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Regional Niche and Spatial Distribution of Foreign Investment in China from 2012 to 2021

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Abstract: Strategic positioning is the core issue of strategic management, and regional niche is the core of strategic positioning. Regional niche has important implications in sustainability transition. In this study, the regional niche and spatial distribution of foreign investment in 31 provinces of China from 2012 to 2021 are explored regarding sustainability transition. The results show that: (1) Low fierce competition is important for foreign-investment resources in sustainability transition in general. (2) The gradient of niche-evolution momentum is considerable in sustainability transformation. (3) The spatial echelon distribution of foreign investment is obvious in sustainability transition with a positive spatial-geography correlation. Therefore, in view of the overall space–time development and political layout of foreign investment in emerging industrialized countries such as China in the future, this study has important practical significance. It proposes countermeasures for policy-makers and managers to promote the expansion, evolution, and coordination of foreign investment in regional resources. The conclusion is helpful for China and other emerging industrial countries to successfully realize the space–time layout of regional niche, through foreign investment, and improve their open capabilities of global sustainable development.

Keywords: regional niche; evolutionary momentum; foreign investment; competitive advantage; strategic management

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1. Introduction

Looking at the process of global economic development, mainly developed countries promote policies of reshoring the manufacturing sector and decoupling industrial transfer, raising insiders' concern about foreign investment in China. Based on the data of actual utilized foreign direct investment from 2012 to 2021, released by the National Bureau of Statistics, the scale of China's actual utilized foreign investment is increasing year by year, covering 19 primary industry categories on average and occupying 95% of primary sectors. How does foreign investment in China position and develop? This paper finds that the regional niche of foreign investment brings sustainable advantages of business ecosystems to comprehensively deepen reform and opening-up policies as well as industry transformation and upgrading in China.

Regional niche has important implications in sustainability transition. The local niche is important for policy-makers and managers and for industries in sustainability transition in general [1]. Studying the United States' electricity industry's sustainability transition toward solar from 2010–2017, Weigelt et al. find that as more niche actors enter, regime incumbents are more likely to invest in the niche innovation [2]. The environmental niche has the greatest impact on the sustainability of cultural festival tourism, and local government support plays a key role in sustainable festival development [3]. Gugerell and Penker propose strategies on how cities may foster the development of niche organizations and their networks to highlight local opportunities for supporting a food system's

sustainability transition, i.e., increasing food literacy, enabling access to space, and engaging in networking [4]. Systemic and niche intermediaries are the most crucial forms of intermediary actors in transitions, but they need to be complemented by a full ecology of intermediaries, including regime-based transition intermediaries, process intermediaries, and user intermediaries [5]. Diversified farms' increasing their economic sustainability to partially produce for niche markets, thereby, generates a higher added value [6].

Scholars at home and abroad have come up with niche development from the perspectives of niche width, niche overlap [7], technological niche [8], evolution [9], spatial distribution [10], and so on. The more similar the enterprises demand for resources are, the closer the product technology and the market are, the higher the niche overlap is, and the fiercer the competition will be. Tough competition leads to the separation of an enterprise's niche [11,12], which contributes to the enterprise's gaining of ecological competitive advantages. This research provides beneficial enlightenment and reference for this paper. However, there are two gaps: (1) more theories and empirical studies are needed to study the field of foreign investment from the perspective of regional niche; and (2) systematic research on the evolution and spatial distribution of regional niche is insufficient in sustainability transition.

Quantifying niches (such as niche intensity, width, overlap, and spatial distribution) are important to assess interspecies resource partitioning and competition. Therefore, this paper tries to discuss the above questions through a study of regional niche history of foreign investment in 31 provinces of China regarding sustainability transition from 2012 to 2021. The regional niche, evolutionary momentum, and spatial distribution discussed in this paper will have reference value for emerging industrialized countries to realize strategic positioning as well as space–time distribution of foreign investment and improve global, sustainable, open development capabilities.

2. Literature Review

2.1. Origin and Concept of Niche

The word niche was first used by Johnson (1910); one expects the different species in a region to occupy different niches in the environment [13]. Deeply rooted in the Darwinian struggle for survival, "niche" has been a core, although slippery, idea in ecology since its origins [14]. Enterprise niche is originated from ecological niche, which Freeman first introduced as a concept and a research method for business. Enterprise niche characterizes the different resource requirements and productive capacities. It is the state where the enterprise is, after interacting with the environment. Enterprise niche means predominantly competing on niche market segments neglected by competitors and not discussing a broad range of these segments [15]. A single enterprise has its own niche, and the enterprise population is a collection of companies with similar niches [16]. Enterprise population forms a fundamental niche, occupying the space of specific resources. Each enterprise in the population actually occupies part or all of the fundamental niche, which is called the realized niche [13].

2.2. Evolution and Spatial Distribution of Niche

Enterprise niche evolves along with time. As an approach of evolution, Strategic Niche Management (SNM), emphasizing space protection and user involvement, is a new path for early technologies to be able to replace unsustainable technologies [17]. It aims at fostering innovations with sustainability benefits and securing the sustainability of those innovations. Support and control have a role to play in this. It is a tool for fostering radical technological change and contribution, to overcome a lock-in that is rather located at the system level [18]. SNM has been proposed as a means to protect potentially useful innovations from full-market competition, while specialist niches supply technologies to few customers in more stable environments [19]. Liang et al. bring up that the evolution of an enterprise niche has its own state and potential [20]. Xu and Li propose that contraction, expansion, movement, and coevolution are the four forms of niche

evolution due to competition and cooperation among enterprises [21]. Zhu et al. reveals that structural innovation is an effective way of enterprise niche optimization, providing a unique opportunity for later-developing companies to take up a favorable niche [22]. Ye and Xu consider that as an analysis model of technological-paradigm evolution, enterprise niche is a bridge linking ecology, evolutionary economics, and technical research, offering new thoughts on the study of technological change in a comprehensive, analytical way [23]. Li and Tao think that enterprises should study and use the cheap copy mode for reference, to choose and optimize their own niche [24]. Xu and Wang believe that energy and chemical enterprises have two different green niche mechanisms [25]. Energy justice and transitions frameworks can be combined through an exploration of the multi-level perspective on sociotechnical systems and an integration of energy justice at the model's niche, regime, and landscape levels [26]. China should adopt the strategy of following up, keeping in distance but not falling behind, and surpassing if there is opportunity [27].

Spatial heterogeneity lies in species within niche space. Usually, similar species do not appear in the same space, but, if they do, they have different food or active time (e.g., day and night or different seasons), or they occupy niches differently in other ways [27]. Along the gradient of an occupied climate condition, the geographical distribution of a species is split into spatial subsets that are considered as proxies for intraspecific spatial niche variation [28]. As a whole, China's equipment manufacturing industry has spatial interactions. The high–high aggregation effect is significant in the eastern region, with Jiangsu province as the core, and the low–low aggregation effect is significant in the northwestern region, such as in Xinjiang, Gansu, and Ningxia. There are low–high dispersion and high–low dispersion effects in some other regions [10]. China's innovation-niche fitness is relatively low, as innovation-pioneering regions and innovation-leading regions account for 20% of the provinces of China, while the rest are innovation-backward regions. The innovation-niche fitness presents a decreasing trend from the east region to the west region [29]. The niche distribution of effort is non-random with respect to an environmental gradient thought to be correlated with a species' distribution [30]. Local niches can facilitate paradigm shifts and establish important milestones on the way to a more resilient and sustainable future (Boschma et al., 2017) [31]. Multiple local practices can combine many different places to form a common transition trend, thus extending the niche from local to global (Gibbs & O'Neill, 2016) [32].

