Research on Impact of New Energy Industry Agglomeration on Economic Growth

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Abstract. In this paper, the degree of new energy industry agglomeration is obtained by calculating the location entropy, and the results show that China's new energy industry agglomeration generally presents a pattern of "east > middle > west". Then, based on the panel data of 30 provinces from 2013 to 2019, an econometric model is built to explore the impact of new energy industry agglomeration on economic growth. The regression results show that the new energy industry agglomeration has a significant positive effect on economic growth, and has obvious industrial heterogeneity. The impact of general equipment manufacturing industry agglomeration on economic growth is better than that of electrical machinery and equipment manufacturing industry agglomeration on economic growth.

Keywords: new energy industry · industrial agglomeration · location entropy · economic growth

1 Introduction

With high-quality economic development becomes a major theme of current economic development. Building a resource-conserving and environment-friendly society and achieving sustainable development have increasingly become a trend of national development. However, the traditional energy with high pollution and non renewable characteristics can no longer meet the needs of future development, so cultivating and expanding new energy industry has become the focus of government's work.

In recent years, the research on industrial agglomeration is increasing [1]. On the one hand, with the continuous development of the industry, many enterprises will gather in the same area to form an industrial cluster, such as an industrial park, where a large number of identical or similar enterprises are gathered; On the other hand, according to the scholar Wang Jici [2], industrial clusters are not only conducive to obtaining external economies of scale and scope, but also can promote learning economy. In addition, many scholars' research results prove that industrial agglomeration reflects a positive impact on economic and technological innovation [3–5]. As China's economy is now entering a stage of high-quality development, it is urgent to change the driving force of economic development, and academia generally believes that innovation is the key driving force to

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maintain high-quality economic development [6]. The strategic emerging industry represented by the new energy industry has the characteristics of knowledge and technology intensive, low pollution, low energy consumption, large growth potential, and good comprehensive benefits [7]. It can have a positive impact on economic growth through knowledge spillover and technology driven by scientific and technological innovation.

Therefore, this paper takes the new energy industry as the research object, builds an econometric model, analyzes the impact of the new energy industry cluster on economic growth, and provides suggestions for the future development of the new energy industry.

2 Measurement of Industrial Agglomeration

Firstly, we should determine what industries are involved in the new energy industry. As the new energy industry has many categories and covers a wide range, data is not easy to obtain. Therefore, based on the research of scholars Guo Liwei and Shen Manhong [8], this paper takes the industries involved in production and manufacturing in the new energy industry chain as the representative industries of the new energy industry, including general equipment manufacturing industry and electrical machinery and equipment manufacturing industry. This paper refers to the research of reference scholar Zhang Hu [9, 10] and uses the location entropy index to calculate the agglomeration degree of new energy industry. The formula is as follows:

$$co = \frac{e_{ij}}{e_j} \Big/ \frac{e_i}{e} \tag{1}$$

where "e_{ij}" represents the number of employees in j industry in region i, and "e_j" represents the number of employees in j industry nationwide; "e_i" refers to the total number of employed people in region i, and "e" refers to the total number of employed people in the country. This paper selects the data of 30 provinces except Hong Kong, Macao, Taiwan and Tibet from 2013 to 2019 to calculate the location entropy index of the new energy industry. The missing values in this paper are supplemented by linear interpolation. The calculation results are shown in Table 1.

The agglomeration of new energy industry generally shows a trend of "east > middle > west", and the industrial agglomeration of most eastern provinces such as Zhejiang, Jiangsu, Guangdong and Shanghai is more than 1 or close to 1, indicating that the industrial agglomeration in the eastern region has basically reached a high degree of agglomeration, which is mainly due to the economic development, convenient transportation and high scientific and technological level of the eastern provinces, This has provided strong material conditions for the development of new energy industry in the eastern region. However, the new energy industry in the western region has a low degree of agglomeration, but on the whole, it shows a growing development trend, which indicates that the development of the new energy industry in the western region has gradually entered the right track and is developing continuously.

