

Research Article

“Local versus Nonlocal” Enterprise Linkages of Global Cities: A Comparison between Beijing and Shanghai, China

Jiayi Lu,^{1,2} Dongqi Sun ,¹ Jiali Yu,³ Jiaming Li,¹ and Fangqu Niu ¹

¹Key Laboratory of Regional Sustainable Development Modeling,
Institute of Geographic Sciences and Natural Resources Research, CAS, Beijing 100101, China

²University of Chinese Academy of Sciences, Beijing 100049, China

³China Academy of Urban Planning & Design, Beijing 100044, China

Correspondence should be addressed to Dongqi Sun; sundq@igsnr.ac.cn and Fangqu Niu; niufq@reis.ac.cn

Received 14 April 2020; Revised 13 May 2020; Accepted 15 May 2020; Published 2 July 2020

Guest Editor: Jun Yang

Copyright © 2020 Jiayi Lu et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Two global cities of China, Beijing and Shanghai, have completely different development statuses with their hinterlands. There is a large economic development gap between Beijing and its hinterland, Hebei Province, while Shanghai has formed a highly integrated region with its hinterland, the Yangtze River Delta. According to the Outline of Collaborative Development of Beijing, Tianjin, and Hebei Province, enterprise linkages between Beijing and Hebei should be strengthened in order to narrow the economic gap between the center and the hinterland. On this basis, this paper proposes two hypotheses. (1) The economic gap between Beijing and Hebei has not really changed, because more enterprise linkages of Beijing are nonlocal. (2) The gradual narrowing of the economic gap between Shanghai and Jiangsu as well as Zhejiang is due to the fact that more enterprise linkages of Shanghai are local. We have used enterprise data on business registration from the State Administration for Industry and Commerce of China and have selected two indicators, namely, the number of headquarters-branches offices and the amount of enterprise investment, to examine the enterprise linkages between Beijing/Shanghai and their hinterlands as well as the hinterworld, and have verified these two hypotheses. The results show that nonlocal enterprise linkages based on the hinterworld are the main form in Beijing, while local enterprise linkages based on the hinterland are the main form in Shanghai. In addition, we have analyzed the mechanisms of formation of the enterprises linkages of the two cities and have put forward some policy suggestions.

1. Introduction

The study of enterprise linkages between central cities and their hinterlands has always been an important aspect of research on regional and urban development [1, 2]; its essence is the exploration of intercity interactions within regions. Since the 1930s, a number of studies have been conducted into the relationship between cities and their hinterlands, and these have produced a variety of classic theoretical perspectives represented by central place theory, the study of backwash effects and spread effects, and the core-periphery model [3–6]. Christaller's Central Place Theory provided the foundation for a number of studies of the relationship between cities and their hinterlands [3]; an example is Berry's concept of an “urban system,” which

reflects the correlation between city and hinterland [7]. However, these theories have some limitations in explaining linkages between cities, and they usually limit the research object to a relatively complete and closed area of a physical geographical unit or administrative division and pay more attention to the hierarchy, scale, and local (hinterland-based) linkages between cities [2]. In 1969, Jacobs argued that “cities need each other,” and she was one of the few theorists at the time to acknowledge the existence of nonlocal linkages in cities [8]. In 1985, Hohenberg and Lees proposed the concept of a “dual system,” which clearly defined the local and nonlocal linkages in cities. “System 1” refers to a description of the local linkages of a city and its hinterland based on central place theory, and “system 2” refers to the nonlocal linkages that a city creates with its

wider hinterland [9]. The dual system provided a reference for the classic paper “The World City Hypothesis,” published in 1986 by Friedmann, who pointed out that the world city hierarchy, centered in London, New York, and Tokyo, seemed to have been deeply embedded in the sense of globalization [10]. Hall further deepened Friedmann’s point of view in 2002, trying to build a rigorous analytical framework to spread the hierarchy to the global scale [11]. Although Friedmann mainly emphasized the city hierarchy, he acknowledged that cities have nonlocal linkages in the context of globalization [12, 13].

Since the 1990s, globalization and informatization have profoundly affected the development and evolution of cities and regions around the world [14]. The linkages between cities are outside the scope of central place theory, and the development of any region or city is no longer carried out in a closed system [15–17]. In 1991, Sassen proposed the concept of global cities, referring to cities that directly influence global affairs in social, economic, cultural, or political ways [18]. She found that a global city is the center of a global capital spatial organization, playing an important role in market-oriented accumulation and in organization and reconstruction of production space. A global city influences the social and economic space of the world via four forces: economic globalization, political multipolarization, social informatization, and cultural diversification [18–20]. Castells proposed the concept of a “space of flows” in 1996 [21]. He believed that, owing to the prominence of time-space compression, research on intercity connections transformed from dealing with a “space of places” to dealing with a “space of flows” [22]. Driven by the increasingly powerful global economy, this space of flows will gradually weaken the restrictions imposed by internal administrative boundaries, social relations, and political systems in urban and rural areas [23]. In other words, the core idea of Sassen and Castells is that, with the acceleration of globalization, marketization, and informatization, the connections of any influential global city or central city cannot be confined to those with its hinterland. The powerful economic strength of global cities such as London, New York, and Hong Kong is obviously not just based on their surrounding hinterlands. There is some extra energy that fuels their development [18–23].

Taylor et al. proposed central flow theory on the basis of the existence of global cities and a “space of flows,” taking account of the nonlocal linkages between a city and other cities outside its hinterland [17], the essence of which is a further revision of central place theory. According to Taylor, the key deficiency of central place theory is its neglect of nonlocal linkages [16, 17]. He constructed an “interlocking network” for empirical research [2, 24], which provided a comprehensive analytical framework for the study of the local and nonlocal linkages of cities [17]. Derudder and Taylor argued that the traditional relations between cities and their hinterlands are only stable to a certain degree. Under the influence of the space of flows, the economic characteristics of cities will develop from simple local connections (based on the surrounding hinterlands) to complex nonlocal connections, and a hinterland with

nonlocal linkages is called a “hinterworld.” All urban areas have a hinterland and a hinterworld [2]. In addition, Derudder and Taylor pointed out that the nonlocal linkages of cities are seriously overlooked in geographical studies [15–17]. Therefore, future investigations should consider not only the local linkages between cities and their hinterlands, but also the broader nonlocal linkages with the hinterworld [2].

Central place theory and the later concept of the space of flows constitute the theoretical foundations for the study of local and nonlocal enterprise linkages. Empirically, studies of intercity enterprise linkages are mainly divided into two approaches: those that consider enterprises based on advanced producer services (APS) and those that consider enterprises based on a headquarters-branches structure [25]. The urban network research method based on APS enterprises was proposed by the GaWC research team and is widely used in empirical studies [15–17, 25]. In addition, the POLYNET project team led by Peter Hall also adopted the APS enterprise network perspective to study the European urban system and proposed the concept of a “megacity region” [12]. Urban network studies based on headquarters-branches enterprises are represented by the research of Alderson and Beckfield. They analyzed the spatial structural features of the world city system as well as the power and status of nodal cities with the help of social network analysis, based on spatial distribution data on the headquarters and branches of 446 multinational enterprises from the entire industry in 3,692 cities [26]. In addition, Wall and Knaap used the distribution data of the headquarters-branches of the world’s top 100 multinational enterprises in 2,259 cities in 2005 for a comparison with the world city network based on APS enterprises and industry-wide enterprises and found that the node centrality and network structure of the two had high similarity [27]. According to Krätke, APS enterprise linkages exhibit one-sidedness, while intercity enterprise linkages in terms of the headquarters-branches structure give a better reflection of the overall picture [28].

