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AN EMPIRICAL STUDY ON INFLUENCING FACTORS OF HIGH-TECH INDUSTRY AGGLOMERATION IN CHINA

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ABSTRACT

Using the panel data of 30 provinces, municipalities, and autonomous regions in China from 2009 to 2019, this paper measures the level of high-tech industry agglomeration through location entropy, and empirically tests the current situation of high-tech industry agglomeration in each region and its influencing factors. The results show that from 2009 to 2019, the agglomeration degree of high-tech industries increased slightly and stabilized, and there was regional heterogeneity in the degree of aggregation. gradually shrink. The increase in regional economic development level, the number of students in school, and government spending on science and technology all have a positive effect on agglomeration, while the increase in the number of employed people and average wages has an inhibitory effect on agglomeration.

Keywords:

High-Tech Industry, Industrial Agglomeration, Empirical Research, Location Entropy

INTRODUCTION

Under the background of economic globalization and the rapid advancement of science and technology, the extensive economic growth mode with high energy consumption, high pollution and high emission has become unsustainable. The knowledge-based economic development model characterized by information technology has gradually replaced the traditional economic model and has become a viable an important way of sustainable development, technology and knowledge-intensive industries, especially high-tech industries, have become the most dynamic economic growth points to promote sustainable economic development. Cluster development can promote economies of scale and scope, and industrial agglomeration is an important engine and growth pole for economic development. Schumpeter's early research proposed that industrial space agglomeration and technological innovation can promote each other, and technological innovation, as the most important feature of high-tech industries, plays an increasingly important role in technological innovation. From the perspective of high-tech industry agglomeration, this paper examines the status quo of high-tech industry agglomeration and its influencing factors in various regions, in order to combine the research conclusions to put forward relevant strategies to rationally plan industrial layout, promote high-tech industry agglomeration and improve regional innovation efficiency, so as to build a reasonable regional green The development pattern provides theoretical reference.

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LITERATURE REVIEW

With the intensification of economic globalization and the degree of specialization of factors of production, cooperation and competition among countries (regions) have become more intense, and economic exchanges between regions have also promoted the formation of industrial agglomeration. The influencing factors of industrial agglomeration are relatively rich, and scholars at home and abroad have conducted a lot of research on this. Scholars have studied the influencing factors of agglomeration from the aspects of cost, geographical location, market demand, labor force, and regional economic level. Liang Qi (2003) pointed out that the main factors affecting the spatial distribution of industries are factor endowments, transportation costs, economies of scale, externalities (labor market sharing, knowledge spillovers, etc.), local demand, product differentiation, market linkages, trade costs and foreign direct investment. Zhang Hua (2007) and others have shown through empirical research that factor endowments, externalities, and economies of scale play an important role in the formation of industrial agglomeration. Fan Xiufeng (2013) and other researchers on the industrial agglomeration of manufacturing in Shaanxi Province pointed out that industry labor intensity, industry growth level, economies of scale, labor productivity, transportation costs and government intervention have an impact on industrial agglomeration. Xi Yanling (2012) pointed out that the factors of scale economy, transportation convenience and human capital in the new economic geography theory have a significant impact on the regional agglomeration of China's high-tech industries. The research results of Jiang Yao et al. (2017) show that there is a significant positive linear correlation between enterprise scale, human capital, market demand, degree of openness, and urban transportation and high-tech industry agglomeration. Wang Yanhua (2020) and other studies pointed out that factors such as the level of opening to the outside world, human resources, information flow, economies of scale, and government behavior have an impact on the financial industry and agglomeration. To sum up, this paper selects four aspects of regional economic development level, labor quality, technological innovation level and government policy to empirically study its impact on high-tech industry agglomeration.

METHODOLOGY

Scholars at home and abroad use different methods to measure the level of industrial agglomeration. The main methods are: location entropy, industry concentration, Herfindahl-Hirschmann index, spatial Gini coefficient, EG index, etc. Krugman (1991) and others used the spatial Gini coefficient to measure the degree of manufacturing agglomeration in the United States. Ellision and Glaeser (1997) established a geographic concentration index to measure the degree of industrial agglomeration. Liang Qi (2003) calculated the location Gini coefficient of China's industries to reflect the national concentration of each industry. Wu Xuehua (2004) and others conducted an empirical study on the agglomeration of China's manufacturing sectors by using concentration, Gini coefficient, and Herfindahl index. In this paper, the method of location entropy is used to measure the agglomeration degree of high-tech industries in various regions. The calculation formula is as follows:

$$AGG_{it} = \left(h_{it}/h_t\right)/\left(Q_{it}/Q_t\right) \quad (1)$$

Among them, h_{it} represents the main business income of the high-tech industry in the i region at time t,

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h_t represents the operating revenue of the national high-tech industry, Q_{it} represents the total production value of the i region at time t, and Q_t represents the national total production value at time t. The larger the location entropy index AGG_{it}, the higher the agglomeration degree of high-tech industries in the region.