Table 1. Industrial Agglomeration

province	2013	2014	2015	2016	2017	2018	2019
Zhejiang	2.6325	2.6175	2.5892	2.6220	2.7436	2.8687	3.0027
Jiangsu	2.6717	2.6703	2.7185	2.7486	2.6957	2.6409	2.5792
Guangdong	2.4874	2.3928	2.3291	2.2954	2.3483	2.4029	2.5152
Shanghai	2.4038	2.2994	2.2170	2.0920	2.1463	2.2100	2.2819
Fujian	0.8451	0.8162	0.8117	0.8097	0.8689	0.9395	1.0140
Tianjin	1.3931	1.2954	1.2427	1.1657	1.1219	1.0610	0.9969
Liaoning	1.5469	1.4444	1.1145	0.8051	0.7896	0.7740	0.7551
Jiangxi	0.6652	0.7239	0.7771	0.8351	0.8052	0.7777	0.7456
Anhui	0.7100	0.7201	0.7440	0.7498	0.7417	0.7340	0.7269
Shandong	1.0203	0.9809	1.0213	0.9872	0.8817	0.7987	0.6712
Chongqing	0.5359	0.5846	0.6069	0.6473	0.6485	0.6498	0.6508
Henan	0.4966	0.5433	0.5844	0.6173	0.5909	0.5721	0.5552
Hunan	0.4089	0.4238	0.4550	0.4758	0.5020	0.5267	0.5524
Hubei	0.4995	0.5238	0.5300	0.5411	0.5383	0.5354	0.5320
Beijing	0.7141	0.6715	0.6440	0.5740	0.5638	0.5613	0.5272
Shaanxi	0.4526	0.4167	0.4595	0.4381	0.4371	0.4356	0.4335
Sichuan	0.4165	0.4232	0.4137	0.4197	0.4055	0.3902	0.3736
Hebei	0.4734	0.4905	0.4844	0.5193	0.4733	0.4219	0.3662
Ningxia	0.2726	0.2730	0.2564	0.2429	0.2562	0.2713	0.2879
Qinghai	0.1546	0.1686	0.1855	0.1931	0.2034	0.2145	0.2272
Heilongjiang	0.2691	0.2784	0.2310	0.2235	0.2110	0.1964	0.1994
Shanxi	0.1889	0.1520	0.1466	0.1391	0.1536	0.1699	0.1879
Guangxi	0.1851	0.1843	0.1858	0.1891	0.1766	0.1627	0.1477
Guizhou	0.0824	0.0933	0.1075	0.1223	0.1213	0.1216	0.1223
Gansu	0.1282	0.1118	0.1074	0.1112	0.1100	0.1089	0.1082
Jilin	0.2324	0.2260	0.2364	0.2308	0.1921	0.1494	0.1025
Xinjiang	0.0678	0.1087	0.0944	0.1024	0.0935	0.0853	0.0755
Yunnan	0.0703	0.0745	0.0615	0.0574	0.0599	0.0624	0.0651
Inner Mongolia	0.1597	0.1536	0.1563	0.1328	0.1105	0.0859	0.0534
Hainan	0.1187	0.0786	0.0823	0.0676	0.0607	0.0550	0.0517

Table 2. Variable interpretation

Variables	Meaning	Quantitative indicators
pgdp	Economic growth	Per capital GDP
agg	Degree of Industry agglomeration	Location entropy
gov	Government expenditure	Government financial expenditure
edu	Human capital stock	the number of college students per 10000 people
industry	the level of industrialization	the proportion of secondary industry GDP in regional GDP

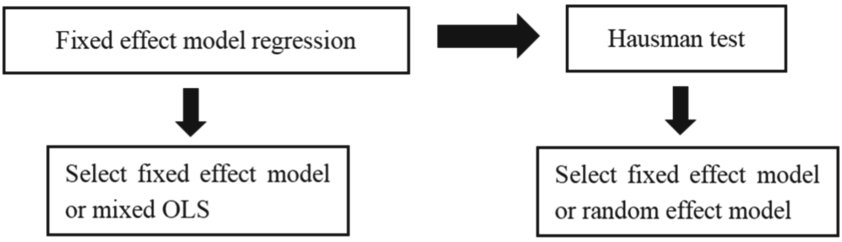

Fig. 1. Inspection Flow Chart

3 Model Construction and Empirical Analysis

3.1 Model Construction

Based on the needs of this study and considering the availability of data, this paper constructs the following panel regression model and the meaning of each variable is shown in Table 2.

$$\ln pgdp = \beta_0 + \beta_1 agg_{it} + \beta_2 \ln gov_{it} + \beta_3 \ln edu_{it} + \beta_4 industry + \mu_{it} \quad (2)$$

Except agg, all variables participate in the model in logarithmic form. The data in this paper are mainly from the "2014–2020 China Industrial Statistics Yearbook" and the "Statistical Yearbooks" of provinces and cities.

3.2 Empirical Analysis

This paper uses panel data, so a series of tests are needed to determine the best regression model. The inspection process and results are shown in Fig. 1 and Table 3.

