

Spatial Spillover Effects of Co-Agglomeration of Producer Services on the Upgrading of Global Value Chain: Evidence from China's Spatial Panel Data

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Abstract

With the rapid development of information technology and transportation, will industrial co-agglomeration present spatial spillover effect on the upgrading of global value chain? This paper studies the effect of co-agglomeration of producer services and manufacturing on the upgrading of global value chain, especially its spatial spillover effect. Results show that a significant spatial correlation exists in the upgrading of global value chain in Chinese cities, and the trends of geographical agglomeration and spatial correlation of the function links of global value chain are strengthened. Furthermore, the co-agglomeration of inter industries has a significant spatial spillover effect on the upgrading of global value chain, which shows that the spatial synergy effect of China's urban secondary and tertiary industries is gradually emerging. Moreover, compared with external radiation spillover effect, the local spillover effect is more obvious, which suggests the significance of constructing mechanism of cross regional industrial cooperation. To accelerate the industrial integration and spatial connection, it is necessary to build a new pattern of multipolar network space development, and strengthen the spatial externality of service provision as well as the upgrading of global value chain.

Keywords

Co-Agglomeration of Producer Services; Upgrading of Global Value Chain; Spatial Spillover Effect.

1. Introduction

With the deepening of economic globalization, it is increasingly critical to optimize the division of global value chain. In this context, the Chinese government has proposed to promote China's industries to the high end of global value chain and incubate several world-class advanced manufacturing clusters. With the trend of "internet plus intelligent manufacturing", new production methods are emerging. To enhance the position of the global value chain, manufacturing enterprises need to change pattern of quantitative input which relies on low-cost elements. Instead, they are encouraged to transform into quality-driven mode of producers service, thus promoting deeper integration as well as interactive development of producer services and manufacturing. The spatial synergy effect between secondary and tertiary industries attracts more attention.

Existing papers have discussed the spatial interaction relationship between producer services and manufacturing (Ellison et al., 2010; Kolko et al., 2010; Jacobs et al., 2014; Ke et al., 2014).

In general, most of them used linear panel models to analyze the linear average effect of a single industrial agglomeration size or to explore the agglomeration effect of producer services on manufacturing industries. A spatial correlation analysis using spatial econometric model to explore the co-location relationship or spatial interaction between industries is inadequate. Therefore, this study investigates the spatial interaction efficiency and spillover effects between producer services and manufacturing using prefecture-level city data and spatial econometric model, and ultimately provides policy implications for the upgrading of global value chain of Chinese manufacturing enterprises.

2. Analysis of Impact Mechanisms

Producer services such as information technology services, financial services, business services, R&D design, with specialized human capital and intellectual capital as the main inputs, provide service support for manufacturing processes of industrial production and operational management of enterprises. According to the theory of agglomeration externalities, co-agglomeration of producer services and manufacturing industries can promote the innovation performance of manufacturing firms and the dynamic rise of enterprise value chain links in global production networks through the formation of shared labour markets, increased labour productivity, expanded market size effects, reduced transport and transaction costs, and enhanced knowledge or technology spillovers (Kolko, 2010; Ke et al., 2014).

In particularly, as China's regions become more economically and socially integrated with the application of ICT and the increasing sophistication of transport infrastructure, it is increasingly possible for various regions to have more access to innovative resources or innovation achievements from neighboring regions through information exchange, mutual learning and human capital flows. In this context, the knowledge diffusion or knowledge spillovers effect, triggered by industrial collaboration and synergistic clustering between regions, intensifies. Hence, the co-agglomeration of producer services and manufacturing will not only generate significant spatial externalities for the R&D involvement, production and manufacturing, marketing branding, logistics and transportation, and other value-added activities or links in manufacturing's GVCs in local regions, but also for the upgrading activities of GVCs in surrounding or adjacent regions (Jacobs et al., 2014). In other words, the co-agglomeration of producer services and manufacturing can have significant spatial spillover and interaction effects on the upgrading of GVCs in economic or geographic neighborhood, not only in terms of promoting upgrading of global value chain of manufacturing firms in local city, but also in nearby cities through mechanisms of spatial linkage.