2.3. Evolution of Niche Affecting Competitive Edge

The evolution of niche width affects competitive edge. Hannan and Freeman describe the relationship of niche and competitive edge among populations by using niche width and niche overlap [7]. Enterprises usually adopt strategies of specialization and generalization, called specialist–generalist, to occupy a niche [33]. Peng and Sun reveal that the strategy of generalization is a better choice for comprehensive third-party logistics enterprises, while asset-oriented and management-oriented third-party logistics enterprises should adopt specialization strategy [34]. Friesen and Miller point out that for an enterprise in a population, its status in population niche and its realized niche width determine the number of competitors and the enterprise's intensity of competition [35]. The niche width as a contextual feature interacts with review certainty, and reviewer characteristics influence review usefulness [36]. The breadth and situation of the firm's niche have a significant positive impact on the performance of technological collaborative innovation [37]. Technological-niche width mediates the relationship between competition and vertical integration [38]. The increase in niche width is achieved by individual specialization (decrease in niche overlap) [39]. The center of a quadratic curve represents a species' optimal environmental conditions, and the width represents its ability to tolerate deviations from the optimum [40].

The evolution of niche overlap also affects competitive edge. Diversity is a way species avoiding competition. However, there's niche overlap if two enterprises occupy the same resource or environmental variable in order to survive and develop. Niche

overlap results in competition [12]. Niche overlap can trigger interspecific competition and intraguild predation [41]. It is impossible for two species to occupy the same niche in the long term [42]. Fierce competition leads to niche separation. Enterprises with different niches are more likely to succeed than those sharing similar market niches [43]. Niche overlap has a significant negative impact on the performance of technological collaborative innovation [37]. Bian and Liu came up with the measure method of niche width, niche overlap, and niche fitness of tech start-ups' population, by extracting their niche factors [44]. From the perspective of market recognition, niche overlap has significant negative impacts. From the perspective of government recognition, niche width has significant positive impacts. The interaction term of niche width and niche overlap has significant negative impacts, and there is a double-threshold effect [45]. The ecological gradients interact to influence the degree of niche overlap between species, which surprisingly decreased with a population's total niche-width degree of the niche overlap between species that decreases with a population's total niche width [46]. The competition of living resources leads to the change of niche-overlap role and function, which affects social development [47]. Large simultaneous changes in niche overlap and competitive difference often result in one of the species being excluded [48].

In summary, existing research highlights the space–time evolution of enterprise niche, and the relationship of enterprise niche and competitive edge. In addition, China's market is highly open for overseas investors [49]. However, further exploration of regional niche, evolutionary momentum, and spatial distribution is needed, especially in the field of foreign investment.

3. Methodology and Data

3.1. Measure Models of Niche Intensity and Evolutionary Momentum

3.1.1. Niche-Intensity Model

Niche intensity refers to the proportion of local resources in the global scope. The larger the niche intensity is, the greater the economic contribution is, and the stronger the industrial competitiveness is. Based on the niche-intensity measure model of the equipment manufacturing industry, from the findings of Jiang et al. [10], this paper constructs a model, with a data matrix, of the regional niche-industry intensity of foreign investment by taking N provinces (autonomous regions and municipalities) as the rows and R foreign-invested primary industries as the columns. Thereinto, x_{ij} represents the resources of the foreign investment that are put into industry j in province i:

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^{N} X_{ij}} \quad (1)$$

The overall niche intensity of foreign investment in province i can be calculated by summing up the niche intensity of R industries in province i:

$$P_i = \sum_{j=1}^{R} P_{ij} \quad (2)$$

3.1.2. Evolutionary Momentum of Niche-Intensity Model

The evolutionary momentum measures the evolutionary inertia of the niche. Based on the findings of Liu et al. [9], this paper constructs a model of regional niche-intensity evolutionary momentum of foreign investment by setting P_{ij} as the real niche intensity of industry j in province i and setting $P_{aj} = \max(P_{ij})$ as representing the optimized niche intensity of industry j:

$$EMP_i = \sqrt{\frac{\sum_{j=1}^{R} (P_{aj} - P_{ij})}{R}} \quad (3)$$

Thereinto, EMP_i represents the evolutionary momentum of the niche intensity of foreign investment in province i.

3.2. Measure Models of Niche Width and Evolutionary Momentum

3.2.1. Niche-Width Model

This paper measures regional niche width of foreign investment based on the Shannon–Wiener index [10]:

$$B_i = -\sum_{j=1}^{R} \left(\frac{P_{ij}}{P_i} \lg \frac{P_{ij}}{P_i}\right) \tag{4}$$

where B_i represents the niche width of foreign investment in province i.

3.2.2. Evolutionary Momentum of Niche-Width Model

Based on the finding of Liu et al. [9], this paper constructs a model of regional niche-width evolutionary momentum of foreign investment by setting $B_{ij} = -(P_{ij}/P_i) \times \lg(P_{ij}/P_i)$ as the real niche width of industry j in province i, and $B_{aj} = \max(B_{ij}) = \max[-(P_{ij}/P_i) \times \lg(P_{ij}/P_i)]$ as the optimized niche width of industry j:

$$EMB_i = \sqrt{\frac{\sum_{j=1}^{R} (B_{aj} - B_{ij})}{R}} \tag{5}$$

Thereinto, EMB_i represents the evolutionary momentum of the niche width of foreign investment in province i.

3.3. Nich- Overlap Model

This paper measures regional niche overlap of foreign investment based on Pianka's index.

$$O_{mn} = \frac{\sum_{j=1}^{R} P_{mj} P_{nj}}{\sqrt{\left(\sum_{j=1}^{R} {P_{mj}}^2\right) \bullet \left(\sum_{j=1}^{R} {P_{nj}}^2\right)}} \tag{6}$$

Thereinto, P_{mj} and P_{nj} represent the niche intensity of foreign investment of industry j in province m and in province n, respectively, while O_{mn} represents the niche overlap of foreign investment from province m to province n.

3.4. Spatial-Distribution Models

3.4.1. Global Moran's I Model

This paper analyzes the spatial autocorrelation of niche intensity of foreign investment by using the global Moran's I index [10]. The model of the global Moran's I is as below:

$$I = \frac{N}{\sum_{i=1}^{N} \sum_{t=1}^{N} w_{it}} \frac{\sum_{i=1}^{N} \sum_{t=1}^{N} w_{it}(P_i - \overline{P})(P_t - \overline{P})}{\sum_{i=1}^{N} (P_i - \overline{P})^2} \tag{7}$$

Thereinto, P_i and P_t represent the overall niche intensity of each province, while W_{it} is the space weight matrix among provinces measuring the adjacent relation among provinces, and N is the total number of provinces.

3.4.2. Local Moran's I Model

This paper analyzes the spatial correlation of niche intensity of foreign investment in local regions by using the local Moran's I index [10]. The model of the local Moran's I is as below:

$$I_i = \frac{N(P_i - \overline{P}) \sum_{j=1}^{N} w_{ij}(P_j - \overline{P})}{\sum_{i=1}^{N} (P_i - \overline{P})^2} \quad (8)$$

Thereinto, I_i represents the Moran's I index to the niche intensity of foreign investment in province i.