The panel model settings are as follows:

$$AGG_{it} = \beta_0 + \sum \beta_i X_{it} + \varepsilon_{it} \quad (2)$$

Among them, AGG_{it} is the agglomeration degree of high-tech industries in year t in i region, X_{it} is the influencing factor of agglomeration, and ε_{it} is the random disturbance term.

Data source: Based on the availability of data, the high-tech industries at the provincial level in mainland China from 2009 to 2019 were taken as the research sample. Due to the serious lack of data in Hong Kong, Macau, Taiwan and Tibet Autonomous Region, they were excluded. Corresponding data comes from EPS data platform, "China Statistical Yearbook", "China High-tech Statistical Yearbook", "China Science and Technology Statistical Yearbook", "China Energy Statistical Yearbook" and "China Environmental Statistical Yearbook", and some data come from various provinces (municipalities, Autonomous Region) Statistical Yearbook, individual missing data are filled by linear interpolation.

CURRENT SITUATION AND TREND OF HIGH-TECH INDUSTRIAL AGGLOMERATION

The location entropy is used to measure the agglomeration degree of high-tech industries in each region, and four regions are compared and analyzed according to the division of economic zones on the official website of the National Bureau of Statistics of China. Among them, the eastern region includes: Beijing, Tianjin, Shanghai, Hebei Province, Shandong Province, Jiangsu Province, Zhejiang Province, Fujian Province, Guangdong Province and Hainan Province; The central region includes Shanxi Province, Henan Province, Hubei Province, Anhui Province, Hunan Province and Jiangxi Province; The western region includes inner Mongolia Autonomous Region, Xinjiang Uygur Autonomous Region, Ningxia Hui Autonomous Region, Shaanxi Province, Gansu Province, Qinghai Province, Chongqing, Sichuan Province, Guangxi Zhuang Autonomous Region, Guizhou Province and Yunnan Province; Northeast China includes Heilongjiang Province, Jilin Province and Liaoning Province. The agglomeration results of high-tech industries from 2009 to 2019 are shown in Table 1:

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Table 1 The agglomeration degree of high-tech industries in various regions from 2009 to 2019

AGG	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Beijing	1.4201	1.2724	1.1058	1.0130	0.9618	1.0443	0.8956	0.8501	0.9209	1.0194	1.0241
Tianjin	1.4579	1.3379	1.2888	1.3878	1.4475	1.4610	1.3201	1.0654	0.9265	0.8247	1.1942
Hebei	0.2064	0.2332	0.2295	0.2300	0.2392	0.2751	0.2951	0.2900	0.2557	0.2578	0.2780
Shanxi	0.1339	0.1369	0.1454	0.2603	0.2753	0.3337	0.3493	0.3871	0.4108	0.4490	0.4633
Inner Mongolia	0.1356	0.1039	0.1175	0.0873	0.1004	0.1067	0.1140	0.1137	0.1348	0.1356	0.1310
Liaoning	0.4863	0.4990	0.4615	0.4521	0.4277	0.4408	0.3262	0.3322	0.3676	0.4194	0.4795
Jilin	0.3726	0.3992	0.4693	0.4839	0.5405	0.6484	0.6778	0.7087	0.4768	0.2518	0.3258
Heilongjiang	0.2373	0.2074	0.2030	0.1942	0.2082	0.2256	0.2127	0.1606	0.1498	0.1486	0.1911
Shanghai	2.1981	2.2027	1.9881	1.7727	1.5483	1.6067	1.4804	1.2600	1.2963	1.3467	1.2071
Jiangsu	2.1205	2.1025	2.1338	2.1458	2.0592	2.1528	2.0981	2.0097	1.7740	1.6433	1.4894
Zhejiang	0.6389	0.6458	0.6030	0.5821	0.5689	0.6401	0.6358	0.6308	0.6925	0.7755	0.8326
Anhui	0.2451	0.2883	0.3726	0.4304	0.4715	0.6519	0.7180	0.7444	0.7384	0.7745	0.6731
Fujian	0.9101	0.9417	0.9199	0.8316	0.7986	0.8092	0.7864	0.7851	0.8509	0.9405	0.9586
Jiangxi	0.5551	0.5923	0.6611	0.7275	0.7827	0.8918	1.0231	1.0715	1.1156	1.2577	1.3089
Shandong	0.7671	0.7080	0.7291	0.7841	0.8019	0.9221	0.9441	0.9130	0.7098	0.5316	0.5150
Henan	0.2633	0.2766	0.4079	0.5584	0.6531	0.8129	0.9272	0.9262	0.8021	0.7340	0.6982
Hubei	0.4525	0.4240	0.4271	0.4623	0.4859	0.5778	0.6378	0.6530	0.6275	0.6413	0.5991
Hunan	0.2697	0.3043	0.4047	0.4307	0.5131	0.5625	0.5852	0.5877	0.5566	0.5625	0.6256
Guangdong	2.4263	2.4528	2.3584	2.2267	2.1977	2.3999	2.3588	2.3655	2.5197	2.7953	2.6871
Guangxi	0.1727	0.2160	0.2487	0.3138	0.3840	0.4774	0.5496	0.5744	0.4620	0.4112	0.4479
Hainan	0.1742	0.2001	0.1972	0.2699	0.1892	0.2019	0.2171	0.2031	0.2467	0.2988	0.3009
Chongqing	0.2968	0.3451	0.6000	0.8375	1.0163	1.2918	1.3218	1.3977	1.4018	1.5153	1.5154
Sichuan	0.6396	0.6597	0.8188	0.8420	0.9632	1.0317	0.8874	0.9218	0.9375	0.9928	1.0309
Guizhou	0.3579	0.3113	0.2890	0.2539	0.2278	0.3279	0.3962	0.4334	0.4366	0.4708	0.4250
Yunnan	0.1217	0.1194	0.1146	0.1178	0.1217	0.1307	0.1325	0.1583	0.1899	0.2308	0.2277
Shaanxi	0.4659	0.4604	0.4324	0.4346	0.4198	0.5003	0.5445	0.6251	0.6413	0.6775	0.7745
Gansu	0.0953	0.0996	0.0943	0.1008	0.1102	0.1275	0.1359	0.1380	0.1511	0.1669	0.1975
Qinghai	0.0793	0.0850	0.0699	0.1037	0.1184	0.1332	0.2143	0.2539	0.2377	0.2140	0.2735
Ningxia	0.1204	0.0985	0.0923	0.0691	0.0607	0.0729	0.1981	0.2819	0.2813	0.2924	0.3007
Xinjiang	0.0255	0.0253	0.0254	0.0114	0.0121	0.0156	0.0397	0.0473	0.0659	0.0851	0.0496

