Core-periphery Industrial Linkages of the Metropolitan Area from the Perspective of Enterprise Linkages: The Case of Three Cities Adjacent to Shanghai

Author's Name: Lin Tian[1*], Yao Cheng[1]
Affiliation: College of Architecture and Urban Planning, Tongji University, Shanghai, China
Email: 2210293@tongji.edu.cn

Abstract

To explore how cross-border industrial linkages are constructed between the centre and peripheral cities of the metropolitan area, this study takes the perspective of enterprise linkages and selects three county-level cities which are adjacent to Shanghai, as cases. First, city networks in the Shanghai metropolitan area are built using enterprise headquarter-branch linkage data; then, the descriptive statistical analysis is conducted based on enterprise questionnaires. The results show that from 2001 to 2018, enterprise linkages between Shanghai and its surrounding county-level cities increased significantly. The market forces in the industrial linkages between the three cities and Shanghai have somewhat transcended administrative barriers, which is the result of enterprises' 'voting with their feet'. The key reason why enterprises are located in these three cities is that they are close to Shanghai for access to productive services, technology, labour, information and other resources while enjoying the lower rent and preferential policies of the local industrial parks.

Keywords:

City Network, Metropolitan Area, Peripheral Cities, Cross-border, Industrial Linkage

1. Introduction

Modern urban regions' development has seen a new stage marked by the deepening and restructuring of the spatial division of labor. Specifically, design, R&D, marketing, and other functions at the two ends of the value chain have become more concentrated in high-level cities, while manufacturing has been gradually dispersed and relocated to surrounding small(medium)-sized cities, which, in turn, will influence the central cities after the formation of new agglomerations on the periphery. Yet this is not necessarily

a spatial gradient of dispersion, as periphery-core linkages across geographical and administrative boundaries may be formed. This economic geography phenomenon can be explained by the 'urban network externalities' theory - the agglomeration externality from the central city extends beyond its geographical boundary, while some peripheral cities 'borrow size' from it, jointly generating externalities through the city network (Capello, 2000; Hesse, 2016). The emergence of growth poles of regional economic development in an agglomerate form of metropolises has also led to the passive and active integration of their peripheral areas. Small or medium-sized cities (towns) on the periphery of megacities face enormous opportunities and challenges, not only as carriers of their economic activities but also in their important positions in the industrial networks of the larger region.

Since China's reform and opening up in 1978 and its membership of the World Trade Organization since 2001, its economy has developed rapidly and has become increasingly integrated into the global production network, driving the evolution of the spatial organisation of local industries. This is manifested in the gradual specialisation of the division of labour among industries in the geographical space, and the frequent flow of people, logistics, capital and information among cities. As a result, large-scale urban spatial organisations such as city clusters and metropolitan areas have been formed and developed, and have become important spatial carriers for the optimisation and reorganisation of industrial chains and participation in global competition (Shen *et al*, 2023). Smaller cities around developed central cities have shown a tendency to build economic linkages across borders. The latter have also begun to actively take 'integration into metropolitan areas' as an essential strategic choice in order to enhance their position in the regional production network. For example, the practice of cross-boundary industrial co-operation in some pioneering regions, such as the Guangdong-Hong Kong-Macao Greater Bay Area and the Yangtze River Delta Region, has given rise to the mode of enclave economy, and even forms like 'reverse/two-way enclaves' have emerged (Cao and Zeng, 2022; Luo *et al*, 2023).

To verify the above phenomenon, this study takes the perspective of enterprises and uses three county-level cities, Kunshan, Taicang and Jiashan, which are adjacent to Shanghai, as examples. From a macro perspective, using the data on the headquarter-branch of enterprises at three time points, this study constructs city networks in the Shanghai metropolitan area and takes a longitudinal view of the evolution of industrial linkages. From a micro perspective, based on 144 enterprise questionnaires distributed in the three cities, the study explores the detailed expressions of their industrial linkages with Shanghai by descriptive statistical analysis, and qualitatively explains the causes. Finally, planning implications are discussed concerning the findings, i.e. how peripheral-core industrial linkages across borders should be built.

2. Literature Review

The earliest studies on the spatial organisation of industries were mainly based on the Industrial Cluster Theory (Marshall, 1890). After comparative advantages gave rise to the regional division of labour, regional industrial organizations were formed through enterprises' linkages between regions (Massey, 1984). Although the openness and outward linkages of industrial clusters have been gradually emphasised in later periods (Maskell, 2001), they are still based mainly on geographical proximity over local space. Evolutionary economic geography challenges the authoritative explanation by Marshallian externalities for the emergence and development of clusters (He, 2018). It incorporates temporal and spatial elements to reveal the mechanisms of progressive evolution in the spatial distribution of economic activities (Frenken and Boschma, 2007; He, 2018). In this regard, scholars mostly start from the entry, growth, decline and exit of enterprises and their locational behaviour to explore the synergistic evolution of enterprises, industries, networks and regions (He, 2018).