As an important economic engine, urban agglomeration, i.e., the formation of urban regions, has been regarded as a significant part of China’s regional development strategy [29–31]. The development of the Beijing-Tianjin-Hebei region is extremely unbalanced [32]. As a global city, as well as a national and regional center, Beijing has a large gap in development with the hinterland of Hebei Province, and this situation has not changed over time. According to Wu et al., the development of Hebei has been subject to backwash effects from Beijing for a long time, and it has become a “shadow area” [30]. In 1990 and 2018, Beijing’s per capita GDP was, respectively, 3.12 times and 2.95 times that of Hebei, as calculated from data provided in the China Statistical Yearbook. This demonstrates that, in the Beijing-Tianjin-Hebei region, over the past nearly 30 years, the development gap between Beijing and Hebei has not fundamentally changed. In 2015, coordinated development of the Beijing-Tianjin-Hebei region was promoted as a major national strategy, the core aim of which was to gradually relocate some enterprises from Beijing to Hebei, so as to strengthen the enterprise linkages between the central city

and its hinterland and to gradually achieve the goal of coordinated development of regional economy [33]. However, among the 16 cities in the Yangtze River Delta (hereinafter referred to as the YRD), in 1990 and 2018, respectively, the per capita GDP of Shanghai, which is also a global city as well as the national and regional center, was 2.29 times and 0.93 times that of Jiangsu and 1.12 times and 0.98 times that of Zhejiang, which are in Shanghai's hinterland. This shows that, over the past nearly 30 years, the economic development gap between Shanghai and its hinterland has been narrowing or has even reversed. In view of the above two different regional phenomena, we propose two hypotheses at the national level. (1) The economic gap between Beijing and Hebei has not really changed, because more of Beijing's enterprise linkages are nonlocal. (2) The gradual narrowing of the economic gap between Shanghai and Jiangsu as well as Zhejiang is due to the fact that more of the enterprise linkages of Shanghai are local.

In this paper, we draw mainly on the temporospatial evolution of the local and nonlocal enterprise linkages of Beijing and Shanghai from 1990 to 2018 based on the availability of data, with the aim of verifying the above hypotheses. Two contributions are made. First, we improve the data quality. We use data on headquarters-branches and on enterprise investment to measure intercity enterprise linkages. The study is more comprehensive than previous studies, which mostly chose only headquarters-branches indicators to describe the overall enterprise linkages and network structure characteristics of the region [26]. Second, we further refine the spatial scale and set the smallest research unit at the county level. The results are more detailed than those of previous studies set at the city level [34–36].

The remainder of the paper is organized as follows. The next section deals with materials and methods, including the study area and the selection of appropriate years, together with a description of research concepts, data sources, and methods. We then present and discuss our results and finally arrive at some conclusions.

2. Materials and Methods

2.1. Study Area. According to the official Outline of Collaborative Development of Beijing, Tianjin, and Hebei Province [37], Hebei is the hinterland of Beijing. Beijing has enterprise linkages with 168 county units in 11 cities in Hebei, which we call “local linkages” of Beijing. Shanghai is the central city of the YRD, and its hinterland includes 15 cities, namely, Nanjing, Suzhou, Wuxi, Changzhou, Zhenjiang, Yangzhou, Nantong, and Taizhou in Jiangsu province and Hangzhou, Ningbo, Jiaxing, Huzhou, Shaoxing, Zhoushan, and Taizhou in Zhejiang province. Shanghai has enterprise linkages with 113 county units in these cities, which we call “local linkages” of Shanghai. The enterprise linkages between Beijing and all county units within China's national boundaries (excluding for now the Hong Kong, Macao, and Taiwan regions) except those in Hebei are called “nonlocal linkages” of Beijing. The enterprise linkages between Shanghai and all county units within the boundary of mainland China except those in the YRD are called

“nonlocal linkages” of Shanghai. Among these, each urban district is treated in the same way as a county unit (Figures 1 and 2).

2.2. Selection of Appropriate Years. According to Wei, globalization, marketization, and other factors have influenced China's regional economic development pattern [38]. On the basis of availability of data, we selected four representative years from the period of 1990–2018 (1990, 2000, 2010, and 2018) to compare the spatial and temporal evolution of local and nonlocal enterprise linkages of Beijing and Shanghai, with the aim of verifying the hypothesis put forward in the introduction. The reasons for choosing these four years were as follows. (1) China implemented the Reform and Opening-up Policy in 1978 and did not initially establish the socialist market economy system until 1992 [39]. Therefore, the year 1990 represents the exploration period of market reform. (2) China formally joined the WTO in 2001 [40], and the process of globalization has constantly accelerated since then. Thus, the year 2000 represents the period of marketization, the year 2010 represents the period of globalization, and the year 2018 represents the latest period.

2.3. Basic Idea. We selected two indicators, namely, the number of headquarters-branches offices and the amount of enterprise investment, to examine intercity enterprise linkages. The specific research ideas are as follows. (1) If an enterprise in Beijing/Shanghai sets up a branch office in a county in another city, we consider that there is an enterprise linkage between Beijing/Shanghai and the county. If an enterprise in Beijing/Shanghai invests an enterprise in a county in another city, we also consider that as an enterprise linkage. In this way, Beijing/Shanghai will have two enterprise linkages with the county. Compared with previous studies that chose only headquarters-branches as indicators [29], this approach provides a more scientific reflection of real enterprise linkages. (2) Using the above ideas, we calculate the number of enterprise linkages between Beijing/Shanghai and all counties in China and visualize them in space. (3) We apply the spatial autocorrelation method applied to categorize the results into three types, namely, “high-value clusters,” “low-value clusters,” and “random distribution.” We then analyze the enterprise linkages of Beijing/Shanghai with regard to the types into which local and nonlocal enterprise linkages, respectively, of Beijing/Shanghai, are more likely to fall. Finally, we draw our conclusions and verify the hypothesis put forward in this study.

2.4. Data Sources and Processing. The data sources of this paper are as follows. (1) Enterprise linkages data are taken from enterprise data of business registration from the State Administration for Industry and Commerce of China in 1990, 2000, 2010, and 2018. (2) Based on the county administrative boundaries of China in 2015 (from the Resources and Environment Data Center, Chinese Academy of Sciences) and taking the administrative division code of China in 2018 (from the Ministry of Civil Affairs of People's Republic of China) as the standard, 2,856 county

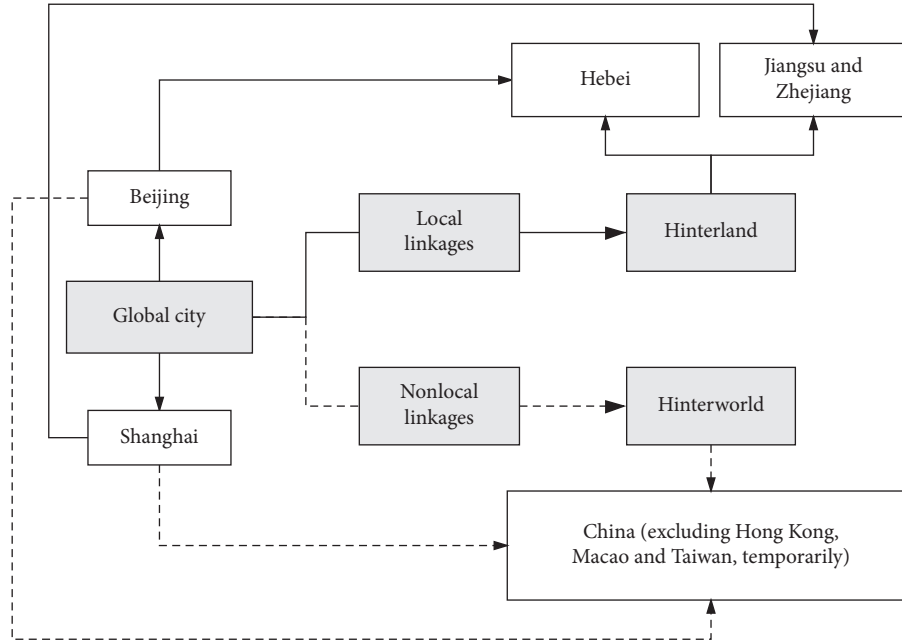


FIGURE 1: Definition of local and nonlocal enterprise linkages.

administrative divisions of mainland China for 2018 were obtained, with taking adjustments of administrative divisions in various cities into account. Owing to these adjustments, line elements were transformed into point elements. Through an overlay analysis in ArcGIS, enterprise linkages between Beijing/Shanghai and each county were obtained. The basic data processing procedure of this study is shown in Figure 3.

