Research on the Impact of Producer Service Industry Agglomeration on Economic Green Transformation

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Abstract. This paper selects the data of the lower Yangtze River Economic Belt from 2013 to 2017 as the reference. First, the location entropy method is used to measure the level of producer services agglomeration. Through the establishment of the SBM model, the input and output indicators are introduced to calculate the trend of economic green transformation in provinces and cities of lower Yangtze River economy. Finally, this paper takes the green efficiency value as the dependent variable and uses the five quantities such as the agglomeration degree of the producer service industry as independent variables to construct the Tobit model, and uses the MLE method to measure the variable coefficients to analyze the impact of the agglomeration of the producer service industry on the economic green transformation. The results show that in the lower Yangtze River Economic Belt, Shanghai, Jiangsu Province and Zhejiang Province have a good development trend in the green transition of the producer service industry agglomeration economy; and they all show the spatial distribution characteristics of "east high and west low"; producer services Industry agglomeration has a significant positive role in promoting green economic transformation.

1. Introduction
The lower Yangtze River Economic Belt is one of the most economically developed and resource-rich regions in China. Meanwhile, it also undertakes the important responsibility of promoting economic green transformation in the Yangtze River region. Studying the impact of the agglomeration of producer services in the lower Yangtze River Economic Belt on economic green transformation has Important theoretical and practical significance.

Chen Xiaofeng studied the agglomeration of producer services in the Yangtze River Delta and urban economic growth over the past 6 years and found that there is an obvious inverted U-shaped relationship between the two [1]. Howells & Greent believes that producer services mainly include finance, business services, and scientific services [2]. The driving effects of Cheng and Li on the two factors of R&D and technology introduction were used to study the green growth level of China's manufacturing industry from 2003 to 2015 [3]; Zhu Bin and Shi Xuanya jointly built a system of industrial green transformation. In the evaluation system, the two scholars conducted a comprehensive evaluation of the status of industrial green transformation in Fujian Province and its nine major jurisdictions, starting from five aspects: green economic benefits, green resource utilization, and green production development [4].

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2. Research methods and data sources

2.1. Research methods for agglomeration of producer services
When the location entropy is used to measure the concentration of a certain industry or industry, the results are more objective and comprehensive; at the same time, related data are also easier to obtain and more feasible. Based on the data of various provinces and cities in the lower Yangtze River Economic Belt, this paper measures the development level of producer services in the region by calculating the location entropy of each city. The calculation formula of location entropy is as follows:

\[ J_{it} = \left( \frac{P_{ij}}{P_i} \right) / \left( \frac{P_{ij}}{P_k} \right) \]  

(1)

Where \( J_{it} \) is the agglomeration level of the productive service industry in area \( i \) in year \( t \), \( P_{ij} \) is the employment in industry \( j \) in area \( i \), \( P_i \) is the total employment in area \( i \), \( P_k \) is the employment in industry \( j \) in the country, and \( P_k \) is the total employment in the country [5].

2.2. Research methods of economic green transition
For the impact of the agglomeration of producer services on economic green transformation, based on the existing literature and theoretical support, combined with the availability of data on producer services and urban green transformation, this paper calculates the urban green efficiency calculated above as dependent variables, the agglomeration of producer services, foreign direct investment, GDP per capita, industrial structure, and environmental regulations are used as independent variables to measure the impact of agglomeration of producer services on the green transformation of the urban economy. This paper establishes the following models:

\[ \rho^* = \min \left[ 1 - \frac{1}{m} \sum_{j=1}^{m} \frac{S_j^-}{x_0} \right] \]
\[ 1 + \frac{1}{s_1 + s_2} \left[ \sum_{j=1}^{s_1} \frac{s_j^e}{y_{j0}} + \sum_{j=1}^{s_2} \frac{s_j^u}{y_{j0}} \right] \]

s.t.

\[ x_0 = X \lambda + s^- \]
\[ y_j = Y \lambda - s^e \]
\[ y_j = Y \lambda + s^u \]
\[ s^- \geq 0, s^e \geq 0, s^u \geq 0, \lambda \geq 0 \]

Among them, \( s^- \) indicates the surplus or redundancy of input, \( s^e \) indicates the redundancy of undesired output, and \( s^u \) indicates the lack of expected output. When \( s^- \), \( s^e \), and \( s^u \) are smaller, it means that the city is better in terms of input and output. The objective function is to minimize the efficiency of input, less pollution and sufficient output. The larger the objective function, the higher the green efficiency of the city. \( \rho^* \) represents the city's green efficiency. The larger the value, the better the city's green development in the year. When \( \rho^* = 1 \), it indicates that the model has obtained the optimal solution, indicating that the city reached the best urban green development model in the year, that is, there is no phenomenon of input redundancy, excessive undesired output and insufficient expected output.