With the deepening of economic globalisation and the international division of labour, the era of global production networks has arrived (Hess and Yeung, 2006). The spatial unit used to study economic evolution has shifted from local industrial agglomerations to inter-city (region) industrial networks. Frobel (1980) was the first to introduce the concept of the new international division of labour into the study of regions, arguing that it led to a global restructuring of national or regional production structures, resulting in the formation of a metropolitan area in which the peripheral areas are closely linked to the central city. The spatial organisation of industries in the metropolitan area is differentiated under the law of market economy in accordance with the principle of optimal production efficiency, and the relationship between cities is gradually transformed from one of mutual competition and independent development to one of central city-driven hinterland and inter-city co-operation.

Scott (1982) believed that as firms grew, their production and management functions were hierarchically restructured, and a process of concentration of management and control functions in the central city and decentralisation of production functions occurred within urban areas. Not all firms within an industrial cluster are connected to each other (Giuliani and Bell, 2005), but similar location, knowledge, norms, organisations, and social ties help heterogeneous actors to form partners or engage in knowledge exchange and collective learning, and these similarities are referred to as geographic proximity, cognitive proximity, institutional proximity, organisational proximity and social proximity, respectively (Boschma, 2005). The last four do not necessarily rely on geographic proximity and can be connected beyond boundaries; in other words, these proximities depend on agglomeration in certain kinds of networks (Capello, 2000). Proximity can explain why intra-cluster networks are not homogeneous and why some firms can have more linkages with firms outside the cluster (Taylor, 2001).

Enterprises choose their location freely on the basis of the profit-maximising principle, so that their linkages are essentially more reflective of the laws of the market economy. According to the doctrine of 'transaction costs', when it is more cost-effective to carry out all types of activities within the same enterprise, a vertically integrated structure is formed within the enterprise, which is spatially reflected in the fact that the enterprise's headquarters set up branches in different places to conduct all types of activities more efficiently; when outsourcing a certain type of activities (inter-firm transactions) is less costly, it will result in the formation of inter-firm horizontal integration, which is reflected in the process of specialisation of enterprises (Liu and Ren, 2006). Thus, the self-organising power of enterprises - as 'actors' - profoundly affects the regional economic configuration and the position of cities and towns in the economic network (Liu and Ren, 2006). Influenced by Castells' (1996) theory of the 'space of flow', studies of city networks based on enterprise linkages have begun to emerge. Network analysis methods mainly include Taylor's (2002) connection network modelling method, and Alderson's corporate headquarters-branching method (Alderson and Beckfield, 2004). This type of methods has also begun to be used by some Chinese scholars in meso-level studies of city clusters and metropolitan regions (Cheng and LeGates, 2018).

To sum up, previous research on the regional industrial spatial organisation based on cross-city linkages is insufficient in the following aspects: most of the analyses use enterprise linkage data to build city networks, focusing mainly on the characteristics of regional industrial spatial structure at the macro level, but lacking in-depth discussions on the mechanisms of linkage construction and factor flows caused by enterprise behaviours at the micro level. Research on the 'centre-periphery' of metropolitan areas tends to take the central city as the study object. However, what distinguishes peripheral cities from ordinary small and medium-sized cities (towns) is that they are an important component of the regional industrial division of labour and the production chain, and they have taken on industrial functions far beyond their own. But few studies have taken peripheral cities as the entry point, making it difficult to comprehensively observe the 'centre-periphery' relationship. On the other hand, studies of city industry tend to view cities as independent systems, ignoring the fact that their industrial functions are greatly influenced by the outside world, especially by nearby metropolises.

3. Method and Data

3.1. Study Area

Three county-level cities bordering Shanghai are selected for this study (Figure 1), of which Taicang and Kunshan are administered by the Suzhou prefecture-level city in Jiangsu Province, and Jiashan is under the Jiaxing prefecture-level city in Zhejiang Province. The three cities have well-developed economies, with GDPs of 173.494 billion yuan, 514.060 billion yuan, and 90.811 billion yuan in 2023, respectively, and

a high proportion of secondary and tertiary industries; they have high rates of urbanisation (all exceeding 70% in 2023), with permanent populations of 848,000, 2,148,500 and 664,000, respectively. All three cities are within 30 minutes of Shanghai by high-speed railway and belong to the core of the Shanghai metropolitan area, with close connections with Shanghai. They have long had the key goal of connecting to Shanghai in terms of local industrial development, and have been selected in many studies as typical research cases of small and medium-sized cities in the surroundings of large cities for comparison. The Shanghai metropolitan area, located at the heart of China's eastern seaboard and the Yangtze River Delta region, is not only an important national economic growth pole, but is also growing into a city region with global influence. In recent years, with the deepening of the regional industrial spatial division of labour, Shanghai has upgraded its industrial structure and driven the economic development of its hinterland. Therefore, the industrial spatial organisation of small and medium-sized cities around Shanghai is undergoing deep changes and needs to be re-recognised from the perspective of external influences.