2.5. Spatial Autocorrelation Method. Since global assessment of spatial autocorrelation does not clearly reveal local conditions on a small scale, local indicators need to be employed to detect local spatial agglomeration [41]. The most commonly used indicators of local spatial autocorrelation include Local Moran's I [42] and Local G [43]. In this study, we use Local G to investigate the spatial distribution of enterprise linkages of Beijing and Shanghai from 1990 to 2018.

Proposed by Ord and Getis [43], Local G is a local spatial autocorrelation index based on a distance weight matrix, which can detect both high-value and low-value aggregations. It is given by the following formula:

$$G_i = \frac{\sum_{i=1}^N \sum_{j=1}^N W(i, j) x_i x_j}{\sum_{i=1}^N \sum_{j=1}^N x_i x_j}, \quad (1)$$

where $W(i, j)$ is the weight matrix between units i and j . A significantly positive G_i indicates a high observed value around unit i , while a significantly negative G_i indicates a low observed value around unit i .

3. Results and Discussion

3.1. Spatial Patterns of Beijing's Local and Nonlocal Enterprise Linkages. We analyzed the spatial autocorrelation of

Beijing's local and nonlocal enterprise linkages. The results are shown in Table 1 and Figure 4.

In 1990, among 2,827 counties nationwide that had enterprise linkages with Beijing, there were 730 with significant Local G results, 15 of which were in Hebei, accounting for only 2.0%, and 715 of which were in the hinterworld, accounting for 98.0%. Among those counties with significant results, 287 were significantly positive, only 2 of which were in Hebei, accounting for only 1.2% of Hebei's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for 10.7% of the hinterworld's total counties. This indicates that Beijing has stronger enterprise linkages with its hinterworld. It shows a spatial pattern that is overall scattered and locally concentrated. Counties with strong linkages were mainly distributed in the coastal areas of China, such as the Bohai Rim, the YRD, and the Pearl River Delta (hereinafter referred to as the PRD). In addition, Hubei Province, Chongqing, and other regions in Midwest China also saw scattered counties with strong enterprise linkages with Beijing.

In 2000, among 2,827 counties nationwide that had enterprise linkages with Beijing, there were 725 with significant Local G results, 19 of which were in Hebei, accounting for only 2.6%, and 706 of which were in the hinterworld, accounting for 97.4%. Among those counties with significant results, 247 were significantly positive, only 1 of which was in Hebei, accounting for only 0.6% of Hebei's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for 9.3% of hinterworld's total counties. This indicates that, compared with the hinterland, the hinterworld still has stronger enterprise linkages with Beijing. The spatial patterns have not changed much since 1990. What is different is that the number of counties with strong linkages in the YRD has

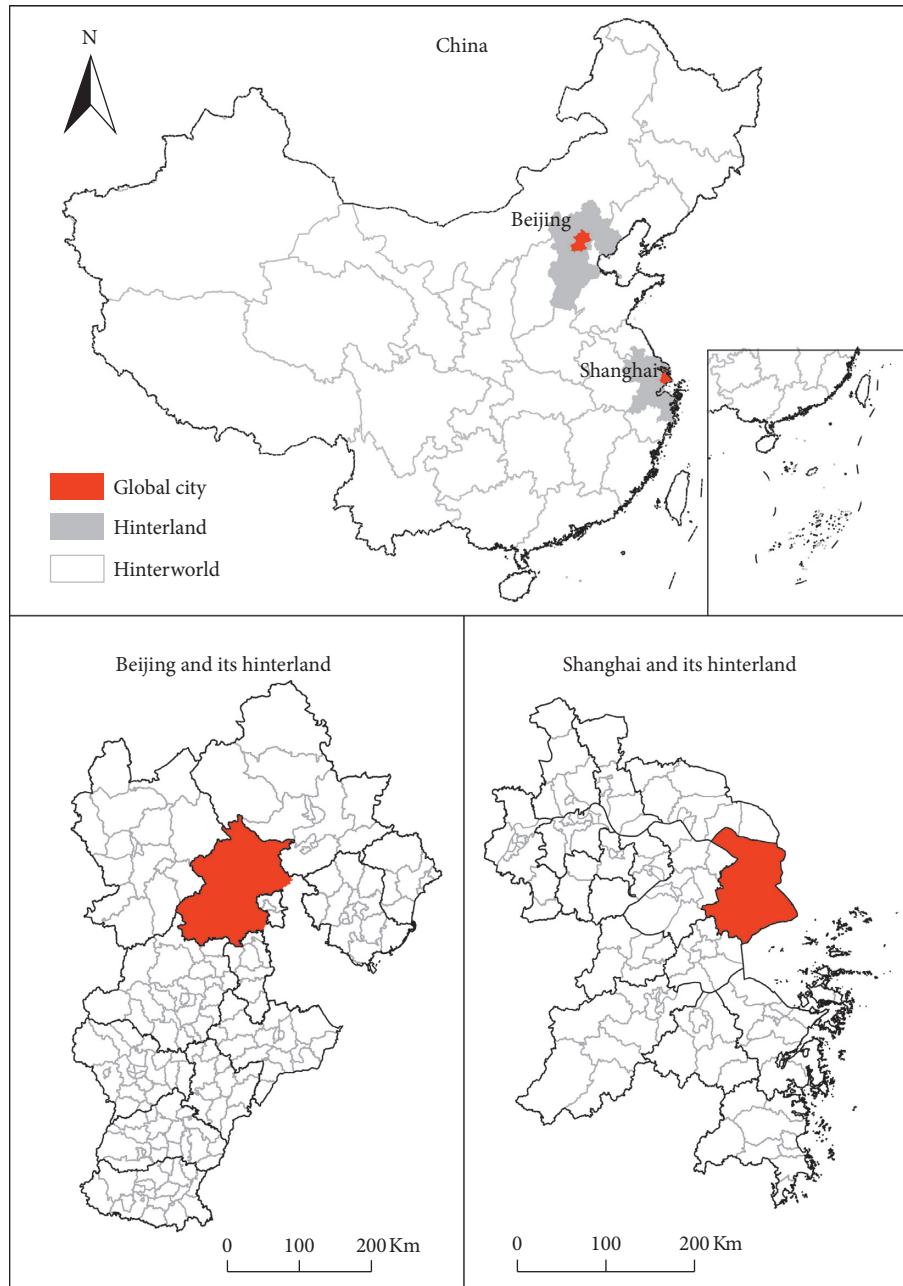


FIGURE 2: Map of the study area.

increased significantly, while the number of those in other areas has decreased.

In 2010, among 2,827 counties nationwide that had enterprise linkages with Beijing, there were 646 with significant Local G results, 14 of which were in Hebei, accounting for only 2.2%, and 635 of which were in the hinterworld, accounting for 97.8%. Among those counties with significant results, 214 were significantly positive, only 6 of which were in Hebei, accounting for only 3.6% of Hebei's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for 7.8% of the hinterworld's total counties. In 2018, there were 655 counties with significant Local G results, 11 of which were in

Hebei, accounting for only 2.1%, and 644 of which were in the hinterworld, accounting for 97.9%. Among those counties with significant results, 203 were significantly positive, only 8 of which were in Hebei, accounting for only 4.8% of Hebei's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for 7.3% of the hinterworld's total counties. From 2010 to 2018, the counties with strong enterprise linkages with Beijing were mainly concentrated in the YRD and the PRD, with significant declines in other regions.