2.3. Constructing the mathematical model of influencing factors
For the impact of the agglomeration of producer services on economic green transformation, based on the existing literature and theoretical support, combined with the availability of data on producer
services and urban green transformation, this paper calculates the urban green efficiency calculated above as dependent variables, the agglomeration of producer services, foreign direct investment, GDP per capita, industrial structure, and environmental regulations are used as independent variables to measure the impact of agglomeration of producer services on the green transformation of the urban economy. This paper establishes the following models:

\[ y_i = \alpha_0 + \alpha_{JJ_i} + \alpha_{J2} + \alpha_{TZ_i} + \alpha_{PGDP_i} + \alpha_{JG_i} + \alpha_{GZ_i} \]  

(3)

Among them, \( JJ_i \) is the degree of agglomeration of producer services mentioned in the above location entropy, \( TZ_i \) is foreign direct investment, \( PGDP_i \) is GDP per capita, \( JG_i \) is the industrial structure of year \( i \) in city \( i \), expressed as the proportion of the output value of the tertiary industry to GDP. \( GZ_i \) is environmental regulation.

2.4. Data sources
This paper refers to "China City Statistical Yearbook", "Jiangsu Statistical Yearbook" (2014-2018), "Shanghai Statistical Yearbook" (2014-2018), "Zhejiang Statistical Yearbook" (2014-2018), "Anhui Statistical Yearbook (2014-2018) and other statistical yearbook data, as well as social bulletins and statistical data issued by the official websites of Shanghai, Jiangsu Province, Zhejiang Province and Anhui Statistics Bureau, collected and sorted out what we need. The data related to urban green efficiency, agglomeration of producer services, foreign direct investment, GDP per capita, industrial structure, and environmental regulations are preliminarily processed and analyzed.

3. Results and analysis

3.1 Analysis of the agglomeration characteristics of producer services
Based on the calculation results of the location entropy of the five types of industries above, the agglomeration levels of the producer services in the economic zones of the lower Yangtze River in Shanghai, Jiangsu Province, Zhejiang Province and Anhui Province.

| Province | 2013  | 2014  | 2015  | 2016  | 2017  |
|----------|------|------|------|------|------|
| Shanghai | 1.352| 1.368| 1.372| 1.377| 1.385|
| Jiangsu  | 0.917| 0.932| 0.944| 0.960| 0.970|
| Zhejiang | 0.991| 0.994| 1.004| 1.013| 1.023|
| Anhui    | 0.874| 0.862| 0.844| 0.823| 0.814|

The producer service industry in Shanghai is in a highly concentrated state, and it is at the most advanced level in the lower Yangtze River Economic Belt (as shown in Table 1). The overall location entropy of producer services in Jiangsu Province, although it has been growing, is still less than 1. The situation of agglomeration of producer services in Zhejiang Province is similar to that of Jiangsu Province, but the agglomeration level of each city is generally better than that of Jiangsu Province, second only to Shanghai, and the value of location entropy also increases year by year. The overall development of the productive service industry in Anhui Province is not good. In contrast to the other three provinces, the location entropy of the productive service industry in Anhui Province is declining year by year.

3.2 Analysis of the results of economic green transformation
Combining the data obtained by the review and calculation, it is substituted into the established model 2, and MATLAB software is used to calculate the green efficiency values of the provinces and cities in the past five years, and the results are obtained (as shown in Table 2).
Table 2. Green Efficiency Value Levels of Provinces in the Lower Yangtze River Economic Belt from 2013 to 2017

| Province | 2013    | 2014    | 2015    | 2016    | 2017    |
|----------|---------|---------|---------|---------|---------|
| Shanghai | 1.0000  | 1.0000  | 1.0000  | 1.0000  | 1.0000  |
| Jiangsu  | 0.6509  | 0.6567  | 0.6599  | 0.6804  | 0.6642  |
| Zhejiang | 0.6697  | 0.6654  | 0.6680  | 0.6832  | 0.6796  |
| Anhui    | 0.3721  | 0.3686  | 0.3639  | 0.3590  | 0.3539  |

Shanghai’s performance is outstanding. The city’s green efficiency has been 1 for the past five years. The green efficiency values of Jiangsu and Zhejiang have increased steadily. The green efficiency value of Jiangsu has increased from 0.65 in 2013 to 0.6642 in 2017. The green efficiency value of Zhejiang Province has also changed from close to 0.67 in 2013 to 0.6796 in 2017. Although there is a certain gap between Jiangsu and Zhejiang’s economic green transition and Shanghai, this gap is narrowing year by year. In contrast, Anhui Province is just the opposite. In 2013, the green efficiency value of Anhui Province was only 0.3721, which is relatively backward compared with the other three provinces and cities. However, with the passage of time, its urban green efficiency value did not increase but fell back to 0.3539 in 2017. For China, which is pursuing green development across the country, the decline in green efficiency in Anhui Province is an urgent problem to be solved.