3.5. Data Collection

This paper conducts an empirical analysis using data of 31 provinces in China (Taiwan, Hong Kong, and Macau are excluded as the data are not available) from 2012 to 2021, which was acquired from National Enterprise Credit Information Publicity System from the State Administration for Market Regulation and provided by the project team. According to Industrial Classification for National Economic Activities, foreign investment in China from 2012 to 2021 covers 20 industries in total: mining and quarrying; production and supply of electric power, heat power, gas, and water; real estate activities; public administration, social security, and social organizations; extraterritorial organizations; construction; transportation, storage, and postal activities; education; financial activities; resident service, repair and other services; scientific and technical activities; agriculture, forestry, animal husbandry, and fishing; wholesale and retail trade; water, environment, and public facilities management; human health and social work activities; culture, sports, and entertainment; information transmission, software, and information technology services; manufacturing; accommodation and food service activities; and leasing and business services. It covers 19 industries every year on average. This paper chooses newly registered capital of foreign investment in China as an indicator of investment level, gathering data of foreign-invested enterprises from 31 provinces to form panel data by industry for each province from 2012 to 2021.

4. Empirical Study on Regional Niche and Spatial Distribution of Foreign Investment

4.1. Regional Niche Intensity and Evolutionary Momentum of Foreign Investment

4.1.1. Regional Niche Intensity of Foreign Investment

According to the niche-intensity model [10], Figure 1 shows the competitiveness of foreign investment in every province. The overall result is that there is a large gap in foreign investment in different provinces, and there are few provinces with above-average niche intensity. The niche intensity is relatively low. From 2012 to 2021, the top five provinces in terms of the average niche intensity of foreign investment in China are Guangdong, Chongqing, Jiangsu, Shandong, and Zhejiang, in sequence. Guangdong and Jiangsu have always been leading in the country, with developed export-oriented economies. Meanwhile, Xinjiang, Gansu, Ningxia, Qinghai, and Tibet are the five provinces with the lowest average niche intensity of foreign investment in China, with weak export-oriented economies.

According to the niche-intensity model [10], Figure 2 shows the industrial competitiveness of foreign investment in each province. The industries covered by foreign investment in Shandong, Guangdong, Jiangsu, and Hainan are relatively complete, and most of the industries rank in the top five in terms of niche intensity. It means that the competitiveness of the export-oriented economy is strong. Some provinces do not rank high in terms of the overall niche intensity, but some of their industries rank in the top five, such as mining in Tianjin; construction in Guangxi and Yunnan; financial activities, culture, sports and entertainment in Zhejiang; and manufacturing in Guizhou.

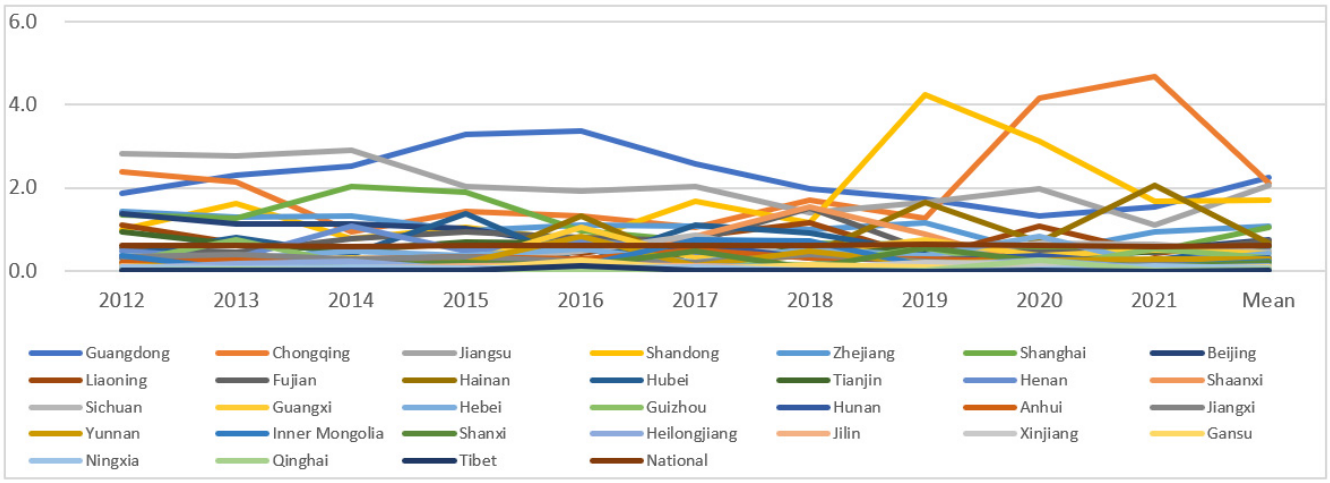

Figure 1. Niche intensity of foreign investment by province from 2012 to 2021.

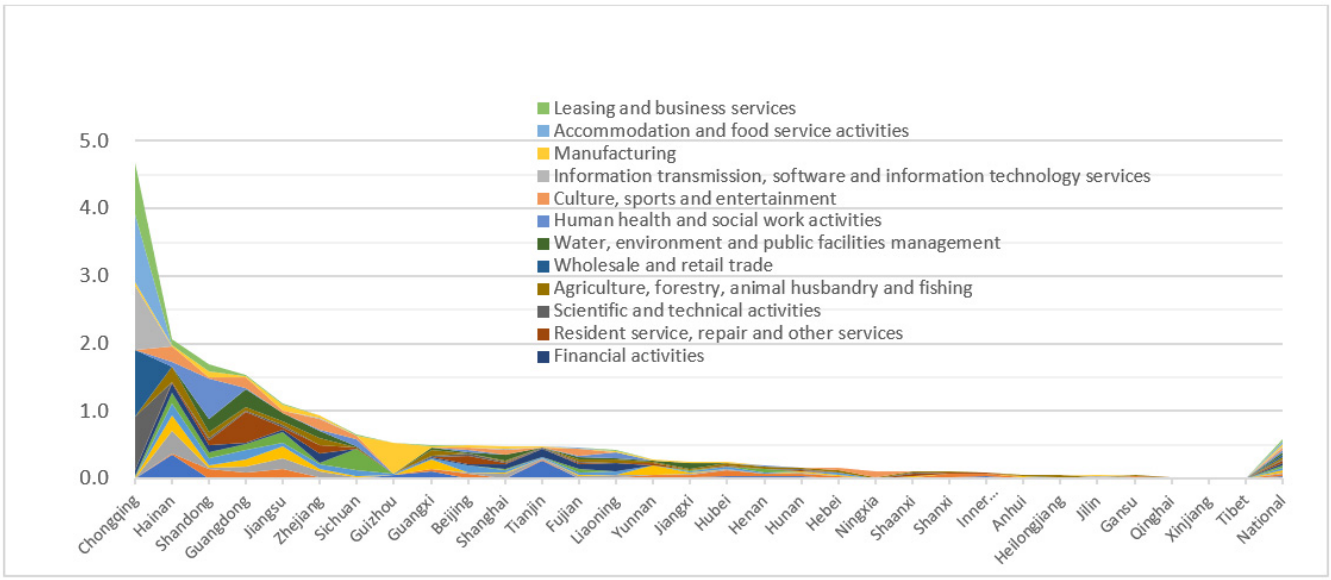

Figure 2. Niche intensity of foreign investment by province in 2021.