To sum up, it can be seen that, from 1990 to 2018, local enterprise linkages with Beijing were relatively weak, and the overall distribution patterns hardly changed during this

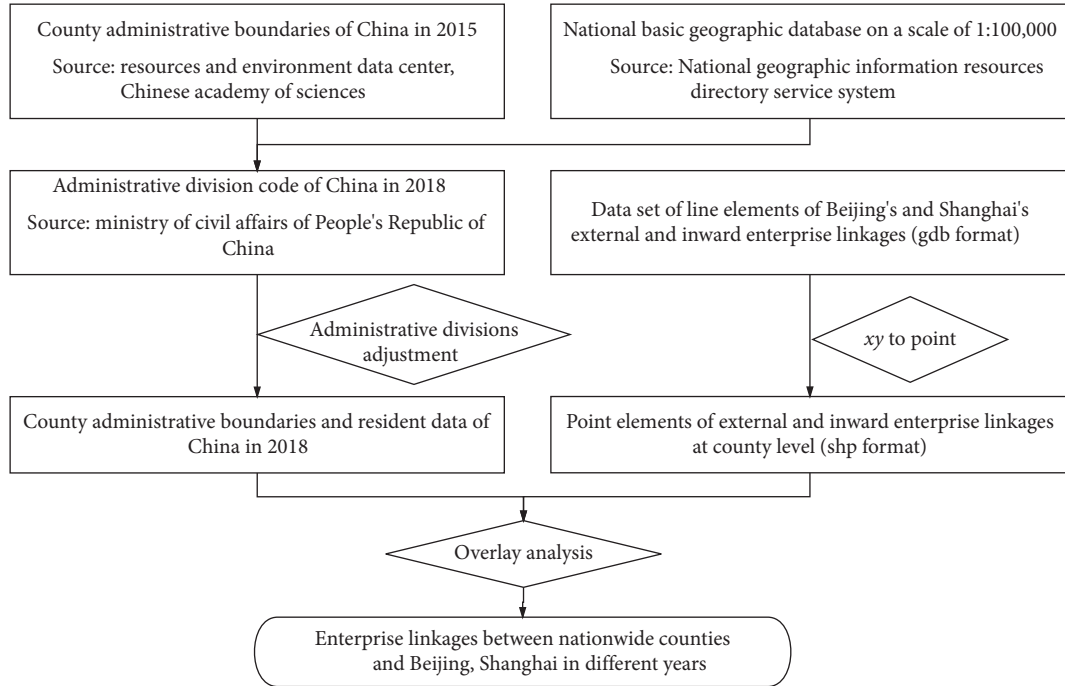


FIGURE 3: Basic data processing procedure of the study.

TABLE 1: Local spatial autocorrelation of Beijing's enterprise linkages from 1990 to 2018 (at a significance level of $p < 0.05$).

Area	Local G	1990	2000	2010	2018
Hinterland (168 counties in total)	Number of counties with significant results	15	19	14	11
	Number of counties with significantly positive results	2	1	6	8
	Proportion of positive results in total counties of hinterland (%)	1.2	0.6	3.6	4.8
Beijing	Number of counties with significant results	715	706	632	644
	Number of counties with significantly positive results	285	246	208	195
	Proportion of positive results in total counties of hinterworld (%)	10.7	9.3	7.8	7.3

period. Counties with strong enterprise linkages accounted for a larger proportion in the hinterworld, especially in the YRD and the PRD. Nonlocal linkages are the main form of enterprise linkages for Beijing. Thus, hypothesis 1 is verified: the economic gap between Beijing and Hebei has not really changed, because more of Beijing's enterprise linkages are nonlocal.

3.2. Mechanisms of Formation of Beijing's Enterprise Linkages.

The economic gap between Beijing and Hebei Province has not really changed, because Beijing has relatively weak local enterprise linkages. The following are possible mechanisms underlying the weak local linkages.

- (1) Beijing has been exerting an obvious siphoning effect for a long time, which has brought some negative effects on the economic development of Hebei province. As the national key industrial city and the industrial center of North China, Beijing has concentrated a large number of heavy industrial projects. Hebei, rich in coal, iron ore, limestone, and other mineral resources and oil resources, has long been

the supply base for Beijing's industrial raw materials, as well as its mineral, water, and power resources [44]. Tangshan, Handan, and Xingtai in Hebei, for example, supply Beijing with coal for coking and power generation and supply Shougang with iron ore and pig iron for steelmaking, as well as large quantities of glass, cement, and other building materials. Zhangjiakou, Chengde, Qinhuangdao, and Tangshan are the main run-off forming areas and water conservation areas of Miyun Reservoir, which guarantees a fresh water supply for Beijing. The one-way strategy that has been serving Beijing for so long has cost Hebei dearly [45]. First, under the conditions of a long period of planned economy, Hebei, as an exporter of energy, raw materials, and industrial semifinished products, was in a weak position in the regional trade pattern and industrial division structure. Second, there were basically no standardized channels to ensure that Hebei received the ecological compensation it deserved. All of these factors had a negative impact on the economic development of Hebei [46].

