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On the Correlation between Green Innovation Efficiency and the Gathering of Scientific and Technological Talents

-- Taking Anhui Province as an Example

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Abstract

This article analyzes the relevant data of 16 prefecture level cities in Anhui Province from 2015 to 2020, calculates the innovation efficiency of green regions through a super efficient SBM model containing unexpected outputs, and comprehensively evaluates the aggregation of scientific and technological talents from three dimensions: area density, population density, and employment density. The correlation between the two is analyzed using SPSS26 software. The analysis results indicate that there is a significant correlation between the two, and the aggregation of technological talents has a positive impact on the efficiency of green innovation.

Keywords

Green Innovation Efficiency; Gathering of Technological Talents; Relevance.

1. Introduction

In recent years, with the country's emphasis on environment and innovation, sustainable development of the economy, green economy, and innovative development have gradually entered the public's vision. In this context, scholars have begun to study the efficiency of green innovation. Similarly, with the development of society, it is gradually discovered that "talent" plays a crucial role in the development of society and enterprises, and research on talent aggregation is also becoming increasingly popular. Especially in recent years, due to the sanctions imposed by some Western countries, we have come to understand that the weakness of Chinese enterprises lies in high-tech areas such as chips. The country has increasingly attached importance to technology, and more and more scholars have begun to study the gathering of technological talents. Technological talents refer to scientific research and technological talents, which should include professional and technical personnel, R&D personnel, and technological activity personnel. However, due to the lack of data and the need to be consistent with the green innovation efficiency model, this article uses R&D personnel to represent technological talents. Green innovation efficiency refers to the output to input ratio of innovation activities under the consideration of pollution.

Tang Yuan found that talent aggregation has a growth effect on long-term per capita GDP. Rui Xueqin, Li Yanan, Niu Chonghuai and others believe that the regional economy and the gathering of scientific and technological talents are in a collaborative and progressive relationship. Li Guangpei and Zhang Mengqian believe that there is a correlation between green innovation efficiency and economic growth, and the impact is positive. Since the aggregation of technological talents has a positive impact on economic development and green innovation

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efficiency also has a positive impact on economic growth, is there a correlation between the aggregation of technological talents and green innovation efficiency? Is there a positive or negative impact on each other? This article further explores how to improve the economic benefits of Anhui Province by studying the correlation between green innovation efficiency and the gathering of scientific and technological talents, and opens up a new path for seeking further improvement in the economic development of Anhui Province.

2. Calculation of Green Innovation Efficiency in Anhui Province

2.1. Model Construction and Indicator Selection

This article adopts a super efficient SBM model with unexpected outputs when calculating the efficiency value of green innovation. The reasons for choosing this model are: (1) The value calculated by the super efficiency SBM model can be greater than 1, and the measurement results are not affected by the input and output units. (2) The green innovation efficiency model calculated in this article includes unexpected output items such as solid waste generation. (3) Due to reasons such as the persuasiveness of the experimental results. The data in this article is from 2015 to 2020 in 16 prefecture level cities in Anhui Province, and requires cross period comparison.

The super efficient SBM model with unexpected outputs is as follows:

$$\mathrm{Min}\rho^{*}=\frac{1+\frac{1}{m}\sum_{m=1}^{M}(s_{m}^{x}/x_{m}^{t})}{1-\frac{1}{l+h}\left(\sum_{l=1}^{L}s_{l}^{y}/y_{jl}^{t}+\sum_{h=1}^{H}s_{n}^{b}/b_{jh}^{t}\right)}$$

$$\begin{cases} x_{jm}^{t}\geq\sum_{j=1,j\neq0}^{n}\lambda_{j}^{t}x_{jm}^{t}+s_{m}^{x} \\ y_{jl}^{t}\geq\sum_{j=1,j\neq k}^{n}\lambda_{j}^{t}y_{jl}^{t}-s_{l}^{y} \\ b_{jh}^{t}\geq\sum_{j=1,j\neq k}^{n}\lambda_{j}^{t}b_{jh}^{t}-s_{h}^{b} \\ \lambda_{j}\geq0, s_{m}^{x}\geq0, s_{l}^{y}\geq0, j=1,2,\cdots,n \end{cases}$$

Where, ρ* is the evaluation value of ecological efficiency; m, L and h represent the number of input, expected output, and non expected output elements, respectively; s_{m}^{x}, s_{l}^{y} and s_{h}^{b} are relaxation variables for corresponding inputs, expected outputs, and unexpected outputs, respectively; x_{j}^{t}, y_{j}^{t} and b_{j}^{t} respectively represent the inputs, expected outputs, and non expected outputs of the decision-making unit during period t; n represents the number of decision-making units; λ is the weight vector of the decision-making unit.