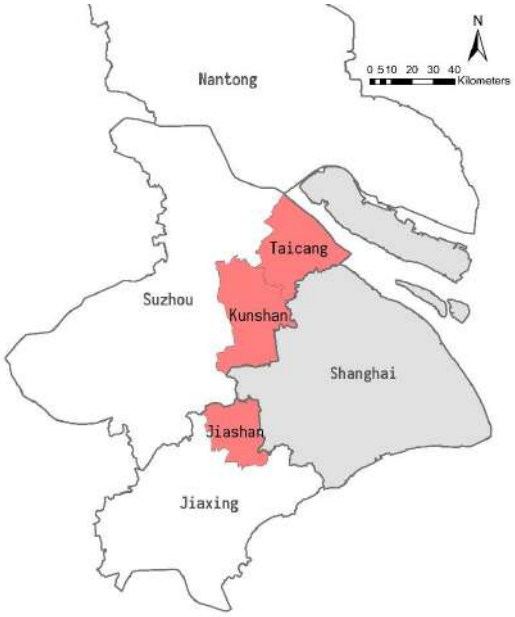

Figure 1. Study area: location of Taicang, Kunshan and Jiashan around Shanghai

3.2. Research Design

Firms or enterprises are the key ‘actors’ in the regional production chain. Driven by the market, guided by the government, and influenced by other actors, their behaviours and decisions (e.g. re-location, branching, transactions, cooperation, investment, etc.) build

inter-city industrial linkages; conversely, industrial linkages can be manifested through the internal and external connections, and forward and backward linkages of firms.

On this basis, the empirical study of this article takes enterprises as the perspective and is divided into two parts. The first part is a macroscopic city network study, which aims to take a longitudinal view of the overall picture of the evolution of industrial linkages in the Shanghai metropolitan area. The study area is extended to the Shanghai metropolitan area (but this is much smaller than the government-planned 'Greater Shanghai metropolitan area'). County-level zones ('municipal districts', 'counties', or 'county-level cities', which are below prefecture-level cities) are used as the analysis units, with a total of 16 units. A number of municipal districts in the Shanghai central city are merged into a single unit, while six units in the suburbs of Shanghai are retained; outside of Shanghai, in addition to the three case study cities, the other six county-level units are included in this part of the analysis for comparison.

For enterprise linkages, we obtained data from the 2001 and 2008 China Economic Census, and data from the 2018 registration by the Bureau of Industry and Commerce of enterprises[1]. This study focuses on only two categories of enterprises, manufacturing and productive services. Then, referring to Cheng's (2018) approach, we applied SQL to identify the headquarters (head office, group, etc.) and branches (branch office, sub-factory, sub-division, etc.) based on the matching of the enterprise names and thus processed them as enterprise headquarters-branch linkage pairs[2]. Next, we summarised the headquarters and branches of each link based on the units in which they are located, and then translated them into a directed matrix of 'city dyads.' Then, the city networks of the Shanghai metropolitan area were constructed by taking the analysed units as nodes and the number of 'city dyads' as the weights of the edges. Finally, these city networks were visualised in the ArcGIS platform to describe the evolution of the industrial linkages between the three cities and Shanghai.

The second part is a microscopic questionnaire data analysis, in order to explore more in-depth characteristics and causes. We distributed enterprise questionnaires in the three cities between September to November 2018, with questions on basic information about the enterprise, distribution of their upstream and downstream linkage enterprises in the industry chain, their service and technology linkages, inter-city commuting of their employees, and their choice of cities for future investment, etc. A total of 144 valid

[1] These datasets provide statistical information on all enterprises in the nation in various industries in the current year, including enterprise name, establishment time, address, city, industry category, number of employees, etc. There are differences between the two types of datasets, but due to the large sample size and comprehensive enterprise lists and information, comparative analyses are possible.

[2] Within the enterprise linkage, the headquarters implements managerial decisions and issues directives, while the branches carry out the orders, and the headquarters have a controlling role over their branches, and it can be assumed that the city in which the headquarters is located is more in control. Thus the enterprise headquarter-branch linkage is directional.

questionnaires were eventually collected (73 from Taicang, 37 from Kunshan, and 34 from Jiashan). We then applied descriptive statistical analysis method to explore the specific performance of the industrial linkages between these three cities and Shanghai. At the same time, combined with interviews with enterprise managers and other materials, we qualitatively explained the causes of the phenomenon.

4. Results

4.1. Macro Perspective: Evolutionary Characteristics of Industrial Linkages

Figure 2 illustrates the changes in city networks based on enterprise linkages in the study area from 2001 to 2018. Overall, both productive services and manufacturing networks have been increasing in density, but have diverged in terms of spatial organisation. Manufacturing enterprises have been spreading to the periphery step by step - from 2001 to 2008, the direction of linkages were mainly from Shanghai to the periphery, indicating that manufacturing headquarters remained in Shanghai and branches spread to the periphery; by 2018, however, linkages from the periphery pointing to Shanghai were even stronger, suggesting that the headquarters of some enterprises have also relocated out of the Shanghai central city or that enterprises from peripheral areas have set up branches in Shanghai. In stark contrast, although the production service industry has seen near-domain diffusion in the suburbs of Shanghai, it tends to be polarised at the metropolitan area scale, i.e., the headquarters are highly concentrated in Shanghai, and the direction of the headquarter-branch linkages mainly points to the peripheral cities from the Shanghai central city, which suggests that the Shanghai metropolitan area has formed a hierarchical network structure. To some extent, this result confirms Scott's (2001) view that highly modular manufacturing industries spread over a wider spatial area without being restricted by location, while high value-added and high-grade industries represented by productive services have a higher sensitivity to location and are more likely to form agglomerations. Embedded in the whole production chain, the productive service industry is difficult to fully divide labour, the services they offer are often intangible, and there is a need for the transmission of intentional information between enterprises and between enterprises and their customers. In order to face markets with great uncertainty, productive services enterprises choose to concentrate in central cities to reduce costs and are closely linked to each other to form flexible network systems.