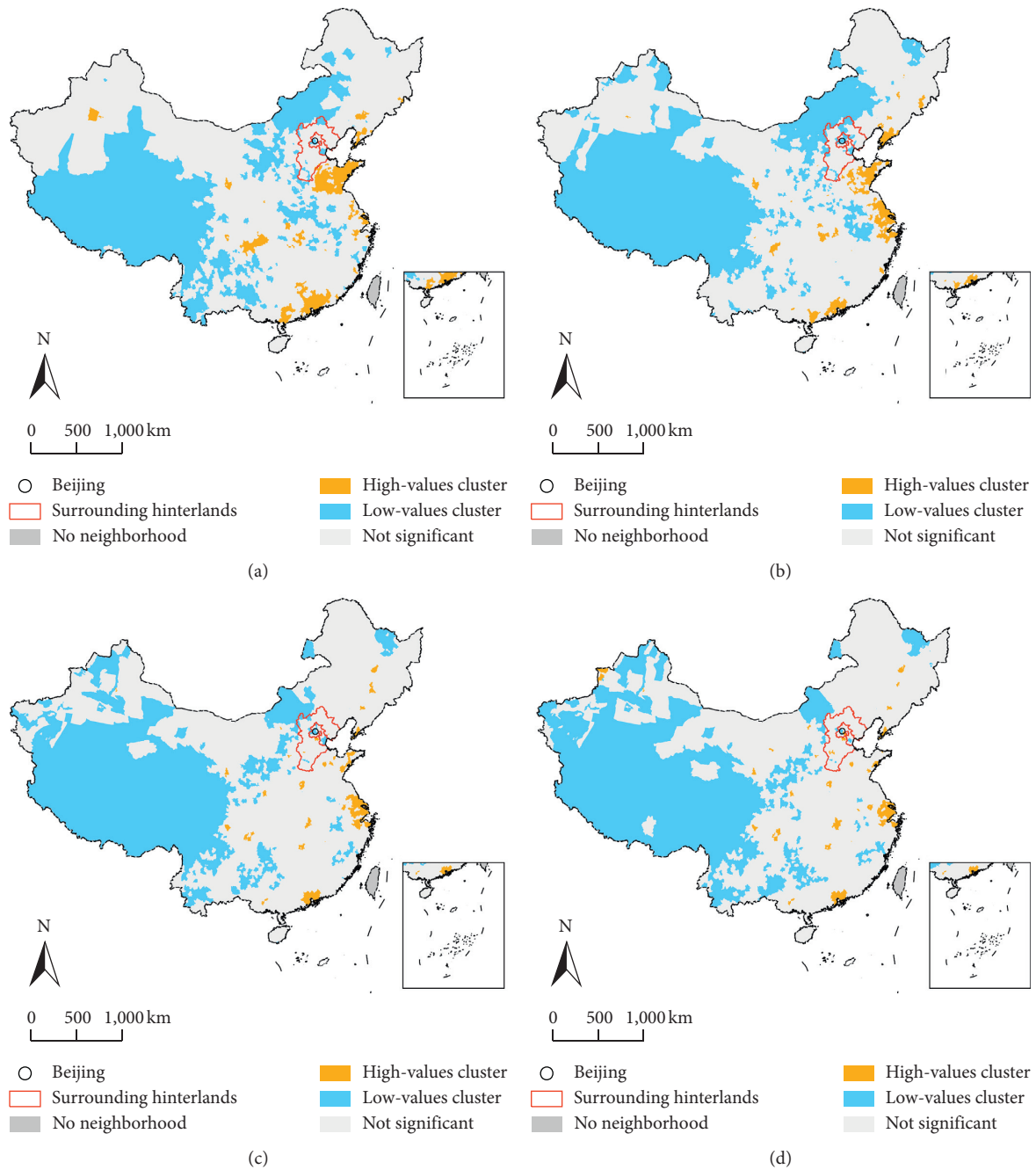


FIGURE 4: Local spatial autocorrelation patterns of Beijing's enterprise linkages. (a) 1990, (b) 2000, (c) 2010, and (d) 2018.

(2) The raw material industry in Hebei province has problems in matching and coordinating with Beijing's cutting-edge industry. In the postindustrial society, the development of advanced producer services has made Beijing the world's most thriving metropolis but has failed to bring about prosperity over a larger region [47]. As the national capital, Beijing is becoming an essential base for finance, trade, high-tech, and large-scale R&D, as well as information, intermediary, and other advanced services [48]. Currently, the proportion of producer

services in Beijing's GDP has reached 51%. Beijing's advanced services are mainly geared towards the national market, and it even plays an important role as a nodal city in the world economy [49]. However, at the same time, branches of Beijing's enterprises in Hebei accounted for only 6.87% of enterprises there in 2017. The industries most closely related to Beijing's producer services such as information and business services are the equipment manufacturing industry. However, industrial development in Hebei has focused mainly on heavy industries, especially

raw material industries. In 2016, the proportion of heavy industries in Hebei was close to 70%, of which more than 50% were raw material industries such as metal smelting, petroleum refining, and mining. The mismatch between Hebei's raw material industry and Beijing's cutting-edge industry is an important reason for Beijing's weak local enterprise linkages.

- (3) The top-down administrative power of the state has failed to promote effective market interaction between Beijing and Hebei Province. In the late 1980s, Beijing and Hebei began to focus on coordinated development. In 1988, they established the Circum-Beijing Economic Cooperation Zone and set up a system of joint conferences of mayors and commissioners to promote regional economic cooperation. In the 1990s, Beijing, Tianjin, and Hebei carried out a study on the Rational Distribution of Productivity in the Capital and Surrounding Areas and began some top-down industrial cooperation, such as that between Beijing and Hebei to cobuild the Jingtang Port. In 1993, Hebei took advantage of its location to implement the opening-up policy based on the expanded ports of Tangshan, Huanghua, and Qinhuangdao. However, the hinterlands of the three ports are mainly Inner Mongolia, Shanxi, and Liaoning province, which are abundant in raw materials. Beijing, however, has not developed an effective market interaction with Hebei. In 2004, the National Development and Reform Commission decided to establish a regular consultation system for Beijing-Tianjin-Hebei development and a regular high-level joint conference. In the following year, the Regional Plan for the Beijing-Tianjin-Hebei Metropolitan Area was issued. The above strategic actions have been promoted in a top-down manner from the national level through administrative forces, in an attempt to establish a regional coordination mechanism, which is more in the form of a mandatory coordination from the top, instead of spontaneous interaction within Beijing-Tianjin-Hebei [50]. Among the strategic interactions between Beijing and Hebei, there has been little voluntary active coordination in response to market demand (which is more common between Shanghai and southern Jiangsu). The conservative institutional environment has led to the relatively weak local enterprise linkages of Beijing.

3.3. Spatial Patterns of Shanghai's Local and Nonlocal Enterprise Linkages. We also analyzed the spatial autocorrelation of Shanghai's local and nonlocal enterprise linkages. The results are shown in Table 2 and Figure 5.

In 1990, among 2,843 counties nationwide that had enterprise linkages with Shanghai, there were 2,414 with significant Local *G* results, 75 of which were in the YRD, accounting for only 3.1%, and 2,339 were in the hinterworld, accounting for 96.9%. Among those counties with significant results, 134 were significantly positive, 69 of which were in

the YRD, accounting for 61.1% of the YRD's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for only 2.4% of hinterworld's total counties. This indicates that Shanghai has much stronger enterprise linkages with its hinterland. There was a spatial pattern of concentrated and contiguous distribution around Shanghai. The counties with strong enterprise linkages were mainly located in Suzhou, Wuxi, Changzhou, Jiaxing, Ningbo, and other cities.

In 2000, among 2,843 counties nationwide that had enterprise linkages with Shanghai, there were 1,122 with significant Local *G* results, 74 of which were in the YRD, accounting for only 6.6%, and 1,048 were in the hinterworld, accounting for 93.4%. Among those counties with significant results, 166 were significantly positive, 74 of which were in the YRD, accounting for 65.5% of the YRD's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for only 3.4% of the hinterworld's total counties. This indicates that, compared with the hinterworld, the hinterland still has stronger enterprise linkages with Shanghai. Compared with 1990, the number of counties with strong enterprise linkages decreased in Nanjing, Yangzhou, Taizhou, and other cities but increased in Jiaxing, Ningbo, etc. The spatial distribution tended to be more concentrated.

In 2010, among 2,843 counties nationwide that had enterprise linkages with Shanghai, there were 888 with significant Local *G* results, 71 of which were in the YRD, accounting for 8.0%, and 817 of which were in the hinterworld, accounting for 92.0%. Among those counties with significant results, 174 were significantly positive, 71 of which were in the YRD, accounting for 62.8% of YRD's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for only 3.8% of the hinterworld's total counties. In 2018, there were 816 counties with significant Local *G* results, 79 of which were in the YRD, accounting for 9.7%, and 737 were in the hinterworld, accounting for 90.3%. Among those counties with significant results, 180 were significantly positive, 79 of which were in the YRD, accounting for 69.9% of the YRD's total counties. The remaining counties with significantly positive results were in the hinterworld, accounting for only 3.7% of the hinterworld's total counties. From 2010 to 2018, the counties with strong enterprises linkages with Shanghai were mainly concentrated in southern Jiangsu and northern Zhejiang near Shanghai.

To sum up, it can be seen that, from 1990 to 2018, the nonlocal enterprise linkages of Shanghai were relatively weak. Counties with strong enterprise linkages accounted for a larger proportion in the YRD, especially in southern Jiangsu and northern Zhejiang. Local linkages are the main form of enterprise linkages for Shanghai. Thus, hypothesis 2 is verified: the gradual narrowing of the economic gap between Shanghai and Jiangsu as well as Zhejiang is due to the fact that more of Shanghai's enterprise linkages are local.

3.4. Mechanisms of Formation of Shanghai's Enterprise Linkages. The gradual narrowing of the economic gap

TABLE 2: Local spatial autocorrelation of Shanghai’s enterprise linkages from 1990 to 2018 (at a significance level of $p < 0.05$).