3. Study Desgin

3.1. Model Construction

With the deepening of division of labor in GVCs, manufacturing production networks are more decentralized. The spatial spillover effect of inter-city manufacturing is increasingly obvious. If only a simple linear regression model is used in this study, a risk of bias may exist in the conclusions. Therefore, a spatial correlation model needs to be tested to ensure the applicability of a spatial econometric model. For this purpose, we test the spatial relevance of the upgrading of manufacturing's global value chain by using Moran's I index, as shown in equation (1).

$$Moran' SI = \frac{n \sum_{i=1}^n \sum_{j=1}^n \omega_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^n \sum_{j=1}^n \omega_{ij} \sum_{i=1}^n (x_i - \bar{x})^2} = \frac{n \sum_{i=1}^n \sum_{j=1}^n \omega_{ij} (x_i - \bar{x})(x_j - \bar{x})}{S^2 \sum_{i=1}^n \sum_{j=1}^n \omega_{ij}} \quad (1)$$

$S^2 = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2$. $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$. n is the total number of cities, ω_{ij} represents the spatial weight matrix element, measured as the inverse distance matrix normalized between cities, and x_i is the observation of the manufacturing value chain in city i . Further, this paper uses a spatial lag model (SAR) for the metric analysis, as shown in equation (2).

$$upgrade = \rho \cdot W \cdot upgrade + \beta_1 \cdot MSK + \beta_2 \cdot X + \varepsilon, \varepsilon \sim N(0, \delta^2 I) \quad (2)$$

3.2. Indicator Measurement and Data Sources

For the variable of co-agglomeration of producer services and manufacturing, this study overcomes the inadequacy of some papers which consider only a single indicator on the scale of industrial clustering. The inter-industry synergistic clustering or co-agglomeration method was proposed by Ellison et al. (2007), which was calculated as equation (3). Here, MK_{ij} and SK_{ij} are the location entropy index of manufacturing and producer services in a country, respectively. MSK_{ij} is an index measuring the synergistic agglomeration of manufacturing and producer services in city j .

$$MK_{ij} = \frac{K_{ij}}{K_j} \bigg/ \frac{K_i}{K} \quad SK_{ij} = \frac{K_{ij}'}{K_j'} \bigg/ \frac{K_i'}{K'} \\ MSK_{ij} = \left(1 - \frac{|MK_{ij} - SK_{ij}|}{MK_{ij} + SK_{ij}} \right) + |MK_{ij} + SK_{ij}| \quad (3)$$

Previous studies have used profit share, cost share, export technical sophistication to measure the upgrading of manufacturing's global value chains. But most of them cannot describe well the division position of manufacturing enterprises in global value chains. To reflect the true characteristics of global value chain division of labor, this paper follows Ju and Yu (2015) to calculate the upstream degree of each industry, based on export weights which are adopted to calculate the upstream degree of enterprises' exports. And then, we measure the average city upstream degree to better evaluate the division of labor position of global value chain in each city's manufacturing industry. For more robust conclusions, this paper applies three approaches to calculate the upgrading of manufacturing's global value chain, which weighted by the output value of firms, the number of persons employed and the value of exports, respectively.

$$upgrade_i = 1 \times \frac{C_i}{H_i} + 2 \times \frac{\sum_{j=1}^N \vartheta_{ij} C_j}{H_i} + 3 \times \frac{\sum_{j=1}^N \sum_{k=1}^N \vartheta_{ik} \vartheta_{kj} C_j}{H_i} + 4 \times \frac{\sum_{j=1}^N \sum_{k=1}^N \sum_{l=1}^N \vartheta_{il} \vartheta_{lk} \vartheta_{kj} C_j}{H_i} + \dots \quad (4)$$

ϑ_{ij} is the contribution of industry i output to production per unit value j . C_i is the contribution of industry i output in final consumption. H_i is the total industry i output. Based on this, the export value of an enterprise in each industry is weighted to estimate the export upstream of the global value chain.

Within this framework, data of co-agglomeration of producer services and manufacturing are obtained from China City Statistics Yearbook, and data on the upgrading of manufacturing's global value chain are from the China Industrial Enterprises Database and the China Customs Database, etc., by aggregating and averaging the micro enterprise data at city level. Since

spatially measured regressions require balancing panel data, interpolation is used to compensate for individual missing data.