Regarding the number of ‘city dyads’ between peripheral county-level cities and Shanghai, Kunshan ranks the highest, followed by Zhangjiagang, Jiangyin, Taicang, and Changshu, and even equals (or surpasses) their own prefecture-level cities or provincial capitals. It can be seen that in the regional division of labour, certain cities are gradually demonstrating their important position by taking advantage of their specialization.

In recent years, Kunshan has seized the opportunity of the accelerated inflow of international capital into the Yangtze River Delta region, actively developed export processing trade and attracted investments, and taken the initiative to share part of Shanghai's modern service functions, attracting a large number of enterprises to move in, and successfully realising the externally oriented economy and dislocation development. As early as the 2002 version of the city's comprehensive plan, Kunshan considered the development of connecting with Shanghai; in 2016, its 'Thirteenth Five-Year Plan for National Economic and Social Development' further clarified the strategic goal of 'integrating into Shanghai, complementing Shanghai and serving Shanghai', proposing to fully connect with Shanghai's functions as a centre of economy, finance, trade, shipping, and R&D. Similarly, Taicang in 2003 for the first time defined 'connecting to Shanghai' development strategy, and then in its 'thirteenth five-year plan' put forward to focus on the promotion of concepts, planning, industry, elements, platforms, transport, social services and other aspects of the integration into Shanghai in depth. On the contrary, Jiashan and Pinghu, which also border Shanghai, have far fewer linkages with Shanghai than Kunshan and Taicang, or even Zhangjiagang and Changshu, which do not border Shanghai. Although Jiashan has also been emphasising the strategy of connecting to Shanghai from the early days to the present, it has not replicated the success of Kunshan due to its development land constraints, the distance between its main urban area and Shanghai, and its failure to keep up with investment attraction.

To sum up, with the deepening of the division of labour and the upgrading of the overall economic level of the Shanghai metropolitan area, the spatial polarization of productive service enterprises has been further enhanced, while manufacturing enterprises are gradually spreading to the periphery, and the overall spatial pattern of the industry tends to be networked, and the cross-regional organization of enterprises has promoted the frequent flow of factors of production within a wider range.

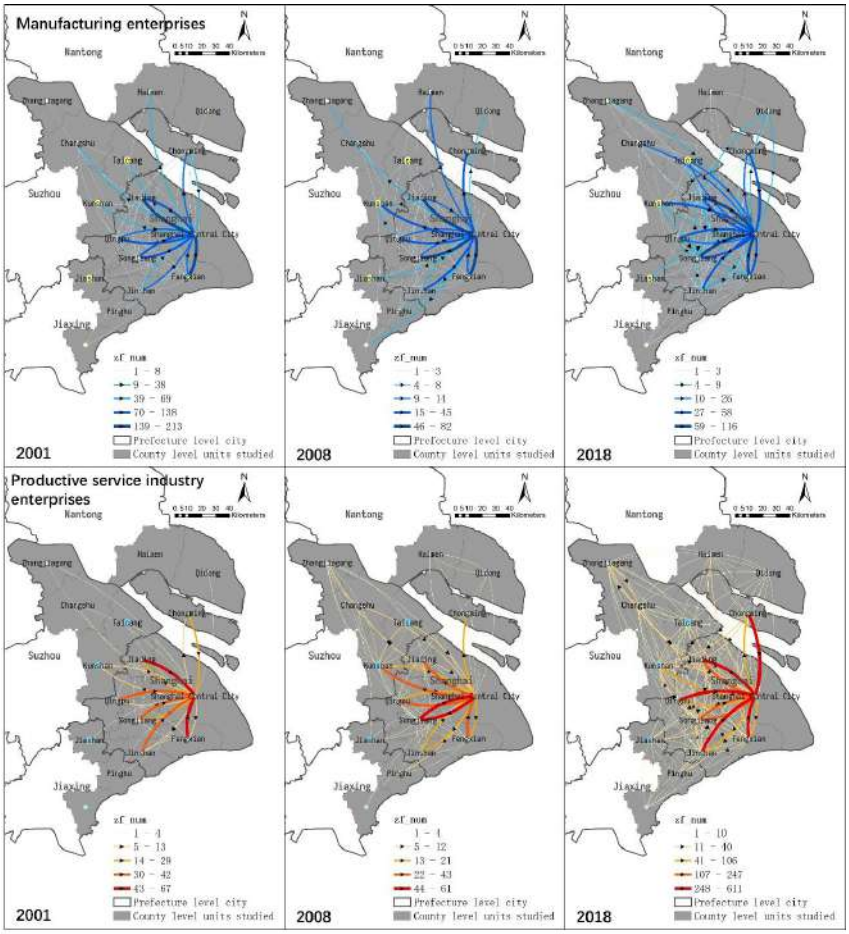

Figure 2. Headquarter-branch linkage networks of manufacturing and productive services enterprises, 2001, 2008 and 2018 (In this figure, the thicker and darker the connecting lines, the greater the number of links; the direction of the arrows represents the direction from the headquarters to the branches.)