According to the test results in Table 3, this paper finally selects the fixed effect model.

Table 4 shows the impact of industrial agglomeration on economic growth Models (1) - (3) use mixed OLS regression, and each model shows that the variance expansion factor is less than 10, indicating that there is no serious multicollinearity problem.

Table 3. Inspection Results

Model	Inspection method	p-value	Result	Conclusion
agg to pgdp	Fixed effect model test	0.000	$p < 0.05$	Select fixed effect model
agg_gem to pgdp	Fixed effect model test	0.000	$p < 0.05$	Select fixed effect model
agg_emem to pgdp	Fixed effect model test	0.000	$p < 0.05$	Select fixed effect model
agg to pgdp	Hausman test	0.000	$p < 0.05$	Select fixed effect model
agg_gem to pgdp	Hausman test	0.000	$p < 0.05$	Select fixed effect model
agg_emem to pgdp	Hausman test	0.000	$p < 0.05$	Select fixed effect model

Table 4. Impact of industrial agglomeration on economic growth

	lnpgdp					
	(1)	(2)	(3)	(4)	(5)	(6)
agg	0.324***			0.185**		
	(0.043)			(0.084)		
agg_gem		0.303***			0.148**	
		(0.038)			(0.054)	
agg_emem			0.269***			0.121
			(0.055)			(0.086)
lngov	-0.021	0.022	-0.001	0.309***	0.235**	0.399***
	(0.080)	(0.076)	(0.091)	(0.087)	(0.098)	(0.103)
lnedu	0.638***	0.534***	0.734***	0.016	0.047	0.018
	(0.190)	(0.185)	(0.217)	(0.115)	(0.115)	(0.108)
lnindustry	-0.381*	-0.366*	-0.364	0.532***	0.514***	0.581***
	(0.204)	(0.195)	(0.217)	(0.099)	(0.102)	(0.097)
t				0.052***	0.057***	0.046***
				(0.008)	(0.008)	(0.010)
cons	7.125***	7.325***	6.516***	8.313***	8.766***	7.668***
	(1.318)	(1.268)	(1.435)	(0.851)	(0.906)	(1.014)
VIF	1.25	1.21	1.25			
N	210.000	210.000	210.000	210.000	210.000	210.000
F	24.070	26.427	11.000	113.073	123.631	112.297
r2	0.653	0.658	0.592	0.905	0.908	0.899

Models (4) - (6) are double fixed effect models that control time and region. According to model (4), it can be seen that new energy industry agglomeration has a significant impact on economic growth at the level of 5%, with an estimated coefficient of 0.185, indicating that industrial agglomeration has a positive effect on economic growth. While model (5) and model (6) respectively reflect the impact of the industrial agglomeration of general equipment manufacturing and electrical machinery and equipment manufacturing on economic growth. Among them, the industrial agglomeration of general equipment manufacturing is significant to economic growth at the level of 5%, with an estimated coefficient of 0.148, while the industrial agglomeration of electrical machinery and equipment manufacturing is positive to economic growth, but it does not pass the 5% significance level test, Therefore, it is believed that the positive effect of general equipment manufacturing industry agglomeration on economic growth is better than that of electrical machinery and equipment manufacturing industry. In addition, according to Table 4, it can be found that both government expenditure and industrialization level have a positive impact on economic growth, while the estimated coefficient of human capital stock on economic development is positive, but it does not pass the 5% significance level test.

4 Conclusions

This paper measures the industrial agglomeration by calculating the location entropy, and the results show that the degree of China's new energy industry agglomeration generally presents a pattern of "East > Central > West". Through empirical analysis, it is found that the new energy industry cluster has a positive effect on economic growth, among which the general equipment manufacturing industry agglomeration has a stronger role in promoting economic growth. In addition, government expenditure and industrialization level also have a positive impact on economic growth. Based on the above conclusions, this paper puts forward the following suggestions to promote the development of new energy industry.

First of all, provinces with a high degree of industrial agglomeration should not only maintain the positive role of agglomeration, promote economic growth and improve the level of science and technology, but also avoid problems such as excessive economic load and population congestion caused by excessive industrial agglomeration. For provinces with low industrial concentration, it is necessary to strengthen communication and cooperation with surrounding provinces, create an integrated development model, and increase policy support and financial support to provide a good development environment for the cultivation and growth of local new energy industry.

Secondly, we should attach importance to the training of talents. Although the empirical results show that the stock of human capital is not significant for economic growth, as time goes on, college students will be a huge human resource when they enter work. It can improve the level of scientific and technological innovation, thus promoting the development of new energy industry.

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