of establishments in the consumer electronics and garments industries by county, China, 1995. Figure based on four-digit data from the 1995 Industrial Census provided by the State Statistical Bureau, People's Republic of China. *Note:* Counties in which the number of establishments is less than 0.04 percent of all consumer electronics and garments establishments in China are excluded.

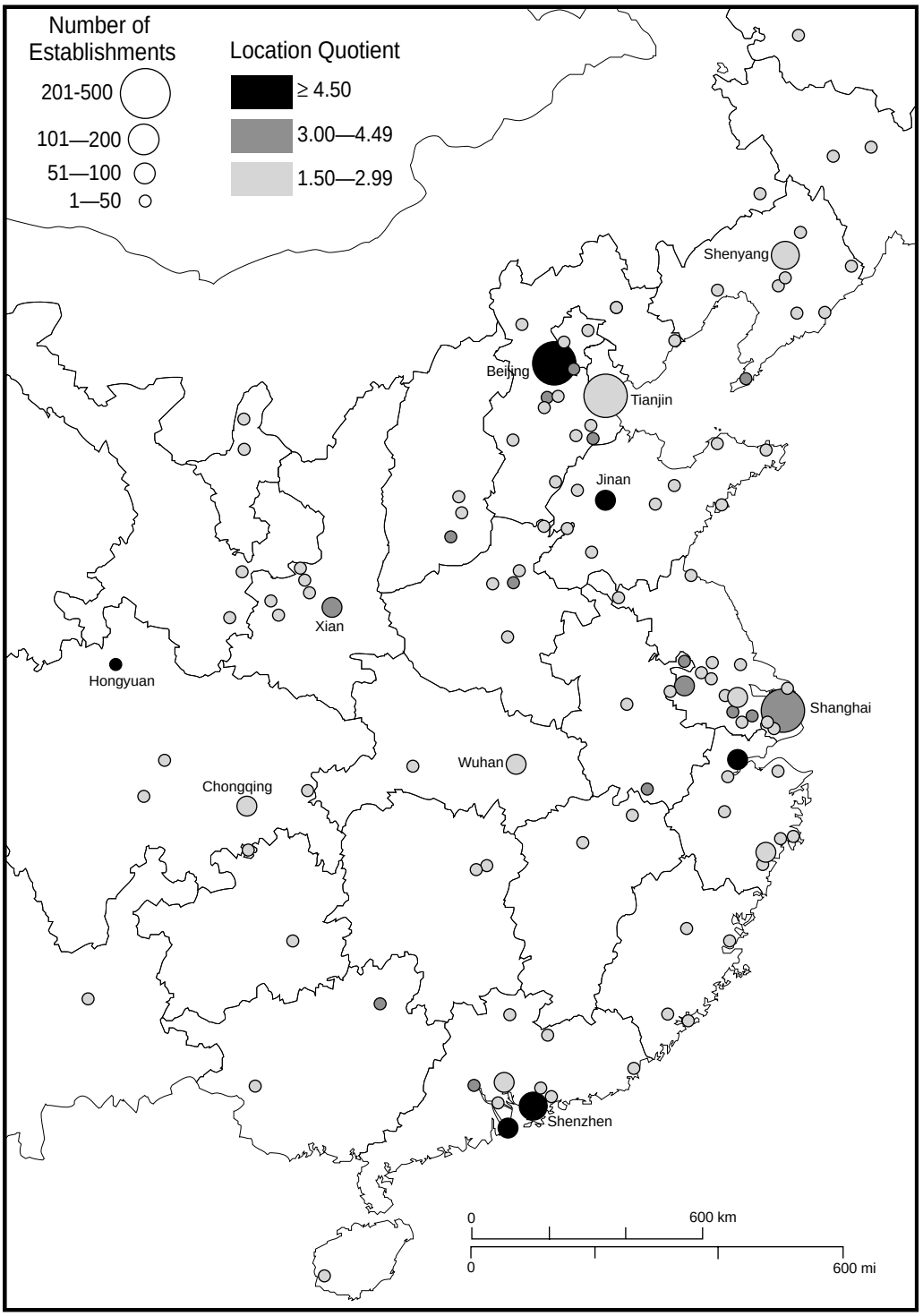

Figure 3. Distribution of establishments in the computers, electronic equipment and instruments industries by county, China, 1995. Figure based on four-digit data from the 1995 Industrial Census provided by the State Statistical Bureau, People's Republic of China. *Note:* Counties in which the number of establishments is less than 0.04 percent of all computers, electronic equipment and instruments establishments in China are excluded.

Delta, eastern coastal Guangdong and coastal Fujian, Shanghai and nearby areas in southern Jiangsu and northern Zhejiang, and in Beijing and Tianjin and adjacent areas. Industries in this subgroup are characterized by relatively low capital-labor ratios, which as we have already shown is a sign of the tendency toward locational agglomeration. In addition, these industries are among the largest export industries in China, and the Chinese government has actively reinforced their concentration in the Pearl River Delta. These industries are much favored by overseas Chinese investors, whose social ties and networks have helped to boost economic development in the area (Chisterson and Lever-Tracy 1997). The Pearl River Delta has benefited from both governmental policy and strong social ties to overseas Chinese investors. The large number of adjacent counties with high location quotients and/or a large number of establishments in that area suggests not only that the industries are spatially concentrated, but also that institutional forces have effectively fostered functional linkages and agglomeration economies. Similar processes appear to have begun in and near Beijing, Tianjin, and Shanghai.

The computer, electronic equipment and instruments subgroup also displays a degree of clustering in the Pearl River Delta, especially in and near Shenzhen, and in areas near Shanghai, Beijing, and Tianjin, but there are a number of other clusters scattered throughout the country. In a few isolated cases, the high location quotients observed for this subgroup are a statistical artifact resulting from the small total number of industrial establishments in certain counties. Hongyuan county in western China, for