4.2. Micro Perspective: Mechanistic Explanation of Linkage Formation

As it is difficult to contact and get permission from numerous enterprises, there are very few studies on the spatial organisation of industries using enterprise questionnaire data. This study attempts to explore more details and reasons for this through questionnaires for individual enterprises after mapping the macro data.

Firstly, we look into the basic information of the interviewed enterprises. The industry types of the interviewed enterprises in the three cities are different, but they are all

mainly in the electronic information, machinery manufacturing, new energy and new material industries. In regard to the types of enterprises, they all contain a certain proportion of foreign investment components, including foreign or Hong Kong/Macao/Taiwan investment, Chinese-foreign joint ventures or co-operative operations, etc. Kunshan has the highest proportion of foreign (or Hong Kong/Macao/Taiwan) invested enterprises, while Jiashan has a lot of Taiwan-invested enterprises due to historical factors, and Taicang has the highest proportion of privately owned and state-owned enterprises. In terms of enterprise size, they are concentrated at both ends of the spectrum - large (annual output value of 100 million to 500 million yuan) and micro (annual output value of less than 10 million yuan), with Taicang having a significantly higher proportion of small and micro enterprises, and Kunshan having a higher proportion of large and super-large enterprises. Divided by the number of employees, small and micro enterprises with less than 300 employees accounted for the highest proportion, with Taicang having the highest proportion of enterprises with less than 50 employees.

The reasons why interviewed enterprises chose to locate in the three cities are very consistent (Figure 3), with ‘proximity to Shanghai’ and ‘favourable investment incentives of industrial parks’ ranking in the top two, followed by ‘convenient transportation’, ‘proximity to upstream and downstream enterprises’, and ‘good cultural atmosphere of the city’. As to which city the interviewed enterprises are currently invested in and which city they would like to invest in in the future (Figure 4), the largest number is the provinces in which the enterprises are located, which is to be expected. But it is worth noting that the next most common city is Shanghai. Similarly, as shown in Figure 5, Shanghai is second only to their respective provinces, in terms of the location of upstream and downstream supporting enterprises (e.g., raw material suppliers, component manufacturers, sales agents, etc.), the source of productive service providers (including advertising, tax, consulting, lawyer, etc.), and technological consulting collaborators (for enterprises that do not have their own R&D centres) for these interviewed enterprises. This means that market forces have to some extent surpassed administrative barriers in the construction of industrial links between the three cities and Shanghai.

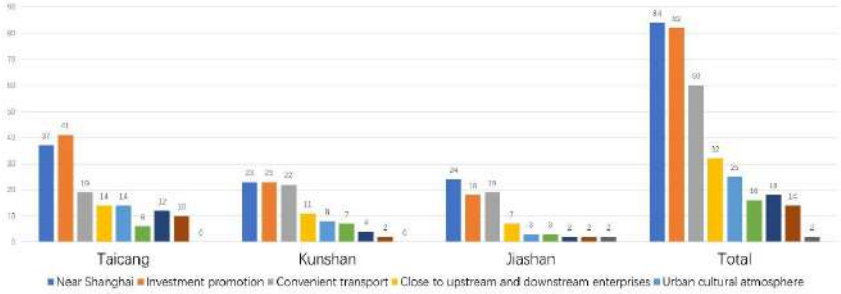

Figure 3. Reasons for locations selected by enterprises interviewed in the three county-level cities[3]

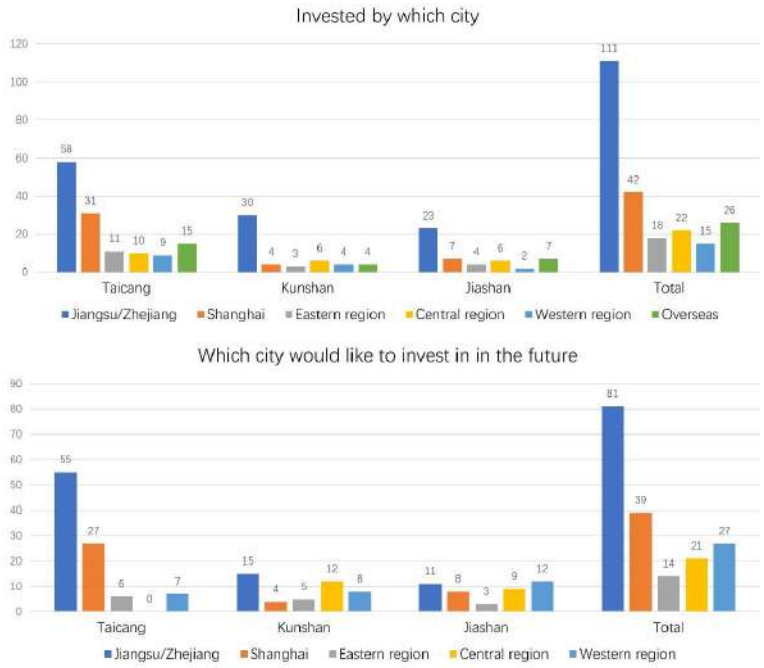

Figure 4. Main origins and future directions of investment of interviewed enterprises

[3] The reason that the total number is greater than the number of surveyed firms 144 is because this question is a multiple-choice question, and the same reason is also true for the following figures that show the same situation.