4.1.2. Regional Niche-Intensity Evolutionary Momentum of Foreign Investment

Based on the niche evolutionary momentum model [9], substituting the niche intensity of foreign investment in each province from 2012 to 2021. Figure 3 shows the niche-intensity evolutionary momentum of foreign investment in each province. The overall result of Figure 3 shows that more than half of the provinces are with evolutionary momentum of niche intensity above the mean, which means that the evolutionary momentum is large. From 2012 to 2021, the top five provinces with the highest evolutionary momentum of niche intensity of foreign investment in China, in sequence, are Tibet, Qinghai, Ningxia, Xinjiang, and Gansu. The five provinces with the lowest evolutionary momentum of niche intensity are Shanghai, Shandong, Chongqing, Jiangsu, and Guangdong.

4.2. Regional Niche Width and Evolutionary Momentum of Foreign Investment

4.2.1. Regional Niche Width of Foreign Investment

According to the niche-width model [10], Figure 4 shows the resource competitiveness of foreign investment in each province. The overall result is that more than half of the provinces with a niche width of foreign investment are above the niche width mean, which means that the foreign-invested resources are fully utilized and wide-ranging. From 2012

to 2021, the top five provinces in terms of the average niche width of foreign investment in China are Guangdong, Zhejiang, Jiangsu, Shandong, and Shanghai. Guangdong, Zhejiang, Jiangsu, and Shandong are leading the country in most years, and they have a wide variety of foreign investment. Gansu, Tibet, Ningxia, Inner Mongolia, and Qinghai are the five provinces with the lowest niche-width mean of foreign investment in China, which means that they have few foreign-investment resources.

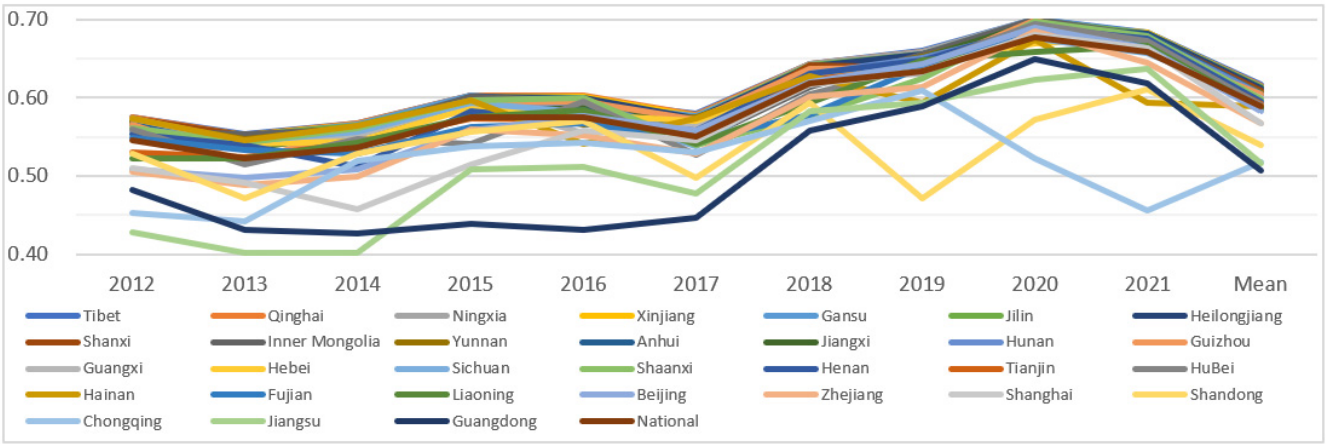

Figure 3. Niche-intensity evolutionary momentum of foreign investment by province from 2012 to 2021.

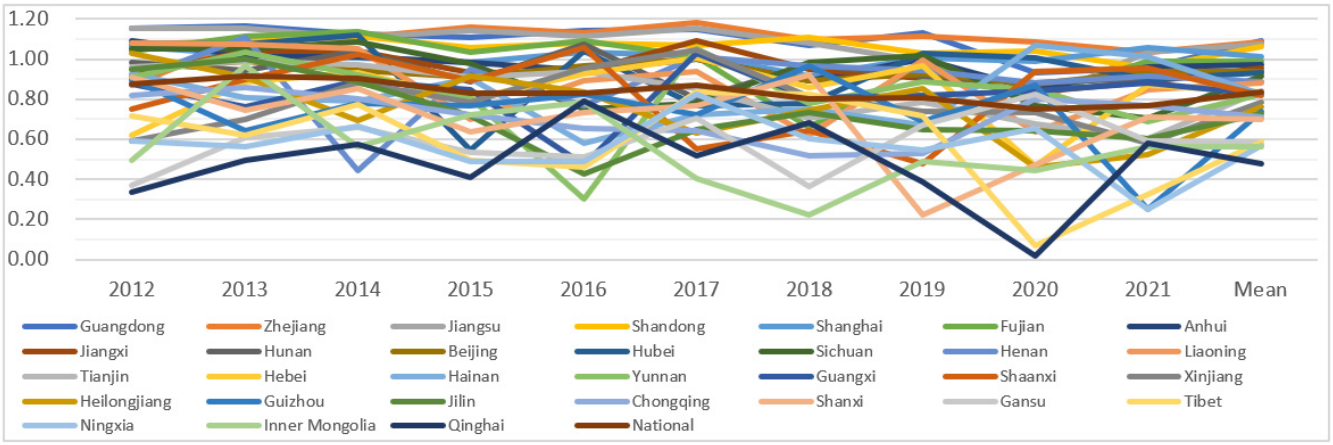

Figure 4. Niche width of foreign investment by province from 2012 to 2021.

4.2.2. Regional Niche–Width Evolutionary Momentum of Foreign Investment

Based on the niche evolutionary-momentum model [9], substituting the niche width of foreign investment in each province from 2012 to 2021, Figure 5 shows the niche-width evolutionary momentum of foreign investment in each province. The overall result shows that there are few provinces with an evolutionary momentum of niche width that is above the mean, indicating that the evolutionary momentum is small. From 2012 to 2021, the top five provinces with the highest niche-width evolutionary momentum of foreign investment in China, in sequence, are Qinghai, Ningxia, Inner Mongolia, Gansu, and Tibet. This means that their evolutionary momentum is huge. The five provinces with the lowest niche-width evolutionary momentum of foreign investment are Shanghai, Shandong, Jiangsu, Zhejiang, and Guangdong This means that their evolutionary momentum is small.

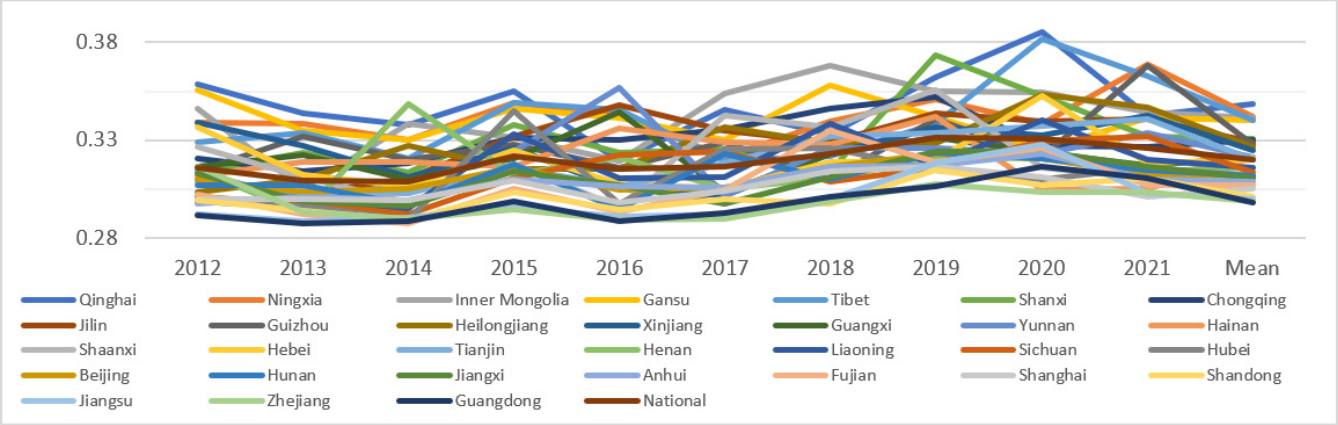

Figure 5. Niche-width evolutionary momentum of foreign investment by province from 2012 to 2021.