Area	Local G	1990	2000	2010	2018
Hinterland (113 counties in total)	Number of counties with significant results	75	74	71	79
	Number of counties with significantly positive results	69	74	71	79
	Proportion of positive results in total counties of hinterland (%)	61.1	65.5	62.8	69.9
Shanghai Hinterworld (2,730 counties in total)	Number of counties with significant results	2339	1048	817	737
	Number of counties with significantly positive results	65	92	103	101
	Proportion of positive results in total counties of hinterworld (%)	2.4	3.4	3.8	3.7

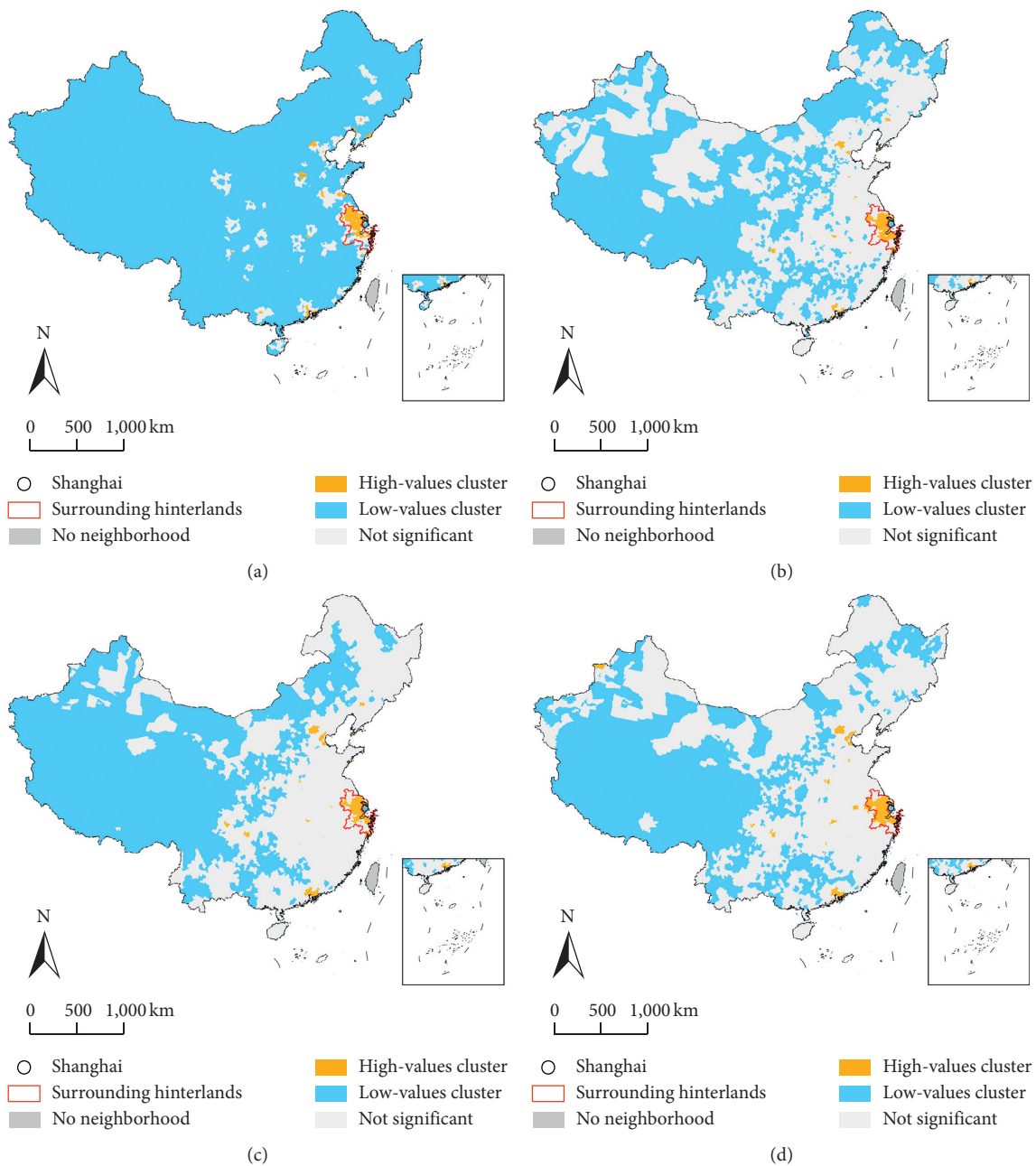


FIGURE 5: Local spatial autocorrelation patterns of Shanghai’s enterprise linkages. (a) 1990, (b) 2000, (c) 2010, and (d) 2018.

between Shanghai and Jiangsu as well as Zhejiang is due to the fact that more enterprise linkages in Shanghai are local. The following are possible mechanisms underlying the significant local linkages.

- (1) The enterprise traditions of Jiangsu and Zhejiang have laid the foundation for their cooperation with Shanghai. Since the 1970s, the YRD has developed a horizontal division-of-labor system with the characteristics of a modern market economy. Southern Jiangsu developed township enterprises based on its advantageous geographical environment and historical traditions, while, in Wenzhou, Zhejiang province, private economy has been built up on the basis of domestic industry and specialized markets, forming the unique “Southern Jiangsu Mode” and “Wenzhou Mode” [51]. To solve the problem of shortage of technology and talent in their rapid economic development, Jiangsu and Zhejiang tactfully used a folk network, relying on their proximity to Shanghai and their extensive social connections to connect with Shanghai’s talent and technological advantages and adopt flexible methods for the introduction of talent, such as “Sunday engineers.” Since the 1990s, with the development of a market economy, the introduction of foreign enterprises, and the formation of a buyers’ market, enterprises in Shanghai have tended to look for cheaper raw materials and a semifinished product supply base under the rules of the market. At present, the foundation of industrial development of township enterprises in southern Jiangsu has met the demands of Shanghai, as has the industrial manufacturing industry in northern Zhejiang. The active interactions have led to the hinterland becoming the biggest beneficiary of the adjustment and transfer of industrial structure in Shanghai. The hinterland has received a large amount of capital, technology, and talent overflowing from Shanghai and has continuously cultivated its own production capacity and markets [52].
- (2) The Shanghai Pudong development provides conditions for industrial cooperation within the YRD. In 1990, the central government announced the opening-up of Pudong. In 1992, it was proposed that that Shanghai should become an international economic, financial, and trade center as soon as possible, with the YRD and the whole Yangtze River Basin being revitalized. This proposal greatly enhanced Shanghai’s status as a gateway city. Other cities in the YRD have put forward a strategy of responding to the opening-up of Pudong and have taken the initiative to cooperate with Shanghai. For one thing, they hope to use the opening-up of Pudong as an important shortcut for the local economy to connect with the international market. For another, they also hope to improve the level of investment attraction by taking advantage of the opportunities presented by the opening-up. In these circumstances, cities in the YRD have taken active measures. For example,

Suzhou started to build four state-level economic development zones and nine provincial-level development zones in the early 1990s. Through these development zones, it was able to connect seamlessly with Shanghai and build an advanced manufacturing base around the Shanghai metropolitan area [53]. As a result of the great attraction presented by Shanghai’s opening-up, southern Jiangsu has also been favored by foreign investment. Suzhou Industrial Park and Kunshan Economic and Technological Development Zone are home to a large number of Taiwan-funded enterprises, the Taicang Economic and Technological Development Zone is home to a large number of German-funded enterprises, and the Wuxi High-Tech Zone is home to a large number of Japanese enterprises. So far, the YRD has presented a vibrant development scene. Suzhou, Wuxi, and other cities have rapidly become star cities comparable to Shenzhen. The hinterland not only increases the attraction of foreign investment, but also improves the level of local manufacturing and service industry and further adds to the opportunities for cooperation with enterprises in Shanghai [54].