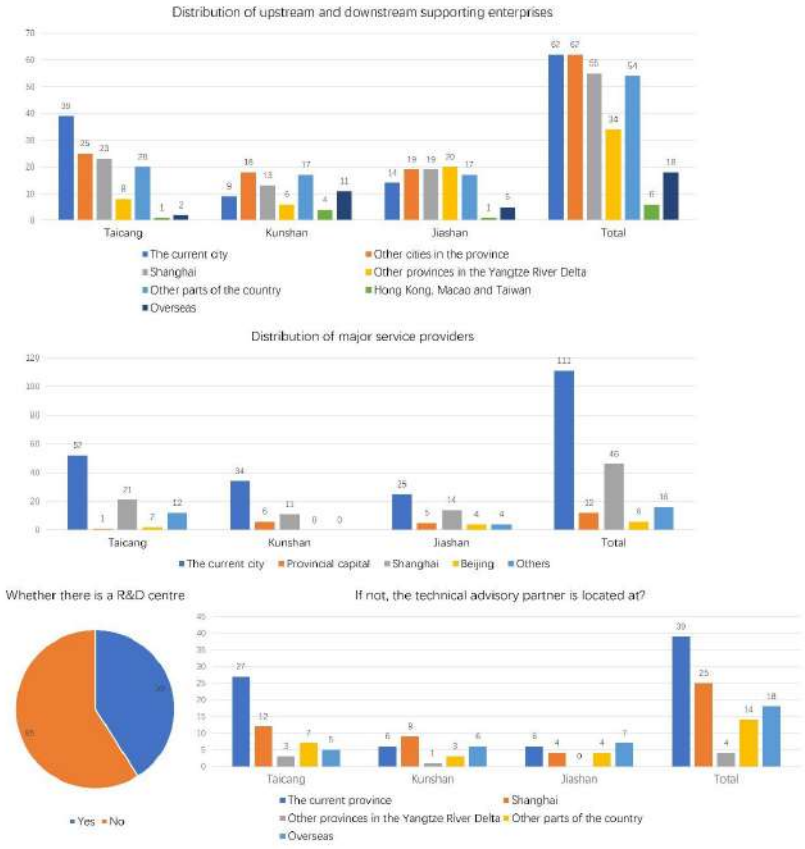

Figure 5. Locations of upstream and downstream supporting enterprises, service providers and technical consulting partners of the interviewed enterprises

With regard to the employee profile of the interviewed enterprises (Figure 6), although the vast majority of the labour force originates from and resides in the local area due to constraints on the recruitment costs of the enterprises and the cost of employee commuting, a portion of the employees still reside in Shanghai (15.3% of the total). According to Figure 7, 28% of enterprises have employees with frequent commutes to and from Shanghai, most of whom are top managers and senior technicians. This is because this group of people has settled their entire family in Shanghai in order to enjoy a high level of public services and living environment, and they also have enough financial capacity to afford the cost of extra-long-distance commuting (they usually

drive a car or take a high-speed train between their home and their workplace). Their commuting frequency concentrates on daily round trips, followed by weekly round trips on weekdays at the company and weekends back to Shanghai. This supports the existence of frequent industrial linkages and factor mobility relationships between the three case cities and Shanghai, as people flows are the concrete spatial manifestation of abstract linkages.