Table 1. Green Innovation Efficiency Indicator System

Input indicator 1	R&D development funds
Input indicator 2	R&D personnel equivalent to full-time equivalent
Input indicator 3	Total energy consumption
Expected output indicators 1	Patent application volume
Expected output indicators 2	New product sales revenue
Expected output indicators 3	Technology Market Turnover
Unexpected output indicators 1	Chemical oxygen demand in wastewater
Unexpected output indicators 2	Total emission of sulfur dioxide in exhaust gas
Unexpected output indicators 3	Solid waste generation

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This article refers to Zhao Zhifang's approach and constructs a super efficient SBM and Tobit model to measure the efficiency of green innovation. The indicator system used in the modified model includes input indicators, expected output indicators, and non expected output indicators. The specific indicator system is shown in Table 1.

2.2. Calculation Results and Analysis

The green innovation efficiency values of various cities in Anhui Province from 2015 to 2020 are shown in Table 2.

Table 2. Green innovation efficiency values of various cities in Anhui Province from 2015 to 2020

City	2015	2016	2017	2018	2019	2020
Hefei	1.3338	1.6673	1.6185	1.6592	1.5266	1.4873
Huaibei	0.2509	0.3248	0.3527	0.4388	0.4349	0.3048
Bozhou	0.4041	0.4021	0.4691	0.5649	1.0136	1.0072
Suzhou	1.0460	0.0813	0.1425	0.0192	0.0726	1.0576
Bengbu	1.0090	1.0119	0.5790	0.5334	0.7120	1.0749
Fuyang	0.2588	1.0466	1.0887	1.1137	1.0699	1.0482
Huainan	0.2349	1.0098	0.2557	0.2542	0.3762	0.3191
Chuzhou	1.1140	1.1086	1.1095	1.0884	1.0549	1.1328
Lu'an	1.0265	1.0182	1.0472	1.0536	1.0542	1.0685
Ma'anshan	0.3760	0.3736	0.3811	0.4174	0.4457	0.4586
Wuhu	1.1448	1.1378	1.1135	1.1037	1.0955	1.0179
Xuancheng	0.0845	0.1377	0.3354	0.3770	0.6339	1.0470
Tongling	1.0350	1.0065	1.0325	1.0714	1.0843	1.0318
Chizhou	1.0403	1.0374	1.0271	1.0403	1.0293	1.0020
Anqing	1.0367	1.0323	1.0316	1.0323	1.0619	1.0529
Huangshan	0.2957	1.0387	1.1028	1.1597	1.2773	1.4191

3. Calculation of the Degree of Science and Technology Talent Aggregation

3.1. Measurement Indicators for the Degree of Technological Talent Aggregation

Due to the fluidity of people, talent aggregation cannot be studied from a single perspective. Therefore, drawing on Xu Guanglin's research method, we comprehensively describe technology talent aggregation from three dimensions: area density, population density, and employment density.

Area density = full-time equivalent of R&D personnel in various cities in Anhui Province/administrative area of various cities in Anhui Province. Population density = full-time equivalent of R&D personnel in various cities in Anhui Province/total number of permanent residents in various cities in Anhui Province. Employment density = full-time equivalent of R&D personnel in various cities in Anhui Province/total number of urban and rural employed population in various cities in Anhui Province.

3.2. Data Processing

In order to avoid significant differences and differences in units between data, non dimensional standardization is applied to the data. In this article, the data of area density, population density, and employment density are uniformly processed and normalized to a normal state, resulting in a mean of 0 and a standard deviation of 1 for the three indicators of area density, population density, and employment density. Due to the inability to determine the weight of the three

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indicators of area density, population density, and employment density, each accounts for one-third. Technology talent gathering=1/3 area density+1/3 population density+1/3 employment density. To avoid negative numbers in the aggregation value of scientific and technological talents, the aggregation value of scientific and technological talents is subjected to range standardization.