example, has a high location quotient of 10.1 but is the location of only six industrial establishments in total. More important, the many different agglomerations of establishments in this subgroup reflect their affinity for large cities, which, in addition to the cities of the coastal areas, include Chongqing, Xian, Wuhan, Jinan, and Shenyang. This pattern can be related, in part, to the combined effects of market forces and the past locational policies of the Chinese government in promoting the growth of inland cities. In addition, the work of Wang and Wang (1998) on the Zhong'guancun high-technology district adjacent to Beijing University underlines the significance of institutions of higher education in helping to anchor agglomerations of industries in the second subgroup. Beijing's large number of establishments and high location quotient again point to the important role of institutions of higher education. This factor appears to be related also to the large number of establishments in Tianjin and Shanghai.

As we indicated in Table 1, the garments and electronics and telecommunications industries (at the two-digit level and with provinces as units of observation) are highly concentrated in spatial terms. On the basis of our county-level data, we recomputed the H-indexes for all industries and again found that garments and electronics and telecommunications are close to the top of the sectoral rankings. The analysis presented in Table 4 also suggested that the clustering of these two industries has statistically significant effects on their productivity. Specifically, we found that urbanization has a positive impact on productivity in the garments sector, and localization has a positive impact in electronics and telecommunications. The Chinese space-economy is a highly complex one, however, and for some industries spatial concentration does not necessarily or always lead to unusually high levels of productivity. This seems to be especially the case in transportation-equipment manufacturing, which is marked by dense spatial concentration, especially in areas around Shiyan in central China, Changchun in the northeast, and Chongqing in the southwest, as shown in Figure 4. There are undoubtedly some productivity effects in these areas that are due to agglomeration, but these industries were initially located in these relatively inaccessible places during the Maoist period for political reasons. During the 1950s, the First Auto Works was located in Changchun so as to be close to the former Soviet Union (Sit and Liu 2000). After the Sino-Soviet split and