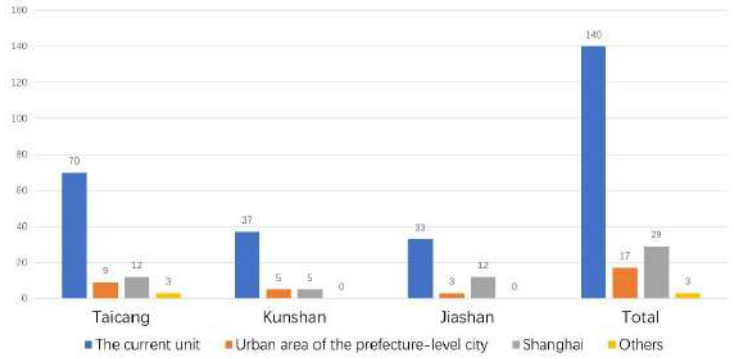

Figure 6. Location of employees' residence in the interviewed enterprises

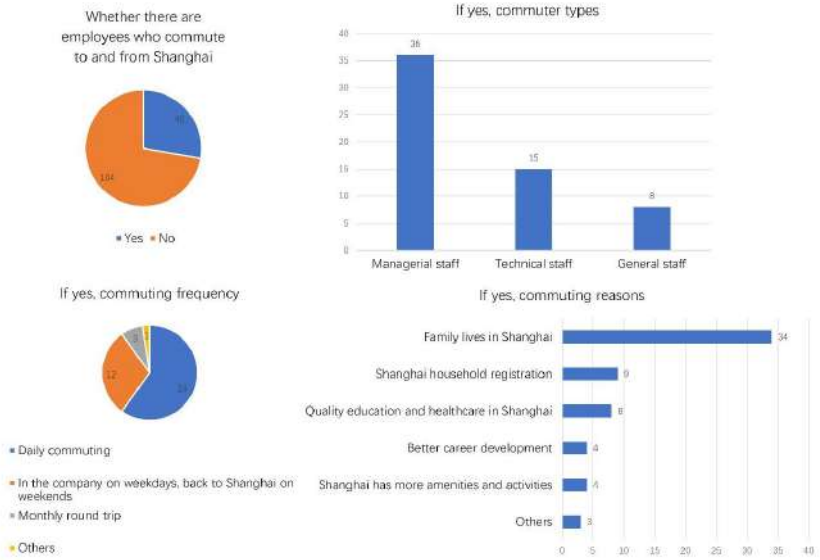

Figure 7. Employees of the interviewed enterprises commute to and from Shanghai

With regard to the satisfaction of the interviewed enterprises with various aspects of the industrial parks in which they are located, they are more satisfied with the parts on geographic location, infrastructure, social security conditions, investment and financing environment, and the efficiency and flexibility of government services, while the most dissatisfied parts concentrate on human resource supply as well as the cost of land, labour, and facilities. This suggests that the location of these enterprises is mainly based on better location and investment and production environment, and also reveals that the industrial policies of the three cities in terms of tax incentives, financial subsidies and talent attraction are still insufficient or have not met the expectations of most of the enterprises, even though these factors have been postponed by them.

The above results suggest that cross-border industrial linkages are formed as a result of independent 'voting with feet' by enterprises, and are also influenced by local government policies. The key reason why firms choose to locate in these three cities is the proximity to Shanghai for access to productive services, technology, talents, labour, information and other resources while enjoying relatively lower land rents and preferential policies in local industrial parks. Taking all factors into account, these are the options that maximise their benefits.

5. Discussion and Conclusion

5.1. Discussion

Urban competition in the era of globalisation has been transformed into city-region competition between metropolises and their surrounding areas. As engines of regional economic growth and 'fronts' for regional economic integration, metropolitan areas are no longer a collection of isolated economies, but rather a series of small and medium-sized cities with close economic ties to the central city to allocate resources together. As any node city in the network, the all-industry development model is unsustainable. The main feature of the metropolitan area economy is the centre-periphery linkage, i.e., integrated resource allocation and vertical division of labour in industries (Shen *et al*, 2023). Therefore, small and medium-sized cities in the periphery of the metropolitan area should not continue the traditional independent and self-sufficient mode, but seek to cooperate with the central city and other cities, and transform into the metropolitan area economy mode.

This paper draws the following planning implications: firstly, as shown in our city network analysis, Shanghai's economy is closely dependent on the cities in its hinterland. More precisely, the rise of Shanghai as a metropolis with international influence is behind the rise of the Shanghai metropolitan area as a whole, which relies on the joint interaction between the centre and its hinterland, and on the establishment of a close division of labour and collaboration system between cities of different levels. To develop into a global city region, the Shanghai metropolitan area needs to further

promote the optimisation and upgrading of its economic and industrial structure and segmentation of its industries, promote the concentration and heightened development of its core functions, and guide the transfer of other functions outward in an orderly manner. Cities around Shanghai should seize the opportunity of the metropolitan area's industrial spatial organisation evolution and function overflow, take into account their own comparative advantages in their development positioning, and accurately undertake the specific functions overflowed from Shanghai, so as to enhance their position in the city network.

Secondly, the regional specialised division of labour is premised on close and rational functional links between cities, so it is important to reshape the overall architecture of regional governance to guide the spatial reconfiguration of industrial organisation and the development of specialised nodes in the metropolitan area. In addition to the Shanghai metropolitan area, this also applies to other metropolitan areas regions in China. The market segmentation caused by the ‘’administrative economy‘’ model needs to be broken up, and a sound regional coordination mechanism should be established to promote the free flow of factors of production, so as to realise the overall benefit of ‘’1+1>2‘’. The governments should build a cooperation platform between cities without breaking through the administrative boundaries, coordinate the development positioning, urban planning, policy support and other issues in regional cooperation, and then guide enterprises and the society to enrich the content of cooperation through market-oriented means, and enterprises should provide timely feedback to the government for the problems existing in the cooperation to make up for the market failure and governmental failure.

Finally, returning to the perspective of small cities on the periphery of the metropolitan area, although the three case cities have attracted more and more transferring industries by their proximity to Shanghai, the results of the enterprise questionnaire analysis indicate that the survival environment of the interviewed enterprises still shows some deficiencies. In order for these small and medium-sized cities to sustainably attract high-quality enterprises to settle in, and thus truly achieve ‘integration into Shanghai’, the following two points should be considered: first, they should flexibly and purposefully optimize the preferential policies for investment incentives and the talent introduction, to optimize the soft environment for economic development through policy innovation; second, they should provide housing and a higher level of public services for the imported talents and labour.