4.3. Regional Niche Overlap of Foreign Investment

According to the niche-overlap model [10], the niche overlap of foreign investment in each province from 2012 to 2021 can be seen, which reveals the difference of foreign investment in each province. Table 1 shows the niche overlap of 2021. Table 2 shows the combinations of provinces with a niche overlap over 0.75 in 2019, 2020, and 2021. The overall results of Tables 1 and 2 indicate that among 465 pairs of overlapping relationship formed by 31 provinces, there are no more than 13 pairs with a niche overlap of foreign investment over 0.8. It means that most provinces have low similarity in foreign-investment resources.

Table 2 shows that the ranking of provinces with high niche overlap of foreign investment varies significantly in the 3 years. In 2019, the combinations with the highest niche overlap of foreign investment in China all involve Jiangxi, Yunnan, and Hunan. In 2020, the combinations with the highest niche overlap of foreign investment in China are Heilongjiang and Gansu, Liaoning and Ningxia, and Hebei and Chongqing. In 2021, Beijing and Qinghai, Shandong and Gansu, and Beijing and Guangdong are the three combinations of provinces with the highest overlap degree of foreign-investment niche in China. The ranking of the combinations of provinces with the highest niche overlap of foreign investment changes, obviously, in each year, and most of them are not adjacent, indicating that the competition of foreign-investment resources among provinces is not fierce.

Table 1. Niche Overlap of Foreign Investment Province in 2021.

Province	Liaoning	Jilin	Heilongjiang	Beijing	Tianjin	Hebei	Shandong	Shanghai	Jiangsu	Zhejiang	Fujian	Guangdong	Hainan	Shaanxi	Shanxi	Henan	Inner Mongolia	Hubei	Hunan	Jiangxi	Anhui	Yunnan	Guizhou	Sichuan	Chongqing	Guangxi	Gansu	Qinghai	Ningxia	Tibet	Xinjiang
Liaoning	1.000																														
Jilin	0.592	1.000																													
Heilongjiang	0.354	0.389	1.000																												
Beijing	0.736	0.383	0.150	1.000																											
Tianjin	0.450	0.769	0.552	0.178	1.000																										
Hebei	0.627	0.205	0.360	0.376	0.279	1.000																									
Shandong	0.334	0.177	0.051	0.068	0.054	0.163	1.000																								
Shanghai	0.515	0.327	0.675	0.298	0.383	0.701	0.088	1.000																							
Jiangsu	0.718	0.644	0.597	0.628	0.438	0.484	0.102	0.547	1.000																						
Zhejiang	0.474	0.328	0.412	0.514	0.314	0.576	0.173	0.682	0.525	1.000																					
Fujian	0.587	0.183	0.365	0.418	0.151	0.551	0.123	0.395	0.589	0.439	1.000																				
Guangdong	0.773	0.553	0.249	**0.943**	0.293	0.458	0.178	0.453	0.719	0.617	0.388	1.000																			
Hainan	0.618	0.492	0.302	0.593	0.488	0.565	0.119	0.743	0.455	0.704	0.391	0.711	1.000																		
Shaanxi	0.505	0.247	0.140	0.166	0.140	0.130	**0.821**	0.312	0.142	0.212	0.181	0.254	0.339	1.000																	
Shanxi	0.773	0.444	0.544	0.520	0.544	0.599	0.257	0.645	0.571	0.594	0.307	0.593	0.532	0.466	1.000																
Henan	0.456	0.396	0.365	0.395	0.564	0.390	0.193	0.437	0.486	0.455	0.277	0.523	0.531	0.297	0.628	1.000															
Inner Mongolia	0.305	0.386	0.543	0.184	0.216	0.194	0.118	0.485	0.307	0.300	0.263	0.293	0.276	0.302	0.373	0.284	1.000														
Hubei	0.459	0.407	0.101	0.684	0.319	0.521	0.110	0.438	0.371	0.640	0.192	0.753	0.790	0.033	0.284	0.331	0.074	1.000													
Hunan	0.108	0.172	0.706	0.094	0.278	0.082	0.016	0.347	0.470	0.059	0.152	0.109	0.072	0.020	0.118	0.098	0.032	0.056	1.000												
Jiangxi	0.308	0.245	0.195	0.491	0.450	0.350	0.048	0.218	0.303	0.406	0.139	0.544	0.454	0.020	0.444	**0.873**	0.134	0.521	0.047	1.000											
Anhui	0.311	0.470	0.339	0.229	0.348	0.247	0.143	0.313	0.303	0.380	0.188	0.294	0.218	0.253	0.397	0.391	0.701	0.167	0.052	0.353	1.000										
Yunnan	0.601	0.506	0.129	**0.851**	0.355	0.451	0.086	0.302	0.499	0.561	0.238	**0.895**	0.689	0.040	0.418	0.437	0.106	**0.898**	0.073	0.634	0.245	1.000									
Guizhou	0.615	0.769	0.461	0.348	0.773	0.405	0.117	0.395	0.391	0.324	0.311	0.445	0.578	0.190	0.485	0.229	0.347	0.472	0.123	0.190	0.293	0.532	1.000								
Sichuan	0.432	0.466	**0.832**	0.162	0.652	0.290	0.244	0.630	0.463	0.302	0.183	0.315	0.405	0.432	0.682	0.666	0.582	0.087	0.488	0.439	0.405	0.178	0.477	1.000							
Chongqing	0.131	0.259	0.470	0.070	0.281	0.147	0.029	0.383	0.369	0.677	0.063	0.148	0.108	0.069	0.499	0.186	0.243	0.028	0.159	0.056	0.421	0.040	0.095	0.291	1.000						
Guangxi	0.076	0.090	0.246	0.182	0.091	0.469	0.107	0.619	0.069	0.540	0.023	0.353	0.646	0.050	0.123	0.228	0.330	0.706	0.032	0.311	0.092	0.455	0.241	0.243	0.024	1.000					
Gansu	0.363	0.356	0.082	0.025	0.268	0.102	**0.949**	0.029	0.086	0.107	0.109	0.126	0.127	0.788	0.257	0.156	0.109	0.096	0.012	0.008	0.167	0.084	0.327	0.275	0.020	0.011	1.000				
Qinghai	0.670	0.468	0.163	**0.954**	0.230	0.284	0.077	0.176	0.593	0.411	0.280	**0.911**	0.473	0.079	0.453	0.332	0.235	0.678	0.085	0.482	0.253	**0.864**	0.413	0.168	0.046	0.176	0.070	1.000			
Ningxia	0.640	0.261	0.274	0.372	0.391	0.776	0.047	0.401	0.384	0.222	0.224	0.368	0.268	0.056	0.698	0.305	0.085	0.288	0.044	0.310	0.223	0.367	0.437	0.295	0.094	0.056	0.075	0.372	1.000		
Tibet	0.491	0.575	**0.907**	0.200	0.760	0.365	0.118	0.639	0.558	0.333	0.395	0.315	0.459	0.275	0.590	0.527	0.601	0.180	0.545	0.334	0.402	0.223	0.669	**0.907**	0.259	0.243	0.221	0.223	0.326	1.000	
Xinjiang	0.170	0.094	0.050	0.021	0.025	0.051	0.031	0.067	0.028	0.018	0.014	0.067	0.032	0.088	0.070	0.023	0.058	0.003	0.001	0.010	0.082	0.095	0.139	0.125	0.017	0.040	0.055	0.011	0.008	0.063	1.000

Note: Combinations of provinces with niche overlap over 0.8 are in bold.