3.3. Calculation Results and Analysis

The calculation results of the degree of technological talent aggregation in Anhui Province from 2015 to 2020 are shown in Table 3.

Table 3. Calculation Results of the Degree of Science and Technology Talent Aggregation in Various Cities of Anhui Province from 2015 to 2020

City	2015	2016	2017	2018	2019	2020
Hefei	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Huaibei	1.6766	1.6064	1.9999	1.8754	2.5388	2.9677
Bozhou	0.0000	0.0000	0.0000	0.1222	0.1636	0.4239
Suzhou	0.0903	0.0972	0.0337	0.0000	0.0000	0.0000
Bengbu	4.7022	4.8756	3.9928	3.7629	2.9565	3.9082
Fuyang	0.1258	0.0671	0.0116	0.1344	0.2383	0.4065
Huainan	2.0517	1.4969	1.2074	0.8590	0.9628	1.2747
Chuzhou	2.1156	1.7789	1.9242	2.6618	2.4091	2.9336
Lu'an	0.2288	0.1696	0.2500	0.2497	0.3729	0.5864
Ma'anshan	4.9875	5.1617	4.2414	4.8366	4.6667	5.4011
Wuhu	5.6773	5.8171	5.8407	5.6186	6.3395	6.3341
Xuancheng	1.6964	2.0090	2.2530	2.7019	2.5670	3.1961
Tongling	5.2177	3.8922	4.4826	2.8448	1.7480	3.7733
Chizhou	0.6101	0.5866	0.6547	1.0141	0.6985	1.0698
Anqing	1.1482	1.2192	1.2516	1.4306	1.4654	2.1939
Huangshan	1.6083	1.4416	1.5903	1.0572	1.3647	1.6819

4. The Correlation between Green Innovation Efficiency and the Degree of Scientific and Technological Talent Aggregation

4.1. Pearson Correlation

Table 4. Pearson correlation

		Green innovation efficiency	Gathering of technological talents
Green innovation efficiency	Pearson correlation	1	.382**
	Sig. (Double tailed)		.000
	N	96	96
Gathering of technological talents	Pearson correlation	.382**	1
	Sig. (Double tailed)	.000	
	N	96	96

Note: * * indicates a significant correlation at the 0.01 level (double tailed).

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In order to test the correlation between green innovation efficiency and the degree of technological talent aggregation in Anhui Province, the above two model values were imported into SPSS26 for Pearson correlation analysis validation. The conclusions obtained are shown in Table 4.

4.2. Kendall and Spearman Correlation

In order to further verify the correlation between green innovation efficiency and the degree of technological talent aggregation in Anhui Province, a Kendall Spearman correlation test was conducted, and the results are shown in Table 5.

Table 5. Kendall and Spearman correlations

			Green innovation efficiency	Gathering of technological talents
Kendall	Green innovation efficiency	Correlation coefficient	1.000	.190**
		Sig. (Double tailed)	.	.006
		N	96	96
	Gathering of technological talents	Correlation coefficient	.190**	1.000
		Sig. (Double tailed)	.006	.
		N	96	96
Spearman	Green innovation efficiency	Correlation coefficient	1.000	.268**
		Sig. (Double tailed)	.	.008
		N	96	96
	Gathering of technological talents	Correlation coefficient	.268**	1.000
		Sig. (Double tailed)	.008	.
		N	96	96

Note: * * indicates a significant correlation at the 0.01 level (double tailed).

According to the above SPSS26 analysis results, there is a significant correlation between the green innovation efficiency and the gathering of scientific and technological talents in various cities in Anhui Province, with a p-value of < 0.01, and the impact is positively correlated.

5. Conclusion

In summary, there is a positive correlation between green innovation efficiency and the gathering of scientific and technological talents, that is, with the increase of the gathering degree of scientific and technological talents, the green innovation efficiency of cities will also improve. Therefore, the suggestion for Anhui Province to improve the development of green economy innovation is that each city should formulate favorable policies to attract and retain scientific and technological talents. If the policies are sufficient to attract talents and attract enterprises, the economy and talents will have both, and the two are interrelated and collaborative.

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