4. Results and Analysis

4.1. Spatial Correlation Test

Figure 1 shows the results of Moran's I index test for upgrading of manufacturing's global value chain in China from 2004 to 2013. Figure 2 shows the spatial correlation trend of manufacturing's global value chain in China from 2004 to 2013. The results revealed a significant spatial correlation in upgrading of global value chains over the sample period. In fact, the spatial autocorrelation coefficient is significantly positive, which indicates that there is spatial effect, so further spatial econometric analysis is needed. Furthermore, in terms of spatial correlation, Moran's I index has experienced a fluctuating trend of strengthening→decaying→strengthening, especially after the financial crisis due to the impact of international production networks, which led to a downward trend. But in recent years, the spatial correlation of upgrading of manufacturing's global value chain has been increased, which dues to multiple policy support and improving business environment.

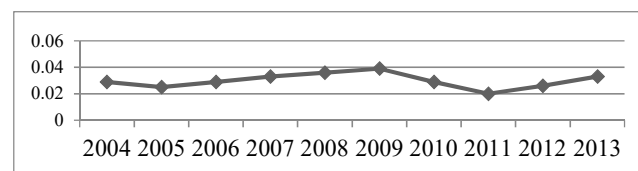


Figure 1. Moran's I Index Test for Global Value Chain of Manufacturing Sectors in China, 2004-2013

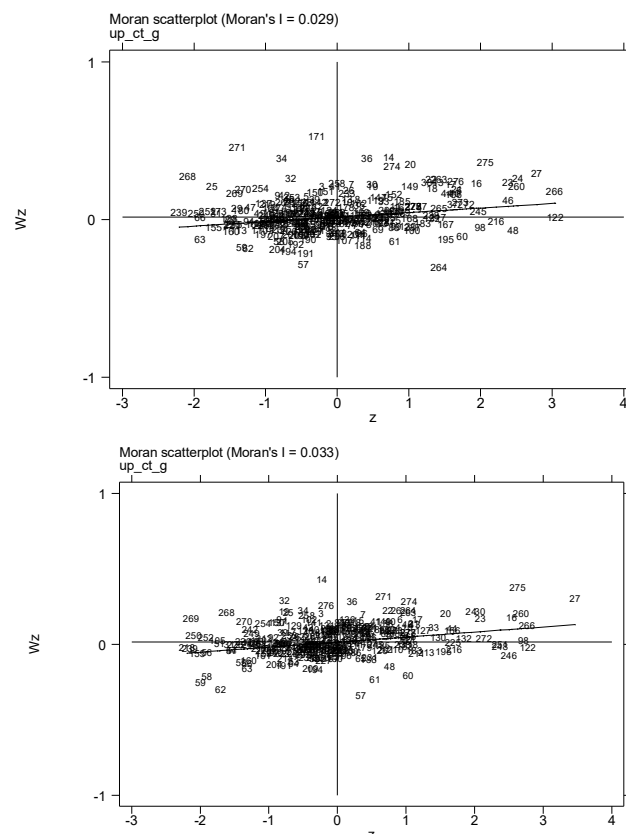


Figure 2. Spatial Relevance of Global Value Chain of Manufacturing Sectors in China, 2004 and 2013

4.2. Analysis of Regression Results of Spatial Econometric Model

Table 1 reports the regression results of the SAR fixed effects and random effects models calculated by different measurement methods of division position of global value chain as the explanatory variables. Hausman's test indicates that the estimated results of the random effects model should be adopted. The results show that after incorporating spatial relevance, no matter which method is adopted, the co-agglomeration of producer services and manufacturing will produce positive and significant spatial spillover effects on the upgrading of manufacturing's global value chains. With the gradual transformation of industrial economy to service economy, stronger industrial specialization and spatial connection of inter industry can further improve the service efficiency and quality of the industrial value chain. The whole industry chain pattern of functional synergy is also forming. It is crucial for promoting the upgrading of the division of labor in the global value chain.