Table 2. Top 15 niche-overlap provincial combinations in 2019, 2020, and 2021.

	2019			2020			2021			
No.	**Provincial Combinations**	**Adjacent**	**Niche Overlap**	**No**	**Provincial Combinations**	**Adjacent**	**Niche Overlap**	**No**	**Provincial Combinations**	**Adjacent**	**Niche Overlap**
1	Jiangxi–Yunnan	No	**0.994**	1	Heilongjiang–Gansu	No	**0.928**	1	Beijing–Qinghai	No	**0.954**
2	Hunan–Yunnan	No	**0.920**	2	Liaoning–Ningxia	No	**0.891**	2	Shandong–Gansu	No	**0.949**
3	Hunan–Jiangxi	Yes	**0.916**	3	Hebei–Chongqing	No	**0.890**	3	Beijing–Guangdong	No	**0.943**
4	Liaoning–Jiangsu	No	**0.913**	4	Liaoning–Hubei	No	**0.874**	4	Guangdong–Qinghai	No	**0.911**
5	Hubei–Guizhou	No	**0.883**	5	Beijing–Ningxia	No	**0.861**	5	Sichuan–Xizang	Yes	**0.907**
6	Hunan–Ningxia	No	**0.839**	6	Liaoning–Beijing	No	**0.853**	6	Heilongjiang–Xizang	No	**0.907**
7	Fujian–Hainan	No	**0.830**	7	Heilongjiang–Sichuan	No	**0.840**	7	Hubei–Yunnan	No	**0.898**
8	Heilongjiang–Xizang	No	**0.813**	8	Chongqing–Guangdong	No	**0.817**	8	Guangdong–Yunnan	No	**0.895**
9	Heilongjiang–Henan	No	0.771	9	Sichuan–Xizang	Yes	**0.817**	9	Henan–Jiangxi	No	**0.873**
10	Fujian–Ningxia	No	0.765	10	Jiangxi–Qinghai	No	**0.813**	10	Yunnan–Qinghai	No	**0.864**
11	Chongqing–Sichuan	Yes	0.765	11	Hebei–Hunan	No	**0.810**	11	Beijing–Yunnan	No	**0.851**
12	Guangdong–Inner Mongolia	No	0.761	12	Heilongjiang–Xizang	No	**0.810**	12	Heilongjiang–Sichuan	No	**0.832**
13	Beijing–Ningxia	No	0.744	13	Jilin–Sichuan	No	0.794	13	Shandong–Shaanxi	No	**0.821**
14	Hainan–Xizang	No	0.726	14	Hebei–Guangdong	No	0.794	14	Hainan–Hubei	No	0.790
15	Heilongjiang–Hainan	No	0.719	15	Zhejiang–Xizang	No	0.748	15	Shaanxi–Gansu	Yes	0.788

Note: Combinations of provinces with niche overlap over 0.8 are in bold.

4.4. Regional Niche Spatial Distribution of Foreign Investment

4.4.1. Spatial Distribution of Regional Niche and Its Evolutionary Momentum of Foreign Investment

Figure 6 is a hierarchical clustering dendrogram, using the niche intensities and evolutionary momentum of foreign investment of 31 provinces from 2012 to 2021 as classified variables with the help of SPSS. Dividing the clusters into three categories, Guangdong, Chongqing, Jiangsu, and Shandong belong to the first echelon, which is named "Foreign Investment Intensity Pioneering Zone" in this paper. Zhejiang, Shanghai, Beijing, Liaoning, Fujian, Hubei, Tianjing, Henan, and Shaanxi belong to the second echelon, named "Foreign Investment Intensity Developing Zone", and the rest of the 18 provinces belong to the third echelon, named "Foreign Investment Intensity Backward Zone". It can be seen that 58% of China's provinces are backward regions for foreign investment.

Figure 7 is a hierarchical clustering dendrogram, using the niche width and evolutionary momentum of foreign investment of 31 provinces from 2012 to 2021 as classified variables, with the help of SPSS. Dividing the clusters into three categories, Guangdong, Zhejiang, Jiangsu, Shandong, Shanghai, Fujian, Anhui, Jiangxi, Hunan, Beijing, Hubei, Sichuan, Liaoning, and Tianjin belong to the first echelon, which is named "Foreign-Investment Resources Leading Zone" in this paper. Gansu, Tibet, Ningxia, Inner Mongolia, and Qinghai belong to the second echelon, named "Foreign-Investment Resources Developing Zone". The rest of the 12 provinces belong to the third echelon, named "Foreign-Investment Resources Backward Zone".

In order to find out the niche spatial-distribution pattern and its evolutionary momentum of foreign investment, this paper divides mainland China into eight economic zones, according to the National Bureau of Statistics. Table 3 is the mean of the niche and the evolutionary momentum of every economic zone from 2012 to 2021. The results shows that the niche intensities of China's foreign investment decrease, in sequence, from the eastern coast, the southern coast, the northern coast, the southwest, the middle reaches of the Yangtze River, the middle reaches of the Yellow River, the northeast, and the northwest. The evolutionary momentum ranks opposite. The niche widths of China's foreign investment decrease, in sequence, from the eastern coast, the southern coast, the middle reaches of the Yangtze River, the northern coast, the southwest, the northeast, the middle reaches of the Yellow River, and the northwest. The ranking of the niche widths of China's foreign investment are also opposite to their evolutionary momentum.