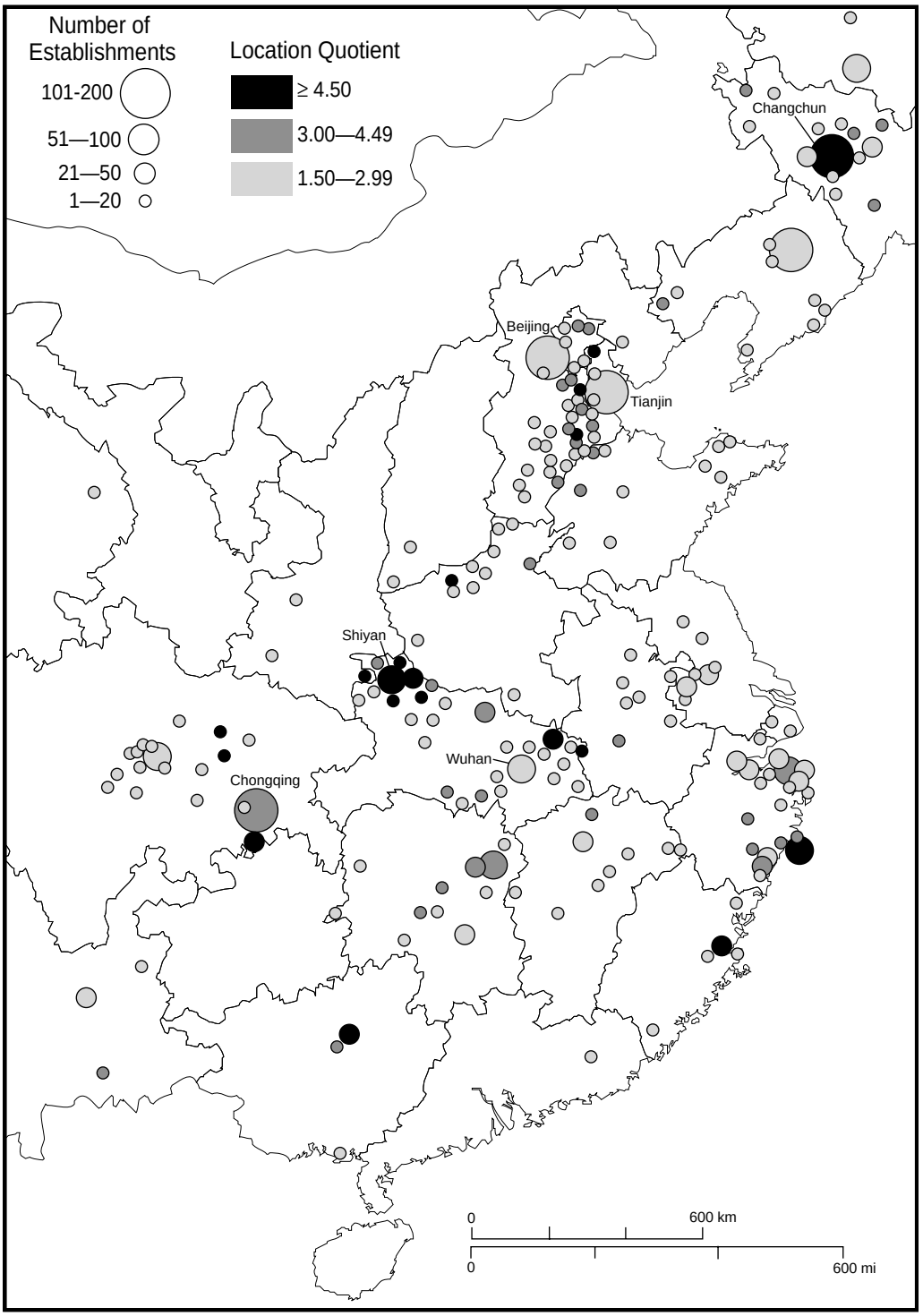

Figure 4. Distribution of establishments in the transportation-equipment manufacturing industry by county, China, 1995. Figure based on four-digit data from the 1995 Industrial Census provided by the State Statistical Bureau, People's Republic of China. *Note:* Counties in which the number of establishments is less than 0.04 percent of all transportation-equipment manufacturing establishments in China are excluded.