5.2. Conclusion

The study reaches the following base conclusions: a. Comparing the changes in city networks in 2001, 2008 and 2018, the links between Shanghai and its neighboring county-level cities have increased significantly. Among them, Kunshan and Taicang have seen the most significant growth, with their links to Shanghai even equaling (or surpassing) those of the prefecture-level cities and provincial capitals to which they

belong; Jiashan, however, is a little less impressive. b. The top reason for location choice of the interviewed enterprises is 'proximity to Shanghai', followed by ' investment promotion policies of industrial parks', meaning that the formation of cross-city industrial linkages is the result of enterprises voting with their feet actively. c. Shanghai is second only to the cities in the provinces to which the three cities belong in terms of the cities in which they invested in the interviewed enterprises, the cities where upstream and downstream specialized enterprises are located, and the cities where they provide productive services, which means that the market forces in the links between the three cities and Shanghai somewhat surpass the geographic proximity and barriers of administrative factors. d. 25% of the interviewed enterprises have frequent (daily or weekly) commuters between their workplace and Shanghai (residential place), which also indicates the frequent factor flows between these three cities and Shanghai.

To summarize, although these three cities are relatively small in scale and low in rank, they have all successfully 'captured' the flowing resources in the production chain of the Shanghai metropolitan area, developed industrial interactions with Shanghai across the provincial administrative boundaries, and realized their own elevated status in the regional economic network.

The main contributions of this study are twofold: first, to provide reference for the integration planning of the metropolitan areas - to explore the industrial spatial planning and cross-city industrial cooperation paths between the center and the periphery cities in order to achieve the goal of complementarity and win-win situation. Second, to guide the industrial planning of small and medium-sized cities on the periphery of megacities - to seek connection and cooperation with the central city and to optimize their industrial space, so that they can adapt to the development direction of regional industrial linkages and transition to a metropolitan-area economy.

References

Capello, R. (2000) 'The city network paradigm: measuring urban network externalities', *Urban Studies*, 37(11), pp. 1925-1945.

Hesse, M. (2016). 'On borrowed size, flawed urbanisation and emerging enclave spaces: the exceptional urbanism of luxembourg, luxembourg'. *European Urban and Regional Studies*, 23(4), pp. 612-627.

Shen, M. R. and Z. Q. Wang, et al. (2023). 'Planning Metropolitan Regions in China: Theoretical Origins and Planning Practices'. *Urban Planning Forum*, (02), pp. 57-66. (in Chinese)

Cao, Y and G. Zeng (2022). 'The Cooperation Characteristics and Development Path of Innovation Enclave in Yangtze River Delta'. *Shanghai Urban Management*, 31(5), pp. 19-26. (in Chinese)

Luo, Y and K. Qiu, et al. (2023). 'Cross-border Practice and Research on the Guangdong-Hong Kong-Macao Greater Bay Area from the Perspective of a Multi-scale Space of Flows'. *Urban Planning International*, 38(05), pp. 40-46. (in Chinese)

Marshall, A. (1890), Principles of economics, London, Macmillan.

Massey, D. (1984), Spatial divisions of labour, London, Macmillan.

Maskell, P. (2001), 'Knowledge Creation and Diffusion in Geographic Clusters', *International Journal of Innovation Management,* 05 (02), pp. 213-237.

He, C. F. (2018). 'Regional industrial development and evolution: Path dependence or path creation?', *Geographical Research*, 37 (07), pp. 1253-1267. (in Chinese)

Hess, M. & Yeung, H. W. (2006), 'Whither Global Production Networks in Economic Geography_ Past, Present, and Future', *Environment and Planning A: Economy and Space*, 38 (7), pp. 1193-1204.

Frenken, K. and Boschma, R. A. (2007), 'A theoretical framework for evolutionary economic geography: industrial dynamics and urban growth as a branching process', *Journal of economic geography,* 7 (5), pp. 635-649.

Fröbel F. (1980), The new international division of labour: structural unemployment in industrialised countries and industrialisation in developing countries, Cambridge, Cambridge University Press.

Scott, A. (1982), 'Locational Patterns and Dynamics of Industrial Activity in the Modern Metropolis', *Urban Studies,*19(2), pp. 111-141.

Giuliani, E. and Bell, M. (2005), 'The micro-determinants of meso-level learning and innovation: evidence from a Chilean wine cluster', *Research policy,* 34 (1), pp. 47-68.

Boschma, R. (2005), 'Proximity and Innovation: A Critical Assessment', *Regional Studies,* 39 (1), pp. 61-74.

Taylor, P. J. (2001), 'Specification of the World City Network', *Geographical Analysis,* 33 (2), pp. 181-194.

Liu, Y. J and Ren, S. M. (2006), 'Industrial Division, Industrial Reorganization and Producer Services Development'. *Science Technology and Industry*, 6(8), pp. 1-4.

Castells, M. (1996). The rise of the network society, Malden, Blackwell Publishers.

Taylor, P. J., Hoyler, M., Walker, D. R. F. and Szegner, M. J. (2002). 'A new mapping of the world for the new millennium'. *The Geographical Journal,* 167, pp. 213-222.

Alderson, A. and Beckfield, J. (2004). 'Power and Position in the World City System'. *American Journal of Sociology,* 109(4), pp. 811-851.

Cheng, Y. and Legates, R. (2018). 'China's hybrid global city region pathway: Evidence from the Yangtze River Delta'. *Cities,* 77, pp. 81-91.

Scott A J. (2001). Global city-regions: trends, theory, policy, Cambridge, Oxford University Press.