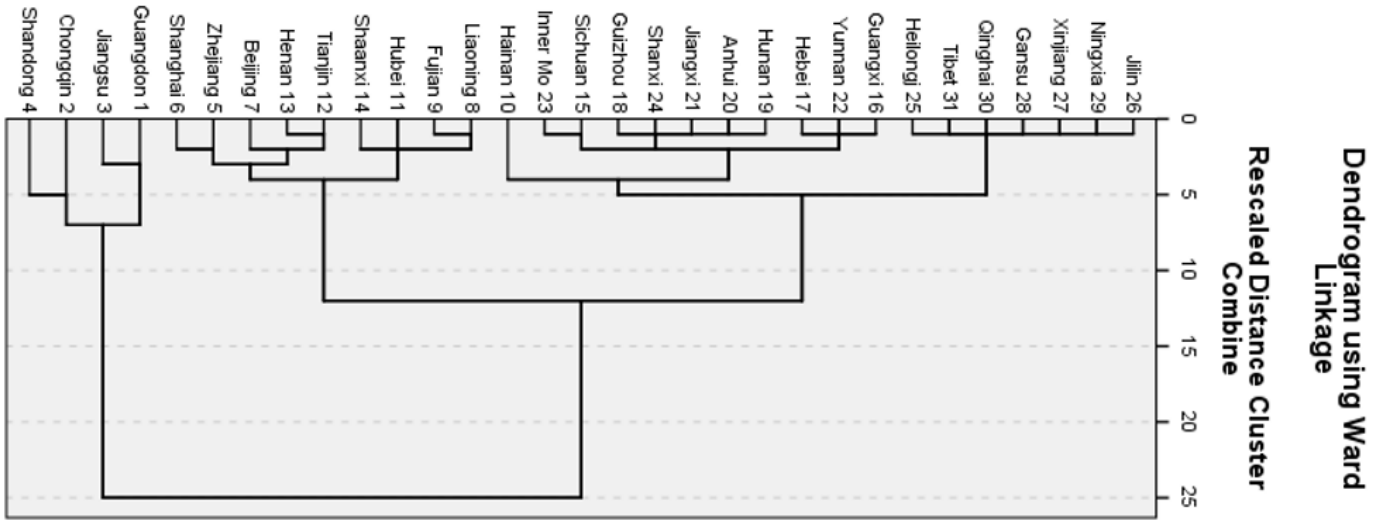

Figure 6. Cluster result of niche intensity and evolutionary momentum of foreign investment by province.

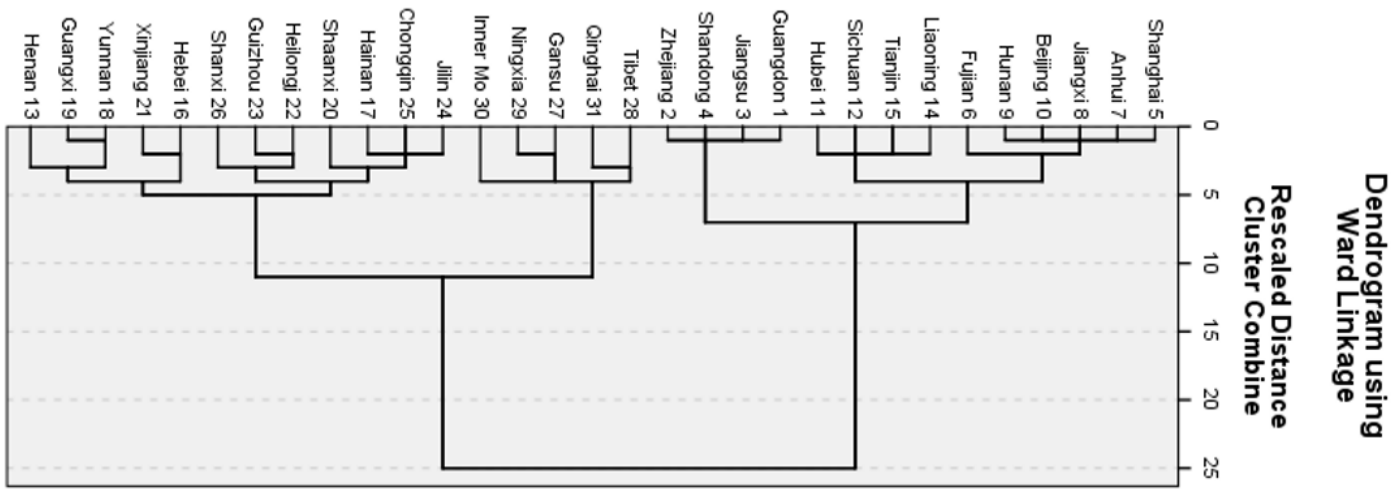

Figure 7. Cluster result of niche width and evolutionary momentum of foreign investment by province.

4.4.2. Regional Niche Spatial-Distribution Correlation of Foreign Investment

This paper constructs a Rook adjacent-space weight matrix with the help of Stata, using the niche intensity of foreign investment P_i of each province as the analysis unit and putting it into a global Moran's I index model [10] to obtain Table 4, which shows the spatial correlation of foreign investment in China. The overall result of Table 4 shows that the global Moran's I index is greater than 0 and has passed at least 10% significance level test from 2012 to 2019, indicating that the spatial correlation of foreign investment in China is positive at the provincial level from 2012 to 2019. The larger the global Moran's I index is, the more obvious the spatial correlation of foreign investment in different provinces is. The spatial correlation of foreign investment in different provinces from 2012 to 2019 shows a trend of expansion reduction, indicating that foreign investment in China has spatial agglomeration, which shows a trend of fluctuation.

Table 3. Comparison of niche and evolutionary momentum of foreign investment in 8 zones.

Region	Niche Intensity				Niche Width			
	Mean	Ranking	Evolutionary Momentum	Ranking	Mean	Ranking	Evolutionary Momentum	Ranking
Western coast	1.3974	1	0.5506	8	1.0574	1	0.3015	8
Southern coast	1.2139	2	0.5603	7	0.9681	2	0.3090	7
Northern coast	0.8636	3	0.5782	6	0.9184	4	0.3134	5
Southwest	0.7098	4	0.5849	5	0.8034	5	0.3229	4
Middle reaches of the Yangtze River	0.3683	5	0.6008	4	0.9506	3	0.3107	6
Middle reaches of the Yellow River	0.3398	6	0.6021	3	0.7422	7	0.3275	2
Northeast	0.3116	7	0.6034	2	0.7902	6	0.3239	3
Northwest	0.0590	8	0.6147	1	0.5990	8	0.3391	1

Table 4. Global Moran's I index of niche intensity of foreign investment in China from 2012 to 2021.

Variables	I	E (I)	sd (I)	z	*p*-Value *
P_i2012	0.187	−0.033	0.110	1.995	0.023
P_i2013	0.229	−0.033	0.111	2.366	0.009
P_i2014	0.344	−0.033	0.108	3.500	0.000
P_i2015	0.225	−0.033	0.106	2.442	0.007
P_i2016	0.157	−0.033	0.100	1.907	0.028
P_i2017	0.123	−0.033	0.109	1.435	0.076
P_i2018	0.119	−0.033	0.115	1.329	0.092
P_i2019	0.113	−0.033	0.091	1.600	0.055
P_i2020	0.031	−0.033	0.099	0.648	0.258
P_i2021	0.011	−0.033	0.088	0.511	0.305

* 1-tail test.

This paper constructs a Rook adjacent-space weight matrix with the help of GeoDa, using the niche intensity of foreign investment P_i of each province as the analysis unit to draw a LISA agglomeration map, where the provinces in four quadrant diagrams have passed the 5% significance level test to obtain Table 5, showing the spatial agglomeration distribution of foreign investment in China.

From the perspective of agglomeration types, the first quadrant is high–high agglomeration (HH), indicating that the niche intensity of foreign investment in a certain province and its surrounding provinces is high, and the regional difference is small. The second quadrant is low–high dispersion (LH), indicating that the niche intensity of foreign investment in a certain province is low, but the one in its surrounding areas is high, which means that the regional difference is high. The third quadrant is low–low agglomeration (LL), indicating that the niche intensity of foreign investment in a certain province and its surrounding provinces is low, and the regional difference is small. The fourth quadrant is high–low dispersion (HL), indicating that the niche intensity of foreign investment in a certain province is high, but the one in its surrounding areas is low, which means that the regional difference is high.