- (3) The integration of the YRD is driven by industrial upgrading and complementation of manufacturing structures. The introduction of a series of national policies has continuously promoted the formation of a highly integrated region in the YRD. From the “Joint Conference System of Directors from Cooperation Departments in the Yangtze River Delta” in 1992 to the “City Economic Coordination Committee of the Yangtze River Delta” in 2003, the YRD urban agglomeration framework with the 16 cities of Jiangsu, Zhejiang, and Shanghai was gradually established and widely recognized. On 3 June, 2016, the State Council issued the Development Plan for the Yangtze River Delta Urban Agglomerations, which increased the number of cities in the YRD urban agglomeration from 16 to 26, covering Shanghai and three provinces (Jiangsu, Zhejiang, and Anhui). On 5 November, 2018, at the first China International Import Expo, Xi Jinping proposed that “the integrated regional development of the Yangtze River Delta should be supported and promoted to a national strategy.” Series of conferences and important documents have rapidly driven the YRD integration process, which has made astonishing progress in economic integration. The gap between the gross domestic production of the regional core cities (Suzhou, Hangzhou, Nanjing, Wuxi, etc.) and that of Shanghai has gradually narrowed. Meanwhile, the upgrading of industrial structures, the complementarity of manufacturing structures, and industrial transfer within the region have become new driving forces promoting high-quality development of economic integration in the YRD region [55]. Shanghai and its hinterland have maintained a high level of division of labor and economic

cooperation, which has promoted the formation of Shanghai of strong local enterprise linkages.

4. Conclusions

In this paper, we have used enterprise data on business registration from the State Administration for Industry and Commerce of China and selected the number of headquarters-branches offices and the amount of enterprise investment as the basis for investigating enterprise linkages between Beijing/Shanghai and their hinterlands as well as the hinterworld, and we have thereby verified our two hypotheses. We have further analyzed the mechanisms of formation of the enterprise linkages of Beijing and Shanghai. Our main conclusions are as follows.

- (1) Nonlocal enterprise linkages based on the hinterworld are the main form in Beijing. In 1990, 2000, 2010, and 2018, for Hebei Province, the counties with stronger enterprise linkages accounted for only 1.2%, 0.6%, 3.6%, and 4.8% of the total, respectively, whereas, for the hinterworld of Beijing, these accounted for 10.7%, 9.3%, 7.8%, and 7.3% of the total, respectively. Local enterprise linkages of Beijing were relatively weak and the overall distribution patterns hardly changed. Counties with strong enterprise linkages accounted for a larger proportion in the hinterworld, especially in the YRD and PRD. Thus, more enterprise linkages of Beijing are non-local. Beijing's significant siphoning effect, the mismatch of its industrial system with Hebei, and the top-down administrative power impeding the vitality of the market all resulted in the relatively weak local enterprise linkages.
- (2) Local enterprise linkages based on the hinterland are the main form in Shanghai. In 1990, 2000, 2010, and 2018, for the YRD, the counties with stronger enterprise linkages accounted for 61.1%, 65.5%, 62.8%, and 69.9% of the total, respectively, whereas, for the hinterworld of Shanghai, these accounted for only 2.4%, 3.4%, 3.8%, and 3.7% of the total, respectively. Nonlocal enterprise linkages of Shanghai were relatively weak. Counties with strong enterprise linkages accounted for a larger proportion in the hinterland, especially in southern Jiangsu and northern Zhejiang. Thus, more enterprise linkages of Shanghai are local. The enterprise traditions of Jiangsu and Zhejiang, the conditions for industrial cooperation provided by the opening-up of Pudong, and the economic integration in the YRD region all contributed to the relatively strong local enterprise linkages of Shanghai.

The findings of this study have a number of important implications for future practice. To narrow the economic gap between Beijing and Hebei Province, it is necessary to strengthen enterprise linkages between the central city and its hinterland. Management to enhance local linkages might involve further intensifying the coordinated development of Beijing, Tianjin, and Hebei. For Hebei, the existing energy

and raw material industries need to undergo major structural and scale adjustments, as well as technological renewal, in order to upgrade and promote an industrial structure that can better connect with related industries in Beijing. Moreover, the role of the Xiongan New Area needs to be strengthened in terms of industrial coordination with Beijing-Tianjin-Hebei in the future. On the one hand, this area should actively continue the transfer of high-tech and new technology industries from Beijing. On the other hand, it should intensify its industrial interactions with Hebei, push forward the industrial upgrading of Hebei, and gradually promote the coordinated and integrated development of Beijing, Tianjin, and Hebei.

However, this study has been limited in terms of its comprehensive nature. For example, enterprise linkages involving specific industrial sectors are unknown. Does manufacturing in Beijing have more enterprise interactions with Hebei Province compared with producer services? Enterprises of which industry in Hebei have the closest connection with those in Beijing? Moreover, the study has analyzed the underlying mechanisms of enterprise linkages mainly from a qualitative point of view. Further research could be conducted using quantitative methods to examine the factors influencing enterprise linkages.

Data Availability

The enterprise linkages data that we used to support the findings were supplied by State Administration for Industry and Commerce of People's Republic of China under license and so they cannot be made freely available.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This study was supported by the National Natural Science Foundation of China (Grant nos. 41971162 and 41701128).

References

- [1] K. Pain, "Examining "core-periphery" relationships in a global city-region: the case of London and Southeast England," *Regional Studies*, vol. 42, no. 8, pp. 1161-1172, 2008.
- [2] B. Derudder and P. J. Taylor, "Central flow theory: comparative connectivities in the world-city network," *Regional Studies*, vol. 52, no. 8, pp. 1-14, 2017.
- [3] W. Christaller, "Grundsatzliches zu einer neugliederung des deutschen reiches und seiner verwaltungsbezirke," *Geographische Wochenschrift*, vol. 1, 1933.
- [4] S. H. Frankel, G. Myrdal, and P. A. M. V. Philips, "Economic theory and under-developed regions and public finance and less developed economy. With special reference to Latin America," *International Affairs*, vol. 34, no. 3, pp. 361-362, 1958.
- [5] T. G. Moore, "Core-periphery models, regional planning theory, and appalachian development," *Professional Geographer*, vol. 46, no. 3, pp. 316-331, 2005.