From the results in Table 1, it can be seen that the average value of the national high-tech industry agglomeration index is 0.65. The overall agglomeration level in the eastern region is the highest and has the advantage of specialization. The central region is slightly lower than the average level. Due to the weak industrial foundation and relatively lagging development of high-tech industries in the western and northeastern regions, the level of agglomeration is far lower than the national average.

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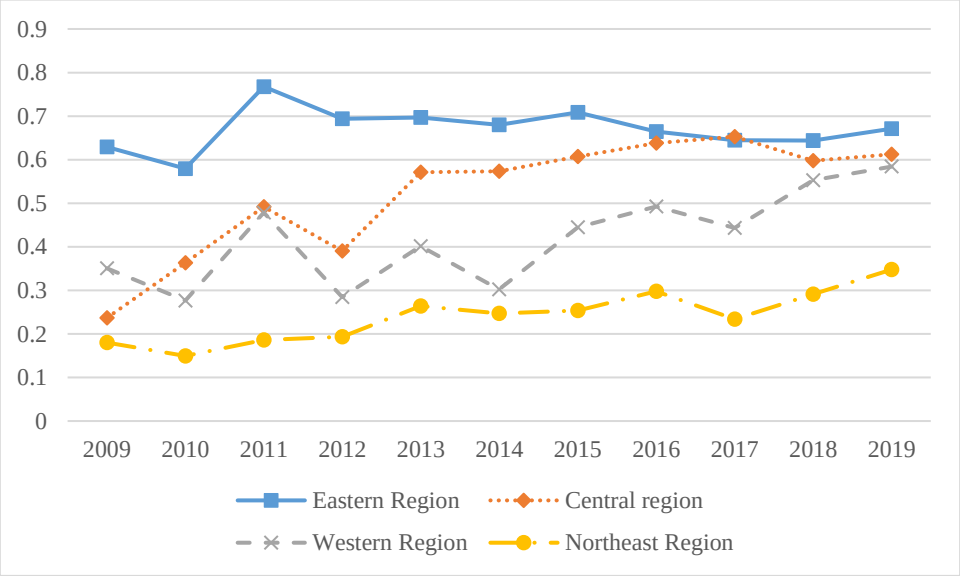

Figure 1 Trend of high-tech industry agglomeration in various regions

It can be seen from Figure 1 that from 2009 to 2019, the overall high-tech industry agglomeration has increased slightly and is relatively stable, the eastern region has the highest agglomeration degree and has a downward trend, and the central region has gradually increased and exceeded the overall average. There is an upward trend year by year, and the degree of agglomeration in Northeast China is low and there is no obvious upward trend.