From the perspective of agglomeration effects, the third quadrant has the most provinces, followed by the first quadrant. There is no stable agglomeration area in the fourth quadrant. In detail, the first quadrant mainly includes Shanghai, Jiangsu, and Fujian, which are located on the eastern coast and the southern coast. The second quadrant mainly includes Anhui, Jiangxi, and Hunan, which are located in the middle reaches of the Yangtze River. The third quadrant mainly includes Xinjiang, Tibet, Inner Mongolia, Gansu, Qinghai, Ningxia, and Heilongjiang, which are located in the northwest, the middle reaches of the Yellow River, and the northeast. The agglomeration provinces of the fourth quadrant are fewer and not fixed.

Table 5. LISA agglomeration map of niche intensity of foreign investment in China from 2012 to 2021.

Year	First Quadrant (HH)	Second Quadrant (LH)	Third Quadrant (LL)	Fourth Quadrant (HL)
2012	Shanghai	/	Inner Mongolia, Tibet, Gansu, Qinghai, Xinjiang	/
2013	Shanghai, Jiangsu	Anhui	Heilongjiang, Inner Mongolia, Tibet, Gansu, Qinghai, Xinjiang	/
2014	Shanghai, Jiangsu, Zhejiang, Fujian	Anhui	Inner Mongolia, Sichuan, Tibet, Gansu, Qinghai, Ningxia, Xinjiang	/
2015	Fujian	Jiangxi, Hunan	Heilongjiang, Inner Mongolia, Tibet, Gansu, Qinghai, Ningxia, Xinjiang	/
2016	Shanghai, Fujian, Guangxi	Hunan	Inner Mongolia, Gansu, Xinjiang	Chongqing
2017	Shanghai, Fujian	Jiangxi, Anhui	Tibet, Xinjiang	Inner Mongolia
2018	Shanghai, Jiangsu, Zhejiang, Fujian	Jiangxi	Tibet, Qinghai, Xinjiang	/
2019	Jiangsu	Anhui	Heilongjiang, Xizang, Qinghai, Xinjiang	/
2020	/	/	Heilongjiang, Ningxia, Xinjiang	/
2021	/	Hunan	Inner Mongolia, Gansu, Ningxia, Xinjiang	/

From the perspective of synergistic development, Shanghai, Jiangsu, Zhejiang, and Fujian of the first quadrant are adjacent, with a strong effect of synergistic development. Anhui, Hunan, and Jiangxi in the second quadrant, which are located in the middle reaches of the Yangtze River, have not absorbed the surrounding overflow resources of foreign investment. Heilongjiang, Inner Mongolia, Tibet, Gansu, Qinghai, Ningxia, and Xinjiang of the third quadrant are adjacent, with obviously low foreign-investment resources.

5. Conclusions

Based on the registered capital of foreign investment in every province and every industry, this paper measures the niche intensities, the niche widths, and the niche overlaps of foreign investment in 31 provinces from 2012 to 2021. It compares the differences of the niche-intensity evolutionary momentum and the niche-width evolutionary momentum of every province. It further explores the spatial distribution of foreign-invested industrial layout. The conclusions are as follows:

First, this research shows that low fierce competition is important for foreign-investment resources in sustainability transition in general. All of the provinces' foreign-investment resources are fluctuating in sustainability transition, while the resource competition has not been fierce in years. Since niche overlap has a negative impact on the performance of technological collaborative innovation [37], China's niche intensity and the niche overlap are not high, while the niche width is relatively large. There are few provinces above the niche-intensity mean. More than half of the provinces are with niche widths of foreign investment above the mean, indicating that foreign-investment resources are fully utilized and wide-ranging. The niche overlap of foreign investment in most provinces is not high, which means that the industrial structures of foreign investment differentiate, and the similarity of resources is low.

Second, this research reveals that the gradient of niche evolution momentum is considerable in the sustainability transformation. An environmental gradient is thought to be correlated with a species' distribution [30]. This research finds that the niche intensity and niche evolutionary momentum of foreign investment are fluctuating and gradient for China's 31 provinces. The evolutionary momentum is strong in the northwest and weak in the coastal areas. More than half of the provinces are with niche-intensity evolutionary momentum above the mean. Less than half of provinces are with niche-width evolutionary momentum above the mean.

Third, it demonstrates that the spatial echelon distribution of foreign investment is obvious in sustainability transition with a positive spatial geography correlation. The niche intensity of China's foreign investment decreases, in sequence, from the eastern coast, the southern coast, the northern coast, the southwest, the middle reaches of the Yangtze River, the middle reaches of the Yellow River, the northeast, and the northwest, while the evolutionary momentum ranks the opposite. The niche width of foreign investment decreases, in sequence, from the eastern coast, the southern coast, the middle reaches of the Yangtze River, the northern coast, the southwest, the northeast, the middle reaches of the Yellow River, and the northwest, while the evolutionary momentum ranks the opposite. This finds that some regions show high–high agglomeration; some regions show low–high dispersion; and some regions show low–low agglomeration. The synergistic effect among some regions is obvious. Some regions have low absorption of the external spillover of foreign-investment resources. The synergistic effects among some regions are, apparently, low.

Based on the above conclusions, the practical significance of the space–time development and political layout of foreign investment is as below, for emerging industrialized countries such as China to improve their global sustainable open-development capabilities:

First, it guides policy-makers and managers to promote the expansion and evolution of foreign-investment resources. As a "Foreign-Investment Intensity Pioneering Zone" and a "Foreign-Investment Intensity Developing Zone", they should continue deepening opening reform. They should participate in the competition and cooperation of the international economy and technology at a higher level and optimize the allocation of foreign-investment resources. They also should make up for the shortcomings of the technology chain and supply chain to improve economic growth as well as governance level. As a "Foreign-Investment Intensity Backward Zone", the rest of the regions should promote deepening reform and attract foreign investment at a wider range and for a broader area, to make full use of the comparative advantages of international and domestic markets. They should strengthen the exchange and cooperation with the international economy and a "Foreign-Investment Intensity Pioneering Zone" and a "Foreign-Investment Intensity Leading Zone", to promote local participation in the competition and cooperation of the international economy and technology.

Second, it leads policy-makers and managers to optimize the resource structure and the evolutionary momentum of foreign investment. As a "Foreign-Investment Resources Leading Zone", the regions should lead the optimization and upgrading of foreign-invested industries. The regions, as a "Foreign-Investment Resources Developing Zone" and a "Foreign-Investment Resources Developing Zone", should actively undertake the industrial transfer of a "Foreign-Investment Resources Leading Zone" and of the international market, to further promote the development of an open economy, integrating with the "Belt and Road Initiative".

Third, it directs policy-makers and managers to strengthen the effects of synergistic development and industrial agglomeration of foreign investment. Some regions, such as Guangdong and Shandong, as a "Foreign-Investment Intensity Pioneering Zone" and a "Foreign-Investment Resources Leading Zone", do not have the high–high agglomeration effect. Therefore, Guangdong should give full play to the joint advantages of the "Pan-Pearl River Delta (9 + 2)" region and the synergistic development advantages of the Guangdong–Hong Kong–Macao Greater Bay Area, to further promote the synergistic development, dislocated development, and circumjacent radiation with the neighboring regions. Meanwhile, Shandong should further lead Hebei, Henan, and Anhui. The low–high dispersion regions, such as Anhui, Hunan, and Jiangxi, should further form synergistic effect with the leading regions to realize their transition. The developing regions should make full use of regional comparative advantages, actively strengthen collaboration of foreign investment, and increase the level of opening up in a larger field, a broader area, and at a higher level.

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