- [6] M. Dunford, *Regional Development Models: International Encyclopedia of Human Geography*, Wiley, Hoboken, NJ, USA, 2009.
- [7] B. J. L. Berry, "Relationships between regional economic development and the urban system," *Tijdschrift Voor Economische En Sociale Geografie*, vol. 60, no. 5, pp. 283–307, 1969.
- [8] J. Jacobs, *The Economy of Cities*, Vintage, New York, NY, USA, 2016.
- [9] P. M. Hohenberg and L. H. Lees, *The Making of Urban Europe, 1000–1994: With a New Preface and a New Chapter*, Harvard University Press, Cambridge, MA, USA, 1995.
- [10] J. Friedmann, "The world city hypothesis," *Development and Change*, vol. 17, no. 1, pp. 69–83, 1986.
- [11] P. Hall, "Christaller for a global age: redrawing the urban hierarchy," September 2001, <https://www.lboro.ac.uk/gawc/rb/rb59.html>.
- [12] P. G. Hall and K. Pain, *The Polycentric Metropolis: Learning from Mega-City Regions in Europe*, Routledge, London, UK, 2006.
- [13] P. V. Hall and M. Hesse, *Cities, Regions and Flows*, Routledge, London, UK, 2012.
- [14] Y. D. Wei and C. C. Fan, "Regional inequality in China: a case study of Jiangsu province," *The Professional Geographer*, vol. 52, no. 3, pp. 455–469, 2000.
- [15] P. J. Taylor and B. Derudder, *World-City Network: A Global Urban Analysis*, Routledge, London, UK, 2nd edition, 2006.
- [16] P. J. Taylor, "Urban economics in Thrall to Christaller: a misguided search for city Hierarchies in external urban relations," *Environment and Planning A: Economy and Space*, vol. 41, no. 11, pp. 2550–2555, 2009.
- [17] P. J. Taylor, M. Hoyler, and R. Verbruggen, "External urban relational process: introducing central flow theory to complement central place theory," *Urban Studies*, vol. 47, no. 13, pp. 2803–2818, 2010.
- [18] S. Sassen, *The Global City: New York, London, Tokyo*, Princeton University Press, Princeton, NJ, USA, 1991.
- [19] S. Sassen, *Globalization and its Discontents*, New Press, New York, NY, USA, 1999.
- [20] S. Sassen, "Global financial centers," *Foreign Affairs*, vol. 78, no. 1, p. 75, 1999.
- [21] M. Castells, *The Rise of the Network Society*, Blackwell, Oxford, UK, 1996.
- [22] M. Castells, *The Space of Flows: The rise of the network society*, Vol. 1, Blackwell, Oxford, UK, 1996.
- [23] M. Castells and Manuel, "Grassrooting the space of flows," *Urban Geography*, vol. 20, no. 4, pp. 294–302, 1999.
- [24] P. J. Taylor, *World-city Network: A Global Urban Analysis*, Routledge, Abingdon, UK, 2004.
- [25] P. J. Taylor and D. R. F. Walker, "World cities: a first multivariate analysis of their service complexes," *Urban Studies*, vol. 38, no. 1, pp. 23–47, 2001.
- [26] A. S. Alderson and J. Beckfield, "Power and position in the world city system," *American Journal of Sociology*, vol. 109, no. 4, pp. 811–851, 2004.
- [27] R. S. Wall and G. A. Van der Knaap, "Sectoral differentiation and network structure within contemporary worldwide corporate networks," *Economic Geography*, vol. 87, no. 3, pp. 267–308, 2011.
- [28] S. Krätke, "Network analysis of production clusters: the Potsdam/Babelsberg film industry as an example," *European Planning Studies*, vol. 10, no. 1, pp. 27–54, 2002.
- [29] C. Fang, X. Guan, S. Lu, M. Zhou, and Y. Deng, "Input-output efficiency of urban agglomerations in China: an application of data envelopment analysis (DEA)," *Urban Studies*, vol. 50, no. 13, pp. 2766–2790, 2013.
- [30] W. Wu, S. Zhao, C. Zhu, and J. Jiang, "A comparative study of urban expansion in Beijing, Tianjin and Shijiazhuang over the past three decades," *Landscape and Urban Planning*, vol. 134, pp. 93–106, 2015.
- [31] J. Yang, W. Liu, Y. Li, X. Li, and Q. Ge, "Simulating intraurban land use dynamics under multiple scenarios based on Fuzzy cellular automata: a case study of Jinzhou District, Dalian," *Complexity*, vol. 2018, Article ID 7202985, 17 pages, 2018.
- [32] C. Li, X. Gao, B. He, J. Wu, and K. Wu, "Coupling coordination relationships between urban-industrial land use efficiency and accessibility of highway networks: evidence from Beijing–Tianjin–Hebei urban agglomeration, China," *Sustainability*, vol. 11, no. 5, pp. 1–23, 2019.
- [33] S. Liu, M. Han, X. Wu et al., "Embodied water analysis for Hebei Province, China by input-output modelling," *Frontiers of Earth Science*, vol. 12, no. 1, pp. 72–85, 2018.
- [34] Y. Li and N. A. Phelps, "Articulating China's science and technology: knowledge collaboration networks within and beyond the Yangtze River Delta Megalopolis in China," *Chinese Geographical Science*, vol. 28, no. 2, pp. 247–260, 2018.
- [35] Y. Li and N. Phelps, "Megalopolis unbound: knowledge collaboration and functional polycentricity within and beyond the Yangtze River Delta region in China, 2014," *Urban Studies*, vol. 55, no. 2, pp. 443–460, 2018.
- [36] F. Pan, W. Bi, J. Lenzer, and S. Zhao, "Mapping urban networks through inter-firm service relationships: the case of China," *Urban Studies*, vol. 54, no. 16, pp. 3639–3654, 2017.
- [37] National Development and Reform Commission, *The Outline of Collaborative Development of Beijing, Tianjin and Hebei Province*, National Development and Reform Commission, Beijing, China, 2016.
- [38] Y. D. Wei, "Decentralization, marketization, and globalization: the triple processes underlying regional development in China," *Asian Geographer*, vol. 20, no. 1-2, pp. 7–23, 2001.
- [39] Y. Qian and B. R. Weingast, "China's transition to markets: market-preserving federalism, Chinese style," *The Journal of Policy Reform*, vol. 1, no. 2, pp. 149–185, 1996.
- [40] B. Garrett, "China faces, debates, the contradictions of globalization," *Asian Survey*, vol. 41, no. 3, pp. 409–427, 2001.
- [41] S. J. Rey and B. D. Montouri, "US regional income convergence: a spatial econometric perspective," *Regional Studies*, vol. 33, no. 2, pp. 143–156, 1999.
- [42] A. Guo, J. Yang, X. Xiao, J. Xia, C. Jin, and X. Li, "Influences of urban spatial form on urban heat island effects at the community level in China," *Sustainable Cities and Society*, vol. 53, Article ID 101972, 2020.
- [43] J. K. Ord and A. Getis, "Local spatial autocorrelation statistics: distributional issues and an application," *Geographical Analysis*, vol. 27, no. 4, pp. 286–306, 1995.
- [44] L. Jiang, B. Xue, Z. Ma, L. Yu, B. Huang, and X. Chen, "A life-cycle based co-benefits analysis of biomass pellet production in China," *Renewable Energy*, vol. 154, pp. 445–452, 2020.
- [45] L. Hao, M. A. Lin, L. I. Guoping et al., "Pattern evolution and its contributory factor of cold spots and hot spots of economic development in Beijing–Tianjin–Hebei region," *Geographical Research*, vol. 36, no. 1, pp. 97–108, 2017.
- [46] Z. Xingang, Z. Yuzhuo, L. Ji, Y. Li, R. Jia, and L. Wang, "The sustainable development of the economic–energy–environment (3E) system under the carbon trading (CT) mechanism: a Chinese case," *Sustainability*, vol. 10, no. 2, p. 98, 2018.
- [47] H. Hanssens, B. Derudder, and F. Witlox, "Are advanced producer services connectors for regional economies? An

- exploration of the geographies of advanced producer service procurement in Belgium,” *Geoforum*, vol. 47, pp. 12–21, 2013.
- [48] C. Li, K. Wu, and X. Gao, “Manufacturing industry agglomeration and spatial clustering: evidence from Hebei Province, China,” *Environment, Development and Sustainability*, vol. 22, no. 4, pp. 1–25, 2020.
- [49] M. Zhao, X. Liu, B. Derudder, Y. Zhong, and W. Shen, “Mapping producer services networks in mainland Chinese cities,” *Urban Studies*, vol. 52, no. 16, pp. 3018–3034, 2015.
- [50] D. Sun, D. Lu, J. Zhang et al., “Spatial production from strategic interactions among regional actors: a comparative study of Shanghai surrounding areas and Beijing surrounding areas,” *Scientia Geographica Sinica*, vol. 37, no. 7, pp. 967–975, 2017.
- [51] Z. Wang, *Urbanization and Economic Transition in Regional Economic Development: Private Sector Development and Urbanization in China*, Palgrave Macmillan, London, UK, 2015.
- [52] D. Sun, J. Zhang, Y. Hu et al., “Metropolitan shadow—analyze of the foundation of Jiaying and the evolutionary diversity between Suzhou and Jiangsu,” *Human Geography*, vol. 29, no. 1, pp. 66–71, 2014.
- [53] B. Xue, L. Zhang, Y. Geng, B. Mitchell, and W. Ren, “Extended land use categories in urban brownfield redevelopment of China: case of Tiexi District, Shenyang of China,” *Journal of Urban Planning and Development*, vol. 142, no. 3, Article ID 05015014, pp. 1–11, 2016.
- [54] Y. D. Wei, C. K. Leung, and J. Luo, “Globalizing Shanghai: foreign investment and urban restructuring,” *Habitat International*, vol. 30, no. 2, pp. 231–244, 2006.
- [55] H. Guo and Z. Deng, “Research on the integrative high-quality development of Yangtze River delta regional economy under the new normal,” *Economy and Management*, vol. 33, pp. 22–30, 2019.