Table 1. Spatial Spillover of Co-agglomeration of Producer Services on the Global Value Chain of Manufacturing Sectors

	GVC _{ug_output}		GVC _{ug_labor}		GVC _{ug_value of export}	
	<i>Random</i>	<i>Fixed</i>	<i>Random</i>	<i>Fixed</i>	<i>Random</i>	<i>Fixed</i>
<i>MSK</i>	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(15.491)	(15.320)	(5.392)	(10.423)	(5.199)	(9.948)
<i>_cons</i>	0.127**		0.065**		0.221***	
	(2.358)		(2.027)		(3.572)	
<i>rho</i>	0.956***	0.959***	0.975***	0.977***	0.917***	0.921***
	(55.909)	(56.107)	(88.043)	(88.591)	(40.844)	(40.762)
<i>lgt_theta</i>	-1.410***		-0.902***		-0.958***	
	(-21.056)		(-5.733)		(-9.970)	
<i>sigma2_e</i>	0.049***	0.044***	0.102***	0.092***	0.175***	0.158***
	(13.566)	(13.567)	(7.398)	(7.390)	(6.768)	(6.768)
<i>N</i>	2780	2780	2780	2780	2780	2780
<i>R</i> ²	0.003	0.003	0.026	0.026	0.001	0.001

Note: Figures in parentheses are t statistics. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2 reports the results of the decomposition considering direct and indirect effects of spatial spillovers. Result shows that the direct effect of co-agglomeration of producer services and manufacturing on the upgrading of global value chain is noticeably positive, indicating that co-agglomeration of producer services and manufacturing industries not only affect the upgrading of local enterprises' global value chain, but also have a significant spatial spillover effect on the upgrading of global value chain in neighboring regions. However, its effect on the upgrading of global value chain of manufacturing in neighboring regions is relatively weak. It's probably that the upgrading of manufacturing's global value chains is usually accompanied by infrastructure connectivity, the free flow of production factors and accelerated concentration of industrial population, which is also the process of deepening regional socio-economic cooperation as well as the evolution of regional spatial integration. The synergistic concentration of producer services and manufacturing industries will therefore have a more obvious spatial spillover effect on the upgrading activities of local manufacturing's global value chain. Nevertheless, due to the existing administrative barriers and regional disordered competition, the synergistic effects between producer services and manufacturing sectors in different regions have not been fully released. So the impact of co-agglomeration of local producer services and manufacturing on the upgrading of global value chains of manufacturing sectors in neighboring regions has not yet been enhanced.

Table 2. Decomposition of Spatial Spillovers of GVCs

	GVC _{ug_output}		GVC _{ug_labor}		GVC _{ug_value of exports}	
	<i>Random</i>	<i>Fixed</i>	<i>Random</i>	<i>Fixed</i>	<i>Random</i>	<i>Fixed</i>
<i>Random effect MSK</i>	0.001***	0.001	0.001**	0.001**	0.002***	0.001***
	(9.293)	(1.544)	(2.294)	(2.296)	(5.124)	(9.713)
<i>Fixed effect MSK</i>	0.019	0.016	0.030	0.026	0.017**	0.016**
	(1.023)	(0.115)	(0.372)	(0.298)	(2.367)	(2.306)
<i>Total effect MSK</i>	0.019	0.017	0.031	0.027	0.019**	0.018**
	(1.060)	(0.120)	(0.379)	(0.305)	(2.522)	(2.479)

5. Conclusions and Implications

In the era of service economy, the interaction between producer services and manufacturing is crucial. However, the existing studies mostly focused on the role of a single industrial agglomeration scale, and might neglect the spillover effects of industrial co-agglomeration on the industrial upgrading process. Thus, this paper applies spatial methods and data from Chinese cities at prefecture level to verify the spillover effects of co-agglomeration on the upgrading of global value chain. Besides, the spillover effects are regionally heterogeneous, with strong local spillover effects and weak external radiation. Therefore, the synergy between industrial policy and spatial planning policy should be coordinated. The capacity for synergism of new technological infrastructure and industry in digital economy should also be enhanced. Furthermore, it is necessary to promote not only close cooperation with the surrounding areas, but also synergy with service enterprises in upstream and downstream of industrial chain to strengthen the linkage effect. Moreover, the producer services should adopt a differentiated strategy according to regional diversity. The eastern and big cities should focus on the clustering of modern service. Midwest cities and small cities should improve the public service infrastructure and platform systems, while introducing appropriate service enterprises. Additionally, administrative barriers should be broken down to reinforce internal and external spatial links and networks, which enabling the integration of multiple functions and comparative advantages of different cities.

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