Quantitative Analysis on Influencing Factors of High-tech Industry Agglomeration

The agglomeration of China's high-tech industries is mainly affected by four aspects: the level of regional economic development, the quality of labor, the level of technological innovation and government policies. Therefore, this paper selects the per capita GDP (PGDP) of each region as the proxy variable of the regional economic development level; the labor quality adopts the average number of students in high schools (SN) per 100,000 people, the regional employed population (EP) and the average salary of on-the-job workers (AW); the level of technological innovation is expressed by the technology market turnover (TM) and the proportion of scientific and technological expenditures (GS) in government financial support. For the sake of stationarity, logarithm processing is performed on the original independent variable. The descriptive statistics of relevant variables are shown in Table 2:

Table 2 Descriptive statistics of related variables

Variable	Obs	Mean	Std.Dev.	Min	Max
AGG	330	.654	.582	.011	2.795
PGDP	330	10.304	.557	8.764	11.836
SN	330	7.792	.308	6.95	8.766
EP	330	7.644	.788	5.715	8.875
AW	330	10.899	.378	10.114	12.062
TM	330	4.401	1.802	-.58	8.647
GS	330	4.094	1.074	1.324	7.064

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The most commonly used estimation methods for panel data models are fixed-effects model (FE), random-effects model (RE) and mixed regression model (OLS). In this paper, these three estimation methods are used to regress the panel data, and the regression results are shown in Table 3. The chi-square statistic is -24.04, so this paper uses a fixed effect model to regress the high-tech industry agglomeration. In order to ensure the validity of the regression results, the inflation factor (VIF) test was performed on each variable, and the results showed that there was no strong collinearity between the data.

Table 3 Empirical regression results

	(1)	(2)	(3)
AGG	OLS	FE	RE
PGDP	0.175***	0.696***	0.503***
	(0.0509)	(0.226)	(0.150)
SN	-0.0170	0.675***	0.665***
	(0.113)	(0.112)	(0.108)
EP	-0.252***	-0.448***	-0.0389
	(0.0468)	(0.169)	(0.0817)
AW	-0.679***	-0.587***	-0.563***
	(0.113)	(0.163)	(0.106)
TM	0.0259	-0.0687***	-0.0521***
	(0.0168)	(0.0193)	(0.0179)
GS	0.541***	0.161***	0.194***
	(0.0624)	(0.0402)	(0.0385)
Constant	5.984***	-2.309	-3.839***
	(1.782)	(1.441)	(1.090)
Observations	330	330	330
R-squared	0.586	0.367	
Number of id		30	30

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Table 3 reports the regression results of the influencing factors of high-tech industry agglomeration. Model (1) is an ordinary least squares estimation (OLS), model (2) is a fixed-effects model, and model (3) is a random-effects model. It can be seen that the impact of regional economic development level on high-tech industry agglomeration is significantly positive, indicating that the improvement of regional economic development level is conducive to promoting the spatial agglomeration of high-tech industries. In the fixed-effects model and the random-effects model, the impact of the number of students on agglomeration is significantly positive, indicating that increasing the number of students has a positive effect on the agglomeration of high-tech industries. The impact of employment and average wages on agglomeration is negative, indicating that the increase in employment and average wages inhibit the agglomeration of high-tech industries. The impact of technical market turnover on agglomeration is negative, but the coefficient is small, and the negative impact is low. The proportion of science and

technology expenditure in government expenditure has a significant positive impact on agglomeration, indicating that increasing government expenditure on science and technology is conducive to improving the agglomeration level of regional high-tech industries.

CONCLUSIONS AND RECOMMENDATIONS

This paper takes high-tech industries in 30 provinces and cities in China from 2009 to 2019 as the research object, uses location entropy to measure the degree of high-tech industry agglomeration in each region, and empirically analyzes the influencing factors of agglomeration. The results show that from 2009 to 2019, the agglomeration degree of high-tech industries increased slightly and stabilized, the eastern region with the highest agglomeration degree decreased slightly, and the agglomeration degree of the central, western and northeastern regions increased year by year, and the gap between regions gradually narrowed. The increase in regional economic development level, the number of students in school, and government spending on science and technology all have a positive effect on agglomeration, while the increase in the number of employed people and average wages has an inhibitory effect on agglomeration.

Based on the above research conclusions, the following policy recommendations are put forward: (1) Strengthen the construction of regional universities and promote industry-university-research cooperation; (2) Scientifically formulate differentiated industrial agglomeration policies according to the regional economic level and population size; (3) Comprehensively consider the actual industrial status and resource differences in the region, and increase the number of high-tech industries The introduction and improvement of industrial support policies. Promote the cluster development of high-tech industries through effective means such as building high-tech industrial parks, and promote the scale effect of high-tech industrial clusters.

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