3.3 Model Result Analysis of the Impact of Producer Service Industry Agglomeration on Economic Green Transformation

3.3.1 Model measurement results.
Combining the above-mentioned data from the provinces and cities in the lower Yangtze River Economic Belt between 2013 and 2017, urban green efficiency, agglomeration of producer services, foreign direct investment, GDP per capita, industrial structure, and environmental regulations, combined the multiple regression model that has been constructed is calculated and analyzed using Stata software, and the measurement analysis results are obtained.

The result reports the regression results under different models under different combinations of independent variables (as shown in Table 3). Among them, model (1) to model (3) only consider the primary term of the agglomeration degree of producer service industry, while model (4) and model (5) introduce the independent variable of the secondary term of producer service industry.

Table 3. Econometric analysis table of agglomeration of producer services and economic green transition in the economic zone of the lower reaches of the Yangtze River

| Province | Model (1) | Model (2) | Model (3) | Model (4) | Model (5) |
|----------|-----------|-----------|-----------|-----------|-----------|
| Degree of concentration of producer services $J_{it}$ | 0.3082*** (4.02) | 0.3077*** (4.00) | 0.3083*** (4.04) | 0.1001*** (3.21) | 0.1013*** (3.28) |
| Degree of concentration of producer services $\left(J_{it}\right)^2$ | | | 0.4120*** (4.65) | 0.4038*** (4.59) | |
| Foreign direct investment $T_{it}$ | -0.0243*** (-2.26) | -0.0286*** (-2.54) | -0.0275*** (-2.38) | -0.3112*** (-2.74) | -0.3113*** (-2.74) |
| GDP per capita $PGDP_{it}$ | 0.0179*** (1.30) | 0.0165*** (1.14) | 0.0173*** (1.22) | 0.3083*** (4.04) | 0.3083*** (4.04) |
As far as the provinces and cities in the lower Yangtze River economic zone are concerned, the agglomeration of producer services has a significant positive effect on the improvement of urban green efficiency, indicating that the agglomeration of producer services is conducive to the green transformation of the economy. Regardless of the primary or secondary term of the agglomeration degree of the producer service industry, the coefficients are positive and all have passed the significance test. Unlike industrial enterprises with high energy consumption and high pollution, producer service industries are industries with knowledge, technology and capital agglomeration. Such industries generally do not have much negative impact on the environment. At the same time, these high-tech industries will also drive the development of environmental protection is very beneficial to the green transformation of the economy. In contrast, foreign direct investment has a significant negative effect on the green transformation of the economy. As a measure of a city's openness to the outside world, foreign direct investment can be seen from the calculation results of the table that the openness of a city's openness has a negative impact on the green transformation of the economy, which also validates the "pollution paradise hypothesis" [6].

The GDP per capita has a significant positive impact on the green transformation of the economy. This shows that cities with higher economic development levels have better economic green transformation. The main reason is that a high-level economy can provide sufficient funding sources and environmental protection related scientific and technical support, which can effectively improve the environmental quality. The industrial structure also has a significant positive impact on the green transformation of the urban economy, and although environmental regulations in various provinces and cities have a positive impact on the green transformation of the economy, this impact is not significant. China’s current environmental regulations are mainly command-control-based [7], which has led many companies to regard energy conservation and emission reduction and total emission control as a task and a mandatory indicator that they have to complete. Instead of actively and voluntarily carrying out energy conservation and emission reduction, the effect of environmental regulations is greatly reduced.

4. Conclusions and suggestions

Based on the analysis results of the previous article, this article mainly obtained the following conclusions:

(1) Producer service industry and green transformation of economy in the lower Yangtze River Economic Zone have problems of uneven regional development and uncoordinated development. Among them, Shanghai’s productive service industry and economic green transformation are the best. Anhui Province is the worst.

(2) The level of agglomeration of producer services in the lower reaches of the Yangtze River is generally high, but there are certain internal differences. The agglomeration level of producer services in Shanghai, Jiangsu Province and Zhejiang Province has increased year by year from 2013 to 2017, while the agglomeration level of producer services in cities in Anhui Province has decreased year by year.

(3) Lower Yangtze River Economic Belt The overall situation of economic green transformation is good. Shanghai and Suzhou have the best green development status at the first level; the remaining cities in Jiangsu and Zhejiang are at the second and third levels, and the green efficiency values of Jiangsu and Zhejiang are increasing rapidly; Anhui Of all cities are in the fourth or fifth tier, and their values have been steadily regressing over five years.
(4) Both the producer services in the lower Yangtze River Economic Zone and the green transformation of the economy are spatially characterized as "high in the east and low in the west", and the gap between the eastern and western cities is increasing;

(5) The concentration of producer services has a significant positive impact on economic green transformation, and there is a clear positive correlation between the two;

(6) GDP per capita, industrial structure and environmental regulations have a positive effect on economic green transformation, and the degree of agglomeration of producer services and production per capita The positive impact of gross value and industrial structure on the green transformation of the economy is significant. Only foreign direct investment has a significant negative impact on the green transformation of the economy.

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