because of efforts to build key industries in inland "third front" locations (Naughton 1988), Shiyan—a remote and inaccessible county—was selected as the site of the Second Auto Works and the nation's first independent auto manufacturing complex. Our statistical analyses (see Table 4) show that productivity in the transportation-equipment sector is statistically related to the capital-labor ratio but *not* to localization or urbanization. In fact, new car-manufacturing clusters in coastal areas around Shanghai, Beijing, and Tianjin have emerged since the reforms and as market forces have increasingly driven locational outcomes in this industry (Sit and Liu 2000). Similarly, market forces underlie the recent trend to diffuse transportation-equipment manufacturing from Shiyan toward Wuhan and other more accessible locations.

Conclusion

In this article, we have sought to explore the interconnections between geography and economic development in the less-developed countries of East Asia, paying special attention to the role of dense industrial regions as conduits of productivity effects and developmental impulses. We have carried out this exploration on the basis of theoretical speculation, appeals to the literature, and a series of empirical investigations focused on the Chinese case. Once again, we stress that the quality of the data on which the latter investigations are based leaves much to be desired. That said, our multifaceted approach to the central question appears to point with some plausibility to a real connection between agglomeration, on the one side, and economic development and growth, on the other. This outcome is of special interest because it concerns situations that are very different indeed from the usual case-study material found in the literature, which is generally focused on developed Western economies.

Our empirical analysis of Chinese industries supports the argument that a positive relationship can be found between industrial agglomeration and productivity in economies that were formerly dominated by central planning, and it highlights, above all, sectors and spaces that are undergoing economic liberalization as those most prone to the formation of agglomeration economies. China has a mixed economy in which socialist legacies exist side by side with new developmental forces as a result of market-opening measures and both formal and informal institutions continue to play important roles in shaping the space-economy. China's economic geography was formerly heavily shaped by a socialist ideology that downplayed agglomeration economies. Our empirical analysis identified transportation-equipment manufacturing as a sector that exhibits a degree of spatial clustering but little in the way of agglomeration economies and suggests that this situation may be a legacy of former state planning. Recent economic liberalization in China, however, seems to have fostered both the macroeconomic and local conditions under which viable industrial agglomerations can emerge. During the past two decades, the Chinese government has promoted labor-intensive industries, mostly for export, and has developed economic zones in which these industries can flourish. Our empirical investigations point to a strong relationship between industrial clustering and productivity, especially in industries like consumer electronics and garments and computers that have gained prominence since the government's drive toward economic liberalization, and especially in the coastal provinces and large cities. In addition to showing that the relationship between agglomeration and productivity is mediated in peculiar ways by governmental policies, both old and new, we have argued that the informal social networks that have traditionally played such a strong role in the Chinese economy are also helping to reinforce regional patterns of economic development.

Of course, much additional work is necessary, not only for its own sake, but also as a prelude to effective policymaking in the many and vastly different regional economic systems (at various levels of development)

that are to be found in East Asia in general, and China in particular. The analysis presented here, despite its shortcomings, provides a reasonably convincing precedent for probing more deeply into the questions raised. As we have indicated, there is a strong conceptual and empirical case for claiming that locational clustering and economic performance are intertwined in complex but important ways. This research agenda is not only of considerable importance and interest in its own right, but is all the more pressing because the insights to be gained offer the possibility of greatly enhanced policymaking and hence of significant economic gains to particular regions and countries. The stakes are especially high in those parts of East Asia that are still struggling to attain to world standards of industrial production and competitive advantage and to establish a durable position for themselves on global markets.

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